Veterinary medicines : their actions and uses / by Finlay Dun.

Contributors

Dun, Finlay, 1830-1897.
Royal College of Physicians of Edinburgh

Publication/Creation

Edinburgh : D. Douglas, 1882.

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VETERINARY MEDICINES

THEIR ACTIONS AND USES

Edinburgh : Printed by Thomas and Archibald Constable,

FOR

DAVID DOUGLAS.

LONDON . . . . . HAMILTON, ADAMS, AND CO.

CAMBRIDGE . . . . . MACMILLAN AND BOWES

GLASGOW . . . . . JAMES MACLEHOSE AND SONS.

VETERINARY MEDICINES

THEIR ACTIONS AND USES

BY

FINLAY DUN

FORMERLY LECTURER ON MATERIA MEDICA AND DIETETICS AT THE EDINBURGH VETERINARY COLLEGE

ROYAL COLLEGE OF PHYSICIANS, EDINR. LIBRARY

Sixth Edition, Revised and Enlarged.

EDINBURGH
DAVID DOUGLAS
1882

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PREFACE TO THE SIXTH EDITION.

THE First Edition of VETERINARY MEDICINES was published in 1854, whilst I was Lecturer on Materia Medica and Dietetics at the Edinburgh Veterinary College. The work continues a Text-book at the Veterinary Colleges, is used by Veterinarians and Agriculturists, and meets with increasing demand both in America and the Colonies.

The progress of Pharmacology and Pharmacy since the publication of the Fifth Edition in 1878, has necessitated the rewriting of large portions of the book, and the addition of much new matter.

As in previous editions, the general actions and uses of Veterinary Medicines, and the more important principles and practice of Pharmacy, are treated of in the Introduction. The bulk of the volume is occupied with the consideration of the natural history, preparation, and properties of the individual medicines; their most common impurities and adulterations; their general action on the various domesticated animals; and their uses, doses, and medicinal forms. To facilitate reference, the several drugs are discussed in alphabetical order, according to their English names.

Earlier editions contained an Appendix, comprising short notices of the nature, causes, symptoms, and treatment of the

more common diseases of the domestic animals; but such matter being somewhat out of place in a Text-book of Materia Medica, it has been superseded by an Index of Diseases, in which, under each disease, are set forth appropriate remedies, arranged chiefly in the order of their value, or of their application in the earlier and later stages of the disorder. This Index of Diseases, supplemented by a copious Index of Medicines, will enhance the usefulness of the book alike to Students and Practitioners.

2 Portland Place, London, W.,
October 1882.

CONTENTS.

	PAGE
INTRODUCTION, ...	1-132
I.—The Actions and Uses of Medicines, . .	2-113
II.—On Veterinary Pharmacy, ...	114-132
VETERINARY MEDICINES (Alphabetically Arranged),	133-637
Index of Diseases, ...	639-657
Index of Medicines, ...	658-676

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 devoted to the description of medicines or drugs, their natural history characters, their pharmaceutic preparations, and their actions and uses among the domesticated animals.

Medicines, although derived from so many sources throughout the animal, vegetable, and mineral kingdoms, possess many actions in common, and are prepared for use by similar pharmaceutical processes. Two preliminary sections will therefore be advantageously occupied with general observations on Pharmacology, which treats of the action of medicines on healthy animals; on Therapeutics, or their application to the cure of disease; and on Pharmacy, which deals with the mode of preparing and dispensing medicines. The description of the medicines themselves occupies the body of the volume.

SECTION I.

THE ACTIONS AND USES OF MEDICINES.

THE treatment of disease has hitherto been less systematic and has progressed more slowly than diagnosis or morbid anatomy. It has been more empiric than scientific. The actions of medicines have only recently been fully and philosophically studied. During the last thirty years more knowledge has, however, been obtained regarding the effects of medicines, and more skill and care have been employed in their use.

This progress in curative medicine has largely resulted from systematic experiments and trained observations, based upon and aided by recent advancing knowledge of the vital textures and their functions in health and disease. Without accurate and thorough knowledge of these cognate subjects, acquaintance with medicines can only be superficial and empirical. Modern physiology has thrown light especially upon cell-development and nutrition, on the actions of ferments or enzymes in the building up, constant change, and breaking down of living tissue, and on the functions of nerves and nerve centres. Pathology has made clearer the nature and localisation of disease, and the complications and mode of death to be guarded against. Clinical thermometers, auscultation, and other modern means of diagnosis inform the practitioner of the site, nature, extent, and tendency of morbid conditions. Familiar with the disordered conditions to be overcome, the practitioner is in a position to arrest certain disorders, to guide others in their favourable course, and successfully to choose and skilfully to handle his curative weapons. Chemistry has proved an essential help in explaining complex living processes; she has eliminated, from bulky bodies, convenient active principles; has supplied antidotes for many poisons; has discovered new remedies; she changes and compounds medicines, varying and intensifying their effects; and now prepares artificially such useful organic bodies as atropine and salicylic

acid. Guided by such progress in the several departments of practical medicine, important observations have recently been made regarding the actions of remedial agents, and the manner in which these actions are established.

Systematic careful experiments on the lower animals and on man, have demonstrated the action of many medicines, both old and new, and have indicated their successful use in the cure of disease. Magendie's experiments with the Java upas antiar showed its power as an exciter of the motor tract of the spinal chord. Examination of other more readily obtained strychnine-containing plants, of the same natural order, discovered similar action in nux vomica. Violently stimulating the spinal chord, and producing tetanic convulsions, it was speedily proved that small doses of nux vomica, or its alkaloid strychnine, counteract paralysis, especially when depending upon imperfect action of the chord, and besides impart general nerve tone. Repeated experiments on animals demonstrated the action of digitalis as a cardiac stimulant, and hence have led to its use in strengthening and steadying the weak and overtaxed heart. Experiments with ergot of rye, and its active constituent, ergotine, proving their power of contracting arterioles and capillaries, suggested their employment for the arrest of hæmorrhage from internal organs. Belladonna, and its active principle atropine, are recognised by experience to quiet irritability both of the heart and lungs—effects which physiological experiments have shown to depend upon stimulating the respiratory centre and paralysing the ends of the vagi and sensory nerves, both of the heart and lungs. The precise action and *modus operandi* of medicines being thus recognised, their practical use is rendered safer and more effective.

Carefully devised observations have already multiplied the weapons with which the veterinarian does battle with disease, and taught their more successful employment. The anthrax disorders, splenic apoplexy, blackleg, hog and chicken cholera, hitherto little amenable to either preventive or curative treatment, can now be held in check, and perhaps entirely exterminated. The rod-like bacilli and spores on which these diseases are shown to depend, can be destroyed and the pabulum

present in the blood of healthy but susceptible animals, and on which they fasten, grow, and multiply, can be broken up or removed by introducing into the system a minute portion of benignant matter. Effects are produced nearly resembling that of the vaccine lymph, in protecting human patients from small-pox. The unregenerate anthrax virus is fitted for its beneficent protective power, by passing it through a series of five or six mice or guinea-pigs. Thus attenuated, it loses its deadly virulence, produces only dulness or slight fever, but the inoculated subject is proof against the particular anthrax, with the poison of which it has been vaccinated, and with impunity may be exposed either to its ordinary causes, or inoculated with its virus taken direct from a fatal case.

Further advances are destined to be made in the treatment of other classes of disease. Medicinal antiseptics may yet be discovered, which shall check the multiplication of septic germs in the blood and tissues as they now do in a wound or external to the body. Medicines will doubtless be found which shall increase, control, or arrest the formation of these ubiquitous ferments which preside over nutrition, and which become sources of disorder when in undue or inadequate amount, or of faulty quality. Recent researches have discovered substances which act very variously on different parts of the nervous system; but as physiology allocates special functions to their particular location in the brain or chord, agents will unquestionably be found which will exert direct effect on these parts, and hence control their abnormal functions. Better knowledge of the sympathetic nervous system, of the functions of its vaso-motor centres, and of its trophic nerves, encourage the belief that remedies may be found to regulate most secretions, and even to control nutritive processes. The increasing number of medicines, the more precise knowledge of their actions, and the more skilful manner of handling them, with the better understanding of the morbid processes they are used to control, give great promise of more system and success in the cure of disease.

The veterinarian who rationally treats disease, must be conversant with the actions of the remedies he employs. Every medicine is endowed with certain dynamical effects on the living animal which distinguish it as decidedly as its physical

and chemical properties. Most medicines when they enter the living body, by a species of elective affinity are attracted to particular organs. Often they are determined to one particular tissue or class of tissues. Recent observation has determined tolerably accurately the precise spots on which many medicines act, and often the manner in which such action is established. Thus, aconite is attracted to the sensory and motor tracts of the spinal chord, paralyses them, but does not affect the brain. Chloral hydrate is shown to act primarily on the brain and motor centres. Calabar bean proves to be a depressor of the spinal chord and a paralyser of the cardiac sympathetic. Even the familiar purgatives are shown to exert their effects on different parts of the alimentary canal, to operate in different ways, and hence to present special fitness for particular purposes.

To facilitate discussion of the actions and uses of medicines, this section is divided into the following heads :—

I. The manner in which medicines establish their actions.

II. The manner in which medicines are believed to cure disease.

III. The arrangement of medicines according to their physiological actions.

IV. The circumstances which modify the actions of medicines.

I.—THE MANNER IN WHICH MEDICINES ESTABLISH THEIR ACTIONS.

Some medicines, as demulcents, caustics, and astringents, have mainly a local or topical action—soothing, corroding, constringing, or altering the animal tissues, but not necessarily extending their influence beyond the part to which they are first applied. Others, either with or without such local effects, have remote or indirect actions on organs at a distance from the part with which they are first brought in contact.

Recent observations render it possible to describe with tolerable accuracy the journey of some medicines through the animal body, to indicate their treatment by the various alimentary secretions, to follow their transit through the circulation,

to note the manner in which they operate on nutrition, modify or antagonise morbid processes, or in poisonous doses derange or arrest vital functions, and finally to trace their excretion, often in altered condition, through some of the emunctories. There is a wide choice of channels by which medicines are introduced into the body. They may be injected directly into either veins or arteries—a method only adopted in extreme cases. Inhaled through the pulmonary mucous membrane, volatile agents or finely divided substances suspended in aqueous or other vapour are quickly carried into the blood. Soluble medicines can be readily introduced through the broken or unbroken skin. Injection is occasionally made into a gland or muscle, and frequently into the subcutaneous areolar tissue, whence the medicine is absorbed by blood-vessels or lymphatics. Drugs as well as food also sometimes find entrance by the rectum.

But the mouth is the most common and generally convenient channel by which medicines make their way into the body. Crystallisable substances in solution undergo early and rapid absorption chiefly through the capillary vessels in the upper part of the alimentary canal. Colloidal substances, like most articles of food, are prepared for absorption by the ferment-containing secretions of the canal. The alkaline saliva mechanically moistens solid bodies, its ptyalin cracks starch granules and renders them soluble. The acid pepsin-containing gastric juice dissolves albuminoids, iron, mercurial and other salts. The alkaline bile emulsionises fats and resins. The pancreatic fluid, combining the properties of saliva, gastric juice, and bile, digests starch, albumin, and fats. The intestinal juices finish the solvent process, and 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 intestines, the dissolved medicines generally enter the circulation by the mesenteric and portal vessels.

Many substances are absorbed and make the round of the circulation with almost incredible rapidity. Professor Hering, of the Veterinary College, Stuttgardt, 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 a solution of one per cent. of atropine in chloroform, 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; and a similar rapidity of distribution doubtless obtains with substances which cannot easily be detected in the blood.

Reaching the general circulation, medicines are attracted, as already stated, to particular parts. Their full and characteristic effects are not produced until they reach the organ or tissue on which they specially operate. Magendie found that strychnine does not excite its notable tetanic convulsions until it is in contact with the spinal chord. Nay more, when a frog or other small animal, immediately after receiving a full dose of strychnine, has the spinal chord broken down by a piece of whalebone, or removed, the tetanic symptoms are not exhibited. As appropriate elements of food are taken by each tissue from the common nutrient stream, so by similar affinity cells and aggregations of cells appear to arrest and take up particular medicines. Lead, various mineral salts, and a few comparatively stable organic bodies, are found in the textures on which they act. On the parts to which they are first applied, or on the remoter spots to which they are subsequently carried, most medicines exert their effects, stimulating, paralysing, or otherwise altering natural functions. These altered conditions, by direct or reflex action, often modify the vital processes of remote organs. After a variable sojourn, and after producing more or less pronounced effects on one or more parts of the body, contributing to the construction of tissue, or hastening

its disintegration, stimulating, altering, or depressing, medicines are removed by one or by several of the great excreting channels sometimes unchanged, often altered by oxidation or broken into simpler forms. Digitalis, for example, after expending its force 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. In their excretion some medicines increase the activity of the excretory organ. This is the important function of a large class of remedial agents. Thus aloes and full doses of oils and neutral salts excreted through the bowels cause purgation. Nitre, small doses of salines, and ethers, chiefly removed through the kidneys, produce diuresis.

II.—THE MANNER IN WHICH MEDICINES ARE BELIEVED TO CURE DISEASE.

Every medicine, as already stated, is possessed of certain inherent and distinctive dynamic effects, which are exerted both in health and disease, and are termed its *physiological* actions. When, however, appropriate medicines are administered for the treatment of any curable disease, they are said to call forth another and secondary series of actions, more variable, uncertain, and limited than the physiological, but springing from them, and leading directly to the mitigation or cure of disease. These are usually called *therapeutic* or *curative* actions. It is unnecessary, however, to regard these effects as twofold; for a physiological action, more or less obvious, is the source and origin of every cure, while the so-called therapeutic action is merely the physiological action exercised in or modified by disease, and specially applied to its alleviation or removal.

Many hypotheses have been propounded in explanation of the manner in which medicines cure disease. Before much was known of chemistry and physiology, the diverse actions of medicines were thought to result from their variously-shaped particles producing diverse mechanical effects on the body. Since the times of the alchemists, the action of medicines has

frequently been ascribed to purely chemical agency; but this, although accounting for some of the effects of such medicines as caustics and astringents, cannot alone explain the general effects of most remedies. The living animal body is much more than a machine or a laboratory; and mechanical and chemical laws are here modified by more complex and less understood vital principles. Such vital laws receiving recognition about the beginning of the present century, it was taught that health depended upon nicely balanced "excitability," which when disturbed was to be regulated either by stimulants or contra-stimulants. Another school ascribed disorders mainly to morbid matters which required to be cast out by eliminatives. Acquiring greater definiteness regarding the location and nature of disease, more recent observations propounded the doctrine of abnormal nutrition and its treatment by alteratives, stimulants, and sedatives.

The complex vital processes regulated in health and disease by laws at present imperfectly understood, when irregular or disturbed, evidently cannot be brought back to their normal state by any one or two modes of cure. No procrustean system or definite formula can be expected to explain the actions of all medicines. The late Professor Headland has lucidly remarked 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*."—(*Actions of Medicines*, third edition.) Two of these systems of counteraction, accounting for the actions of the majority of medicines, are, 1*st*, the *antipathic*, and 2*d*, the *allopathic* mode of cure. A third system professes to cure homœopathically, by the administration of small doses of those medicines which, given in larger amount, produce symptoms similar to the disease to be cured; but this doctrine is illogical, unsupported by evidence, and, when legitimately carried out, is not successful in practice.[1]

[1] The system of homœopathy (ὅμοιος, *homoios*, like or similar; and πάθος, *pathos*), was propounded about eighty years ago by the German physician Hahnemann, who taught 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. The doctrine is enunciated in the aphorism, *similia similibus curantur*. According to homœo-

1*st*, Medicines act antipathically (*ἀντί*, *anti*, opposite; and *πάθος*, *pathos*, a disease); or, in other words, they produce a condition diametrically opposed to the disease in which they are administered. It is thus that astringents are effectual in diarrhœa; purgatives in torpidity of the bowels; and stimulants in depressed states of the system. In these, and in all other cases where an antipathic cure is effected, the physio-

pathy, cinchona cures ague and intermittents, because it produces such febrile symptoms when given to healthy individuals in considerable doses; aconite is the appropriate remedy for reducing inflammatory fever, because in large doses it produces symptoms which are thought to resemble inflammation; and strychnine is the best remedy for palsy, because in large doses it appears to produce paralytic symptoms. This doctrine certainly appears strange and unnatural, and, 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 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 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.

Hahnemann, in his *Organon of Medicine*, translated by Mr. Dudgeon of London, and 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 at once to remove, as is attempted by allopathists, the morbid condition—the source of the evil. *Causâ sublatâ, tollitur effectus.* No curative system directing its efforts, as homœopathy does, merely against the symptoms of disease, can ever rest upon a safe or

logical action of the medicine overcomes the morbid condition, because it counteracts it by a superior and directly antagonistic force. This mode of cure is specially adapted to the treatment of symptoms and local diseases.

2*d*, Medicines act allopathically (ἄλλος, *allos*, another; and πάθος, *pathos*), or produce effects which, though in themselves unnatural, overcome the disease to be cured; or, in other

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 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.

If the principles or foundations of homœopathy be false and imperfect as I have endeavoured to show, the superstructure based on such a foundation cannot be otherwise than weak and tottering. The following important facts and doctrines of homœopathy exhibit, perhaps more clearly than any arguments, the extravagances and inconsistencies of the system:—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 system, according to homœopathists, is believed to become so susceptible of 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 a slight mechanical effect, 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

words, they occasion a short, simple, and manageable disease, which subdues that which originally existed. Nature herself frequently removes maladies in this way. Thus spontaneous diarrhœa often relieves internal congestion; and copious perspiration febrile attacks. In similar manner blisters relieve pleurisy, purgatives alleviate local inflammation, and diuretics

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 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 of course acquire great potency by the triturations above mentioned.

But homœopathists 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 ever be regarded as made up of two distinct parts:—1*st*, 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 2*d*, Attention to diet and regimen—the only effectual and rational part of homœopathy, the true source of all its boasted cures, and that very department of medical treatment which has been insisted upon from the most ancient times by all scientific 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.

But though the principles of homœopathy are unsound, and though its practice among the lower animals has not been more successful than that of many more modest modes of treatment, still it has done some service to the cause of practical medicine by demonstrating the great power of the *vis medicatrix naturæ*, and the inestimable importance of regimen and diet as auxiliaries to the medical treatment of disease. Further, it has aided in the advancement of a more rational system of veterinary practice by discountenancing those copious and repeated bleedings, and large and reiterated physickings, which were often indiscriminately prescribed for all patients; while it has also acted beneficially in elucidating various subjects connected with therapeutics, and in inducing the opponents as well as the supporters of homœopathy to institute numerous and careful observations on the actions of remedies both on man and the lower animals.

remove œdema or dropsy. Those numerous and important zymotic diseases which result from the maturation of a poison within the body, or its introduction from without, according to allopathy, are cured by another and more healthy action being established in the sick body, the special poison being checked in its formation, or destroyed and cast out, by rousing to increased activity those natural purifying emunctories—the skin, bowels, and kidneys.

III.—THE ARRANGEMENT OF MEDICINES ACCORDING TO THEIR PHYSIOLOGICAL ACTIONS.

Grouping together medicines which have similar actions proves a help to the student and also to the practitioner. Such classifications are not, however, so accurate and satisfactory as could be desired. Many medicines, such as mercury and opium, have numerous and complex actions, and reappear in many groups; others differ considerably in their effects according to their dose and mode of administration; some exhibit variety of action on different species of patients. But increasing knowledge will gradually discover those laws which regulate the actions of medicines, and will insure their more philosophical arrangement. The late Professor Headland made a comprehensive serviceable classification of the articles of the materia medica under the four following heads :—

I. Hæmatics, or medicines acting on the blood. They restore some of its wanting or deficient constituents, destroy morbid matters circulating in it, are most valuable in constitutional disorders, are tolerably permanent in their action, and include all true restoratives, tonics, and alteratives. Albumin, iron, and many salines, having a resemblance to or identity with the constituents of the body, are assimilated as food or restoratives. Certain salines exert a solvent effect on the fibrin and lessen the tendency to aggregation amongst the red corpuscles of the blood. Antiseptics within or without the body retard or arrest destructive changes. Acids neutralise excess of alkalinity, whilst alkalies conversely neutralise acidity. Most hæmatics which are unnatural or foreign to the body, having

acted as antiseptics, catalytics, specifics, or vital antidotes, are more or less rapidly expelled.

II. Neurotics are medicines acting upon the nervous system, exciting, depressing, or otherwise altering its tone, usually prompt but temporary in their effects, and useful in remedying symptoms. They include most stimulants, narcotics, and sedatives. Regarding these neurotics, Dr. John Harley, in the last edition of Royle's *Materia Medica*, 1876, thus writes:—"It is on the nervous system that the effects of medicines are most conspicuously displayed, while their modes of action are altogether obscure. We must look upon the nervous system collectively as a compound voltaic battery and the nerve force as electricity; we may indeed safely assume so much. Reduced to this simple view, we may suppose that neurotic medicines act by exciting or depressing the chemical reaction, on which the development of the nerve force depends, and, by increasing or diminishing the conducting power of the nerve fibres, may cause spasm or palsy accordingly. The electrolytic actions which generate nerve force are probably induced by the decomposition of complex organic substances as albumin, and it is possible that the presence of such similarly constituted bodies as strychnine, quinine, morphine, and the like—all of which significantly contain nitrogen—in the central nervous system, may have a similar effect upon the changes going on in the nerve cells, as the addition of sulphuric acid or neutral oxalate of potash to a cell of Daniells' battery would have on the current proceeding from it."

III. Astringents cause contraction of both voluntary and involuntary muscular fibre, and especially of the latter, and thus arrest secretion and bleeding.

IV. Eliminatives are irritant medicines, unnatural to the blood, which are expelled from it through the various excreting organs, and in their passage heighten the activity of these organs, increase their discharges, and thus carry noxious matters out of the system. Purgatives, diuretics, and diaphoretics are examples of this class.

TABLE OF DIFFERENT CLASSES OF MEDICINES, ARRANGED ACCORDING TO THEIR PHYSIOLOGICAL ACTIONS.

I.—MEDICINES WHICH ACT CHIEFLY AS MECHANICAL AGENTS.

		Examples:
Demulcents.	Soothe, soften, and sheath.	Solutions of gum, albumin, milk, and oils.
Diluents.	Dilute the fluids.	Water, and watery fluids.

II.—MEDICINES WHICH ACT CHIEFLY AS CHEMICAL AGENTS.

		Examples:
Antiseptics.	Prevent or arrest putrefaction.	Common salt, tar acids, zinc and iron chlorides.
Disinfectants.	Absorb, alter, or destroy contagious matters.	Tar acids, sulphurous acid, lime chloride.
Deodorisers.	Disguise or destroy odours.	Bleaching powder, tar acids and dry sodium sulphite, Condy's fluid.
Antidotes.	Counteract poisons.	Dilute alkalies for acids. Hydrated iron sesquioxide for arsenic.
Caustics.	Destroy the animal solids, and decompose the fluids.	Strong acids, metallic salts, as silver nitrate, butter of antimony.
Acids.	Counteract alkalinity.	Sulphuric, nitric, and hydrochloric acids.
Antacids.	Counteract acidity.	Alkalies, and alkaline earths, with their carbonates.

III.—MEDICINES WHICH ACT CHIEFLY AS VITAL AGENTS.

			Examples:
Agents which increase local action.	Rubefacients.	Cause redness of the skin.	Alcohol, turpentine.
	Vesicants.	Cause discharge of serum from the skin.	Cantharides, boiling water.
	Suppurants.	Cause discharge of pus from the skin.	Croton oil, tartarised antimony.
	Errhines.	Irritate the mucous membrane of the nostrils.	Veratrum album, euphorbium.
	Stomachics.	Promote digestion.	Ginger, cardamoms, volatile oils.
	Emetics.	Cause vomiting.	Tartarised antimony, zinc and copper sulphates, mustard, salt.
	Ecbolics.	Induce contractions of the uterus, and expulsion of its contents.	Ergot of rye, savin, cantharides.
	Aphrodisiacs.	Stimulate the generative organs and the venereal appetite.	Phosphorus, cantharides, peppers.
Anthelmintics or vermifuges.		Remove intestinal worms.	Purgatives, suitable dietary.
Vermicides.		Kill worms.	Turpentine, areca nut, many antiseptics.
Parasiticides.		Destroy parasites.	Carbolic acid, tobacco, many antiseptics.

			Examples:
Agents which increase local action and secretion.	Purgatives.	Evacuate the bowels.	Aloes, croton, oils, jalap, neutral salts.
	Cholagogues.	Promote secretion of bile.	Podophyllin, aloes, jalap.
	Expectorants.	Increase secretions of respiratory membrane.	Ipecacuan, balsams, gum-resins.
	Diaphoretics.	Increase perspiration.	Warm clothing, ammonia acetate, ethers.
	Diuretics.	Increase secretion of urine.	Turpentine, resin, nitre.
	Sialagogues.	Increase salivary secretions.	Mercurials, iodine, pungent-tasted bodies.
Agents which increase general action.	Restoratives.	Supply materials for growth and repair.	Food, air, salines, iron, phosphates.
	Tonics.	Gradually but permanently improve appetite and increase vigour.	Cinchona, quinine, iron and copper sulphates.
	Stimulants.	Promptly but temporarily increase nervous vigour, and thus exalt action of the heart and other functions.	Ammonia, alcohol, ethers, volatile oils.
Agents which improve state of blood.	Alteratives.	Correct morbid conditions without causing marked physiological effects.	Mercury, iodine, arsenic, salines, and alkalies.
Agents which contract living textures.	Astringents.	Contract living tissues.	Oak bark, tannin, alum, and other metallic salts.
Agents which diminish local action.	Emollients.	Soften, soothe, and relax.	Poultices, fomentations, moistened spongiopiline.
	Refrigerants.	Lower animal heat.	Cold air, cold water, ice, salines, and ethers.
Agents which diminish general action.	Sedatives.	Depress both the nervous and circulatory systems.	Aconite, prussic acid, bloodletting.
	Narcotics.	Pass from the blood to the nerves and nervous centres, and act so as first to exalt nervous force and then to depress it; and have also a special action on the intellectual part of the brain. — (*Headland.*)	Opium, Indian hemp, belladonna.
	Anæsthetics.	Diminish sensibility to pain, and to external impressions.	Chloroform, ether, naphtha, coal gas, nitrous oxide.

Dr. John Harley states that the fundamental action of drugs is fourfold—first, they may retard or accelerate osmose; secondly, they may alter the condition of the blood; thirdly, they may increase or diminish those changes in the nerve cells which result in the generation of nerve force; and lastly, by virtue of similar influences, they may increase or diminish the conductivity of the nerve fibres.—(Royle's *Materia Medica*, sixth edition.)

Professor Bartholow of Philadelphia, in his Treatise on Materia Medica and Therapeutics (1882), classifies remedies under the six following heads:—

Promoters of constructive metamorphosis.
Promoters of destructive metamorphosis.
Modifiers of nervous function.
Preventers of septic decomposition.
Evacuants.
Topical remedies.

On the two previous pages is presented a tabular view of a classification which I adopted in my lectures, and in which are grouped medicines, classed and denominated according to their physiological actions, into three great divisions of mechanical, chemical, and vital agents—a plan followed by Dr. A. T. Thomson and several other authors.

To familiarise the student with the names, general actions, and therapeutic applications of these different classes of medicines, I shall briefly notice them in the order in which they occur in the above table.

Demulcents.

Demulcents (*demulceo*, I soften) soothe, soften, and sheath parts with which they come in contact. They are sometimes defined as internal emollients. They include gums, mucilage, sugar, starch, gelatin, albumin, fats, oils, and milk. They take the place of such natural demulcents as the tears or mucus, where these are defective or wanting; lubricate and defend irritable parts from injurious action of air, of acrid secretions,

or of irritating and poisonous matters; when absorbed unchanged, they exert a general demulcent effect or act as diluents. They are chiefly prescribed to relieve dry, irritable, and inflamed states of the respiratory, digestive, and urino-genital mucous membranes.

Diluents.

Diluents (*diluo*, I dilute) consist of bland watery fluids which (as the name indicates) dilute the blood and the watery secretions. They include water and such simple drinks as linseed and hay tea, barley and treacle water. In febrile and inflammatory attacks they assuage thirst, counteract torpor of the digestive organs, favour activity of the several secreting channels, and in their removal from the body carry with them waste or deleterious matters. They hasten and increase the action of purgatives, diuretics, and other evacuants; and in irritation of the urinary organs, augment the quantity and lessen acridity of the urine. In febrile cases they were wont to be prescribed in a tepid state, or "with the cold air off;" but are generally more palatable and refreshing when cold; and, if small quantities only are given at a time, no harm results even from ice-cold drinks. Horses working hard, and kept mostly on dry food, often suffer from the want of diluents, which, if more freely and frequently supplied, not only ward off trying thirst, but help to prevent indigestion, skin irritation, febrile attacks, and even farcy.

Antiseptics—Antiputrescents—Antizymotics.

Antiseptics (*ἀντί, anti*, against; and *σηπτικός, septikos*, putrefying) prevent or arrest decomposition of organic bodies. The breaking up, fermentation, or putrefaction, to which complex organic substances are so prone, is favoured by moisture, by warmth, and usually by the presence of air or oxygen, but directly depends upon the presence of particular ferments or enzymes. These ferments are either soluble and unorganised, or insoluble and organised. Amongst the former are emulsin, diastase, myrosyne, pepsin, and the remarkable

vegetable digestive, papaine. Most of these bodies may be extracted by solution of glycerine and precipitated therefrom by alcohol. Unlike the living ferments, their action is not interfered with by chloroform. Of the organised ferments, some, like yeast, and the Mycodermi aceti which convert alcohol into acetic acid, resemble vegetable fungi and find their fitting habitat on vegetable matters in a condition susceptible to molecular change. Others may be regarded as a low grade of animal organism, finding congenial residence in decomposing or morbid animal tissues, moving, capable of rapid multiplication, each variety reproducing its own kind, and during, or in consequence of reproduction, developing in the bodies of higher animals distinct pathological conditions.

The recent investigations of Pasteur and Kock, and of Professors Lister and Greenfield, have thrown light on many of these organised disease-producing germs which Dr. George Harley has endeavoured to group under the following heads (*Lancet*, June 25, 1881) :—

a. Brownian granules, spherical, moving, $\frac{1}{50000}$th of an inch in diameter, occurring naturally in buccal mucous cells, abnormally in all decomposing animal fluids.

b. Vibriones, strings or branched, not occurring in healthy textures, but in decomposing animal fluids, such as in small-pox, in glanderous and other contagious pus.

c. Micrococci, spherical, homogeneous, pellucent, separate, or in groups or strings, present in the pus of sheep-pox and of wounds, on erysipelatous and diphtheritic surfaces, and in living blood in low putrid fevers.

d. Bacteria, singly or in sausage-like strings, found naturally in the pancreas and alimentary canal, and in all decomposing animal matters, in the blood of subjects suffering from cattle plague, chicken anthrax, and malignant pustule.

e. Spirilli, hair-like, often of corkscrew form, $\frac{1}{3000}$th of a line in diameter, actively moving, found in the blood in relapsing malarial fevers and in wool-sorters' disease.

f. Bacilli, rod-like, sometimes branched, present in the blood and other fluids, in anthrax, septicæmia, and malarial fevers.

g. Germ spawn of various descriptions, granular, found in animal fluids in which mature germs are present, as in tuberculous and cancerous discharges.

Of these organised disease germs the most dangerous to animal life are those developed amidst morbid animal textures. Each has its own mode of life, its own congenial soil. Several occasionally are found together in the same animal. In the various groups are evidently several distinctive varieties. Amongst the Bacilli, for example, some produce local gangrene, others erysipelas, others widely-spread septicæmia, others the infectious poultry anthrax, others splenic apoplexy. Although many of these rapidly-multiplying germs die with the death of the tissue on which they are nourished, their spores survive, sometimes for years, and may be distributed by water, carried by flies or worms, or wafted through the air.

Recent researches of M. Pasteur, Professor Greenfield, and others, demonstrate that these organised animal ferments or disease-producing germs can be disarmed of evil by rendering the bodies on which they usually attach themselves unsuitable for their reception. Yeast does not multiply in solutions from which sugar and sugar-producing bodies are removed. Virus attenuated by cultivation is found to become an antidote to its deadly parent virus. Pasteur has shown that the virus of charbon not only loses its lethal effects when passed by inoculation through five or six mice or guinea-pigs, but protects the inoculated subject from the fatal anthrax. Professor Greenfield has demonstrated that the deadly virus of splenic apoplexy with impunity may be introduced into the bodies of cattle which have previously been vaccinated with attenuated lymph. Recent experiments encourage the hope that even rabies may be prevented by inoculating subjects bitten by a mad dog with attenuated rabies lymph. The beneficent cultivated virus used in such cases appears to exhaust or break up the congenial material present in the susceptible subject, and on which the corresponding deadly virus, had it the opportunity, would fix itself. Some medicinal antiseptics possibly possess similar powers in altering the animal fluids so that they are rendered unsuitable for the growth of particular animal poisons. Professor Polli of Milan found that dogs,

which for five days previously had been receiving daily doses of sodium sulphite, suffered comparatively little inconvenience from the inoculation of fœtid pus, which destroyed, with gangrene and typhoid, dogs not previously protected by the antiseptic. Mr. Crookes (*Third Report of the Cattle Plague Commission*) injected into the veins of a cow affected with cattle plague 105 grs. of carbolic acid, dissolved in six 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.

Some of these multitudinous widely distributed bodies which break up both dead and living organised substances are themselves destroyed or their actions stayed by antiseptics. Their access is prevented by exclusion or filtration of air, which usually contains many varieties. Compressed air and oxygen have been found to destroy some animal ferments, but failed to impair the activity of vaccine lymph, glanderous pus, or scorpion's virus. Exposure to a temperature of 212° Fahr. destroys some ferments. Some are mechanically entangled by charcoal, dry earth, and cotton wool, which hence sometimes retard or prevent putrefaction. Chemical action, such as oxidation or deoxidation, the abstraction of some other essential element of the unstable organism, or the coagulation of its albumin, explain the operation of some antiseptics. Dr. Angus Smith ascribes to some a colytic or restraining influence; whilst others, without much chemical effect, appear to exert a distinct poisonous action on the living germs. But in what manner soever they operate, all true antiseptics destroy those living germs which develop change and decay, and probably, also, render the pabulum on which they grow and multiply less suitable for their nourishment.

Antiseptics have been used from remote antiquity. The Egyptians employed them in embalming their dead; Ulysses burnt brimstone to fumigate his house and courts; the Romans

successfully disinfected their sewage. Dr. Angus Smith made, for the Cattle Plague Commissioners,[1] a most instructive series of experiments with antiseptics. He found that cresylic acid and fusel oil stood at the head of the list. A few drops of either placed in the bottom of wide-mouthed bottles in which pieces of fresh meat were suspended, prevented putrefaction during fifty-one days, although the stoppers were occasionally removed. Carbolic acid and creasote proved equally effective, but caused some darkening of the meat, to which they also communicated their peculiar tar flavour. Oil of mustard, wood naphtha, and oil of bitter almonds follow next in order, preserving as effectually as the cresylic acid, but interfering with the natural colour of the meat. Next in order stood acetic and pyroligneous acids, essence of pine-apples, and coal naphtha. Lower in the scale come the essential oils, with turpentine, aniline, and phosphorus. As pointed out by Dr. Angus Smith, the most effectual preservers, and those which least interfere with the colour, flavour, and consistence of the meat, are the following bodies of the alcohol series. (The first column gives the old formula; the second the new, which is generally adhered to throughout the volume.)

Methylic alcohol,	$C_2 H_4 O_2$ or C	$H_4 O$
Ethylic ,,	$C_4 H_6 O_2$	$C_2 H_6 O$
Amylic ,,	$C_{10} H_{12} O_2$	$C_5 H_{12} O$
Carbolic (phenylic),	$C_{12} H_6 O_2$	$C_6 H_6 O$
Cresylic ,,	$C_{14} H_8 O$	$C_7 H_8 O$

For preserving meat for food, these agents are not equally available; amylic, carbolic, and cresylic acids or alcohols, unless used sparingly, prove injurious when swallowed.

Various gases were introduced into securely-corked bottles, containing weighed portions of meat suspended in them. These trials extended over twenty-eight days. The mineral acids (hydrochloric, nitric, and nitrous acids) prevented putrefaction most effectually, but darkened and destroyed the natural appearance of the flesh. Sulphurous acid produced less discoloration, but left an unnatural pink colour. Carbonic acid after seven days left the meat smelling and slimy. Heavy oil

[1] *Third Report of the Commissioners appointed to inquire into the Origin and Nature, etc., of the Cattle Plague*, 1866.

of tar, hydrogen peroxide, and M'Dougall's powder, were equally ineffectual. Ammonia and iodine kept the meat well during the twenty-eight days, and without leaving their special odours. Chlorine was equally effective, but bleached. Ether communicated its flavour, but preserved the meat well.

Another valuable series of experiments was undertaken by Dr. Angus Smith (*Third Report to Cattle Plague Commissioners*), in order to test the power of various antiseptics on blood and water kept from two to forty-two days. The most thorough preservation was obtained by zinc and iron chlorides. Corrosive sublimate came next; arsenious acid and copper sulphate followed. In the experiment on the disinfection of sewage, the best results followed the use of iron perchloride, followed by lime salts. Aluminium chloride, in the form of chloralum, recommended by Professor John Gamgee, although not so active an antiseptic as the metallic salts first enumerated, and wanting the diffusive power which makes an effective disinfectant, proves convenient both for external and internal use. A 15 per cent. solution of acetate of alumina has been used in Germany; but for surgical purposes it has the disadvantage of being in the moist state; when dry, it decomposes, giving off acetic acid. The progress of putrefaction, and the amount of water added to the blood or other decomposable material, were found greatly to increase the difficulty of disinfection; and hence the important practical conclusion, that antiseptics should be added to animal excreta, and other articles to be preserved, before any change has occurred, or before any water is mixed with them. Common salt, so deservedly prized as a domestic preservative, has wonderful antiseptic powers; two ounces sufficed to preserve from putrefaction and smell, during thirty-four days, one hundredweight of human excrement; but when decomposition has once set in, salt does not effectually arrest it. For deodorising meat condemned as unfit for food, nothing is so cheap and effectual as Cooper's salts, which consist of 80 per cent. of waste chlorides with 20 of water; iron sulphate and picric acid being subsequently added to discolour the meat, and prevent its being used for human food. Chloride of lime, in the familiar form of bleaching powder, destroys ammonia, urea, and uric acid, and hence

proves an effectual deodoriser; but its antiseptic power is low, and on account of its decomposing so many nitrogen compounds, its addition to refuse matters diminishes their manurial value. Hydrogen peroxide and the permanganates are expensive but effectual deodorisers. Carbolic and cresylic acids, the active constituents of the impure brown carbolic acid, of creasote, of tar oils, and of M'Dougall's disinfecting powder, are for general purposes the most effectual antiseptics. Mixed with stable manure, decomposition and heating are prevented; sewage treated as at Carlisle with these tar acids, although deprived of smell, is not diminished in manurial value; flies and animalcules are seldom seen on land dressed with it; potato disease is also said to be prevented; and sheep grazed are not liable to foot-rot.—(*Third Report*, p. 160.)

The phenol or carbolic acid series has near relations with benzoin and the oils of cloves, thyme, peppermint, and other essential oils, and with their active principles, thymol and myrtol. They are antiseptic, and, moreover, paralyse the terminal filaments of sensory nerves. Eucalyptus globulus, or blue gum, is found by Professor Lister and other experimenters to be a useful volatile non-irritating antiseptic; prescribed as a tincture, it has recently been used in typhoid fever in man, and is stated to exert special antiseptic effects on the irritable stomach and duodenum.—(*Edinburgh Medical Journal*, August 1881.) Resorcin, a crystalline substance, a member of the phenol group, is derived from certain resins fused with alkalies, is freely soluble in all liquids excepting chloroform and carbon sulphide; resembles carbolic acid, but is less irritant. A three per cent. solution is serviceable in febrile complaints, lowers both pulse and temperature, and has acquired considerable credit in combating malarial disorders, in which some regard it is only second to quinine.

Salicylic acid ($C_7 H_6 O_3$) is a concentrated effectual antiseptic; unlike carbolic acid and its fellows, non-volatile, and hence having its sphere of action limited to the parts with which it is brought in contact, devoid of irritant, caustic, or poisonous properties, and therefore specially suitable for food preservation and for internal use. Boracic acid has also come

into extensive use as a non-volatile, unirritating, non-poisonous antiseptic. Chloral-hydrate has been recommended by Dr. William Craig of Edinburgh as a pleasant-smelling, soothing, and effectual antiseptic; a solution of five grains to the ounce of water is recommended for dissecting-room and general surgical purposes.

Dr. P. Crace Calvert placed an albuminous solution in separate tubes kept at 80°, and added to each one-thousandth part of various antiseptics. The standard solution without anything added exhibited fungi in 18 days, vibrios in 12 days, and putrid odours in 16 days. This minute addition of carbolic and cresylic acids prevented development of fungi, vibrios, or putrid odours throughout the three months during which the experiments continued. The solution treated with mercury bichloride remained without vibrios or odour, but showed fungi in 81 days. Zinc chloride prevented the growth of vibrios, but fungi appeared in 53 days, and putrid odours in 38 days. Zinc-sulpho-carbolate averted vibrios and odour, but kept fungi away only during 17 days. Arsenious and acetic acids, although preventing smell and retarding the development of vibrios, had no power in retarding fungus growth. But quinine sulphate arrested both fungi and odour, allowing, however, the appearance of vibrios in 25 days. Charcoal had no influence either on the animal or vegetable germs, but prevented odour. Sulphurous acid has somewhat similar effects, but being volatile loses its power, and putrid smell became noticeable in 45 days.

In surgery, zinc and iron chlorides, with other mineral substances, have long been used as antiseptics. For centuries pitch and tar, tinctures of myrrh and of benzoin have been applied both in human and veterinary practice. But Professor Lister has inaugurated a new and thorough system of antiseptic surgery. He uses carbolic acid, ingeniously applied in many different ways, with most satisfactory results, preventing the access to wounds of those ubiquitous germs which induce faulty degenerate action, checking suppuration and gangrene, and hastening healing. Wounds treated antiseptically are as soon as possible thoroughly washed with a solution of carbolic acid, containing one part of acid to twenty of water; every

recess is bathed, and, if need be, syringed out with the preservative fluid. To prevent the carbolic vapour and moisture unduly irritating the wound, it is usually covered with a fold of oiled silk, coated with copal and dextrine, and applied well wetted with the one to twenty solution of carbolic acid. Over this are laid six or eight folds of antiseptic gauze saturated with the carbolic solution. Between the two outer folds of the gauze a piece of Mackintosh cloth is introduced to prevent the direct soakage of drainage through the centre of the dressing, which is retained in position by suitable bandages. To insure full advantage of the antiseptic treatment, the wound until cicatrised must not be exposed, even for dressing, without being played upon by carbolic vapour from a spray producer, or covered with a protecting piece of calico soaked in carbolic solution. To prevent the possibility of conveying into the wound any septic germs, the knives, probes, ligatures, sponges, as well as the hands of the operator, must be repeatedly moistened with carbolic solution. When used at once for serious contused wounds carbolic dressings often coagulate and preserve outpoured blood and serum, and prevent their breaking up. To secure, however, its full advantages, carbolic acid must be applied before destructive germs get access to the wound, and it must be carefully and systematically continued until granulation has made good progress. Under carbolic spray, abscesses and bursæ are opened with greatly reduced risks of destructive inflammation and suppuration.

Carbolic acid having been so signally successful in surgical practice many other antiseptics have been tried, some of them of great utility. Salicylic acid, valuable on account of its concentrated form and its freedom from smell, taste, and irritant effect is not volatile, and hence does not require, like the volatile carbolic acid, that the dressings soaked with it should be so frequently renewed. Boracic acid is another non-volatile unirritating antiseptic, often superseding carbolic acid where bad wounds have got over the early sloughing stage, where frequent dressings are unnecessary, or where granulation and growth of skin are to be encouraged. Chloral hydrate is, like carbolic acid, volatile, penetrating, and able to attack

germs and arrest the decay, irritation, and fœtor of decomposing textures in deep or lacerated wounds, where the non-volatile salicylic or boracic dressings do not actually touch; and further recommends itself on account of its local anæsthetic virtues. Sulphurous acid gas dissolved in water is a cheap, effectual, and soothing antiseptic, suitable for surgical cases. Chlorinated soda solution is sometimes also used, and Professor Spence recommended iodine tincture, diluted according to circumstances, as a valuable stimulant and antiseptic dressing.—(*Lectures on Surgery.*)

Antiseptics have not hitherto been so successful in medical as in surgical practice. They have certainly, however, considerable power in checking ordinary febrile attacks, and cases of hectic septicæmia and even pyæmia. The arrest of ague by quinine, and the control of some forms of rheumatic fever by salicylic acid, encourage the belief that special antidotes may yet be found for such specific diseases as tubercle cancer and glanders. Nay more, the experiments of Professor Polli and Mr. Crookes, above referred to, afford some hope that during the prevalence of epizootic and contagious diseases, the regular administration of antiseptics may protect animals from their attacks.

Antiseptics are given medicinally by the mouth, by subcutaneous injection, and by inhalation; and the two latter modes of administration are especially deserving of extended use in veterinary practice. In epizootic and contagious disorders, for the comfort of the patient as well as for the health of its fellows, they should be more generally employed for sponging the skin and removing the fœtor and contagion of the dejecta.

Disinfectants.

Disinfectants (*dis*, signifying separation; and *inficio*, I infect) are agents which absorb, alter, or destroy contagious matters. They are closely allied to deodorisers and antiseptics. Strictly speaking, antiseptics prevent decomposition, whilst disinfectants neutralise or destroy noxious matters produced by decomposition or change, whether in dead or living matter. Mr. William

Crookes, in his report to the Cattle Plague Commissioners,[1] remarks: "Disinfection, in the widest sense of the term, includes deodorisation, and means the neutralisation or destruction of all substances arising from putrefying organic matter, or emanating from diseased animals, either injurious to health or offensive to the sense of smell."

The *modus operandi* of disinfectants is still somewhat obscure, owing mainly to the imperfect knowledge of the nature and behaviour of the matter of contagion. Air from fever wards, from the sheds containing cattle-plague patients, and from other such places filled with men and animals suffering from diseases of a notoriously contagious kind, has been carefully examined; but the contagious virus which such air undoubtedly contains has not hitherto been isolated or demonstrated, either by the chemist or the microscopist. Until recently the matter of contagion was believed to be in the form of a gas or volatile liquid, and various gases were particularised as the essential causes of contagious disorders; as, for example, carbonic acid, marsh gas, sulphuretted hydrogen, ammonium sulphide, hydrogen selenide. But these gases have not been found in undue amount in the atmosphere in which patients affected by contagious diseases have been kept; moreover, when mixed with air, they may usually be breathed in sensible, and sometimes even considerable, quantities without producing such diseases. While dilution with air or water would diminish, or destroy, the specific action of gaseous or volatile bodies, the matter of contagion frequently retains its power of reproduction unimpaired after being carried considerable distances in air, or even in water. Such observations demonstrate conclusively that the matter of contagion occurs as a finely-divided solid; it possesses a definite shape and form; it is an organised body like the pollen of flowers, or the odorous dust given off by plants or animals; it retains its characteristic activity although carried considerable distances through the air, or lodged for considerable periods in protected or congenial situations. Suspended in air or water, these contagious particles find access to the healthy body mostly through the pulmonary

[1] *Third Report of the Commissioners appointed to inquire into the Origin and Nature of the Cattle Plague*, 1866.

or the alimentary mucous membrane. A sufficient dose having entered the body of a susceptible patient, after a varying period of incubation, produces its notable effects; and each virus develops its own distinctive pathological conditions. Two views are entertained regarding the way in which the matter of contagion, or "contagium," as it is now termed, produces its effects. Some chemists believe that the organic particles, like the soluble ferments or enzymes, communicate their own motion or activity to the decomposable materials with which they come in contact. Physiologists teach that contagium consists of organised germs, and their spores, both of which are possessed of inherent vitality and power of reproduction (p. 19). The germination and multiplication of these living organisms on congenial soils, give rise to the specific disorders from which fresh organisms are again eliminated. Many contagious diseases, such as cattle plague, pleuro-pneumonia, and foot-and-mouth disease, cannot be developed by any combination of circumstances; they spring only from parent germs or spores, given off from patients infected with the specific contagion. Occasionally, however, distinctly contagious germs appear to be developed *de novo,* probably from degenerate cells, during the progress of accidentally occurring cases of influenza, farcy, puerperal peritonitis, or typhoid fever.

In the absence of sickness, perfect cleanliness of the animals and their surroundings, with abundance of pure air and pure water, are the only purifiers requisite; but when serious or catching complaints occur, further precautions are desirable to attack or destroy the special seeds of disease. Particles of contagium are brought, and are also borne away by the air. Diffused by free currents of pure air, they are obviously less likely to be taken into the animal body in doses sufficient to do harm, whilst myriads, doubtless, lose their vitality, or fall where they cannot grow or reproduce themselves. Free ventilation and adequate cubic space, with attention to cleanliness, further remove and dilute many of those organic matters on which contagium is so prone to fasten and flourish. Besides mechanically diluting the particles of contagion, air acts as a chemical disinfectant in virtue of its oxygen, and also of its ozone, which occurs in most salubrious localities, is produced

especially during electrical disturbances of the atmosphere, and is the natural disinfectant which neutralises many dangerous organic impurities. Water, like air, is a valuable means of cleansing and disinfecting. It mechanically dilutes noxious matters, and hastens their oxidation. Sewage freely mixed with running water is hence rapidly decomposed and robbed of injurious properties. Insufficiently diluted with water, decomposing organic and contagious matters, instead, however, of being deprived of their activity for evil, are more likely to get distributed, and even 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. Stables, sheds, market-stances, trucks, or vessels contaminated by contagium, should first have their walls, floors, and woodwork swept, and, if need be, scraped, and the 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; the walls may subsequently be lime-washed, and the floors sprinkled with M'Dougall's powder.

The matter of contagion, as pointed out by the late Professor George Wilson, is probably made up of two or more of the four organic elements—carbon, hydrogen, oxygen, and nitrogen. Even organised disease germs are similarly constituted, and are invested with a very thin protecting envelope. If reached while floating in the air or lurking in fomites they are not difficult to destroy. For their destruction "oxidising agents are plainly of great value, as they can readily convert hydrogen into water, and carbon into carbonic acid, and thus disintegrate and destroy the organic matter. Substances having a great affinity for hydrogen, such as chlorine and its class, will plainly also be of great service; substances having an affinity for oxygen will also be applicable to the destruction of organic poisons; and, finally, all reagents which by contact with organic matter can determine a new arrangement of its ultimate elements. All the powerful chemical disinfectants act in one or other, or all, of these ways." Many substances, such as common salt and the tar acids, exerting feeble

chemical action, nevertheless, have powerful antiseptic and disinfectant properties, probably depending upon their destroying the active organised particles.

Heat is an effective disinfectant; it either breaks up organised bodies or renders the surroundings unsuitable for their germination, it destroys contagious germs; in albuminous and other solutions, microscopic life is effectually killed when the temperature reaches 400° Fahr. Dr. Henry, of Manchester, found that vaccine lymph was rendered totally inert by exposure to a temperature of 140° Fahr. Jackets worn by scarlet fever patients were used with impunity by four children after being exposed during two to four hours to dry heat about 200°; whilst the clothes of typhus patients, after similar exposure, were worn by himself without any bad effects. The thorough cleansing of the wearing apparel, bed-clothes, and such belongings of persons affected with contagious disorders, is now carried out in connection with most hospitals, and under the sanitary regulations of most towns. Extremes of cold, as well as of heat, interfere with the development of many contagions, but seldom effectually destroy them. Charcoal and dry earth mechanically entangle odorous and colouring matters, and in like manner retain contagium brought into immediate contact with them, while the oxygen condensed in the pores of the charcoal is also effective in destroying the germs. In much the same way cotton wool has been used to filter deleterious particles out of foul air, but such mechanical appliances can only have a limited usefulness. The matter of septicæmia, which is heavier than air, when strained through a porcelain filter, is deprived of its septic properties, and with impunity has been injected into recent healthy wounds, but the special germs, in unimpaired activity, remain in the deposit in the filter.

Disinfectants differ materially in their efficacy for different purposes, and their special features have been examined and detailed by Dr. Angus Smith in his admirable report to the Cattle Plague Commissioners. When water is present, mineral salts are best, and the most effective and cheapest is zinc chloride, long used in the familiar form of Sir William Burnett's disinfecting fluid. Iron chloride also stands high, and

is the active constituent of Ellerman's deodorising fluid. For sewage disinfection, or where there is much water, aluminium sulphate, followed by lime, is 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 most effectual for deodorising, has a feeble power of preventing putrefaction of night soil, and when remaining for a day or two freely dissolved in water they give off sulphuretted hydrogen. Common salt, although it exerts small power of checking decay when once established, or of neutralising bad smells, is deservedly prized as a cheap preserver of animal substances, and in the minute quantity of two ounces to one hundredweight of night soil it prevented putrefaction and smell, even although the mixture was kept for thirty-four days at a temperature of 60° or 70°. It is recommended for the preservation or disinfection of infected skins, and, with or without muriatic or carbolic acids, for the injection of carcasses of infected animals, thus enabling them to be used with impunity in the manufacture of manure. For preserving meat seized as unfit for human food, Cooper's salts, consisting of refuse commercial chlorides, are cheap and effectual. Lime chloride, in its convenient form of bleaching-powder, has little antiseptic power, but is an effective deodoriser when used dissolved in twenty parts of water. It cannot be employed in conjunction with sulphurous acid. Where there is little moisture the tar acids are superior to everything at present in use; in small amount they prevent decomposition and check fermentation, and their effect, it should be remembered, is still further increased by admixture with dry sulphites. For the disinfection of dried skins, hair, hoofs, or flesh, and for the purification of sheds, pens, wagons, etc., carbolic acid in its brown impure form is used in the proportion of two ounces to the gallon of water. M'Dougall's powder is conveniently employed to disinfect the droppings of animals, to prevent decomposition of manure, and, freely used in stables or cattle-boxes, it keeps the atmosphere charged with carbolic vapour. Where tar acids have been used to neutralise sewage, as at Carlisle, the meadows irrigated with it are stated to be almost exempt from foot-rot.

The reporters to the Cattle Plague Commission recommend that air contaminated by contagious virus be disinfected by muriatic acid, obtained by pouring oil of vitriol on common salt; by chlorine, cheaply evolved by pouring muriatic acid on manganese black oxide; by sulphurous acid, made by placing sulphur on a shovelful of hot cinders; or by tar acids sprinkled over the floors or walls, or given off more abundantly by dropping a cinder or hot iron into a vessel containing the acid. These tar-acids and sulphurous acid may be very effectually used together, and constitute the most reliable disinfectant mixture at present known.

Iodine stood well in the cattle-plague experiments; and, mainly on Dr. B. W. Richardson's recommendations, has since been 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 volatilises rapidly; it leaves when freely used a film of iodine, and effectually destroys smell and noxious organic matter. Its expense, however, precludes its general use in veterinary practice.

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

In infected sheds or stables occupied by animals, sulphur fumigations may be used two or three times a week. The acid must be evolved gradually, and in amount insufficient to cause coughing or pulmonary irritation, either to the animals or to their attendants. Half a pound of sulphur burnt at one or two spots suffices to fumigate a shed about 100 feet long and 20 feet in breadth and height. Carbolic acid in its impure liquid form is conveniently applied with a brush over the doors, walls, and mangers; and M'Dougall's powder should be scattered over the floors and manure heaps daily. The horns, feet,

tails, and even the backs of the animals, may also, during the prevalence of any actively contagious disease, be brushed over daily with a solution of one part of acid to a hundred of water. Rugs, pieces of carpet, or sacks wetted with a strong solution, should be hung about the premises, to evolve the carbolic vapour, which is not injurious to animal health, and to attract and destroy any floating disease germs. To reduce the risks of attendants conveying virus, their clothes and hands should frequently be sprinkled with weak carbolic solutions, made with one part of acid to a hundred of water. In sheds and other unoccupied premises the sulphurous acid should be evolved more freely, the doors and windows being closed, and the vapour allowed to diffuse itself for several hours. Carbolic acid is subsequently used in the manner already advised.

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 in the midst of active 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 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

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 in large stables has been greatly abated, and the virulence of the disease mitigated.

Contagious germs whilst yet floating in the air or adhering to fomites, as already pointed out, can certainly be attacked and robbed of their power of evil. When in small numbers, they first gain access to the body, they are also apparently checked in their power of reproduction, and hence such disinfectants as carbolic acid and sulphites may be used with fair prospects of success as preventives of contagious and zymotic diseases. But when for many hours or for some days the virus has remained within the body, its destruction is more difficult and uncertain. Before its subtle presence is suspected by the production of external symptoms, it has usually multiplied a millionfold, and engendered a degenerate condition of the blood and soft solids. The work of the disinfectant is now greatly increased. Not only have myriads of active germs to be destroyed, but their destructive effects on the vital functions have also to be counteracted. Mr. Crookes's experiments in cases of cattle plague prove, however, very satisfactorily that sulphites, bisulphites, and carbolic acid, retain their power of destroying disease germs even when these have fructified within the living body. "Better kill an animal with a good disinfectant," as remarked by Dr. Angus Smith, "than let it die putrid, and ready to kill others." But the risk of killing, even by the direct injection of disinfectants into the blood, is small. Mr. Crookes injected into the veins of cattle plague patients one ounce of sodium sulphite, and in other experiments 78 grains of carbolic acid, or nearly enough to preserve from putrefaction the whole mass of the circulating fluids. Although not usually saving the patients, these injections invariably abated for a

time febrile symptoms, and reduced exalted temperature. Adopted at frequent short intervals, their curative results would probably have been much greater. The disinfectant or antiseptic treatment of contagious and zymotic diseases, as already remarked, is of great promise, alike in the way of cure and prevention. The disinfectant may be given by the mouth, often conveniently enough along with food or water; it may be inhaled with the air, with steam, or with other volatile bodies, or it may be injected directly into the blood.

Deodorisers.

Deodorisers disguise or destroy odours. Bad smells, however unpleasant, are not necessarily prejudicial to health, and although sometimes associated with, are perfectly distinct from, the germs or spores 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 solid pollen-like bodies, the noisome offscourings from the skin and lungs of animals. Many 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 such antiseptics as carbolic acid, common salt, or sulphites. 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 and sulphurous acid. For destroying the intolerable smell from the cochineal dye-works, no deodoriser has been found so effectual as sulphurous acid. By free admixture with air, by allowing animals sufficient cubic space and ventilation, rapid subdivision and dilution of odorous particles are effected, and

unpleasant and noxious properties are readily and effectually removed.

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 in the proportion of 20 grains to an ounce, has been introduced by Dr. B. W. Richardson, and although expensive, is an elegant and effective deodoriser. In regulated amount, the iodine vapour may be continuously evolved by placing about the premises portions of bibulous paper, previously wetted, dried, and packed in a closed box. 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. Most effectual, and of moderate cost, is a mixture of dry sodium sulphite with carbolic acid.—(*Report of Dr. Angus Smith to Cattle Plague Commissioners.*) This should be distributed in vessels about the premises to be deodorised. 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. Lime chloride, in the familiar form of bleaching-powder, 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.

Antidotes.

Antidotes (*ἀντί, anti,* against; and *δίδωμι, didōmi,* I give) mitigate or arrest the action of poisons. A poison, in the popular acceptation of the term, is a substance, whether animal, vegetable, or mineral, which, in small quantity, destroys health and life; but in reality it differs from a medicine only in the degree or intensity of its effects. Indeed many valuable medicines, when given injudiciously or in large doses, become active poisons, whilst many poisons, properly administered, prove valuable medicines.

When poison has been swallowed, some antidotes, as charcoal and demulcents, acting mechanically, envelop the particles, retard absorption, or ensheath and protect the mucous surface from irritation. Chemical antidotes alter the composition of the poison, forming mild, insoluble, or innocuous compounds. Thus alkaline solutions are antidotes for poisoning with the mineral acids, on account of their forming with them mild laxative salts; albuminous matters for poisoning with corrosive sublimate, on account of their forming with it the harmless albuminate of mercury; the mixed oxides of iron for poisoning with prussic acid, which is converted into insoluble Prussian blue. Some antidotes counteract or relieve the symptoms produced by the poison: ammonia, for example, overcomes the sedative effects of prussic acid; opium lessens the pain and reflex disturbance caused by irritants; artificial respiration frequently preserves life, while the deadly effects of narcotic poisoning pass away; heat carefully applied often preserves or prolongs life alike in sedative poisoning and in exhausting disease.

An interesting class of antidotes are physiologically opposed to the poison. Thus, nux vomica, with its alkaloids strychnine and brucine, excite the motor centres and tetanise voluntary muscles; chloral hydrate, coneine, and curare, on the other hand, depress and paralyse those motor centres, diminish reflex function, and antagonise spasm. Chloral hydrate, accordingly, is found to save dogs, rabbits, and other animals which have received deadly doses of the tetanising strychnine. Tobacco depresses and paralyses the nervous system generally, and

usually destroys life by arrest of respiratory movements. Its nearest physiological opposite is atropine, which notably stimulates the sympathetic system, and, used subcutaneously, combats the toxic effects of tobacco. Theine is a general nerve stimulant, increases motor and reflex activity, and is physiologically antagonistic to poisonous doses of morphine, which depress and paralyse the cerebro-spinal axis and nerve centres. The present imperfect knowledge of the exact action of many poisons renders it, however, a somewhat dangerous proceeding to administer one active poison to antagonise another. To be effectual, such an antidote must usually be given along with or immediately after the poison—a condition seldom practicable in cases of accidental poisoning.

Various organised animal poisons, or germ parasites as they are termed, such as that of the Bacilli of anthrax and septicæmia, have their effects prevented, and even arrested, by recently-discovered specifics (p. 20). The deadly blood or serum from fatal cases is reproduced by inoculating mice, guinea-pigs, or rabbits. Each successive inoculation diminishes the activity of the original virus. After five or six inoculations, the cultivated fluid, when introduced into the body of a susceptible subject, produces slight febrile disturbance, but affords effectual protection from the original unregenerate disorder. The virus thus attenuated appears to break up the pabulum present in the bodies of susceptible subjects, and on which the virus fixes itself and germinates. This vaccination process appears destined to be widely used as an antidote, alike for the prevention and cure of specific contagious, and perhaps even of zymotic diseases.

Where poison has been swallowed it is generally important at once to evacuate the stomach, in order to get rid of any poison still remaining there. This is effected by the stomach pump, or more effectually in carnivora by emetics. The early administration of such absorbent substances as charcoal, and even of lard, glycerine, or clay, frequently prevents poison that has been given in a comparatively insoluble form from coming freely into contact with the walls of the stomach, and thus retards its absorption. Such measures are serviceable in poisoning, whether of horses or cattle, and have also proved so

effectual in some cases of poisoning both of men and dogs, that various authorities recommend their prompt adoption even before any emetic is given. In the case of corrosive and irritant poisons, demulcents are used to sheath and protect the mucous surface of the canal; but large quantities of fluid should not in general be given until the stomach is evacuated, as they are apt to facilitate solution and absorption of the poison. When active poisons have got access to the blood, their physiological opposites may be administered either by the mouth, or, to save time, by subcutaneous injection. Poisons are sometimes hastened in their removal, and their harmful effects thus averted by the judicious administration of purgatives and diuretics.

Caustics—Escharotics.

Caustics (*καίω, kaiō*, I burn; *καυστικός, kaustikos*, burning) decompose both solid and fluid animal tissues. They act, in the first instance, chemically, separating water, and combining with the albuminoids. This chemical action, which is true combustion, although lowering or destroying the vitality of the part attacked, unless severe and extended, increases vital action of surrounding tissues. The caustics in common use in veterinary practice are salts of aluminium, zinc, lead, copper, mercury, and arsenic, silver nitrate, caustic potash, and concentrated acids. They differ chiefly in the intensity of their action: some are so mild that they have slight effect on the sound skin, or even on mucous surfaces; some, like silver nitrate and carbolic acid, act superficially; others, like caustic potash and nitric acid, are more penetrating. Those causing extensive sloughing receive the special title of escharotics (*ἐσχάρα, eschara*, an eschar, scar, or scab). The chief difference between solid and fluid caustics is that the latter are more prompt and powerful, and more difficult to localise. The firing-iron or actual cautery, used at any temperature above a full red heat, acts as a caustic, producing first chemical and then highly exalted vital action. Besides being used as a caustic, it is also much employed as a counter-irritant (p. 47).

Caustics are used for repressing soft, spongy, and exuberant granulations; for stimulating indolent ulcers, and giving them

an albuminous coating as is done with silver nitrate; for destroying the virus in poisoned wounds, and preventing its absorption, when penetrating fluid caustics are preferable to solid; for expediting and completing the destruction of sloughing textures; for altering morbid actions of the skin or of wounds; for exciting adhesive action in the walls of fistulæ; for opening abscesses and forming issues; for removing warts and other tumours, especially when so deep seated and vascular that they cannot be safely extirpated by the knife; and for arresting hæmorrhage from accidental or surgical wounds. Employed for the last-mentioned purpose, caustics usually receive the special title of *styptics* (στύφω, *stüphō*, I constringe; στυπτικός, *stüptikos*, astringent). In using them the blood should be removed by 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.

Considerable doses of strong caustics taken internally act as corrosive irritant poisons, producing gastro-enteritis and fatal collapse, sometimes preceded by convulsions. Smaller and more diluted doses leave ulceration and dangerous lesions of the digestive canal. The fitting remedies for such irritant poisoning are chemical antidotes, demulcents, and opium.

Acids.

Acids (ἄκις, *akis*, a point) are defined by the chemist as substances which are mostly soluble in water, sour to the taste, redden vegetable blues, and unite with bases to form salts. Those commonly used in veterinary practice are the three mineral acids, sulphuric, nitric, and hydrochloric, with lactic, phosphoric, and acetic acids. From their greater affinity for water, sulphuric and phosphoric acids are especially energetic. Chromic acid is used for the destruction of warts, and disintegration of other morbid growths. Carbolic, salicylic, boracic, and sulphurous acids are chiefly valuable for their antiseptic properties. In large doses and concentrated form the mineral acids and acetic acid decompose the tissues, unite with their water, bases, and albuminoids, and therefore act as

irritants and caustics. In smaller amount or more diluted solution they are astringent and styptic. Applied to diseased surfaces and indolent sores they often establish new and healthier actions. They are antidotes in poisoning by alkalies. When given internally, they must be sufficiently diluted to avoid corrosion. Acting so differently from their several salts, they are evidently absorbed in part unchanged. With a high diffusion power they rapidly reach the blood, in which they neutralise excess of alkali, especially of ammonia, which is often abundant in fever cases, and liberate lactic, and other weaker acids.

It is a fact in therapeutics, clearly set forth by Dr. Sidney Ringer in his *Handbook on Therapeutics*, that alkaline secretions are stimulated by acids, and acid secretions by alkalies. Acids accordingly excite salivary secretion, but check gastric secretion, which is increased by alkalies. Acids promote salivary secretion by reflex action through the cerebro-spinal nerves; when these are divided acids lose their power of augmenting the saliva. Moderate doses of lactic or hydrochloric acids given before meals counteract indigestion depending upon excessive secretion of gastric juice, or irregular or excessive fermentation of food. In conjunction with or following a small dose of physic they relieve horses affected with acid foul mouth, faulty appetite, irregular bowels, and unhealthy skin. With a carminative they are often useful amongst badly managed calves suffering from acidity, hoven, or diarrhœa. Where the gastric secretions are inadequate, acids, usually conjoined with pepsin, given half an hour after feeding, directly supply the wanting solvents and aid in forming peptones. But used injudiciously or persistently, acids certainly diminish gastric secretion. As astringent tonics, they are serviceable in low fevers and convalescence from exhausting disease. These beneficial results depend in variable degree upon their improving digestion, bracing the gastric intestinal membrane, and exerting less understood effects on the blood. Although in the main closely alike in their effects, Professor Waring says that hydrochloric acid promotes digestion, nitric acid secretion, sulphuric acid constriction. Nitro muriatic acid is a hepatic stimulant. Vegetable acids are milder: being readily oxidised

into carbonates, they have a primary acid but secondary alkaline action. In full doses the mineral acids are excreted, usually imperfectly neutralised, and mainly by the kidneys; hence they correct undue alkalinity of the urine, and any tendency to phosphatic deposits.

Sponging weakly perspiring patients with tepid water, acidulated with vinegar or other acid, often lowers temperature probably by reflex action and promoting cutaneous evaporation. An acid outside the skin and the alkaline fluids within obviously favour osmosis.

Acids and acid salts are refrigerant or antipyretic; in other words, they reduce animal temperature. When swallowed they cause a gratefully cooling, though temporary sensation, on the nerves of the throat and stomach, and increase salivary secretion. The wider power of acids and other antipyretics in lowering temperature depends on various physiological effects: —(1.) On their action on the nervous centres and nerves; (2.) On their action on the circulation; (3.) On their promoting secretion and excretion; (4.) On their destroying parasite germs; and (5.) On their encouraging skin transpiration. Acids will again be noticed under the heads of Tonics and Astringents.

Antacids—Alkalies.

Antacids (*ἀντί, anti,* against; and *ἄκις, akis,* a point) include the alkalies, potash, soda, and ammonia; the alkaline earths, lime and magnesia; the carbonates and bicarbonates of these bases, and the neutral salts they form with vegetable acids, which are converted into carbonates in their passage through the body. As an antacid, the volatile ammonia is less permanent than the fixed alkalies. Potash seldom exists, either free or carbonated, in the blood, but is effectual in increasing its alkalinity by setting at liberty soda and ammonia. Potash and its salts are more active than soda and its corresponding salts. Lime salts, being soothing and constipating, are indicated in diarrhœa; magnesia salts, being laxative, are appropriate where constipation is present. Lithium carbonate, present in Baden-Baden and Bath mineral waters, is prized in human medicine as a solvent of urinary calculi

and deposits. The caustic and carbonated alkalies are corrosive, abstract water and albuminoids, and saponify fats. They are prescribed as antidotes for acids of all kinds, and, wherever occurring, for neutralising mineral or vegetable acids given as poisons, and for removing acidity of the alimentary secretions, with the indigestion and diarrhœa to which such acidity often gives rise.

Alkalies stimulate acid secretions. The alkaline bicarbonates given before meals excite gastric secretion. Given after meals they neutralise excessive acidity. They are often conjoined with vegetable bitters. In irritable states of the stomach with excessive acidity, alkalies, however, are contra indicated, and acids, bismuth, and prussic acid are more serviceable. Readily soluble and rapidly diffusible, they quickly enter the blood, slightly increase its alkalinity, assist in maintaining the normal amount and solubility of its fibrin, promote oxidation, and hence remove waste products, and cause absorption of fat. Dr. Parkes believes that potash and its carbonates disintegrate the nitrogenous, and the sulphur containing tissues. Alkalies are administered in rheumatic disorders, eczema, and some other skin diseases, as well as in inflammatory and febrile cases. In large quantities some pass rapidly out of the system by the bowels; in smaller doses they are excreted in the urine, increasing its alkalinity, and counteracting any tendency to lithic acid deposits, which, however, are exceedingly rare either in horses or cattle. Used externally often in the form of soft soap, alkalies have valuable cleansing effects on the skin, stimulate the growth and removal of dermal scales, and are also often serviceable in diminishing the irritating alkaline discharges of eczema, and other skin complaints, in such cases being often alternated with dressings of the tar acids. Alkalies will again be noticed under Alteratives.

Rubefacients—Vesicants—Suppurants.

These three classes of irritants, applied externally, stimulate and inflame the skin, and produce what is termed counter-irritation. On the end organs of the nerves, at the point of application, they induce some favourable molecular arrangement, which is propagated more or less widely to nerve centres,

affecting the calibre of arterioles, and the functions of trophic nerves. Abnormal molecular conditions determining pain, congestion, and even inflammation are thus often combated. Violent or prolonged irritation, instead, however, of promoting healthy conditions, exhausts nervous irritability, sometimes tetanises vaso-motor nerves, and establishes atrophic changes, as illustrated in ulceration of the duodenum following severe burns. Moderate counter irritation applied over considerable areas, such as repeated mustard embrocations to the horse's legs, chest, or abdomen, exert general stimulation, as evidenced by quicker and firmer pulse, increased activity of the skin, and other excretory channels.

Counter-irritants differ widely in the degree and intensity of their action. *Rubefacients* (*ruber*, red; and *facio*, I make) produce slight redness and inflammation, and are represented by alcohol, ammonia liniment, mustard, mild preparations of cantharides, with smart friction and moderate heat. In the lower animals, owing to the colour of the skin and abundance of hair, reddening, however, is less obvious than in man. *Vesicants* (*vesica*, a bladder) are more active and deep-seated, inflame the true skin, and raise vesicles or blisters, which contain a serous fluid, consisting of about seventy-eight parts of water, eighteen of albumin, with a little fibrin, and four of salts. Steam and boiling water rapidly produce large amount of effusion. The 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, turpentine, ammonia, and boiling water are the vesicants in most common use in veterinary practice. *Suppurants* (*sub*, under; and *pus*, pus) are still more powerful, actively inflame the deep-seated tissues of the skin, and cause a crop of pustules and a purulent discharge. This is the effect of croton oil and 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.

Most of these agents act with tolerable certainty on the skin both of horses and dogs, but less perfectly on the thick and insensible hides of cattle, for whom the most convenient

and effective counter-irritant is mustard, made up with cold water, the activity of the dressing increased by the addition of turpentine or ammonia. Blisters require to be cautiously applied to dogs, as the skin is often so irritable and sensitive that the animals bite and rub the blistered parts, and thus induce sloughing. The action of turpentine on the skin of horses is peculiar. Applied over a considerable surface it produces such intense itching irritation that the animal for a short time becomes excited and unmanageable, a result the more remarkable as turpentine acts but slightly on the delicate human skin.

Setons are sometimes substituted for blisters or firing, and are often preferred to firing on account of their being less apt to blemish. The seton consists of a piece of tape, cord, or fine wire twisted and passed by means of a seton needle underneath the skin. To prevent it slipping out, the ends are tied together or knotted. It is usually ordered to be moved daily; and if a severe effect be desired, it is smeared with blistering ointment. Setons act chiefly on the comparatively insensible subcutaneous areolar tissue, and are consequently neither very rapid nor very powerful in their effects. They are serviceable where long-continued irritation is to be maintained, and especially 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 which so frequently follows strangles. Placed in the dewlap, they also prove a tolerably certain preventive for black-leg in calves and young cattle, and for splenic apoplexy in older animals, probably in virtue of their modifying or removing the pabulum on which the Bacillus anthrax fastens and multiplies. 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 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 effected conveniently with a hypodermic syringe introduces water into soft

painful or irritable textures, often relieving nervous or rheumatic pain, and imparting 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 diseased joints, tendons, and ligaments, in which it is so often 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 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 laundress's smoothing-iron heated and pressed lightly 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.

Rubefacients, vesicants, and suppurants differ mainly in the degree and permanence of their effects. According to the way in which they are used they cause local or general stimulation, but as above stated, when violent, or too long continued, they induce local or general depression. In influenza, typhoid fever, and other depressing disorders of horses, rubefacients, such as soap-liniment or mustard paste, rubbed into the legs, and in five minutes again washed off, often beneficially rouse the action of the heart, and avert congestion. Counter-irritants are in common use in certain stages of inflammation of the joints and of the eyes, air passages, and intestines, and their investing membranes. In the outset of inflammatory attacks, by reflex action, external irritants lessen hyperæmia by stimu-

lating the dilated paralysed capillaries, and 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 symptoms have somewhat abated, counter-irritants are, however, again useful in promoting absorption of exudation; while in many chronic cases, by acting on vaso-motor and trophic nerves, they invigorate enfeebled, over-distended capillaries, and substitute higher formative for lower debased action. Their good effects being mainly produced during the few hours immediately after application, prolonged and severe action is seldom desirable. Counter-irritants should generally be applied directly over the inflamed organ, but not directly to tissues of the same kind as those inflamed, or immediately continuous with them. When too near to the inflamed or painful part the mischief is apt to be aggravated. According to the late Dr. Anstie, if applied over a posterior branch of the spinal nerve trunk, from which the irritated nerve issues, a reflex effect of a beneficial character is often produced.

The following conditions mainly determine the choice of the suitable counter-irritant, and the mode of using it. 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 where nutrition has been more seriously impaired, as in pleurisy or phlebitis, cantharides is the appropriate counter-irritant. Where bone, cartilage, or ligament has been chronically affected, a still more permanent and profound effect results from the use of mercury biniodide, the hot iron, or setons. Before the application of a blister 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 of the application 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. A violent, deep-seated action is seldom desirable. An abundant discharge,

evidencing extensive tissue-destruction, is never requisite. Better curative results are attained by more moderate and continuous effects. Acute inflammation, extending over a considerable area, or accompanied by fever, is seldom benefited, and is sometimes aggravated, by the use of blisters. They are more beneficial in laryngitis and bronchitis affecting the larger tubes than in broncho-pneumonia or pure pneumonia. When vitality is low, or the skin irritated, blisters are apt to cause sloughing. When inordinate irritation has been produced, it may be abated by fomentations, while undue constitutional excitement is removed by diluents, a mash diet, and salines. Two or three days after a blister has been applied, the part should be dressed with vaseline, oil, glycerine, or sugar-of-lead lotion.

Errhines.

Errhines (ἐν, *en*, in; and ῥίν, *rhin*, the nose) are a small and unimportant class of topical irritants, which act on the nasal membrane, causing discharge of mucus. The irritation of the membrane often produces the reflex act of sneezing—one or two hurried inspirations are drawn through the nostrils, followed by a forcible expulsion of air, with which are frequently removed any irritants lodged about the nasal passages. Most irritant and acrid substances, when directly applied to the Schneiderian membrane, act as errhines; but the most notable are ammonium chloride, mercury subsulphate and iodide, tobacco, euphorbium, veratrum album, and its alkaloid veratrine. Errhines, although now disused, were formerly prescribed to cause counter-irritation in affections of the eyes and head, and to expel, by inducing sneezing, foreign substances lodged in the nostrils, nasal sinuses, or respiratory passages.

Stomachics—Carminatives.

Stomachics (στόμαχος, *stomachos*, the stomach) promote digestion. They include such spices and condiments as ginger, carraway, and anise, with other seeds from the *Umbelliferæ*, and several volatile oils, as peppermint and rosemary, from the *Labiatæ*. These essential oils stimulate and, in large doses, irritate mucous surfaces. They are cardiac excitants; they

diminish reflex irritability, paralyse the terminations of sensory nerves, and are antiseptic. On account of their gently stimulating the stomach, they are given to relieve simple indigestion, and to remove flatulence and slight colic pains, in which case they usually receive the special title of *carminatives.* They are also used to hasten and facilitate the action of purgatives, and to impart agreeable flavour to many medicines.

Emetics.

Emetics (ἐμετικά, from ἐμέω, *emeō*, I vomit) cause the expulsion of the contents of the stomach through the œsophagus and mouth. The stomach is firmly compressed between the diaphragm and abdominal muscles, the cardiac extremity of the œsophagus is relaxed, and the gastric contents brought up. Pressure of the stomach between the abdominal walls, and relaxation of the lower end of the œsophagus by contraction of its longitudinal fibres which ramify over the stomach, and draw it towards the diaphragm, are the two essential conditions on which vomiting depends. In dogs emesis is imperfectly performed, or does not occur, when the abdominal muscles or diaphragm are cut or paralysed by curara. If the cardiac orifice remains closed, as it does in severe coughing, even although the stomach is squeezed as in vomiting, retching only occurs, but not vomiting. The phenomena of vomiting are thus described by Dr. Lauder Brunton, in the *Practitioner* for December 1874 :—"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."

These complex phenomena are produced usually by what is termed reflex action. When the fauces of men or dogs are tickled with a feather,—when, as in experiments, the interior of the stomach itself has been irritated, or when a tepid solution of mustard is swallowed, the irritation of the digestive mucous membrane is conveyed by afferent nerves to the medulla oblongata, in which is located a centre of vomiting, which is closely connected with the respiratory centre, and in which the special movements are correlated. By the intercostal phrenic and pneumogastric nerves the motor impulses are conveyed to the abdominal muscles, diaphragm, stomach, and œsophagus; muscular contractions occur; vomiting ensues. This centre presiding over vomition has intimate connection with almost every part of the body, and may be excited to produce vomiting, not only by irritation of the fauces and stomach, but by brain disorders, irritation of the liver and gall ducts, the intestines, the kidneys and bladder, or even by pain or injuries of the extremities. Absorption of an emetic from the stomach, or actual irritation of the stomach itself, is not necessary to produce vomiting, as is conclusively proved by Majendie's notable 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.

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 stomach and intestines, and from the action of large doses of aconite, which, however, induce retching and discharge of the excessive secretion of saliva rather than true vomiting. This insusceptibility of horses to the action of emetics 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. Even were the contents of the horse's stomach to get so far in their upward progress, the position and length of the velum palati would cause them to pass out by the nostrils, and not by the mouth. It might be supposed that as cattle naturally ruminate, they might also readily perform the analogous act of vomiting; but none of the substances which cause vomiting in other animals have any 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 these ruminants and in horses the vomiting centre of the medulla may, mereover, be imperfectly developed; and if this be so, it explains the wonderful tolerance which these animals have of tartar emetic.

Emetics are sometimes divided into two classes—(1) those which act mainly by irritating the mucous surface and nerves of the stomach, and include hot water from 105° to 120°, with tepid solutions of common salt, mustard, zinc and copper sulphates; (2) those which, like tartar emetic, tobacco, ipecacuanha and its alkaloid emetine, as well as apomorphine and veratrine, cause vomiting by whatever channel they enter the body, and directly irritate the vomiting centre. But the substances of this second class, when given by the mouth, doubtless act in both ways. Different emetics exhibit some difference in their effects. Zinc and copper sulphates act with great rapidity, and cause much increased salivary and mucous secretion, and hence are specially indicated for the prompt removal of poisons from the stomach. Most emetics, notably veratrum, hellebore, and colchicum, if they pass beyond the stomach, or are long retained, relax the bowels. Apomorphine—one of the alkaloids of opium, the most rapid and certain emetic known—acts by whatever channel it enters the body, exerts

its effects specially on the vomiting centre, and produces full effects in dogs, in doses of one-fifth of a grain.

Amongst dogs and pigs, emetics are used for removing from the stomach crude undigested food, poisons, and foreign bodies. Relaxing the longitudinal fibres of the gullet, and exciting antiperistaltic movements, they are serviceable in removing obstructions from the fauces and œsophagus. Compressing between the abdominal walls the liver, gall bladder, and gall ducts, they empty them, and hence are useful in bilious indigestion and some forms of jaundice. This clearing out both of the stomach and biliary system probably accounts for the advantage which emetics have in cutting short febrile attacks in dogs, mitigating distemper, and arresting epileptic seizures. In an animal which vomits 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 by the anus, doing perhaps further mischief, or running risks of absorption. Most emetics while stimulating the vomiting centre also stimulate the nearly connected respiratory centre, hence provoke mucous secretion, and are of signal service in the dry stage of catarrh, in bronchitis in vigorous animals, and in congestive as well as spasmodic asthma. It has been observed that all emetics paralyse muscular fibre ; hence doubtless the muscular weakness which follows their use, and the fact that overdoses often fail to cause vomiting. (*Practitioner*, Dec. 1874.) Acting repeatedly or violently they lower the force of the heart and the number of the respirations, but are not now employed to produce such sedative effects. Nor are they used, as formerly in human surgery, to relax muscular fibre, and thus aid in the reduction of dislocations. For such purposes they are superseded by chloroform and ether. Emetics are contra-indicated in gastric inflammation and congestion of the brain, 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 zinc sulphate dissolved

in a couple of ounces of warm water, rolled in a piece of meat or mixed with other food. More permanent sedative results follow the administration of three grains tartar emetic and ten grains ipecacuanha given dissolved in three or four ounces of tepid water. To counteract vomiting, which occasionally proves troublesome in dogs, two methods of cure are indicated—(1) the removal, by appropriate means, of the remote irritation of the fauces, bronchi, stomach, or other part which excites the reflex act; and (2) the quieting of the over-activity of the irritable vomiting centre by morphine, chloral, or potassium bromide (Dr. Lauder Brunton).

Ecbolics—Parturients—Oxytocics.

Ecbolics (ἐκ, *ek*, out of; and βάλλω, *ballō*, I throw) cause contractions of the muscular fibres of the uterus. Savin, rue, and cantharides, with active purgatives and diuretics, irritate the bowels and kidneys, and by reflex action excite the uterus. They cannot, however, either with certainty or safety, be administered to bring about or hasten parturition. But ergot of rye contracts involuntary muscular fibre, notably that of the uterus, and is occasionally given to the domesticated animals to excite labour pains, when these are weak or slow, to help removal of uterine tumours, and to arrest the bleeding sometimes depending upon them.

Aphrodisiacs.

Aphrodisiacs (ἀφροδίσια, *aphrodisia*, venery) are substances which have, or are supposed to have, the power of exciting venereal appetite. They include phosphorus, cantharides, peppers, turpentines, arsenic, and salts of gold. On the Continent they are still given to the domesticated animals, especially to cattle; but their employment is unnatural, and besides, seldom produces the desired effects. When the powers of procreation are defective, instead of employing such drugs, the cause occasioning the loss of power should be sought for and removed. If it consist, as it often does, in general debility, the appropriate treatment consists in generous diet and tonic medicine.

Anthelmintics—Vermicides—Parasiticides.

Medicines employed for the expulsion of worms are termed anthelmintics or vermifuges. By increased peristaltic movements and copious secretion of fluid, purgatives dislodge some of these intestinal parasites, cause them to unloose their hold on the walls of the alimentary canal, and wash them away with the mucus in which they are usually imbedded. Earth and sand, sometimes instinctively eaten by animals infested with parasites, mechanically aid in their removal. Such popular remedies as powdered tin, glass, and cowhage are untrustworthy, and often cause serious intestinal irritation. The more effectual anthelmintics are vermicides—they poison the parasites. Different agents are effectual for the destruction of the several species and varieties. To assist the removal of bots in horses, which the spring grasses naturally bring away on their reaching maturity, two drachms each of aloes and asafœtida are dissolved in hot water, half-an-ounce each of oil of turpentine and ether are added when cold, the mixture is administered in gruel or linseed tea, and repeated for several mornings. For destroying the two forms of tape-worms and their varieties in horses this prescription is also useful. Like most other vermifuges, it is most effective when the stomach and bowels are tolerably empty, and the vermicide is thus brought in contact with the head or scolex. Mr. Robert Littler, of Long Clawson, both for tape and round 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. 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. The *Ascaris megalocephala*, the common lumbricoid worm usually occurring in the small intestines of horses, and the *Oxyuris curvula*, familiar as ascarides, and met with in the colon and rectum, are more easily got rid of than tape-worms, and are treated by any of the above prescriptions. When lodged in the rectum the oxyuris are readily removed by clysters of diluted turpentine,

carbolic acid, decoction of quassia, or other bitters. The *Strongylus filaria*, or thread-worms sometimes infesting the bowels, and still more common in the air passages of young cattle and lambs, is destroyed by a few doses of turpentine and oil, by inhalations of chlorine or sulphurous acid, while weakly patients, which are always the greatest sufferers, are benefited by daily doses of iron chloride solution and liberal dietary.

Some of the most serious and fatal cases of parasitism, unfortunately, are beyond the reach of purgatives and specific anthelmintics. Trichinæ become immured in the muscles, the palisade worms develop aneurisms, the strongulus tetracanthus, which causes the death of many Welsh ponies, is incisted in the mucous coat of the colon and rectum, protected from the action of medicinal agents. The treatment of such cases consists in a dose of aloes, with mashes, nutritive food, and tonics, to sustain failing strength. Professor Cobbold, in such cases, discountenances turpentine.

The several species of tape-worm infesting the dog, and in some localities occurring in about half the canine population, are most effectively treated by areca nut. About half a nut or ten grains is the dose for a pointer. Amongst other remedies are a drachm of turpentine and two ounces of castor or linseed oil; the root-stalks, scales, and rootlets of the male shield fern, now reputed the most certain remedy for tape-worm in man; the pomegranate root bark, the flowers of the Abyssinian Kousso, followed by a purge, the American remedy, emulsion of the pumpkin seed, and Kamela, a Euphorbiaceous plant effectually used in India. Whichever tape-worm remedies are used, in any class of patients fasting is enjoined for about twenty-four hours, or only a little milk or gruel is allowed; at intervals of fifteen minutes two or three doses of the vermicide are administered; next day allow as little food as possible, and repeat several doses of the vermicide, an hour later give a dose of ether, and in another hour a dose of physic, and look out for the head of the parasite. The *Ascaris marginata*, the most common lumbricoid of dogs, is attacked by three to five grains of santonine, the active crystalline principle of artemesia or worm-seed. Turpentine and oil, gentian, and other bitters, aconite and various other medicines also remove these round

worms. The auxiliary treatment for all sorts of intestinal parasites consists in small doses of salines and mineral tonics to secure a healthy state of the alimentary canal and liberal dietary to sustain the patient's strength. The spread of parasitism is prevented by isolating infested animals, and keeping sound animals in uncontaminated quarters supplied by pure water.

The several skin parasites are more accessible, and hence more easily got rid of than those in the intestines. The acari producing mange and scab are destroyed by many volatile oils and mineral salts, which penetrate to the borrows in the dermis in which the female and her ova lie concealed. In inveterate cases the scales and thickened skin require to be dissolved or scrubbed off by hot water and soft soap, or other alkaline leys, when the special anti-parasitic with deadly effect can be brought into actual contact with the tormenting parasites. There is a wide choice of remedies ; the safest and most effective consist of equal parts of sulphur and tar oil dissolved in ten parts of any common oil or lard ; iodide of sulphur used with about ten of any fatty matter, or the cautious use of tobacco decoction, oleate of mercury, or corrosive sublimate solution. Two dressings at intervals of about three days thoroughly and diligently applied to every itching spot cure most cases either of mange or scab. If a third application is necessary, it will be well to change the dressing.

Ticks in sheep, being amongst the wool and on instead of in the skin, are more easily got rid of without the need of smart infriction and by dipping the subjects in alkaline and sulphur baths, rendered more effective by admixture of carbolic acid, arsenic, or decoction of tobacco. A useful bath for such purposes is made with one pound each of sulphur, potashes, soft soap, and arsenic, boiled for fifteen minutes in a gallon of water, and diluted with either hot or cold water, until it measures thirty gallons. A quart of crude carbolic acid is then added. These quantities economically used suffice for thirty sheep, or two score lambs, and will cleanse the wool, destroy all ticks and scab acari, if not numerous or deeply burrowing, whilst for some weeks it affords protection from flies. For the destruction of fleas, very troublesome amongst dogs,

carbolic soap and water are effectual, or a bath of soft soap and water, to which is added about one part of carbolic to a hundred of water. For house pets the application of a little oil of aniseed answers well. A few pinches of snuff laid along the back will clear off many. The kennels and bedding should be kept scrupulously fresh and clean; pine-wood shavings should be substituted for straw; the sleeping premises washed with soap and carbolic solution, and occasionally sprinkled with oil of turpentine.

Purgatives—Cathartics.

Purgatives (*purgo*, I purge), or cathartics (*καθαίρω, kathairō*, I cleanse or purge) increase the peristaltic movements and secretions of the bowels, and thus quicken and augment evacuation of softened or fluid fæces. Husks of grain, vegetable fibre, various indigestible substances, with resinous and comparatively insoluble purgatives, previous to absorption, and agents which, like Epsom salt, have a low diffusion power, by topical irritation, provoke augmented peristalsis and increased activity of the intestinal glandular apparatus. Active purgatives, however, wholly or in part, become absorbed. They may gain access to the circulation by being inhaled, by subcutaneous injection, or by absorption from the rectum. When given in the usual way by the mouth, they are taken up chiefly by the capillary veins of the stomach and small intestines, and through the portal system enter the general circulation. Having little affinity for animal textures, they are speedily returned to the intestinal mucous membrane, where they are separated by the secretory glands, and poured into the intestinal tube along with the increased secretion to which they give rise. During both absorption and excretion they irritate the mucous membrane, and consequently increase peristalsis, which, when excessive, occasions the pain and spasm accompanying the action of violent purgatives.

Croton and senna, as well as such poisons as nicotine and sulpho-cyanide of potassium, owe their purgative action mainly to increased peristalsis. Salines, especially if given sufficiently concentrated, partly by diosmosis and partly by increased secretion, cause notably fluid dejections. 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 twelve 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 9 pints of fluid. Such considerations illustrate the depurative and febrifuge effects of an active cathartic.

Different purgatives are excreted from different parts of the alimentary canal. Jalap is chiefly separated from the small intestines; aloes from the large; and croton and saline purgatives from both. Excretion, however, from *some* part of the alimentary mucous membrane appears to be essential to the full effect of most active purgatives, which lose their cathartic effect when administered in combination with articles which cause their removal by the kidneys or other emunctories. In corroboration of this, Dr. Ward records the interesting case of a woman, in whom castor oil did not produce purgation, but was exuded by the skin, and acted as a diaphoretic. Horses are occasionally met with in which the usual aloetic doses excreted by the kidneys instead of by the bowels, provoke diuresis instead of catharsis.

Purgatives vary much in the intensity of their action. When mild, they are *laxatives* or *aperients;* when inducing copious watery discharges, they are termed *hydragogue* cathartics; when griping, are styled *drastic;* and when accompanied by discharge of bile, are known as *cholagogues.* Unless to effect some definite useful purpose, physic should not be given to any animal. Given habitually without good reason, as is still sometimes the case, cathartics are apt to produce dyspepsia. Repeated large doses, especially of cathartics, producing increased peristalsis, are apt to diminish the healthy tone of the intestines, and even to paralyse them, and hence are undesirable in obstinate constipation. Excessive doses cause weakness, and occasionally fatal superpurgation and enteritis: untoward effects are especially apt to ensue in horses suffering from irritation or inflammation of the skin or

mucous membrane of the air-passages. I have seen horses affected by bronchitis die from superpurgation, induced by three drachms of aloes; and similar susceptibility to the action of very moderate doses is also observable in typhoid fever, purpura hæmorrhagica, and laminitis.

The intestines of man have a superficial extent of about 1400 square inches (Meckel). Those of the horse being three times the length, and having at least three times the calibre of the human intestines, must consequently have a surface of about 90 square feet. This extensive superficies is covered by a highly vascular mucous membrane, packed full of actively secreting glands, and abundantly supplied with nerves. Such an immense extent of vascular and sensitive intestinal mucous membrane necessitates great caution in the administration of purgatives to the horse. For at least a day previous to the exhibition of the dose, 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 exercise, until it begins to operate, and by the repeated use of clysters. This last auxiliary, when 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. For horses, aloes is probably the best of all cathartics. The fixed oils are tolerably good, but less certain; while croton is much too drastic, unless in small amount, and largely mixed with less potent medicines. Salines in carthatic doses are irregular, and sometimes act with unexpected violence. Senna, colocynth, buckthorn, and other substances, of much value as purgatives for men and dogs, have scarcely any such effect on horses.

With a warm mash the previous night, and subsequent abstinence, a moderate dose of aloes given in the morning causes in most horses nausea within four hours; and if a little tepid water is given, purging occasionally occurs in ten hours. Without this preliminary mash, which should if possible be given, purgation is produced in horses in from eighteen to

twenty-four hours. In acute febrile cases absorption is usually tardy, and is helped by combination with some 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.

In cattle and sheep, the magnitude of the *quadrisected* stomach, the large proportion of food which it always contains, and the comparatively low vascularity and sensibility of the whole alimentary canal, account for the tardy uncertain action of many purgatives. For these ruminants saline carthartics are preferable, and their action may be 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.

On account of the small size of his stomach and alimentary tube, and the concentrated nature of his food, the dog is peculiarly susceptible to the action of purgatives. In him they generally operate in from five to eight hours. Jalap, with a little calomel, or a mixture of equal parts of linseed and castor oils, are most generally approved of. Aloes act more slowly and uncertainly, while saline medicines are apt to cause vomiting, or, if retained, to purge with undue violence. Indeed, all purgatives must be given to dogs in a well-prepared condition; for, when unpalatable, acrid, nauseous, or bulky, they are apt to be expelled by vomiting. The action of cathartics on the pig is closely analogous to their effects on the human subject and dog; and he is 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 he must be held by the ears by an assistant, who will not be deterred by the patient squealing.

No medicines are applied to so many important purposes as cathartics. They are the most certain and effective evacuants, and sometimes little inferior to blood-letting. They are given to remove from the alimentary canal undigested food, feculent matters, poisons, bile, and worms. Sweeping away partially digested food they shorten the supplies of blood-making materials; provoking free excretion of serous fluid they diminish blood pressure. 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. Purging away offending matters, cathartics relieve dyspepsia, colic, and many cases of diarrhœa. In constipation and torpidity of the bowels, depending upon atony of the muscular coat, they are combined with strychnine or mineral acids.

Cathartics not only purge the intestines, they purge the blood as well. Through the active secreting intestinal surfaces, they remove water, abate arterial pressure, and drain away dropsical effusions. Moreover, they hasten separation of superfluous alimentary matters, disintegrated tissues, and morbid matters which have found their way into the blood. Especially important is this depurative action of the bowels when the analogous duties of the skin or kidneys are from any cause impaired. Excrementitious matters in the blood, even if they do not happen to be themselves a source of disease, aggravate most complaints, are especially prone to impair the functions of the nervous system, and often form the pabulum on which contagious parasite germs fasten and grow. Nature herself sometimes endeavours to remove these deleterious matters by the establishment of spontaneous diarrhœa. Whether induced naturally or artificially, this depurative action is of especial service in removing febrile attacks, relieving congestion of the brain and nervous centres, curing some itching skin complaints, and combating most inflammatory disorders.

In virtue of this depurative action, and sometimes by a sort of counter-irritation, purgatives are often serviceable in abating lymphangitis and lameness in horses, in counteracting the irritability and pain of wounds, whilst apparently by reflex action they often amend disordered states of the kidneys and bladder.

Cholagogues.

Increased action of the liver and extra secretion of bile are stated by Professor Rutherford to be effected in various ways, namely :—" By stimulation of the hepatic secreting apparatus; by stimulation of the muscular fibres of the gall bladder and larger bile ducts—to wit, the bile expelling apparatus; by removing a catarrhal or congested state of the orifice of the common bile duct or of the general extent of the larger bile ducts; or by removing from the intestine substances which had been passing therefrom into the portal vein and depressing the action of the hepatic cells; or lastly, by stimulating the intestinal glands, and thus producing drainage of the portal system, whereby the loaded liver might possibly be relieved." (*Proceedings of the Royal Society, Edinburgh.*)

Experimenting on dogs, Professor Rutherford found the secretion of bile increased by administration of podophyllin, rhubarb, aloes, colchicum, colocynth, ipecacuan, jalap, sulphates of sodium and potassium, Rochelle salt, nitro-hydrochloric acid, corrosive sublimate, and euonymin, a resinous substance derived from Wahoo bark. No material increase occurred by administration of croton oil, magnesium sulphate, sodium chloride, ammonium chloride or calomel. Severe purgation usually diminished biliary secretion (*British Medical Journal*, 1878).

Acids, applied to the bile duct, stimulate discharge from the gall bladder. In this manner the acid chyme naturally evokes outpouring of bile into the intestine, and a similar effect is probably produced by nitro-muriatic and other acids. Purgatives, such as calomel, although possessing no special action on the liver itself, are nevertheless valuable in counteracting biliousness, on account of their action on the duodenum, their clearing away old bile and thus preventing its absorption. In dogs as well as in man, emetics have a similar effect in removing bile lodged in the duodenum.

Dr. A. Röhrig, experimenting upon curarised dogs, introduced various purgatives into the duodenum, and observing the amount of bile excreted through a glass tube placed in the gall duct, found secretion notably increased by croton oil, colocynth, jalap, and aloes; rhubarb and senna followed next in order, castor oil and bitter salts were less effectual; calomel had small effect in re-establishing the secretion when it had ceased, but had a marked power of maintaining and increasing it beyond the natural time for cessation. (Dr. H. C. Wood.) Manganese sulphate was found by Emelin to cause extraordinary secretion of bile.

These cholagogues exert direct effect in relieving the portal circulation and combating congestion of the liver, spleen, and urino-genital organs; whilst clearing out the contents of the canal, they carry away bile, which, if left, would be absorbed. Quinine and other bitter tonics sometimes prove serviceable in torpidity of the liver; they do not, however, appear materially to increase secretion of bile, and their beneficial effects in such cases depend, according to the late Professor Headland, on their striking analogy to the biliary matter taurine, and their taking its place in those disorders where from tardy action of the liver it is deficient. In congestion and torpidity of the liver, in bilious diarrhœa, and bilious influenza of horses, when the mucous membranes continue yellow and the bowels irregular, nitro-muriatic acid is serviceable.

Expectorants.

Expectorants (*ex*, out of; and *pectus*, the breast) increase the natural secretions of the mucous membrane lining the fauces, trachea, and bronchi. This is effected in several ways. Many soluble substances, such as gum and linseed mucilage placed in the mouth, produce impressions upon the terminal filaments of the glosso-pharyngeal or lingual branch of the fifth nerve, which are conveyed thereby to the medulla, and thence by the branches of the vagus, or by the sympathetic are reflected to the pulmonary mucous membrane, modifying its secretions, the movements of its cilia, or even the contractions of the muscular fibres of the bronchii. Internal organs and

their external openings act and react on each other. The throat participates in congestion or inflammation of the bronchial tubes or lung substance, while conversely its soothed or invigorated condition benefits the deeper-seated respiratory organs. Inhalation of chlorine, iodine, sulphur, or water, or fomentations applied externally, exert topical impressions, rousing the activity of the dry, inflamed membrane. Balsams, gum-resins, ipecacuan, and antimonials operate somewhat differently. They are absorbed, determined to, and excreted by the pulmonary mucous membrane, on which they exert stimulant sedative or astringent effects.

Antiseptic solutions of creasote, carbolic acid, and iodine are sometimes inhaled; both by topical and reflex action they lessen the cough, ameliorate the discharges of chronic bronchitis and phthisis, and sometimes greatly aid drying and cicatrisation of diseased lungs. Some astringents, and all nauseants and emetics, exert on the throat and upper part of the digestive tract effects which are likewise propagated by reflex action to the lower air passages, and increase their secretions. Vomiting not only promotes bronchial secretion, but mechanically dislodges it. Iodide of potassium liquifies the bronchial as well as other secretions. Opium, stramonium, lobelia, tobacco, and bromide of potassium, by relieving spasm and lessening inordinate reflex irritability, promote bronchial secretion. Morphia, chloral, and atropine, by soothing the respiratory centre, and ammonia by gently stimulating it, often aid in overcoming irritability of the air passages.

Expectorants are not particularly certain in their action even on human patients, and are still less so on the lower animals. Their chief benefits are secured by irrigating the fauces with medicated fluids from a spray-producer, of which the most effective are worked by steam. In irritable, relaxed, or diphtheritic sore throats in horses, solutions of alum, morphine, belladonna, tannin, iron salts, hydrochloric and carbolic acids are thus advantageously applied several times daily. With even less trouble both to the animal and its attendant, electuaries containing appropriate agents are placed upon the tongue, and prove valuable means of allaying bronchial irritation and promoting secretion.

Diaphoretics—Sudorifics.

The skin in all higher animals performs several very important functions. It removes daily about 1-67th of the weight of the body, about 1·30 per cent. being solids, of which two-thirds are organic and one-third are inorganic matters. 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 arrested by coating considerable portions of the skin of small animals with a thin varnish, febrile symptoms and albuminuria are produced; while complete suppression of perspiration, effected by enveloping such an animal as a dog in a thin coat of varnish, determines imperfect arterialisation of the blood, lowering of temperature, and fatal asphyxia. Further illustration of the evils of arrested perspiration is afforded by Röhrig's experiment of the injection of 3½ centimetres 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 vaso-motor centres situated in the anterior horns of the grey matter of the spinal cord, extending into the medulla, and send nerve fibres to the fore extremities, along with the anterior roots of the third, fourth, and fifth 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, a little over 80° Fahr. The taking of food, the drinking of hot water, or other bland fluids, the administration of strong tea and coffee, and active exercise, by raising arterial pressure increase perspiration. The sweat centres are specially stimulated and their secretion augmented by mental emotions, by heat, friction, reflex irritation, and by such medicinal agents as jaborandi, eserin, picrotoxin, nicotine, and acetate of ammonium. Their functions are checked by cold, damp, and the administration of belladonna and atropine.

Diaphoretics (*διαφορέω, diaphoreō*, I throw off by perspiration), and sudorifics (*sudor*, sweat; and *facio*, I make)—the medicines which increase the secretions of the skin—are somewhat less prompt and certain than the corresponding agents used in human practice. Horses are made to perspire more readily than cattle, while the skin of horses and cattle is more easily acted upon than that of dogs, pigs, or sheep. In all animals the readiest way of promoting full action of the skin is by heavy clothing, warm diluents, and keeping the animal in a dry atmosphere of about 70°. Small and repeated doses should also be given of some of the following medicines, which specially stimulate the sweat glands, namely, acetate of ammonia, sweet spirit of nitre, sulphuric ether, diluted spirits, jaborandi, ipecacuan, or Dover's powder. Sulphur specially stimulates the sudoriferous glands, salts of potassium, and of other metals dilating cutaneous capillaries favour transpiration, and thus act as febrifuge diaphoretics. Muscarin, the active principle of poisonous fungi, closely resembles jaborandi as a stimulant of the salivary and cutaneous secretions, stimulates also the intestinal glands, and in large doses contracts the pulmonary vessels, causing dyspnœa. 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 even blood-letting, by reducing the heart's action, and blood pressure, 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°, are ready and useful diaphoretics.

The hydropathic method of sweating a patient is also usefully employed. The patient is enveloped in a sheet saturated with cold 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 tried both with horses and cattle, and seems useful in many cases of rheumatism, and especially in gross subjects. It should not, however, be adopted unless with due consideration, and under competent superintendence. 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 administered for the following useful purposes:—1st, They restore arrested cutaneous secretion, and hence equalise irregularities of circulation, counteract congestion of internal organs, and lower exalted temperature. They are often serviceable in cutting short chills, colds, and simple febrile attacks amongst horses. 2d, They remove waste azotised matters of food, of tissue metamorphosis or of morbid origin, apt to accumulate especially 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 effete matters usually disposed of by other channels.

Diuretics.

Diuretics (διά, *dia*, through; οὐρέω, *oureō*, I make water) are agents which increase the flow of urine. Co-operating with the skin and bowels in eliminating superfluous water, the kidneys also remove from the blood the chief part of the unused

nitrogenous matters of the food, portions of the waste albuminoids, saline materials introduced with the food and not required or produced from the retrograde metamorphosis of the tissues, as well as various bodies foreign to the blood. The kidneys of horses remove about one-seventh of the fluid ingesta; in dogs they drain away nearly 50 per cent.; in man about 54 per cent. (Carpenter's *Human Physiology*, ninth edition). The urine is removed from the blood by a twofold process: 1*st*, Its more bulky fluid parts filter through the vascular clusters of the Malphigian bodies by a process of mechanical transudation; 2*d*, Its more solid excrementitious parts are separated by a process of vital secretion by the epithelial cells lining the uriniferous tubes. The activity of each of these processes varies greatly. Blood-pressure increases the amount of the mechanical filtration, and hence leaves less to be done by the secreting apparatus. Excess of urea or such other nitrogenous waste products in the blood stimulates the true secreting portion of the gland. The two kidneys do not act in perfect unison. While one is mostly removing concentrated excrementitious matters, the other is getting rid of greatly more diluted urine; this service is alternated.

Different diuretics appear to effect their results in somewhat different ways. Salines, such as alkalies, alkaline and neutral salts, given in moderate amount, for large doses act chiefly on the bowels, with resins and diluents, especially when used cold, determine extra flow of blood to the kidneys and increase osmosis. Alcohol, ether, turpentine, and many volatile oils, besides quickening general circulation, stimulating the vaso-motor centres, and encouraging the flow of blood through the kidneys, raise blood-pressure in the Malphigian bodies, and thus favour physical filtration of urine. The notably increased arterial tension produced by digitalis and belladonna are the chief factors in their diuretic action. Common salt, quinine, colchicum, and caffein exert their effects mainly by stimulating renal glandular epithelium, and hence more especially increase the solid excrementitious parts of the urine. Conjointly with their diuretic effects, certain substances exercise soothing, astringent, and tonic effects as they pass over the irritable urino-genital mucous surfaces. Of this

character are pareira bark, cubebs, and other peppers. The urinary secretion is encouraged by hard work, by mental emotions, and especially by fear, by division of the pneumogastric and of the floor of the fourth ventricle, as well as by the action of cold and other agencies diminishing cutaneous transpiration. It is increased during digestion, and in horses by such food as heated oats and musty hay. Active purgatives, by relieving congestion of the portal system, overcome congestion of the kidneys, and thus act indirectly as diuretics. These conditions, and most diuretic medicines, increase the fluidity of the urine, but diminish the amount of its solid constituents.

The amount of the urine is diminished by conditions which remove fluids through other channels, by blood-letting, and other means which reduce blood-pressure, or by section of the spinal chord, or the sympathetic, at the lower part of the neck. It is almost arrested by poisonous doses of curare. Most diuretic medicines increasing the water of the urine, probably by congestion of the capillary plexuses of the uriniferous tubes, lessen the solid matters in the urine; and when the doses are large, or too frequently repeated, similar congestion and arrested function appear to extend to the Malphigian bodies, completely suspending secretion of urine.

The proportion of the several constituents of the urine is altered by different agents. Urea, uric acid, and hippuric acid are increased by nitrogenous food, by common salt, phosphoric acid, leucin, glycocol, 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 abundant disintegration of albuminous tissues takes up oxygen freely and produces extra amounts of carbonic acid.

A suitable diuretic ball for the horse is made with half an ounce each of nitre, resin, and soft soap, and may be repeated daily for four or five days. When it is sought to increase the solid as well as the watery parts of the urine, ten or fifteen grains of powdered digitalis are added. 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, half a grain of digitalis, and three grains of ginger, made into a pill with linseed meal and water. Another useful combination consists of thirty drops of sweet spirit of nitre and five grains saltpetre in a little water. Diuretics usually act certainly and speedily in all classes of veterinary patients. Their actions are best insured by giving small and repeated doses, by using several together, by encouraging the animal to drink tolerably freely of water, thin gruel, or other bland fluid, and otherwise promoting excretion of the medicine by the kidneys rather than by the skin or bowels.

In the treatment of disease, diuretics are chiefly used for the following important purposes:—To maintain or restore the healthy action of the kidneys in febrile or other diseases in which secretion of urine is diminished or arrested; to carry out of the blood superfluous fluids, albuminoids, or salines, and thus regulate blood-pressure, absorb dropsical effusions, purge out products of inflammation, excrementitious matters, and disease germs, and hasten elimination of poisons; to augment the fluidity of the urine, and thus prevent deposition of its solid parts in the bladder and urinary passages. For this purpose diuretics, conjoined with diluents, are frequently used for human patients, occasionally for dogs and sheep, but seldom for either horses or cattle, which are little liable to gravel. Although diuretics are serviceable when diminished urinary secretion results from functional disturbance of the kidneys, they are contra-indicated when the urinary organs themselves are conjested or inflamed. Further irritation is then injurious; rest is required, and the bowels and skin for a time must be got to perform the chief excretory duties.

Sialogogues.

Sialogogues (*σίαλον*, *sialon*, saliva; and *ἀγωγός*, *agōgos*, evoking) increase the salivary and buccal secretions. Some, like ginger, pellitory, mustard, and radish act chiefly as topical irritants, and further, by reflex actions excite the vessels and cells of the salivary glands. Others, like tobacco, salts of mercury, gold, and antimony, iodine, jaborandi, Calabar bean, and many nauseants, after some amount of local action, are

absorbed, and stimulate the medulla, the submaxillary, and otic ganglia, and thus increase salivary secretion. By paralysing the ends of the sensory nerves in the salivary glands, atropine antagonises their abnormal secretion. Materia medica works published even so lately as 1810 often contained upwards of one hundred sialogogues; but in the present day remedies of this class are only used empirically.

Restoratives.

The growth and repair of the bodies of the higher animals continually demand many and various materials. Food must be supplied in sufficient amount and of suitable quality to nourish the blood, whence the textures extract their several needful materials. Water constitutes four-fifths of the total weight of most animals, is being constantly removed, especially by the skin, lungs, and kidneys, and, unless restored at short intervals by suitable simple drinks, great discomfort and impaired health ensue. Still more imperative is the continual need of pure air to oxygenate and purify the blood, and remove especially the carbonic acid and waste products which are excreted chiefly from the lungs and skin. But, whether in the form of food or given more directly as restorative medicines, the body further requires varying supplies of all its many constituents —phosphorus, 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. Sunlight is a most essential factor of health, especially in young animals. It increases the capacity of the blood and tissues for oxygen and favours healthy excretion.

Essential as these requirements are for animals in health, they are even more essential for those 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 that physiological rest so necessary to restore efficiency. In many febrile complaints, both of horses and cattle, the ordinary grains and dry fodders, not being digested or assimilated, are apt to produce gastric derangement. Animals affected by febrile and inflammatory

disorders should therefore be restricted to mashes, gruels, and such soft food, to which extra nutritive value can be given as required by addition of milk, eggs, 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 sick animal occasionally greedily eats more than is good for him, and against this contingency well-intentioned attendants require to be warned. Many bad 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 diarrhœa, 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° 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.

To the restoration of most sick animals a comfortable bed greatly conduces. 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 tem-

perature and combat congestion of internal organs; but at least twice daily these rugs and bandages should be stripped off, the skin wisped 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 carefully sponging the body several times a day with tepid water acidulated with vinegar, quickly drying, and at once putting on the clothing.

Physiological rest is a great restorative. 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. In irritable and inflammatory states of the digestive organs, the simplest and most digestible food is accordingly given, and as little duty as possible exacted from the stomach and bowels. Again, when the kidneys are diseased, their work should be lightened, and the skin and bowels got vicariously to undertake the chief excretory services. But when acute disease has passed away, the gradual use of an affected part generally does good. Exercise in such circumstances also proves a health-restorer, improving appetite, and promoting the various excretory functions.

Of more purely medicinal restoratives, those in most common use are linseed, which, in the form of gruel, tea, or cake, proves a most soothing, palatable, and digestible laxative combination of food and medicine; cod-liver oil, another convenient form of supplying assimilable fatty matters, especially to dogs and cats; iron salts, indicated in anæmia and debility; phosphates, prescribed for ill-thriving, weakly young animals; salines, where the continued use of dry food has diminished normal secretions, and produced skin eruption and itching, often met with amongst hard-worked liberally-fed horses. Artificial pepsin and pancreatin are sometimes administered to dogs and calves where there is reason to believe that the natural digestive ferments are deficient or faulty. Nearly allied to these restoratives, and forming a connecting-link between them and most tonics, are quinine, theine, caffeine, and cuca, which have the power of retarding tissue metamorphosis.

Tonics.

Processes of metamorphosis and growth are ever going on throughout every part of every animal tissue. When these important conditions of healthy animal existence become enfeebled, endeavour is made to invigorate them by the use of remedies fittingly called tonics (τόνος, *tonos*, tone). Professor Royle defines them as medicines "possessing the power of gradually increasing the tone of the muscular fibre when relaxed, and the vigour of the body when weakened by disease." Allocating as much as possible to each medicine or group of medicines their own special actions, the better definition is an agent which improves the vigour of the part on which it chiefly acts. Accepting such a definition, iron is regarded a tonic for the blood, digitalis for the heart, strychnine and quinine for the nerves, tannin for the muscles, bitters and stomachics for the gastro-intestinal system. Tonics are allied to nutrients and restoratives, such as good food, pure air, and exercise—all of which are truly tonics. 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 allied to astringents, but seldom exert the chemical corrugating action of astringents. The same substances differently handled may, however, appear 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, and, used improperly, are sometimes irritant.

Tonics, judiciously employed, in moderate repeated doses in all animals, improve appetite, give firmness to the weak pulse, increase muscular power and capacity for endurance. They are chiefly prescribed in mal-assimilation dependent upon debility, in chronic and subacute disorders, in tuberculous and other exhausting complaints, and during recovery from debilitating disease. To insure their best effects, they are given in moderate doses several times daily for several days, or even for much longer periods. Given to healthy animals, or in unsuitable cases, large and repeated doses do not, however, improve health; but, on the contrary, sometimes disorder

digestion, and occasionally in men and dogs cause febrile symptoms. They must be withheld where there is active inflammation or acute fever; they seldom do much good unless the bowels are in a tolerably regular normal state.

For special purposes particular tonics are preferred. Although very numerous, no two are exactly alike; each has its own special actions and individual capacity for usefulness. Anæmic disorders, still too common amongst badly reared young animals, are treated with digestible nutritive food, comfortable quarters, and regular daily doses of salts of iron, which directly increase the deficient hæmatoglobin, the important oxygen and ozone carrier of the blood, and in many cases besides improve the digestive processes which in such cases are usually much deranged. Iron and other metallic tonics further stimulate the vaso-motor and trophic nerves, which preside over nutrition. Copper salts are more irritant and astringent than those of iron; are allied to zinc and silver compounds; are used in the treatment of epilepsy and chorea in arresting excessive discharges from the alimentary canal; and, on account apparently of their antiseptic virtues, are frequently serviceable in checking farcy. Manganese salts, usually associated with iron both in the body and elsewhere, exert similar tonic effects, but are also more irritant than corresponding iron salts. Arsenic, especially when conjoined with iron, aids constructive metamorphosis; is prescribed in chronic irritable conditions of the skin and mucous surfaces, and in subacute rheumatic disorders. Bismuth, in the form of subcarbonate and subnitrate, allays irritability of the alimentary mucous membrane; is mildly tonic, occasionally administered in canine practice, and is sometimes used as a desiccant astringent and anodyne in erythema. The mineral acids are prescribed in atonic dyspepsia; being very diffusible, they readily pass into the alkaline blood, exerting there a general astringent influence and some not well explained effect in checking retrograde metamorphosis. Hydrochloric acid administered in rheumatism appears to lessen the production of lactic acid. Nitro-muriatic acid probably acts beneficially in various gastric and liver complaints, by increasing the natural ferments of the intestines and liver.

Vegetable are less irritant than mineral tonics, and are accordingly adapted for the earlier stages of disease. Many owe their activity to bitter alkaloidal or neutral principles; some contain astringent tannin, others aromatic volatile oils. Cinchona and its alkaloid, quinine, besides exerting topical effects on the softened atonic gastric membrane, speedily enter the blood, and diminish the capacity of the hæmatoglobin for carrying oxygen and ozone, hence retard abnormal combustion and waste, and lower temperature. Stimulating the chief nerve centre, which inhibits reflex movements, it diminishes reflex irritability. It moreover possesses marked power in slowing the movements of the white blood corpuscles; frequently repeated doses diminish the size of the spleen; it arrests malarial fevers, doubtless owing to its destruction of bacilli and other micrococci; large doses control many cases of septicæmia. Theine, caffeine, and cuca, and also tobacco, are allied to quinine in conservating waste; but besides this retardation of tissue metamorphosis, the theine alkaloids are cerebral excitants, while tobacco is a motor-depressant. Gentian, on account of its cheapness, is the vegetable tonic most generally used in veterinary practice. It is a pure bitter, free from astringency, useful in promoting digestion and appetite, its tonic powers considered by many to be little inferior to those of cinchona. In the same class of bitters are included calumba, coptis, the American centaury, and quassia, which is specially useful for hastening the removal of ascarides, and rendering the bowels less favourable for the residence of such parasites. Nearly allied to these simple bitters are the aromatic bitters—anthemis, serpentaria, cascarilla, and eucalyptus—which possess astringency from the presence of tannin, and some stimulant effects from their containing aromatic oils. They gently excite the alimentary mucous membrane, promote secretion of the special ferments so essential for healthy digestion, and thus improve assimilation, nutrition, and appetite. Besides stomachic and tonic effects, eucalyptus is now demonstrated to possess valuable antiseptic powers; it controls malarial poisoning, and destroys parasite germs both within and without the body. Digitalis and henbane have special virtues as heart tonics, steadying

and quieting cardiac irregularity and irritability. Alcohol judiciously employed is also a valuable heart tonic, reducing the frequency and increasing the strength of the pulse, and, as a readily assimilable fuel, sustains heat and force, and prevents undue tissue consumpt in exhausting diseases in which the patient refuses food. Fats and fixed oils, fittingly used, are tonics as well as nutrients, and are readily available sources of muscular, nervous, and digestive force. For such objects cod-liver oil is prescribed for canine as well as for human patients. Phosphorus aids constructive metamorphosis, especially of osseous and nervous textures. Cold, in the form of baths, douches, and sponging, proves a valuable tonic, applicable for local as well as general purposes, relieving irritability, bracing up soft flabby textures, and equalizing circulation.

Stimulants or Excitants.

Stimulants, excitants, or calefacients, increase functional activity, rouse vital inertia, and thus prevent, cut short, or remove disease. Although they do not usually give strength like tonics or restoratives, they call forth strength that is latent. They act on many parts and organs. A large number expend their force on nerve ganglia and nerve cords; some notably on the brain, others on the spinal cord; some on motor, others on sensory nerves; some on the sympathetic system, some on glands and excreting organs, acting as evacuants; others on the skin, operating according to circumstances, as diaphoretics or counter-irritants. Their effects are produced in a variety of ways. Some have a very limited, others an extended, area of operation. Light, for example, is the special stimulus of the optic nerve; vibrations of sound of the auditory nerve; contact of food of the ganglia presiding over secretion of gastric juice; but these stimuli act only on their own special nerve systems. Electric currents, many chemical agents, mechanical pressure, and hand-rubbing excite all nerves. Cool, dry air, exercise, and warmth, variously applied, also exert general stimulation. Medicinal stimulants, like alcohol and ether, have likewise general effects on most parts of the nervous system; strychnine and brucine are excitants of the motor tract of the spinal cord; ammonia and belladonna specially exalt activity of the vaso-

motor and respiratory centres. Sensory nerves are more easily acted upon, and by a greater number of agents than motor nerves.

Medicinal stimulants, howsoever entering the body, become absorbed. Those which are taken up and act rapidly, such as ammonia and ethers, are termed diffusible stimulants. Entering the blood, they can generally be detected there as well as in various of the secretions. They are usually brought into immediate contact with the nerve tissue whose functions they exalt; indeed, such actual contact has been shown to be essential to the action of even potent agents like strychnine. They seldom remain long in the body; in more or less altered form they are excreted, and usually excite the organs by which they are removed, exhibiting subordinate actions, as expectorants, diaphoretics, or diuretics. Violent or prolonged stimulation causes exhaustion and depression. Many substances, such as alcohol and ether, which in small or moderate doses are stimulant, in large amount or in unsuitable cases operate as sedatives. Conversely, some medicines, such as mercury and antimonials, which are chiefly sedatives, in small doses act as stimulants.

To select rationally and effectively the stimulants adapted for particular purposes, it is important to understand the organs and parts on which they act, and, if possible, the mode of their operation. Alcohol, ether, turpentine, and ammonia are general stimulants, acting on the cerebro-spinal axis, and also on the sympathetic nervous system. They are of signal service in sustaining the powers of life in animals sinking from sudden shock, from loss of blood, and from poisoning by sedatives and narcotics. They are effectual in controlling those shivering attacks so often the precursors of inflammation; in combating congestion of such organs as the lungs, whether caused by exposure to cold or by violent continued over-exertion; in antagonising spasms, such as those of colic; and in checking tissue waste in influenza, typhoid fever, and other debilitating diseases. With many characters in common, they have each special adaptations for particular uses. Ether is suitable for emergencies where decided and prompt effects are essential. Alcohol is selected where more continuous restorative action is sought. Turpentine is used where it is desired to conjoin with stimulation astringent, diuretic, or anthelmintic effects.

Ammonia exalts vaso-motor activity and stimulates the respiratory centre, and hence is specially valuable in overcoming bronchial congestion and cough, especially in old or debilitated subjects. The effects of diffusible stimulants, being evanescent, require to be kept up by repeated doses. Acting in somewhat diverse ways, more satisfactory permanent results are usually obtained by prescribing two or more together than by using any one by itself.

These general stimulants and digitalis have a marked effect on the action of the heart. They are cardiac stimulants, occasionally termed cordials. Carefully regulated moderate doses sustain the action of the heart when weakened or disturbed by shock, profound anæsthesia, severe continued labour, or exhausting disease. Besides having other special actions, diffusible stimulants are anti-spasmodics. They exalt and control nervous force, and thus overcome that perverted molecular condition of nerve-centres and nerves on which spasm depends. In combating spasms, particularly of the intestines, anti-spasmodics, such as alcohol, ethers, ammonia, or turpentine, are conjoined with anodyne narcotics like opium or belladonna, with paralysers of motor centres, such as hemlock and Calabar bean, or with soothers of reflex irritability, as chloral or bromide of potassium. Under different conditions and in different ways, these diverse substances act as anti-spasmodics, as also do many sedatives, such as aconite, prussic acid, and tobacco. The numerous, often-complicated operations known as reflex actions, and exemplified in deglutition, coughing, and vomiting, are exalted by small doses of opium, alcohol, nicotine, and very notably by strychnine.

Alcohol, ether, and turpentine act prominently on the cerebro-spinal axis, produce in large doses the familiar symptoms of intoxication; in the lower animals they attack the spinal cord rather than the brain; in large doses, after a brief stage of excitement, they paralyse sensibility and consciousness, and thus used form connecting-links between stimulants on the one hand and narcotics and anæsthetics on the other. Occupying an intermediate position between brain stimulants of the alcohol type and spinal excitants like strychnine is picrotoxin, the active principle of Coculus Indicus, which in

large doses, after preliminary restlessness and clonic convulsions, produces paralysis, impaired co-ordination, and coma, and in medicinal doses is prescribed to increase intestinal secretions and peristalsis.

Another important group of stimulants, including nux-vomica, strychnine, benzine, thebaine, codeine, theine, and phosphorus, excite the motor tract of the spinal cord, in large doses destroy life by tetanic convulsions, and are used medicinally in the treatment of chronic paralysis, epilepsy, and chorea accompanied by debility.

Belladonna, hyoscyamus, and digitalis are stimulants of vaso-motor centres, and also of the cardiac ganglia; they impart strength to the weakened heart, contract arterioles, and raise arterial tension. They hence give tone to the heart, and counteract capillary congestion and stasis. The three solanaceæ, belladonna, hyoscyamus, and stramonium, and their active principles, are, moreover, relaxers of the contractor fibres of hollow viscera, and are also mydriatics; in other words, they stimulate the sympathetic ganglia and motores oculi, consequently dilate the pupil, and are useful in ophthalmia, and in examinations of the interior of the eye. Ergot of rye has special stimulant and constringent action on unstriped muscle; it can be shown distinctly to contract the arterioles in the transparent web of the frog's foot; it checks and narrows the nutrient stream, and where long persisted in starves the tissues; in pregnant animals it produces uterine contractions. Cimicifuga or black snake root has a somewhat similar, but much feebler power as a vascular stimulant and constrictor.

Stomachics are a group of topical stimulants, exemplified by ginger, pepper, and the fruits of umbelliferæ, mainly exerting their action on the stomach, and improving appetite and digestion. Carminatives stimulate the stomach and intestinal mucous membrane, provoke reflex action, and expel flatus. They are represented by cajeput and other essential oils, ginger, peppers, aniseed, and other umbelliferous fruits, asafœtida, and other fetid gum resins, with small doses of diffusible stimulants.

The number and power of liver stimulants is not so great as was at one time believed; those that do really provoke biliary

secretion are podophyllin, aloes, colchicum, sulphate of soda, and nitro-muriatic acid. Emetics and active purgatives, irritating the biliary ducts, promote the discharge of their contents, and remove bile lodged in the intestine. Lymphatic glands generally are stimulated by small repeated doses of iodine; mucous membranes are acted on by gum resins; the skin and mucous surfaces by sulphur and arsenic; the cutaneous sudorific glands have their functions excited by diaphoretics; the cilia of the bronchial mucous membrane by ipecacuan, gum-acacia, ammonium chloride, and potassium chlorate; the reproductive organs by phosphorus. The kidneys and intestines have also their own special stimulants.

Electricity readily affects all nerves, especially when passed up or down them, and when the current is induced or interrupted so that the intensity is of varying amount. Undue or sudden stimulation induces pain in a sensory nerve, and tetanises the muscles supplied by the excited motor nerve. Electric currents have been found serviceable in paralysis in horses and cattle depending upon injuries and chronic rheumatism, and in chorea in dogs. They deserve further trial in obstinate torpidity of the bowels, and in the early stages of those cases of wasting of the muscles of the larynx of the horse, which constitute roaring. Heat in moderate amount is a stimulant, and promotes constructive metamorphosis. But in large amount, and when inconvertible into some other healthy mode of motion, it develops morbid processes, increased oxidation, waste, and degeneration. A still higher temperature, extracting water from the living tissues, chars and kills them. Friction or shampooing in certain cases directly stimulates circulation, promotes nutrition, raises temperature, antagonises spasm, reduces swelling, liquefies tolerably firm deposits, and supples stiffened joints. Even a painful strained part may sometimes be benefited by friction begun lightly and gently.

Alteratives.

Alteratives, or alterants, as the name indicates, are a group of medicines which change for the better morbid conditions, seldom however leaving much evidence of the manner in which

their curative effects are produced. The definition is not very satisfactory, for all medicines, changes of diet and surroundings, exert some alterations on animal health and nutrition; while the confession that such alteration is effected in some unexplained manner is an evidence of ignorance which the progress of therapeutics is gradually removing. The long lists of alteratives usually include iodine, sulphur, arsenic, salts of mercury, silver, zinc, copper, and lead, alkalies and their salts, mineral acids and carbolic acid, with colchicum, veratrum, and cod-liver oil. The American pharmacopœias further contain various "blood purifiers," such as sarsaparilla, guiacum, the resin from guiacum officinales, and stillingia, the root of stillingia sylvatica. The action of most of these remedies can now be explained with more exactitude than by styling them alteratives. They are antiseptics, restoratives, tonics, or stimulants of some special part or organ. One or two produce with certainty special curative results, and hence are fittingly termed specifics. Quinine promptly cuts short agues and intermittents in man; salicylic acid controls the pain and fever of some cases of acute rheumatism; iodine arrests polyuria in horses; attenuated anthrax lymph is now shown to prevent splenic apoplexy and other anthrax disorders (p. 20). As therapeutics become better understood the number of those specifics will probably be greatly increased.

The prescriptions entitled alterative are still much used in veterinary practice. Acute febrile and inflammatory symptoms are frequently treated by small repeated doses of calomel and opium, which, in some not easily explained manner, control inflammation and promote absorption of effused products. Alkalies and salines, much used in febrile cases, prove useful mainly in encouraging activity of the secreting organs. A common formula, either for horses or cattle, consists of two ounces of Epsom salt and one of potassium nitrate or chlorate, given either in bolus or draught, and repeated night and morning. Two drachms each of nitre, sal ammoniac, gentian, and ginger are often prescribed twice daily for either horses or cattle. In such patients, suffering from rheumatism, a drachm each of potassium iodide and nitrate, and sodium carbonate, with or without sulphur, repeated every two hours, often

relieves pain and fever. Some alteratives exert special local effects. Thus borax has local, not easily explained, effects in stomatitis and other such cases of irritation of the digestive mucous membrane. Arsenic and sulphur specially control eczema and other such cutaneous irritation. Calcium sulphide, and indeed all sulphides, are stated by Dr. S. Ringer to prevent or arrest suppuration. Calcium chloride has notable power in reducing enlargements of the lymphatics, solidifying tubercular deposits, and cicatrising ulcers—effects which cannot at present be referred to any physiological actions.

Astringents.

Astringents (*ad*, to; and *stringo*, I bind) condense the soft animal solids and coagulate the fluids. They comprise cold, in the form of baths and freezing mixtures, the mineral acids, carbolic acid, and creasote, the soluble salts of aluminium, zinc, iron, lead, copper, mercury, and silver. Astringents of vegetable origin include oak bark, galls, catechu, kino, the inspissated juice of Pterocarpus Marsupium, rhatany, the root of Krameria triandria, with tannic and gallic acids—the active principles of most vegetable astringents—the former adapted for local application, the latter more soluble, and hence more fitted for general systemic effects. Relaxed, aphthous, and ulcerated throats are often greatly benefited by occasional dressings of glycerine of tannin or glycerine of carbolic acid. Ergot of rye and its active principle, ergotin, are powerful contractors of involuntary muscular fibre, and hence are very effectual styptics, especially when used hypodermically. Most astringents produce, in the first instance, topical chemical actions. Concentrated metallic solutions unite with the water and albumin of the tissues. Most vegetable astringents, in concentrated form, tan them, partially converting them into leather—the tough, insoluble tannogelatin of chemists. This chemical action is exerted equally on dead and living tissues; on the living tissues it is, however, speedily succeeded by vital constriction; textures become lessened in volume, blood-vessels diminished in calibre, exhalations and secretions decreased. These primary local impressions are often followed by bene-

ficial reflex effects: cold applied to the loins arrests bleeding from the uterus; ice swallowed checks hæmorrhage from the nose or lungs; astringents in contact with the mouth and fauces relieve atony of the respiratory membrane. But still more extended action sometimes ensues; many astringents are in part absorbed, and constringe the unstriped muscular fibres of the arterial and capillary vessels, and of the mucous membranes and glands, giving firmness to the pulse, promoting digestion, improving general health—producing, indeed, effects resembling those of tonics.

Astringents prescribed internally counteract relaxation with the morbid conditions dependent thereon, arrest the excessive mucous secretion resulting from defective tone, and stay hæmorrhage. Used externally they often impart firmness and tone to soft weak textures, abate excessive secretions of serum or pus, coat over irritable sores with a protecting film of precipitated albumin, coagulate blood, and as styptics stop the mouths of bleeding vessels, diminish the volume of protruded organs, such as the rectum or uterus, and thus facilitate their return, constringe dilated and paralysed capillaries, and hence remove inflammation,—a mode of treatment specially applicable to contusions, conjunctivitis, and other cases of circumscribed and superficial inflammation. Acute fever, constipated bowels and local heat, dryness and tenderness usually contra-indicate the use of astringents.

Emollients.

Emollients (*mollio*, I soften) soften, soothe, and relax the parts to which they are applied. They resemble demulcents; and, besides the various substances of that class (page 17), include poultices, fomentations, moistened lint, flannel, sponge, or spongio-piline, with hot water, soap and water, decoction of poppies, oil, glycerine, linimentum calcis, starch powder, and fuller's earth. They are opposed to astringent tonics. They are serviceable in the earlier stages of inflammation for effecting resolution; in more advanced stages for promoting suppuration; in all stages for relieving heat, tension, and pain. Although serviceable for softening and cleansing wounds, they are generally unsuitable for those likely to heal by first intention or adhesion.

Refrigerants.

Refrigerants (*frigeo*, I am cold) reduce the temperature of those parts of the body with which they come in contact. By reflex action their local effects are often distributed to remote parts. As local tonics and stimulants, they sometimes remove circumscribed and superficial inflammation, especially in parts of low organisation. Cold air and cold water are the most common and convenient ordinary refrigerants. Solids becoming fluid absorb heat, and cooling mixtures are accordingly made by dissolving in water, immediately before application, such readily soluble salines as common salt and nitre, or common salt and ammonium nitrate or chloride. Alcoholic, etherous, and other volatile fluids are also employed as cooling lotions, on account of their abstracting heat during evaporation.

More ready and effective refrigeration is, however, secured by ice, broken small, applied either in a gauze bag or thin metallic vessel, used either alone, or, if a still lower temperature is required, mixed with half its weight of common salt. Extreme cold, especially when applied suddenly, is a powerful excitant, but when excessive or prolonged it proves an equally powerful depressant. In cases of phrenitis, meningitis, and puerperal apoplexy, the ice bag often controls dangerous congestion and inflammation. Small portions of ice sucked and swallowed abate inflammation of the throat, and both by direct and reflex action, aid in arresting bleeding from the lungs and stomach. Cautiously used, refrigerants are sometimes serviceable in the treatment of sprained tendons, open joints, and chronic rheumatism. Applied to the prolapsed uterus or rectum, they reduce swelling and inflammation, and greatly assist the safe return of these organs. Congelation effected by ice, or by immersion of a piece of thin metal in the freezing mixture, renders the skin bloodless; subjacent parts become tense, firm, and numbed; congestion disappears; abscesses may be opened, and other minor operations performed, without pain. Such refrigeration continued for five or ten minutes is sometimes repeated several times daily, but, to avoid undue reaction, cold water should be applied for some time after. The healthy glow or reaction which follows the use of refrigerants, whether

employed externally or internally, usually affords indication of their curative value. In human patients, congelation was successfully used by Dr. Arnott in the treatment of erysipelas and other skin diseases; but, as vitality of the chilled parts is apt to be unduly reduced with the results of languid circulation and even of sloughing, care must be taken to employ ice and other active refrigerants with caution, to avoid their sudden or prolonged application, and to moderate the reaction, which is sometimes dangerously violent.

Ice and other refrigerants while in the mouth, and when swallowed, produce agreeable sensations of coolness, promote salivary secretion, and allay thirst (p. 43). Salines and ethers subsequently exert other physiological effects. The reduction of abnormal animal temperature effected by refrigerants and other febrifuge or antipyretic medicines is brought about chiefly in the following ways: 1*st*, By direct abstraction of heat, as by ice swallowed or applied, by cold baths, douches, or otherwise promoting cutaneous transpiration. 2*d*. By encouraging the functions of the skin, kidneys, and other excretory channels. 3*d*. By quieting inordinate nervous excitement and regulating vaso-motor functions. 4*th*. By neutralising or destroying disease germs or morbid matters which have determined increased combustion. The moderation of excessive temperature demands paramount consideration in the treatment of acute fever and inflammation, for high temperature perverts, depresses, and even arrests tissue nutrition, and often sets up degenerative changes.

Sedatives—Depressants.

Sedatives (*sedo*, I calm, or allay) lower nervous force, and are sometimes termed depressants and occasionally antiphlogistics. They include blood-letting, aconite, prussic acid, tartar emetic, and hellebore. Their effects are determined in several different ways, and on various organs. General depression results from abstraction of blood in amount sufficient to produce shock or impair nutrition. Somewhat similar effects are induced by spare diet, inadequate to restore the normal waste of the body. Violent or continued discharges, whether by the

skin, kidneys, or bowels, remove nutrient materials, and hence exercise notable depression. The breathing of impure air charged with carbonic anhydride, or, worse still, with organic matters, the offscourings whether of the lungs or skins of animals, is a common cause of depression, often leading to disease, and interfering with the satisfactory operation of medicines. Insufficient light, want of proper exercise, and many mental emotions exert sedative effects, especially in young animals.

Depression of the vital powers is effected by many medicinal agents operating in various ways. Full doses of most irritant and corrosive poisons have secondary sedative effects. Stimulants acting too violently or continuously, derange, impair, or lower general or local activity. The like effects are produced by such narcotics as ether and opium in large repeated doses, or during their secondary actions. The true sedatives are opposed to stimulants; they bear some resemblance to narcotics, but differ from them in causing little preliminary excitement, and little effect on the brain proper. They have a tolerably uniform operation on man and the domestic animals. They are soluble and find entrance into the blood, have each their particular portions of the nervous system to which they are attracted, and which they derange and depress, producing corresponding effects on the organs governed by them. They destroy life by syncope or arrest of the heart, or by asphyxia or arrest of respiratory movements. Some have a limited field of operations. Bismuth, for example, is a sedative mainly to the irritable nerves of the stomach. Lead salts absorbed into the tissues paralyse adjacent vaso-motor centres and nerves, destroying both sensory and motor functions. Others, like aconite, have more general sedative effects. The dose and condition of the patient modify the actions of many sedatives. Digitalis and various bodies of the alcohol series, which in large doses are sedative poisons, in properly regulated doses are tonics or stimulants. Many possess subordinate actions and uses. Thus antimonials are emetic and irritant as well as sedative; aconite, in addition to its general depressant action, exerts an anæsthetic effect, which proves useful in rheumatism and neuralgia. Eucalyptus globulus, popularly known as an antiseptic and an

antiperiodic like quinine, after slight stimulation, in large doses, powerfully depresses the spinal cord, and fatally paralyses the respiratory centre.

Fuller information regarding sedatives, their mode of operation, and the precise parts of the organism on which they exert their effects, obviously aid greatly in their safe and successful employment, but have not as yet led to their satisfactory classification. Some of the more important have, however, been divided into two groups—(1) Those which act prominently on the heart and respiration, and (2) those which act more notably on the spinal cord, and are usually distinguished as motor-depressants.

Aconite depresses and paralyses first the sensory and subsequently the motor nerves; full doses paralyse respiratory movements, and depress the force and number of the heart-beats; death results from respiratory arrest. Dr. Ringer claims for aconite very extended powers, believing that it paralyses all nitrogenous textures; but it has no direct effect on the brain or special senses. Lowering the pulse, arterial pressure, and temperature, aconite constitutes one of the most effectual means of combating the complex condition of fever. This antipyretic action, and its slowing respiratory movements, explain its efficacy in the early stages of inflammation of the respiratory organs. Numbing and paralysing sensory nerves, it further proves serviceable in rheumatism, neuralgia, and as a topical application for relieving irritative pain.

Digitalis in large or frequently repeated doses is notably a heart sedative. It paralyses the vagus, the cardiac ganglia and muscular substance, causing staggering gait, a small irregular pulse, occasional convulsions, and fatal syncope. In carefully regulated doses, no medicine is, however, more effectual in stimulating and giving tone to the enfeebled, irregularly-acting heart, and to relaxed arterioles. Nearly allied to digitalis is casa or doom, one of the ordeal poisons of South Africa, the bark from a leguminous plant, and the subject of careful investigation by Dr. Lauder Brunton. With local irritation of the alimentary mucous membrane, when swallowed, he finds that it slows the action of the heart, contracts arterioles, also specially contracts the renal arteries, and hence, according

to dose, increases or diminishes excretion from the kidneys. Like digitalis, poisonous doses cause cardiac paralysis, while medicinal doses strengthen and steady defective heart action. The Borneo and Madagascar arrow poisons appear to be very similar to casa. The cobra poison in full doses is, like them, a deadly cardiac sedative.

Besides possessing many other actions, opium and its active principle morphine are valuable sedatives. Full and repeated doses reduce sensibility of sensory nerves, accordingly diminish supplies of blood determined to irritated or inflamed parts, and are thus antipyretic. In acute fever or inflammation such results are usually secured with more certainty when opium is combined with calomel, which has itself much effect in reducing the force and frequency of the heart's action, in controlling inflammation, and also in aiding the removal of inflammatory products. Tartar emetic in men, dogs, and cats, lowers the action of the heart, but according to the dose given it is besides diaphoretic, expectorant, emetic, and also a gastro-intestinal irritant. Veratrum and its alkaloid in large amounts are gastro-intestinal irritants, but in medicinal doses nauseate and lower the force and frequency of the heart. Allied to veratrum are the American remedies pulsatilla, or pasque flower, and grindelia, the leaves, stems, and flowers of Grindelia robusta. Muscarine, the alkaloid of amanita muscaria, or fly fungus, resembles pilocarpine, the alkaloid of jaborandi, increases salivary, nasal, intestinal, hepatic, and cutaneous secretions; full doses cause primarily gastro-intestinal irritation, but muscarine, besides, is a powerful cardiac sedative. A minute trace applied to the heart of a frog immediately slows and arrests its action, with great diminution of arterial pressure, contraction of pulmonary vessels, and consequent laboured breathing, impaired oxygenation, and lowered temperature. Possessed of these decided effects, muscarine promises to become a useful addition to the pharmacopœia.

The group of sedatives acting more prominently on the spinal cord, and known as motor-depressants, are represented by prussic acid, tobacco, and Calabar bean. Prussic acid paralyses the cerebro-spinal axis, exerts general sedative effects, allays irritability of peripheral nerves; in poisonous doses

destroys life by respiratory arrest. Tobacco and its alkaloid nicotine are topical irritants; they paralyse first the end organs of motor nerves, but ultimately the spinal cord, producing trembling, clonic spasms, tetanic symptoms, and finally muscular paresis, which kills by involving the muscles of respiration. Lobelia, or Indian tobacco, in large doses, depresses and paralyses the motor, respiratory, and cardiac centres, and, like tobacco, causes prostration and muscular relaxation, with more or less gastro-intestinal irritation. The upas, from the same order as nux vomica, acts directly on the cord, inducing tetanic convulsions. Curara, or woorara, a South American arrow poison, chiefly obtained from plants of the nux vomica order, usually containing besides the virus of serpents, varies somewhat in its composition and effects. It paralyses the terminals of motor and vaso-motor nerves. The effects of full doses extend to all parts of the nervous system; fatal effects result from paralysis of the muscles of respiration. Calabar bean is a direct depressor of the spinal cord, exhausts its reflex action, lowers the functions of the respiratory centre, inducing slow and shallow breathing, and, like very many sedatives, kills by respiratory arrest. Its power of inducing muscular relaxation has led to its employment in cases of tetanus; it contracts the pupil, and is the physiological opposite of strychnine. Potassium bromide acts on the vaso-motor system, contracts arterioles, especially of the brain, producing cerebral anæmia similar to that naturally occurring during sleep. Large doses cause progressive paralysis, depression of temperature, asphyxia or cardiac arrest in diastole; the cerebrum is more affected than by Calabar bean. It is given to lessen reflex irritability in epilepsy and other spasmodic disorders. Chloral hydrate occupies debatable ground between sedatives and narcotics, produces cerebral anæmia, causing sleep; blunts reflex irritability, relaxes rigid or spasm-bound muscles, and moderately dilates the pupils, while large doses gradually and fatally paralyse the respiratory centre and cardiac ganglia. It shares with opium, chloroform, belladonna, digitalis, bromide of potassium, and acetate of zinc, the valuable property of quieting that reflex excitability which so frequently causes or intensifies pain and spasm.

Amyl nitrite is very volatile; when inhaled it proves a rapidly-acting sedative of the motor tract of the spinal cord, impairs reflex action, causes vascular dilatation, diminished blood-pressure, quickened pulsation, and in large doses fatal failure of respiration, but without impairment of consciousness or sensation. Nitro-glycerine has similar power of controlling motor spasms and reducing vascular tension; large doses fatally paralyse the muscles of respiration. According to Dr. Lauder Brunton, its paralysing powers are exerted chiefly and primarily on muscles and motor nerves. Hemlock and its alkaloid coneine paralyse the extremities of motor nerves; the hind limbs are first affected, clonic spasms occur, cessation of respiratory movement kills; neither brain function nor sensation are impaired. Water hemlock causes giddiness, reeling, and paralysis of the cord. Œnanthe crocata, the hemlock water dropwort, or dead-tongue, is also a depresso-motor. Seventy-four cattle, belonging to Lord Dunraven, turned out to grass at Adare, County Limerick, in 1873, ate the fresh leaves of the plant, and forty-three died, foaming at mouth, shivering, reeling, staggering round in a circle, with rapid and laboured breathing, tetanic spasms, and death within a few minutes. Gelsemium, the root of yellow jasmine, is allied to hemlock, paralyses both motility and sensibility, acts primarily on motor centres; the functions of the fore extremities are first impaired; paralysis of the respiratory muscles, and especially of the diaphragm, destroy life.

Notable sedative soothing and antipyretic effects are produced by the proper use of baths, specially convenient for small animals, and used at temperatures ranging from 90° to 60° Fahr., or by sponging the larger patients with tepid and subsequently with cold water, and rubbing them perfectly dry (see Refrigerants, p. 86). Ice applied to the spine lowers the activity of those parts drawing their nervous force from the particular portion of the cord exposed to refrigeration, and diminishes muscular tension, sensibility, and secretion, but increases peripheral circulation and local heat.

Blood-letting, the most prompt and direct of sedatives, on that very account is the most liable to abuse. It rapidly removes nutrient materials, and especially blood globules and

fibrin. A full bleeding diminishes the activity of all the vital functions, excepting the reproduction of red globules, lowers arterial tension and reflex excitability, and hence abates pain. In fitting cases and judiciously used it mechanically diminishes over-distension of the right cavities of the heart; it combats acute congestion of the lungs, especially when accompanied by venous stasis; in like manner it relieves the brain vessels in acute cerebral congestion. In robust subjects it is serviceable in the earlier stages of acute inflammation of the pleura, peritoneum, brain, and feet, where fever is high, with a firm incompressible pulse, or a full slow, indistinct pulse. In some such cases a timely bleeding checks the progress of mischief, and renders the system more amenable to subsequent treatment. Healthy vigorous animals rapidly repair the effects of an ordinary bleeding; but the recuperative powers are often severely taxed and recovery retarded when the patient has to make good the losses both of venesection and acute disease. Repeated bleedings increase, however, the proportion of fibrin in the blood.

Where the operation is called for, either in horses or cattle, blood may generally be taken to the extent of four or five quarts. The exact quantity must, however, depend entirely upon the circumstances of the case. Blood should flow freely until its abstraction has made a decided effect upon the volume and strength of the pulse, or until the patient shows the earliest symptoms of nausea. Blood should be drawn rapidly from a large opening, as its important effect in relieving tension of over-distended capillaries is thus produced more rapidly and decidedly and with less expenditure of the vital fluids. The jugular vein on either side is usually selected for the operation, and is safer and more convenient than any other vessel. Bleeding from arteries is more troublesome, and not more effectual than from veins. Topical blood-letting is rarely practised amongst the lower animals; but in cases of weed and acute laminitis many successful practitioners still prefer to draw blood by carefully paring away the crust at the toe, laying open the minute vessels, and immersing the foot in hot water or a warm poultice. Except in expert professional hands, fleams are much safer than the lancet, which occasionally in

restive horses makes an ugly gash. If practicable, the horse should be bled with his head erect; for in this position the nauseating effects, which show that no more blood can be spared, are most noticeable. It is not very safe to bleed a horse when he is lying, and never, in any case, to the extent of causing fainting. When enough blood has been taken, the edges of the wound must be brought accurately together, and secured by a pin, round which should be wound some thread, tow, or hair.

Although blood-letting is assuredly a valuable remedy in the early stages of acute inflammation in vigorous animals, it must not be applied in all cases or in all stages of inflammation. It is always injurious in young weakly subjects, in the later stages of disease, in epizootic and eruptive fevers, and, indeed, whenever the pulse is small, quick, and weak. A horse or cow should never be bled if the pulse is small, soft, or very quick, for such a pulse indicates weakness; and bleeding in all such cases increases exudation and effusion, instead of preventing them, whilst it unnecessarily debilitates the patient, retarding recovery, and diminishing the capacity for coping with and throwing off disease. In dogs blood-letting is rarely advisable. In all animals the finger should, during bleeding, be placed upon the pulse, so as to note any changes in its force and frequency; and if, whilst the blood flows, the circulation gets quicker and weaker, and begins to flutter, be assured the treatment is erroneous: at once take away the blood-can, pin up the wound, and beware of prosecuting further the sedative treatment. Such mischance should, however, never happen; for whenever there is the least question as to the propriety of blood-letting, the animal should have the benefit of the doubt, and such a reducing remedy should be avoided.

Narcotics.

Narcotics (*νάρκωσις, narkōsis,* a benumbing) are soothing and stupefying remedies. They include anodynes given for the relief of pain, and hypnotics or soporifics given to induce sleep. They were defined by the late Professor Headland as "medicines which pass from the blood to the nerves or nervous centres, which act so as first to exalt nervous force, and then to

depress it; and have also a special action on the intellectual part of the brain." They have been classified as inebriants, soporifics, and deliriants; and include opium, Indian hemp, belladonna, hyoscyamus, camphor, and tobacco. Large doses induce depression and stupor, preceded by comparatively little excitement, and usually cause death by coma; but in the lower animals the spinal cord, as well as the brain, is notably implicated, and spasms and convulsions are apt to interrupt the stupor. Some narcotics, such as belladonna, hyoscyamus, and Indian hemp, cause considerable preliminary excitement, and in large doses delirium, and form the connecting links between narcotics and such stimulants as alcohol and ether. Narcotising the cord as well as the brain of the lower animals brings these narcotics into near relationship with such depressomotors as Calabar bean and chloral.

There is considerable diversity in the action and uses of the several narcotics, and the same narcotic further comports itself differently according to dose and other modifying conditions. Opium is described by Dr. John Harley "as a hypnotic which includes anæsthesia, and an excitant which includes cramp and convulsions." It has more direct effect on the brain than other narcotics; but in the lower animals this brain action is not so notable as in man; full doses also cause more preliminary excitement in animals than in man; induce in horses more delirium than in dogs or men; leave in all animals nervousness and muscular weakness; poisonous doses cause deep sleep, death by coma, often interrupted by convulsions, and with gradual weakening of the respiratory function. No narcotics are so generally valuable as opium, and its alkaloid morphine, in antagonising pain, spasm, and sleeplessness. Belladonna causes more preliminary excitement than opium; large doses produce delirium rather than stupor; properly regulated doses stimulate the heart and vessels; it dilates instead of contracting the pupil. Henbane resembles belladonna, but paralyses more notably the cerebrum and motor centres, and stimulates less powerfully the sympathetic; it dilates the pupil, diminishes mucous secretion, and relaxes muscular fibre. Indian hemp induces hallucinations and delirium rather than stupor, increases instead of diminishing secretion, and is chiefly used

by veterinarians as an anti-spasmodic in tetanus. Camphor in large doses poisons birds and dogs, causes delirium with convulsions, stupor, and death, usually from respiratory arrest; it is prescribed as an anodyne. Tobacco, especially in full doses, paralyses the cerebral functions, and is hence allied with narcotics as well as with sedatives. Coculus Indicus and its active bitter principle picrotoxin cause giddiness, convulsions, and coma, and are sometimes used to stupefy and take fish and game. Chloral hydrate acts on the intellectual and motor functions, soothing irritability and causing sleep; in full doses it narcotises the cranio-spinal axis, and arrests respiratory movements. Carbolic acid exerts somewhat similar effects, causing delirium and death by coma, and arrest of the respiro-cardiac functions; but with these narcotic effects it conjoins notable irritant and antiseptic properties. Hemlock, once classed with narcotics, has no direct effect on the brain or cord, but paralyses the extremities of motor nerves.

Narcotics are given to relieve inordinate nervous action. They abate the spasms of colic, chorea, and tetanus; diminish the irritability and excessive discharges of chronic cough, bronchitis, diarrhœa, and dysentery; alleviate gastrodynia and chronic vomiting in dogs; and blunt the pain of wounds, rheumatism, pleurisy, and other inflammations. To insure their full effects, they are given at intervals of two or three hours. Most narcotics contain concentrated active principles, which can be conveniently and effectually used hypodermically.

Anæsthetics.

Anæsthetics (*a*, *a* privative; and *αἴσθησις*, *aisthēsis*, sensation) produce insensibility to external impressions and to pain. They are represented by chloroform, ether, and nitrous oxide gas. They resemble narcotics in their general actions; but their peculiar distinctive power of extinguishing sensation demands for them separate consideration.

The practice of anæsthesia is not a new one. Dioscorides speaks of mandrakes being employed for causing insensibility to pain. As early as the third century the Chinese are said to have used a preparation of hemp to induce anæsthesia during surgical operations; while, about the end of the seventeenth

century, Augustus II., king of Poland, underwent an operation, which, on account of the use of some secret agent, is said to have been unaccompanied by pain. In the beginning of the present century, Sir Humphry Davy used nitrous oxide for causing insensibility. About 1831 ether was known to anæsthise the lower animals, and relieve asthma in human patients. It was first used to produce anæsthesia in man in America, on September 30, 1846, by a Mr. Morton, in the extraction of a tooth, and shortly afterwards was generally used for surgical operations. On this side the Atlantic it was first given in London, December 19, by a dentist, and two days later by the celebrated Liston. Chloroform had been known for some time as a chemical curiosity; some of its effects on the lower animals had been observed by Dr. Mortimer Glover in 1842, and by Flourens in March 1847; but its anæsthetic power on man was discovered on November 4, 1847, by Sir James Y. Simpson, in an experiment made with a small quantity on himself and some friends. Since that date its employment has spread over the habitable globe; it has relieved the sufferings of thousands, and saved the lives of hundreds,—probably, indeed, of more than ever have been saved by any single remedy, however ancient or valuable. Although many other anæsthetics have since been tried, none have proved so safe and serviceable as chloroform and ether.

Anæsthetics, being gases or volatile fluids, are usually introduced into the body through the lungs; they have remarkable powers of diffusion; their characteristic effects are believed to depend upon their interference with oxidation of the nervous centres. Their operation is divisible into three tolerably distinct stages. (1.) The cerebral functions are exalted and deranged, much in the same way as by full doses of alcohol, but are presently depressed, causing gradual unconsciousness, obscuration of special sense, and blunting of sensation. (2.) The cerebellum and spinal cord are swiftly involved; the muscles are relaxed, common sensation is suspended, breathing becomes quiet and automatic, unconsciousness is perfect. This is the stage required for serious operations. The anterior or motor centres are not so readily or so fully acted on as the posterior or sensory centres. (3.) Continued action of the

anæsthetic paralyses the medulla, the sympathetic centres, and the cardiac ganglia; the involuntary processes of organic life are arrested; reflex actions fail to be excited; respiratory movements are stayed, and the heart ceases to beat.

The symptoms of anæsthesia in the lower animals do not materially differ from those in man, and, according to Dr. Marshall Hall, are more uniform and perfect. In the first stage, salivation and coughing sometimes occur, the respirations are deep and somewhat hurried, the pulse quickened, the surface-heat raised, the limbs moved irregularly. During this stage in man peculiar sensations and sounds are perceived, and incoherent expressions are uttered. In all animals general insensibility gradually supervenes, the conjunctiva loses its reflex irritability, the pupil is dilated, the pulse becomes soft and slow, the muscles are relaxed, excretion of carbonic acid is diminished. Nausea and vomiting occasionally occur. Dogs sometimes whine as if uneasy or suffering. Even during the full action of the agent there is sometimes observed quivering of the muscles, which renders the performance of delicate operations somewhat difficult, and are more common with ether than chloroform; occasionally there is dangerous depression of the action of the heart, especially when full doses are very rapidly inhaled. In the lower animals, as in man, partial anæsthesia may, however, be safely kept up for many hours continuously. The degree which it is advisable to produce necessarily varies much in different circumstances. When relief of pain or of irritation is sought, paralysis of sensation without loss of consciousness suffices; when a painful operation is to be undergone, the patient must be rendered insensible and unconscious. Inhalation, however, must be at once stopped whenever the pulse, which should be carefully watched throughout, becomes irregular, embarrassed, or feeble; when the breathing gets slow, shallow, or noisy; when the pupil dilates; or when irritation of the conjunctiva fails to excite reflex action and blinking.

Anæsthetics, even when free from pungency, require to be breathed mixed with air, usually to the extent of twenty times their volume. When inhaled undiluted, or when air is excluded from the patient's lungs by the apparatus for admini-

stration, or in any other way, asphyxia occurs; and most of the accidental deaths from anæsthetics, whether in men or the lower animals, are thus accounted for. When deadly anæsthesia is produced, the most important restorative is fresh air, which must be got into the lungs by the operator gently blowing at intervals into the patient's mouth or nostrils, or carefully using a pair of bellows, alternately pressing upon and releasing the ribs, and thus imitating the respiratory movements, whilst the head is kept relatively lower than the rest of the body and the tongue is drawn out, to prevent its interfering with access of air. Respiratory movements may also be encouraged by dashing cold water over the head and neck, by stimulating clysters, by pricking the throat with needles, especially over the track of the phrenic nerve, and by the cautious use of the galvanic battery. Congestion of the right side of the heart may be relieved by a moderate bleeding from the jugular vein. Until partial consciousness takes place the patient is unable to swallow, and hence any attempt to administer stimulants is dangerous.

The mode of dying and the post-mortem appearances vary somewhat with the rapidity of the poisoning. Where human patients have rapidly inhaled chloroform or other anæsthetics death has occasionally resulted from cardiac syncope. In the lower animals, however, this is very rare; the respiratory centres are gradually paralysed, respiratory movements cease, death depends on asphyxia, the pulse continues to beat after the respiratory movements cease. Hence the value of artificial respiration in restoring patients from profound anæsthesia. The blood is dark-coloured and imperfectly coagulable; rigor mortis comes on naturally; the lungs are seldom congested; the veins throughout the chest are charged with dark blood; the right side of the heart is overfilled; the left side nearly empty; the brain and nervous centres are seldom congested.

There are some difficulties and disadvantages in the use of anæsthetics in the lower animals. Horses have generally to be thrown down before inhalation can be effected. A skilled assistant is necessary to regulate administration; on recovery, nausea and depression occasionally continue for several hours.

Anæsthetics have, however, been successfully exhibited in all formidable surgical operations. In parturition, partial anæsthesia affords, as in human patients, immunity from pain, without interfering with the force or frequency of the involuntary contractions of the uterus. Where the neck of the uterus in cows or ewes, arrived at the full term of gestation, continues spasmodically closed in spite of regular labour pains, and where manual efforts to expand the passages have been vainly persevered with for several hours, anæsthetics sometimes prove serviceable. In false presentations in the mare, the straining is sometimes so violent that the practitioner is powerless to rectify the fœtus until anæsthesia has been produced. For relieving the irritability and pain of such diseases as enteritis, peritonitis, pleurisy, and laminitis, and for obviating the spasms of tetanus, colic, and asthma, a low degree of anæsthesia proves useful. In some of these cases diluted solutions are swallowed or injected into the rectum, and exert, by reflex action, anodyne effects on painful conditions of the digestive, urinary, or genital organs.

Local anæsthesia is producible without interfering with general sensibility or consciousness. Lint saturated with the volatile agent is laid over the circumscribed spot; or, with a spray producer, a finely divided stream is directed upon it. Within a few minutes—often, indeed, in a few seconds—the peripheral extremities of the sensory nerves are paralysed, and sensation entirely removed. For such purposes ether is used alone, or mixed with chloroform or with alcohol. On account of its rapidity of action, Dr. B. W. Richardson recommends a mixture of equal parts of ether and amyl hydride. Freezing mixtures (p. 86), and electricity, have somewhat similar benumbing effects. Local anæsthesia has been used by veterinarians in castration, removing tumors, probing and excising fistulæ, opening abscesses, reducing herniæ, extracting teeth, inserting setons, as well as in firing and neurotomy. Those who have used it most do not, however, give it unqualified approval, and often find that the subsequent healing of wounds is tardy and unsatisfactory, and too frequently accompanied by suppuration and sloughing. The risk of such untoward results is diminished by lowering as little as possible the vitality of the

part, anæsthising slowly, not too deeply, and only for a very short period.

Chloroform and ether, the only anæsthetics used in veterinary practice, will have detailed consideration hereafter; but a few of the other anæsthetics demand brief notice. The various substances of the methyl series—of which chloroform ($C\ H\ Cl_3$) is the best anæsthetic representative—are mostly narcotic. Pyroxylic or wood spirit, or methyl alcohol ($C\ H_4\ O$), and methyl hydride or marsh gas ($C\ H_4$), are feebly anæsthetic. Carbon tetrachloride ($C\ Cl_4$), a heavy colourless liquid, anæstheses both men and animals. Methyl chloride, or chloromethane ($C\ H_3\ Cl$), usually obtained by the action of hydrochloric acid upon methyl alcohol, has a low specific gravity and boiling point, is unstable, has been used in surgical operations in man, and requires to be given rapidly, without much admixture of air. It is soluble in water and ether, the solution in the latter, according to Dr. Richardson, being one of the most perfect anæsthetics; in animals purposely poisoned by it, muscular irritability continues perfect for upwards of an hour after death. Methylene bichloride contains an atom of chlorine less, and an atom of hydrogen more, than chloroform; is represented by the formula $C\ H_2\ Cl_2$; is volatile, pleasant to inhale; according to Mr. J. C. Morgan, who has used it upwards of 1800 times in human practice, it conjoins most of the desirable qualities of ether or chloroform; it kills by syncope. Acetone, chemically regarded as methyl acetyl ($C\ H_3, C_2\ H_3\ O$), is more acid and irritating than anæsthetic.

Several members of the ethyl series—nitric, hydrochloric, acetic, and formic ethers—have been subjected to careful experiment, but none have been found so safe and serviceable as ether $(C_2\ H_5)_2\ O$. Aldehyde ($C_2\ H_4\ O$) readily acts as an anæsthetic, but is somewhat uncertain and irritant. Chloral hydrate ($C_2\ H\ Cl_3\ O, H_2\ O$), at ordinary temperatures being a solid, cannot be inhaled; large doses, when swallowed, produce, however, anæsthesia, but only in conjunction with deadly narcosis. Croton-chloral hydrate ($C_4\ H_3\ Cl_3\ O, H_2\ O$), a crystalline solid, resembling chloral hydrate in odour and taste, is a curious illustration of a partial anæsthetic; in full doses it paralyses the cerebral functions and those of the fifth nerve,

but does not, like chloroform or ether, remove general sensibility. Ethyl bromide, in moderate doses, stimulates the heart, and, in less degree, the spinal vaso-motor centres and also the peripheral vaso-motor system.

Amyl hydride, pentane or hydramel ($C_5 H_{11} H$), a derivative of amylic or potato spirit ($C_5 H_{12} O$), is obtained from American petroleum, has the specific gravity ·625, boils at 86° Fahr., and has been used as an anæsthetic by Dr. B. W. Richardson. Pigeons, rabbits, and Guinea pigs, placed in an atmosphere of 35 to 40 per cent. of amyl hydride, are rendered insensible in less than one minute, are deeply narcotised in two minutes, but the effects pass away with about the same rapidity as they are produced. Slight muscular movements precede calm sleep; scarcely any appreciable reduction occurs in animal temperature until continued inhalation is pushed nearly to a fatal issue, when the temperature suddenly falls from 1½° to 2°, the pupils dilate, and presently heart and lungs cease to act nearly simultaneously. The heart is fully charged with blood, which on the right side is darker than usual; but coagulation is not interfered with, the corpuscles show no change, the lungs are not congested, the voluntary and semi-involuntary muscles long retain their irritability. In human patients amyl hydride has been used in dentistry and other short operations. For similar purposes Dr. B. W. Richardson has also recommended (*Medical Times and Gazette* for 1871) a mixture of amyl hydride with methylene bichloride; and more recently a mixture of equal parts of amyl hydride and ether, this product being slower and more persistent in its effects than the hydride alone, and adapted either for general or local anæsthesia. Amyl nitrite ($C_5 H_{11} NO_2$), in full doses, paralyses the sympathetic ganglia and their motor nerves, reduces arterial pressure, lowers reflex irritability, exerts comparatively small effect on consciousness, and when too freely used kills by arresting respiratory movements.

Ethylene, or olefiant gas ($C_2 H_4$), is a powerful, but not very safe, anæsthetic. Conjoined with marsh gas and carbonic oxide, it is present in coal gas, which was twenty-five years ago used by the late Mr. Barlow and myself at the Edinburgh Veterinary College for horses, cattle, and dogs; was found to act almost as effectually as chloroform, but to leave considerable

nausea and depression. More safe and manageable than the coal gas, and not far behind chloroform and ether in general utility as an anæsthetic for veterinary patients, is coal naphtha, the repeatedly rectified distillate of coal tar, sometimes sold as Tennant's Anæsthetic Liquid. Benzine (C_6 H_6), another of the light hydrocarbons derived from coal tar or American petroleum, is also anæsthetic, and is generally used by entomologists to narcotise their specimens. The oily, fragrant Dutch liquid, or ethylene dichloride (C_2 H_4 Cl_2), although favourably regarded by Mr. Nunneley, was pronounced nauseating and dangerous by the late Sir James Y. Simpson and Dr. Snow. Amylene (C_5 H_{10}), another of the olefines, a volatile diffusible liquid, was highly recommended by the late Dr. Snow; but it has a disagreeable odour, and a marked tendency to paralyse the heart. Nitrous oxide, or laughing gas (N_2 O), is successfully used for the brief minor operations of human surgery. It is free from unpleasant smell and taste; it diminishes the amount of oxygen in the blood and increases the carbonic acid; produces unconsciousness after two or three minutes' excitement; recovery is unaccompanied by the nausea and prostration which other anæsthetics often have; prolonged inhalation is, however, dangerous; breathing ceases before the heart stops. The inconvenient gaseous form, the complicated apparatus required for its administration, and its cost, interfere, however, with its use in veterinary practice.

IV.—THE CIRCUMSTANCES WHICH MODIFY THE ACTIONS OF MEDICINES.

The actions of medicines are modified both in nature and degree by many circumstances; particularly by the quantity, quality, and form of administration of the medicine itself; by the species and age of the patient, and by the channel through which it enters the body. To some of these modifying conditions brief notice is now given.

Quantity.—Variations in the quantity of the medicine, or, as it is technically called, the *dose*, evidently alter the degree, and occasionally, also, the kind of action. Small doses of turpentine cause diuresis; somewhat larger doses have a general

stimulant effect, and act chiefly on the bowels. Small doses of most potassium, sodium, and magnesium salts, are alterative and diuretic, whilst larger quantities are purgative. Aloes, in small quantity, is tonic, and in large, purgative. Alcohol and opium afford striking examples of medicines in which variation in dose produces difference in effect. With topical remedies, an increase of the time during which the medicine is applied is generally equivalent to an increase of dose, as illustrated in the case of mustard, cantharides, and nitric acid. Absorption and retention in the body are usually insured by small and repeated doses. Larger doses of most remedies, unable to be retained in the blood, are generally more rapidly excreted, the less soluble by the bowels, the more soluble by the skin or kidneys, some of the gaseous by the lungs. Where uniform and continued effects are required, as with most restoratives, tonics, stimulants, and sedatives, small doses, repeated at intervals of two or three hours, are greatly preferable to larger doses given at longer intervals. That the effects of medicines begin and terminate with their administration may be regarded as a general rule, subject, however, to occasional exceptions. Salts of lead and mercury, and, according to some observers, strychnine and potassium bromide, are often given for some time without any obvious result, but afterwards produce their effects suddenly and violently, as if from the combined or accumulated action of a series of doses, and frequently continue to act for some time after administration of the remedy has ceased. Medicines exhibiting these phenomena are said to be *cumulative*.

Quality.—The quality of medicines must obviously affect their actions. Drugs that are impure, adulterated, or badly kept, cannot have such certain and powerful effects as those which are pure, carefully prepared, and well-preserved. Veterinarians are not always sufficiently careful in keeping their drugs in dry chambers, maintained at a tolerably uniform temperature, and in vessels which prevent undue ingress of air and light. Disappointment not unfrequently occurs from using indifferently prepared or old specimens of such perishable plants as digitalis or hemlock. To protect medical men and the public against the falsification of medicines, the British

Pharmacopœia has introduced a series of tests, by which the purity of simple officinal substances may be ascertained.

Form of Administration.—The form in which a medicine is used often modifies its effects. Thus a state of fine division, by facilitating absorption, materially hastens and increases the action of medicines, which consequently present a variable and decreasing activity, according as they are given in the gaseous, fluid, or solid forms. Chemical combination alters alike the physical, chemical, and physiological properties of medicines. One of the most striking instances of change in chemical constitution, determining change also in physiological action, has been discovered and investigated by Professor Crum Brown and Professor Thomas R. Fraser. The nitrile bases—strychnine, brucine, thebaine, and morphine—which excite muscular spasm, particularly violent in the case of strychnine, when united with methyl iodide, are converted into ammonium bases, and, instead of excitors, become paralysers of the spinal motor nerves. The several salts of the same base, as of iron, copper, morphine, or quinine, usually exhibit a strong family likeness, their variations in activity mainly corresponding with their solubility. To secure rapidity and certainty of effect, preference should usually be given to preparations which are readily soluble. In prescribing, care is requisite to avoid ordering medicines which interfere with or are incompatible with each other, either chemically, mechanically, or physiologically. Prescriptions should invariably be as brief and simple as possible.

Most vegetable substances are liable to be modified by soil, climate, and cultivation. Medicinal plants are usually most active when indigenous; but to this rule the opium poppy liquorice, and tobacco are notable exceptions. Wild are sometimes superior to cultivated specimens, and should generally be preferred until the other be proved of equal efficacy. Selection should be made of vigorous, well-formed, dark-coloured, but not excessively luxuriant, plants, growing on dry soils, and exposed to air, light, and sunshine, except in the case of plants which naturally seek situations of an opposite kind.

Species of Patient.—The several classes 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 lower 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 mesocephalon and cerebellum which regulate motor energy. In the domestic animals the cerebrum is only five times the weight of the posterior parts, 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, whilst in the lower animals they produce deranged motor function and convulsions.

In the horse, the stomach is small, the intestines capacious, highly vascular, and 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 five per cent. are got rid of by this channel, and the amount is still less in dogs and cats. Vegetable purgatives, notably aloes, appear more suitable than mineral purgatives, and act chiefly on the large intestines, and only slightly on the stomach and small intestines. Except in disease, and under the influence of aconite, horses never vomit. Tartar emetic, of which a few grains cause immediate emesis in dogs, has scarcely any physiological effect either in horses or cattle. Vomition in horses is prevented by the small stomach being at a considerable distance from the diaphragm and abdominal muscles, and hence not readily compressed between them; by the stout

band of muscular fibres which surrounds its œsophageal opening; according to some authorities, by the inaptitude of the vagus nerve to receive and convey the special irritation, but more probably from imperfect development of the vomiting centre (p. 51). 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 in 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.

The peculiarities of the action of medicines in cattle are chiefly referable to the construction of their alimentary canal and to their phlegmatic temperaments. In these ruminants the stomach is quadrisected, is extensively lined with cuticular mucous membrane, and, as regards its first three divisions, is less vascular and more mechanical than the corresponding portions of the alimentary canal in men, dogs, or horses. The first and third compartments always contain food, often in large quantity. These facts explain why cattle require such 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. The kidneys and skin of cattle 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 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 large 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, and the head steadied between the operator's knees, while the medicine is cautiously poured over.

Medicines generally operate on dogs 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 the human subject, 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 men, 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 any other veterinary patients. Another peculiarity is the facility with which they can be made to vomit. Indeed, vomition 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 somewhat similar to their action on men and dogs.

Age and Size.—The properties of medicines are modified, especially in degree, by the age of the animal. As a general rule, the younger the animal the more easily is it affected. Tables have been constructed showing the doses suitable for animals of different ages. Thus Bourgelât estimates 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 similar ratio is applicable to cattle. Such calculations are, however, merely approximative. The practitioner readily adapts his doses to the size of his

patients. In this work the doses mentioned under the head of each substance, unless otherwise stated, are those suitable for adult animals of medium size.

Mode of Administration.—The channel by which medicines enter the body frequently modifies the rapidity and degree of their action. Medicines are readily absorbed from the mucous and serous surfaces, from the areolar tissues, and from wounds. They are sometimes injected into veins or arteries, when they act with remarkable rapidity and effect; but this method of exhibition is attended with too much trouble and risk to be of much practical utility. When given by the mouth most medicines are taken up from the surfaces of the stomach and duodenum—which afford great facilities for speedy and complete absorption. From no part of the alimentary canal is absorption so rapid as from the duodenum; it is less active in the large intestines and in the rectum, which, nevertheless, is a serviceable channel for the introduction into the body not only of nutrients, but also of soluble unirritating drugs. Medicines which are promptly absorbed without change should generally be introduced into the stomach while it contains the minimum of food. Indigestible substances, restoratives, such as oils and iron salts, as well as irritants like iodine and arsenic, are best given with food or immediately after eating. The time and patience of attendants, and the equanimity of the patient, are alike preserved by giving comparatively tasteless saline febrifuges or tonics, mixed with palatable food, or dissolved in water-gruel, or milk offered in a bucket. A little care and coaxing generally insure such medicines being thus taken both by horses and cattle, and the practice often saves prolonged injurious struggles, especially with unbroken high-spirited nervous young horses.

The pulmonary mucous membrane has a superficies of fifty times the extent of the skin surfaces, is very actively absorbent, and is well adapted for conveying medicines into the system. This method of administration, now in familiar use with such substances as chloroform and ether, might probably be advantageously extended to many active non-volatile medicines, which can be readily introduced into the lungs along with the vapour of water or of other fluids. Medicines thus speedily

brought in a finely divided state into immediate contact with the blood act with great rapidity and certainty. In most animals the skin is capable of absorbing many medicinal substances. Solutions of opium, tobacco, carbolic acid, and corrosive sublimate, ignorantly or carelessly used for the cure of skin diseases, and especially if applied with smart friction, frequently become absorbed, and develop their poisonous effects. Absorption is further facilitated by removing the cuticle by means of a small blister, and applying the medicine directly to the true skin. This constitutes the *endermic* method of exhibition. Quinine, strychnine, morphine, and the other concentrated medicines, when so used, operate with great certainty, and in doses considerably less than those usually swallowed. Through the punctured cuticle, by the process of inoculation, remedies are also occasionally introduced, and this method is adopted with the benignant lymph used to antagonise pleuro-pneumonia, splenic apoplexy, and other specific disorders.

Subcutaneous injection of concentrated medicines has now superseded the endermic method, has been successfully used in all the domestic animals by Mr. Frederick Mavor of Park Street, Mr. Thomas Dollar of New Bond Street, London, Mr. Fearnley of Leeds, Mr. M'Gillivray of Banff, and many Continental veterinarians; and, on account of its rapidity, certainty, and directness of effect, well deserves more general adoption. It proves especially useful in arresting or controlling the spasms of colic and chronic cough, the sharp twinges of rheumatism, inflammatory pain, such as that of enteritis and pleurisy, as well as the effects of poisons. Where pain is to be counteracted, the injection is made near the affected spot, or over the nerve which is supposed 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 best dissolved in water, or other perfectly bland fluid; half an ounce to an ounce 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. The operation is of the simplest

description. A fold of loose skin is taken up between the finger and thumb of the left hand; a suitable syringe is quietly inserted with the right hand; the point is carried about an inch underneath the skin, parallel with the surface; it is slowly emptied; held for half a minute; cautiously withdrawn; and the finger pressed for a minute on its track. The minute 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.

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 amongst 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).

Idiosyncrasies, 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 careful consideration of the temperament and condition of the patient.

Diseases.—The existence of disease modifies the action of many medicines. A congested or inflammatory condition of

the alimentary canal retards absorption, and the consequent activity of medicines given in the usual way by the mouth. Acute fever, on account of increased arterial pressure, is also unfavourable to absorption. When excretion is hindered medicines are usually retained longer in the system, and some accordingly act more powerfully. Conversely, when excretion is active, as in diuresis, diabetes, or diarrhœa, such medicines as opium, belladonna, and alcohol, being rapidly got rid of, do not manifest their full activity. An organ in a state of disease probably does not act on most medicines in the same way as it does in health. It has been shown, for example, that certain morbid states of the liver prevent the usual transformation of benzoin into hippuric acid (Royle's *Materia Medica*, 6th edition). Influenza, low fevers, and extensive inflammation of mucous or cutaneous surfaces, withstand reducing remedies badly, and require for their successful treatment the early exhibition of restoratives, tonics, and stimulants. 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.

External Circumstances.—The circumstances in which patients are placed often 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 the most skilfully devised curative measures. Medicines can only act effectually when seconded by proper sanitary arrangements. A hot stable favours tissue waste; this is followed by quicker combustion and increased animal temperature, which accelerate circulation and respiration, and further stimulate tissue degeneration. Such facts demand consideration alike in the treatment and prevention of disease. Frequently a horse with influenza, typhoid fever, or pneumonia, is thrown back for days by being senselessly stripped and taken out of his box in cold weather;

bulky indigestible food, even for one meal, or in very moderate amount, often retards recovery from gastric derangements, and indeed from most debilitating diseases; constipation and torpidity of the bowels interfere with absorption and satisfactory operation of all medicines; exposure to cold will seriously injure 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. One other illustration of the influence of surroundings on the action of remedies must suffice. 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 rougher subjects which have been indifferently nourished.

SECTION II.

ON VETERINARY PHARMACY.

THE present section is devoted to a brief notice of such important pharmaceutical compounds as powders, boluses, tinctures, extracts, etc., adverting chiefly to their manufacture, preservation, and administration. To these general observations are appended tables of the Pharmacopœia and metric weights and measures.

POWDERS.

Most medicines may be coarsely powdered in a common hand-mill such as that in ordinary use 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 roof, 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 powder 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 a sieve of wire-gauze or horse-hair. For light pungent or irritant powders, compound sieves, closed in with a lid both above and below, are used. To avoid tedious trituration, some 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. Medicines, especially of the more expensive descriptions, if possible, should not be purchased in powder; for adulterations or impurities are then difficult of

detection. Medicines in powder, when concentrated, are occasionally dropped upon the tongue. Sometimes they are scattered upon or mixed with the food—a method which, as previously stated, saves much trouble to practitioners and attendants as well as annoyance to the patient, and answers well for the administration of tonics and alteratives, especially when without disagreeable flavour.

BALLS—BOLUSES.

Balls correspond in veterinary practice with the pills used in human medicine. They are of cylindrical form, and, besides the active ingredients, usually contain certain subordinate constituents, termed *excipients*, added to give cohesion and consistence. The most common excipients are linseed meal and water, oil, lard, soap, mucilage, liquorice, and powdered gentian, treacle, syrup, glycerine, vaseline, and conserve of roses, the choice being determined by the nature of the active ingredients. The five 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 some 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 together in a mortar or on a slab; but when the materials are waxy or resinous the aid of heat is usually necessary. A good ball mass is often troublesome to make; for it must be soft, and yet possessed of a 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. It 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 get hard, and in this state act tardily and uncertainly, sometimes passing through the alimentary canal unchanged. For cleanliness and facility of administration, balls are given either rolled up in

soft paper, or elegantly and conveniently covered with a coating made of one part of gelatin and twenty of water. For horses the bolus is a common and handy method of administration; for dogs it is also often used. The bolus 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 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 for a couple of minutes kept slightly elevated. Dogs generally bolt their pills if they are deftly rolled up in a piece of meat.

DRAUGHTS—DRENCHES—DRINKS—MIXTURES—EMULSIONS.

Drenches are generally extempore preparations used in a single dose. Bulky substances which cannot be condensed into a 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. Medicine in a liquid form, however, comes immediately into intimate contact with extensive absorbing mucous surfaces, and passes on more speedily towards the second and fourth stomachs. Simple 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 different ingredients are not incompatible, decomposing or injuriously reacting on each other; and further, that their quantity be not too great, as the trouble of administration may thereby be unnecessarily increased.

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. In giving the medicine 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 also be steadied by an assistant who holds either the horns or ears; and 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 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 prevent its interfering with the medicine passing from the bottle. Glass bottles are 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. Drenches ought always to be thoroughly mixed and well shaken before being given, so as to prevent ammonia, turpentine, or other light constituents floating to the surface, or any heavy partially dissolved substance remaining at the bottom. They should be carefully and slowly given; and if coughing occurs, the operation should be stopped, and the animal set free for a few minutes.

Mixtures differ little from draughts or drenches, are usually

prepared extemporaneously, and are exemplified by camphor chalk and catechu mixtures. An emulsion is an opalescent mixture of oil or resin suspended in gum, soap, alkali, or white of egg.

INFUSIONS.

Infusions are solutions prepared by digesting vegetable substances in 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 stoneware 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. *Examples*—Infusion of catechu, gentian, aloes, etc.

DECOCTIONS.

Decoctions are solutions of vegetable substances prepared by boiling the drug in water. To insure perfect solution, the medicine is bruised or cut into small pieces, and occasionally undergoes preliminary digestion. The process is conducted in glass or earthenware vessels, and boiling prolonged beyond twenty minutes is carefully guarded against. Any insoluble residue is subsequently separated by filtering through bibulous or unsized 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, and be bottled and well corked while hot. Without these precautions, they are apt to ferment, or otherwise become spoilt. The British Pharmacopœia gives directions for making decoctions of aloes, poppies, oak bark, and ten others less used by veterinarians.

TINCTURES—SPIRITS—ESSENCES—WINES.

Tinctures are solutions usually of vegetable matters, occasionally of animal or mineral substances, sometimes in rectified spirit, more frequently in proof or pyroxylic spirit, and occasionally in ether. More than half of the sixty-eight tinctures of the British Pharmacopœia 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 at 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. Tinctures are clear, of a yellow red or brown colour, and are well adapted for keeping. The revisers of the British Pharmacopœia have greatly reduced dubiety and risk of accident, by enjoining the preparation of all tinctures of such uniform strength that one drachm shall be the average dose for an adult human patient. Medicated spirits are solutions of definite volatile principles in alcohol, and are represented by spiritus ætheris, camphoræ, and chloroformi. Essences are concentrated tinctures or spirits. Medicated wines, such as vinum antimoniale, or ipecacuanhæ, made with sherry or orange wine, are merely weak tinctures.

EXTRACTS—SUCCI—GLYCERINES.

Extracts are the soft, semi-solid residues left by evaporating the natural expressed juices of plants, or decoctions, infusions, or tinctures, containing their active principles. Water, alcohol,

or ether are the solvents used for making the solution from which the extract is subsequently prepared; and that solvent is preferred which removes the active principles without the starch, gum, or other matters, which not only uselessly increase the bulk of the preparation, but also render it apt to spoil. To avoid the high temperature so liable to decompose or volatilise the active principles, especially of narcotic plants, fluid matters are first got rid of by evaporation *in vacuo*, and the residue is transferred to flat shallow pans, in which it is exposed to currents of air at ordinary temperatures, and continually stirred until the desired consistence is reached. 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-six officinal extracts, veterinarians chiefly use extracts of belladonna, hemlock, digitalis, and Indian hemp. The succi or expressed juices of belladonna, hemlock, henbane, and five other plants, are enumerated in the British Pharmacopœia, and are preserved by addition of one-third of their bulk of rectified spirit. The glycerines of the Brit. Phar. are solutions of four fluid ounces of glycerine to one ounce of carbolic, tannic, and gallic acids, and borax, and of eight of glycerine to one of starch.

LIQUORES—LOTIONS.

Thirty-nine liquors appear in the Brit. Phar., nearly all being solutions of inorganic bodies or of alkaloids. The seven containing the poisons, arsenic, atropine, morphine, and strychine, contain four grains of the active principle to the fluid ounce. Examples of such preparations in common use are liquor ammoniæ acetatis, or Mindererus spirit, liquor arsenicalis, or Fowler's solution; liquor ferri perchloridi; liquor potassæ. No general rules can be laid down for their preparation; their properties are very variable; but those of importance to veterinarians will be noted when treating of the medicines they contain. Lotions are fluid preparations intended for external use, and generally made up extemporaneously. Lotions for the eye are usually called *collyria*.

SYRUPS—CONFECTIONS—ELECTUARIES.

Syrups are medicated saccharine solutions, of a density varying between 1·300 and 1·400. They are usually made with one part of the drug to two and a half of refined sugar; a little spirit is sometimes added to insure keeping. A proper 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. Simple syrup, occasionally employed in veterinary practice, consists of two parts of sugar and one of water. Although the Brit. Phar. recognises eighteen syrups, veterinarians only use syrups of buckthorn, poppies, ginger, and iron-iodide. Electuaries are made of sugar or mucilage. Confections and conserves are soft preparations, chiefly consisting of sugar or treacle, and used as vehicles for administering insoluble or disagreeable-tasted drugs.

OINTMENTS—UNGUENTA.

Oils, fats, and wax constitute the basis of ointments, which have the consistence of butter, are for external use, and are applied with or without friction. To improve their keeping, and prevent rancidity, they are often made with vaseline, or with lard or oil, impregnated with benzoin or other antiseptic balsams. When lard or oil is the excipient, the several ingredients may be mixed in a suitable mortar; but when wax or resin is used, it must be melted over a slow fire, the other constituents then added, and the mass stirred until it has acquired proper consistence. Ointments, of which thirty-four figure in the Brit. Phar., 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 little wooden chip boxes or in earthenware pots, both of which the practitioner should have of several different sizes. In dispensing these and other officinal preparations, spatulæ of steel, bone, wood, and horn, are essential articles of the laboratory furniture. *Cerates* are stiff ointments containing wax. *Liniments*, made with oil or soap, have a

mediate consistence between ointments and oils, are for external use, and intended to be applied with friction.

PLASTERS—EMPLASTRA.

Plasters are solid adhesive substances, usually containing lead oxide (litharge), with resin, wax, soap, fats, tar, or pitch; are conveniently kept fused in rolls, and are prepared for use by being spread on calico, linen, or leather. The equable pressure of a well-applied plaster gives support, protection from the air, retards evaporation, and hence raises topical temperature, increases glandular activity, and sometimes also hastens removal of products of inflammation. Addition of mustard or cantharides heightens stimulation; opium or belladonna insures soothing or anodyne effects. Ordinary plasters are, however, 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 patients' 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 leathern 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 often from their insuring the patient several weeks' release from work.

FOMENTATIONS.

Fomentations are topical baths, often consisting of water alone; but vinegar, saline, and other substances, are sometimes added. Unless otherwise specified, they are applied hot. Their exact temperature, undetermined by definite rules, must be modified by the nature and extent of the malady, and the part of the body to which they are applied. When for the eye, they may be about 100°; for strains, weed, and such cases, they should be as hot as the hand can bear; up to 150° Fahr. their

effects are generally soothing; above that temperature they are irritants; for enteritis, pleuro-pneumonia, or other cases in which they are intended promptly to produce active counter-irritation, their temperature ranges from 160° to 180°. For such cases, flannel or horse-cloths are saturated with boiling water, are partially dried by a wringer or by a couple of men whose hands are protected from scalding by dry coarse towels, and are laid over a large extent of surface contiguous to the parts affected. The hot wet woollen article should be covered with oil-skin or a piece of macintosh to retard evaporation and cooling. Sometimes the pained part to be soothed, or the surface sought to be stimulated, is covered with several thicknesses of woollen stuffs, amongst the folds of 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 often carry putrefactive germs, while the piece of lint or tow is thrown away as soon as done with.

Fomentations are chiefly useful for cleansing and soothing irritable wounds; for relieving external or superficial inflammation, with its attendant symptoms of heat, pain, and swelling; and also for reducing by reflex action internal inflammation, such as that of the respiratory organs or the bowels. The chief disadvantages in the ordinary use of fomentations are their being withdrawn before their heat and moisture have time to do much good, and their causing subsequent rapid 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 rubbed dry, 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°, as shown by Dr. Chapman

(p. 86), stimulates the cord and sympathetic ganglia, contracts 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. Conversely, the ice-bag applied to the spine is a sedative to the cord and nerve centres brought under its paralysing influences, and hence lowers muscular tone, sensibility, and secretion. The ice-bag applied to the spine in the cervical region, 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 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.

POULTICES—CATAPLASMS.

Poultices are local baths or semi-solid packs, convenient for regulating topical moisture and temperature. In their actions and uses they closely resemble fomentations. They are applied either hot or cold. Hot poultices are commonly made of linseed meal, bran, or oatmeal, with a sufficiency of boiling water to bring them to a suitable consistence; or of carrots or turnips, either steamed or boiled. Unless nicely prepared, soft, fresh, and frequently changed, they merit Liston's condemnation that they are associated with putrefaction and nastiness. Concentrating heat and moisture, they directly soothe, soften, and relax the surfaces with which they come in contact. The salutary changes thereby produced in the sensitive nerve-endings, by reflex action, are propagated to remote parts. Applied in the early stages, especially of superficial and circumscribed inflammation, they relieve tension and pain, and promote resolution. They sometimes arrest development of abscesses and pimples. In more advanced stages, when white corpuscles have escaped through the vessels or pus has

begun to form, they favour removal of inflammatory products and often limit extension of inflammation. They are 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. 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.

Cold poultices are made of the same materials and in the same way as hot poultices, and are then allowed to cool. Their temperature is sometimes further reduced by pouring over them vinegar and water, sour milk, solutions of equal parts of nitre and sal ammoniac, or of sal ammoniac and common salt, or mixtures of ice and salt. Cold poultices are especially adapted for sub-acute inflammation, particularly of joints, ligaments, tendons, and feet, and other parts of comparatively low organisation. They are even more useful in joint and feet diseases of cattle than of horses ; and sometimes benefit cases which have previously been ineffectually treated by hot applications.

In veterinary practice some ingenuity and mechanical dexterity are required to get poultices properly and securely applied. To prevent unpleasant sticking, the skin is sometimes covered with a piece of muslin, or moistened with vaseline oil or solution of glycerine. Before application of the poultice the irritable inflamed surface is sometimes dressed with equal parts of belladonna extract, glycerine, or other anodyne. To keep the poultice as long as possible at a uniform temperature, it should be of considerable bulk, and usually several inches thick ; hot or cold solutions are poured over the mass every hour or two, or, better still, fresh poultices are supplied as the old becomes dry, altered 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. 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 carbolic acid or charcoal ; too long persisted

with, they are apt to sodden the skin, 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 gutta percha cloth, or by spongiopiline—a felted wool and sponge, coated on one surface with gutta percha, and when soaked with hot water proving a cleanly, handy substitute for a small poultice.

CLYSTERS—ENEMATA—INJECTIONS.

Clysters are used for all the domestic animals, and to effect many useful purposes. They empty the bowels; destroy and remove worms; exert, acording to their composition, soothing, sedative, or stimulant effects on the rectum; by reflex action these effects are propagated to adjacent and even to remote organs; while in addition they prove convenient vehicles for introducing into the body food and medicines which, in sore throat, tetanus, apoplexy, or other cases, cannot readily be swallowed. A cylinder of soap introduced into the anus, and held for a minute or two, encourages the action of the bowels, especially in dogs and cats, and in young foals and calves. Whether in health or disease, no remedies are more safe and effectual for maintaining the regular action of the bowels, 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 by the hand, finger, or small spatula, laxative clysters may be advantageously thrown up in large amount, intermitting the operation whenever straining occurs, raising the hind parts, and by external pressure from behind increasing the retaining capacity of the anus. A gallon and a half to two gallons may thus be introduced into the rectum of a draught horse, 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. Thus to evoke the full action of the bowels,

there should be slowly introduced a large volume of tepid water and soap, the laxative effects of which are increased by the addition of oil, salines, oil of turpentine, or solution of aloes. It is doubtful whether, even with an extra long tube, fluids can be made to pass forward through the ilio-cæcal valve. These copious tepid injections, with full doses of opium, and occasional tobacco smoke clysters, notably relax intestinal spasm, and prove the chief treatment for cases of invagination and intussusception, whether in horses or dogs. The introduction into the rectum of one part of sodium bicarbonate, dissolved in eight of water, immediately followed by tartaric acid solution of like strength, produces sudden evolution of carbonic anhydride, which has occasionally brought the misplaced intestine into its natural position.

Tolerably copious clysters of tepid water or other bland fluid exert local soothing effects, not only on the intestines, but by reflex action 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 astringent and stimulant enemata. For destroying and dislodging the oxyuris curvula, popularly known as ascarides, clysters of turpentine and lime water, and of solution of aloes, quassia, or iron chloride, are very effective. 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, clysters should be limited in amount; one to two pints suffice for horses, three to four ounces for dogs 20 lbs. weight. To allay irritability 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. Nutrient clysters, useful in tetanus, in sore throat, and low fever, 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°,

and repeated not oftener than four or five times in the twenty-four hours. In cases of low fever in horses and distemper in dogs, a little wine or whisky is sometimes added to the clyster. Suppositories of raw or cooked meat are readily absorbed from the rectum, especially if they are previously moistened with diluted hydrochloric acid and pepsin.

Of the several kinds of apparatus for giving clysters, those in common use are—the old-fashioned bladder tied on a piece of lead pipe; Reid's patent clyster syringe, improved by Mr. Arnold, which has also the advantage of being available as a stomach pump; Mr. Gamgee's block-tin tube and funnel, which fill the intestines 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. Injections are occasionally made into the nostrils, urethra, bladder, and uterus, as well as into wounds; whilst medicated spray thrown from a scent-disperser, from a caoutchouc ball and tube, or, better still, from a steam spray-producer, is often serviceable in irrigating irritable, relaxed, or diphtheritic throats, especially in horses.

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 British Pharmacopœia 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 now 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 for a time may still hold to 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 Brit. Phar.

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 grs.
1 Pound, lb.j..... = 12 ounces = 5760 grs.

The measures of the Brit. Phar. 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 (℥ j.) weighs nine-tenths of a grain; a fluid ounce at 60° weighs exactly an ounce avoirdupois; hence a pint is equal to a pound and a quarter, and a gallon to ten pounds avoirdupois. Every practitioner must, of course, be provided with 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 he dispenses his medicines graduated to ounces; and such bottles may now be purchased at prices very little above those given for the ordinary sorts. To prevent mistakes, medicines alike 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; tea-cups, five to seven fluid ounces; breakfast-cups about eight fluid ounces; wine-glasses, two to two and a half fluid ounces; table-spoons, half a fluid ounce; dessert-spoons, two fluid drachms; and tea-spoons, 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 viscidity 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 tables of the Brit. Phar., 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 centimetre 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 decimetre, equal to one kilogramme, or 1·76 pint.

MEASURES OF LENGTH.

1 Millimetre	=	0·001	metre	=	0·03937 English in.
1 Centimetre	=	0·01	„	=	0·3937 „
1 Decimetre	=	0·1	„	=	3·937 „
1 Metre	=	1·0	„	=	39·37 „
1 Decametre	=	10·0	„	=	32·80 English ft.
1 Hectometre	=	100·0	„	=	328·08 „

A metre 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 Brit. Phar., and in most works on human Materia Medica, is again adopted in this book. As the Centigrade scale is now so extensively used, it is, however, desirable to note the following rule for converting Centigrade

degrees into Fahrenheit degrees,—100° Centigrade being equal to 180° Fahr., 10° Centigrade = 18 Fahr., or 5° Centigrade = 9° Fahr.; hence any number of Centigrade degrees, if multiplied by 9, divided by 5, and 32 added, are converted into Fahrenheit degrees. By the reverse process, Fahrenheit degrees are of course converted into Centigrade.

VETERINARY MEDICINES.

ACETIC ACID.

The British Pharmacopœia recognises the following varieties of acetic acid, namely:

Glacial acetic acid, containing	.	84 per cent. of anhydrous acid.
Acetic acid of chemistry and the shops	28	„ „
Diluted acetic acid . . .	3·63	„ „
British, French, and distilled vinegars	4·5	„ „

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 ($HC_2 H_3 O_2$) or ($CH_3 CO_2 H$). The glacial acid is mobile, oily, and colourless, with a pungent acetous odour and taste, a corrosive action upon organised tissues, and a specific gravity of 1·065. It boils at 243° Fahr., distils unchanged, is combustible, miscible in all proportions with water and alcohol, crystallises at 34° into radiating pearly plates, hence its title of glacial acetic acid. Sixty grains mixed with a fluid ounce of water require for neutralisation 990 grain measures of the volumetric solution of soda. Acetic acid, even when considerably diluted, reddens litmus, dissolves volatile oils, resins, camphor, and vegetable 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 iron perchloride—a colour which changes on boiling to a brown precipitate of basic acetate of iron.

ACETIC ACID (*acidum aceticum*) contains 28 parts of acetic anhydride, is one-third the strength of the glacial acid, is colourless, strongly acid, with a pungent odour, and a specific gravity of 1·044. It is usually prepared from the destructive distillation of such hard woods as oak, ash, or beech, exposed to a red heat in iron retorts. Combustible gases are given off, charcoal remains in the retorts, and there distils over a dark brown tarry acid liquid, which, when it stands, deposits tar. The lighter liquor, which contains 2 to 4 per cent. of acetic acid, is decanted and distilled; wood spirit and acetone are first given off, and subsequently the impure acid, which is neutralised usually with sodium carbonate. The resulting acetate is dried and roasted to remove tar and creasote, and re-dissolved and distilled with sulphuric acid. An imperfectly purified acid still containing some residual tarry matters is sold as pyroligneous acid. The diluted pyroligneous acid of the Brit. Phar. is made by mixing one volume of this commercial acid with seven of water, has the specific gravity 1·006, and corresponds in strength with vinegar.

VINEGAR (*acetum*) is diluted acetic acid, containing traces of colouring matter, mucilage, alcohol, ethers, sulphuric acid, and calcium sulphate. It is got by the destructive distillation of wood, as described above; and more commonly by the oxidation of alcohol, by exposing it to the air, at a temperature of about 80°, and in contact with a ferment. In this way most vinegars are manufactured in this country, from malt, grain, cider, or solutions of sugar or spirit; in France, by exposing some of the poorer wines in half-filled casks; and in Germany, by what is termed the quick or improved method of vinegar-making, from diluted alcohol, which is mixed with about one 1000th part of yeast, honey, vinegar, or other fermentescible body, and allowed slowly to trickle at a temperature of from 75° to 80°, over a large surface of wood-shavings previously soaked in vinegar. After a few days there is 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, as shown by the formula—

C_2H_6O (alcohol) + O_2 (oxygen) = $C_2H_4O_2$ (acetic acid) + H_2O (water).

British vinegar is colourless, or nearly so, has an acid taste and reaction, and a refreshing acetous odour, depending upon traces of acetic ether. French champagne or white wine vinegars are distinguished by their ethereal acetous odour and high density; those made from the red wines yield, when treated with ammonia, a purple colour and a purple flaky sediment.

Impurities.—The most common adulterations of vinegar are water and sulphuric acid. Water is discoverable by its diminishing density and power of neutralising crystallised sodium carbonate. The British vinegars should have the density 1·017 to 1·019; the French, 1·014 to 1·022. According to the British Pharmacopœia one fluid ounce of vinegar requires to neutralise it at least 402 grain measures of the volumetric solution of soda, and corresponds to 4·6 per cent. of anhydrous acid. The following ready method of estimating the strength of any sample of vinegar or acetic acid was communicated to me by Dr. Murray Thomson:—Take a measured quantity (say 100 ♏ of vinegar) and a weighed amount (say 100 grains of prepared chalk), or any other convenient form of calcium carbonate. Add the chalk to the vinegar cautiously, until no more is dissolved. The equivalent of dry acetic acid and chalk being nearly alike, the number of grains of chalk taken up (which is, of course, easily discovered by weighing the quantity left) will therefore indicate almost exactly the number of grains of real acetic acid present in the sample. The addition of 1000th part of sulphuric acid is allowed by the excise, in the belief that it prevents spoiling. But the legal proportion is often exceeded. All the sulphuric acid in one fluid ounce of vinegar should be precipitated by ten minims of Phar. solution of barium chloride. Any traces of copper or lead are detected by their precipitating hydrogen sulphide.

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

Like the mineral acids, strong acetic acid has great affinity for the water and bases of the tissues; has active powers of diffusion; poisonous doses cause uneasiness abdominal pain,

in carnivora vomiting, weakness of the hind extremities, and prostration. An ounce of acetic acid destroyed a medium-sized dog in an hour; a quarter of an ounce in five to nine hours; four or five ounces of vinegar in ten or fifteen hours (Christison on *Poisons*). Horses take six to twelve ounces of vinegar, and cattle three or four pounds, without apparent injury (Hertwig). Once in high repute as an antidote for almost every sort of poisoning, vinegar is now employed only in the case of the alkalies and alkaline carbonates. For human patients diluted solutions prove refrigerant, and stimulate digestion; but large amounts, or prolonged use, retard both digestion and assimilation, and diminish the number of the red globules, and it has hence been sometimes foolishly used to reduce corpulence; this, however, can only be done at the sacrifice of health.

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 styptic or caustic it is rarely used. Dissolving albumin, fibrin, and gelatine, it removes warts as well as corns in the human subject, softens scurf, destroys cryptogamic parasites and acari, and hence is occasionally applied in cases of mallenders and sallenders, ringworm, scab, and mange. In such cases, impure pyroligneous acid is preferable, on account of its creasote and similar empyreumatic bodies. Equal parts of glacial acetic acid and chloroform, mixed in a thin flask, produce vapour which induces local anæsthesia in five minutes. Vinegar, along with either hot or cold water, is a convenient stimulant for superficial inflammation, strains, and bruises, and a refreshing acid antiseptic for sponging the skin in febrile disorders. For fumigating stables or cowhouses, it does more harm than good, inasmuch as it disguises those noxious effluvia which it neither removes nor destroys, and may thus prevent due attention to thorough ventilation, and the use of effectual disinfectants. It dissolves the active principles of many medicines, and enters into the composition of vinegars of cantharides and colchicum, spirit of Mindererus and oxymel. 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.

Doses, etc.—Diluted with water or any simple fluid, acetic acid is given in the same doses as the mineral acids, namely, f℥ss. to ℥j. for horses or cattle; ♏ v. to ♏ xv. for sheep and pigs; and ♏ ij. to ♏ v. for dogs.

ACONITE.

Monkshood. Wolfsbane. Blue Rocket. Aconitum. Tubers, leaves, and flowering tops of Aconitum Napellus, A. ferox, and other varieties.

Nat. Ord.—Ranunculaceæ. *Sex. Syst.*—Polyandria Trigynia.

Botanists have numbered twenty-two species and upwards of a hundred varieties of aconite, which are common throughout the cooler mountainous districts of both hemispheres. Some species are inert, or nearly so; but others, as the Aconitum ferox, Sinense, and Napellus, are very active. The last of these, the common officinal species, is a doubtful native of Britain, but often grown in gardens and shrubberies on account of its flowers. The cultivated are said, however, to be less active than the wild plants. Its several varieties are herbaceous, with tapering, carrot-shaped, brown roots, from which, after the first year's growth, are formed one or more oval tubers, which are at first nourished by the decaying parent root; several annual erect stems two to five feet high; dark green leaves with five wedge-shaped deeply divided lobes; long-stalked, helmet-shaped blue or purple flowers, which form dense spikes, and appear in June or July; and dry, black, shrivelled seeds, which ripen about the end of August. The dried roots, imported from Germany or cultivated in Britain, are two to four inches long, and from half an inch to an inch thick at the crown, which is knotty; are brown externally but white within, conical, rapidly tapering, prominently marked with the bases of the rootlets, of an earthy odour,—characters which should distinguish them from the larger, longer, more uniformly cylindrical, white, pungent, bitter root of horse-radish, for which it has sometimes been fatally mistaken. According to Pro-

fessor Schroff, of Vienna, the root is six times as active as the other parts, and is consequently most valued, 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 seeds are said to be specially potent (Royle). The leaves are less active than the root, but more so than the flowers, fruit, or stem, and, with the flowering tops of plants cultivated in Britain, are directed by the Pharmacopœia to be gathered in July, when about one-third of the flowers are expanded, and when the leaves have matured their special properties. They should be rapidly dried, and at once used for making the preparation desired. Any part of an active or poisonous aconite, when slowly chewed, produces a peculiar acridity, numbness, and tingling of the lips and tongue, unaccompanied by irritation or inflammation. This, besides being a test of aconite, is most observable in those varieties and parts of the plant, and in those preparations which are most potent, and hence roughly gauges the activity of any specimen or preparation.

The root and leaves, when powdered, have a dirty grey colour, and a strong earthy odour; yield their active principles readily to alcohol; and owe their poisonous and medicinal actions to an alkaloid termed aconitine or aconitia. This crystalline base (C_{33} H_{43} N O_{12}) is the chief active constituent of *A. Napellus*, but one batch of roots, probably belonging partly to an unknown species of Aconitum, gave a non-crystallisable alkaloid, picraconitine (C_{31} H_{45} N O_{10}), possessing a bitter taste, but very feeble physiological activity (Groves and Wright). Both these alkaloids form crystalline salts, and yield benzoic acid on saponification. The roots of *Aconitum ferox* contain a third alkaloid, pseudaconitine (C_{36} H_{49} N O_{12}), which is crystalline, and highly active. Other non-crystallisable alkaloids usually mixed with these are probably not present in the plants, but are produced by decomposition of the original bases during the process of extraction. Aconitine is generally obtained from the root of any active variety grown in this country or imported from India, by maceration with rectified spirit, saturating with milk of lime, removing the lime by sulphuric acid, recovering the spirit by distilla-

tion, dissolving the residue in water, separating the alkaloid from its sulphate by precipitating with carbonate of potash, and purifying. About 12 to 60 grains are extracted from 1 lb. of well-preserved dried roots. The *ferox*, grown in the sub-alpine Himalayas, produces the largest percentage. The activity of aconitine, or what is sold as such, varies materially. The crystalline is purer than the amorphous. Morson's preparation is more potent than the aconitine sold on the Continent. These diversities probably depend upon some of the aconitines consisting of only one of the alkaloids, while others contain several. The subject requires fuller investigation. As prepared by the Phar., aconitine is a transparent, colourless, or pale yellow powder; bitter; crystallisable with some difficulty in right rhombic prisms; soluble in 150 parts of cold water, 50 of hot water, and more readily soluble in alcohol and ether. It is distinguished by producing, even when in very diluted solution, peculiar tingling and numbness.

Actions and Uses.—Aconite depresses, and in large doses paralyses the sensory and motor tracts of the medulla and spinal cord, causes spasm of the muscles of inspiration, and death from asphyxia. It is a sedative notably of the respiratory, cardiac, and vaso-motor systems. It is prescribed as a sedative, antipyretic, and anodyne. When chewed, or rubbed on mucous or cutaneous surfaces, it causes a peculiar tingling and numbness, accompanied by no irritation, vascular excitement, or visible alteration of structure, and depending on paralysis of the sensory nerves.

General Actions.—Dr. Sidney Ringer describes aconite as "a protoplasmic poison, which destroys the functions of all nitrogenous tissues; first of the central nervous system, next of the nerves, and last of the muscles; but it has an especial affinity for the sensory apparatus, paralysing first the sensory perceptive centre." It affects, he believes, all the structures of the heart,—first its ganglia, next its nerves, and last its muscular substance. Its action on respiration is stated to depend upon its influence on the respiratory centres (*Hand-Book of Therapeutics*, Ninth Edition). Recent observations indicate that moderate doses attack first the end organs, next the nerve trunks, and eventually the centres; sensory centres and nerves

are earlier implicated than motor; local numbness, the characteristic insalivation, and diaphoresis, precede the champing of the jaws, the peculiar suffocative bronchial spasms, the loss of voluntary power, and the notable dragging of the hind extremities. Neither brain nor special senses, excepting perhaps taste, are affected. Death chiefly results from asphyxia, depending upon paralysis of the muscles of inspiration, particularly of the diaphragm, and spasmodic closure of the glottis. The right side of the heart becomes greatly engorged, whilst the left is nearly empty. When large doses are given the obstructed respiration is probably so extreme that the heart suddenly stops, and asphyxia and syncope concur. The poison is retained in the body in an active form, often for upwards of twelve hours. Its free use at short intervals hence demands caution; it is excreted chiefly by the kidneys, producing increased discharge both of water and solids.

Aconite has a very uniform effect on all animals, from earthworms to man himself. Horses receiving an over-dose, such as one to two drachms of the Brit. Phar. tincture, tremble violently, lose the power of supporting themselves, become slightly convulsed, froth at mouth, perspire freely, appear much nauseated, and make efforts as if about to vomit; the breathing in half an hour becomes slower and feebler, the pulse is reduced in strength, and usually in number; six or eight hours elapse before the breathing and pulse become normal. Impaired appetite and more or less nausea occasionally remain for one or even two days. Viborg mentions that a horse, after receiving eight ounces of the root and lower leaves of Aconitum Napellus, became very uneasy, breathed slowly and with difficulty, attempted to vomit, had a depressed, irregular, intermittent pulse, and looked round at his flanks, as if suffering pain; but he gradually recovered in about six hours. Next day he got three-quarters of a pound of aconite, which induced similar symptoms, and death in about twelve hours (Hertwig). Similar symptoms have been observed in the following experiments, made at the Edinburgh Veterinary College 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. (27th September

1852), 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.

On 24th September 1852, an aged chestnut cab horse, 16 hands high, and useless from a bad quittor, was tied up by the head for ten minutes, to insure perfect quietude. The pulse was then found to be 56, and the respirations 12. The animal had a good appetite and regular evacuations. At ten o'clock he got ninety 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 fifty 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, and increasing distress was shown in the quivering surface and pallid mucous membrane of the mouth, nose, and eyes. 2 P.M.—Pulse 38, and weak; the respirations not easily counted, but probably about nine; in other respects no change. The animal passed fæces 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's 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 seven 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. (25th) he was up and eating. His pulse was 65, his respirations 10, and his appearance very haggard and reduced. October 1st.—Since last date he has never regained his former look or appetite; for two days been unable to rise or stand; and has become 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.

Among carnivorous animals the poisonous effects of aconite are exhibited in the following experiments made at the Veterinary College. A cat of average size got seven 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 thirty 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. The lungs after death 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; but nothing abnormal is noticed about the digestive organs.

In ruminants aconite, introduced into the stomach, is rather less prompt and powerful than in horses and dogs; and the late Professor Fleming found its activity was diminished by digesting it with the gastric secretions either of rabbits or calves. But when injected into the veins or placed in the areolar tissues, it develops its poisonous effects as readily in ruminants as in other animals.

In poisoning by aconite, finely powdered animal charcoal, mixed with a little water, is given in the hope of its absorbing the poison. A prompt active emetic or the stomach-pump must be used to remove any poison that still remains unabsorbed. The only chemical antidote of value is tannic acid, which forms an insoluble compound with the aconitine; but to be of service it must be used very promptly. By move-

ments of the limbs and ribs, and by gentle magneto-electric currents down the back of the neck and round the ribs, Dr. John Harley endeavours to combat the respiratory paralysis. Brandy and ammonia should be cautiously given. The lung congestion may be somewhat relieved by moderate bleeding from the jugular.

Medicinal Uses.—For all the domestic animals aconite is a prompt and effectual sedative and antipyretic. Its power of controlling and cutting short inflammation and fever depend upon its slowing the action of the heart, and movement of blood through the vessels. Within ten or fifteen minutes after a medicinal dose is administered the pulse-beats are often lowered by one-fourth, and their force is likewise reduced. Tissue metamorphoses is hence retarded. From paralysis of vaso-motor centres the arterioles, according to Dr. Fothergill, are dilated, the capacity of the vascular system is consequently increased, the patient, as it were, "bleeds into his own vessels," and congestion of limited inflamed parts is thus further abated. Increased perspiration, moreover, helps to reduce elevated temperature. Whether used internally or externally, it lessens perception of pain, and sometimes removes the conditions on which it depends. These physiological actions explain the efficacy of a few properly regulated doses of aconite in the earlier stages of pleurisy, enteritis, peritonitis, mammitis, lymphangitis, laminitis, acute rheumatism, or indeed in any cases where persistent high temperature indicates the presence of acute inflammation. Acute sore throat in horses, accompanied by high fever, is often controlled by one full dose, followed at intervals of an hour by half-doses, until five or six are given, or, until insalivation, champing of the jaws, or profuse perspiration, indicate that physiological effects are established. Aconite, however, is useless—indeed usually injurious—in the common epizootic sore throat, accompanied by weakness. It is more serviceable in acute sore throat, laryngitis, and pleurisy than in bronchitis and pneumonia. Mr. Balfour of Kirkcaldy for twenty-five years has advantageously used aconite in the treatment of contagious pleuro-pneumonia in cattle. In enteritis in horses, Mr. Hill of Wolverhampton stated that within five minutes after aconite tincture is swal-

lowed 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.) Combined with a purgative, aconite often exerts sedative and anti-spasmodic effects in colic. In acute rheumatism it usually relieves constitutional fever and probably also allays local pain. Mr. Connochie, Selkirk, in the treatment of acute rheumatism, after a dose of physic conjoined with opium, recommends thrice daily, for either horses or cattle, 10 mins. of Fleming's tincture and a drachm of nitre. Repeated small doses are beneficial in the outset of puerperal peritonitis in cattle; and some flockmasters now use it with success during the lambing season, giving it with gruel to all ewes which have a hard time, begin to blow, or show symptoms of fever. Conjoined with perfect quiet and a dose of physic, aconite is successfully used in the earlier stages of tetanus by Mr. Thomas Dollar, London, by Mr. Hill, Wolverhampton, and Mr. Macgillivray, Banff.—(*Veterinarian*, 1871.) In small, frequently repeated doses, either alone or with hemlock, it usually controls and steadies excessive or irregular action of the hypertrophied heart, especially in plethoric patients.

Anæsthesing superficial sensory nerves, aconite is often useful as a local anodyne in neuralgic or rheumatic affections, painful wounds, or swellings of a chronic or non-inflammatory kind; and in such cases not only allays pain, like opium or belladonna, but also sometimes removes its cause. Like other local anæsthetics, it is more effective in combating irritative than inflammatory pain. Diluted with fifteen or twenty parts of water, and used cautiously, Fleming's tincture often relieves the itching, and hastens the cure of grease and other eczematous eruptions in horses or dogs. A serviceable lotion for such purposes consists of an ounce each of tinctures of aconite and arnica dissolved in a quart of water. A still more soothing and diffusible application is made by substituting chloroform for the arnica.

Doses, etc.—The plant is not used in the crude state. The *extract*, unless very carefully prepared from an alcoholic solution, is apt to be of defective or irregular strength. The *tincture*, the simplest and best preparation both for internal and

external use, is sometimes of uncertain and insufficient strength; and, to prevent disappointment, should be obtained only from reliable sources. Its preparation is thus ordered by the Brit. Phar.: Macerate 2½ ounces of aconite root in coarse powder for forty-eight hours in fifteen fluid ounces of rectified spirit in a close vessel, agitating occasionally; then transfer to a percolator, and, when the fluid ceases to pass, pour into the percolator five fluid ounces of spirit. As soon as percolation is completed, subject the contents of the percolator to pressure, filter the product, mix the liquids, and add sufficient rectified spirit to make one pint. It is beautifully transparent, the colour of sherry, with a slightly bitter taste, followed by the characteristic sensation of tingling and numbness. For horses the dose varies from ℥ xxx. to ℥ xl.; for cattle about f ℥ i.; for sheep and pigs, ℥ vi. to ℥ x.; for dogs, ℥ iv. to ℥ vi. *Fleming's Tincture*, still much used in veterinary practice, about four times as strong as the Pharmacopœia tincture, and, on account of its concentration, requiring to be used most carefully, is made as follows:—Take of root of Aconitum Napellus, carefully dried and finely powdered, sixteen ounces troy; rectified spirit, sixteen fluid ounces; macerate for four days; then pack into a percolator; add rectified spirit until twenty-four ounces of tincture are obtained. The dose for horses is from ℥ vi. to ℥ x.; for cattle, from ℥ x. to ℥ xv.; for sheep, ℥ ij. or ℥ iij.; and for dogs, from ℥ ½ to ℥ ij. Whichever tincture is used should be given in water or gruel; it may be repeated in half doses at intervals of one or two hours. The effects of full doses sometimes continue for twelve or fifteen hours; repeated doses at short intervals are therefore to be given with much caution. 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.*)

Aconitine 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; ½ 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; $\frac{1}{20}$th grain subcutaneously injected over the scapula of a horse caused in a few minutes champing of the teeth, salivation, fits of retching, reduced number and force of the heart's action (Mavor and Burness on *Action of Medicines*); $\frac{1}{25}$th of a grain would probably suffice to cause the death of an adult man. Used subcutaneously, especial caution must be had, as it acts even more rapidly and powerfully than when given by the mouth. The symptoms and post-mortem appearances are the same as in poisoning with the crude drug, the extract, or the tincture. In human practice, the alkaloid is used chiefly externally, in the forms of alcoholic solution and ointment.

ALCOHOL.

Ethyl Alcohol. Spirit of Wine. Rectified, Proof, and other Spirit, obtained by fermentation of Sugar.

Alcohol is represented in the Pharmacopœia in several distinct forms—as absolute alcohol, rectified spirit, proof spirit, and methylated alcohol; and is, moreover, extensively used in the forms of wines, beer, and spirits. The various alcoholic fluids are obtained, either directly or indirectly, from fermentation of saccharine solutions; in this country, from infusions of malt; in many parts of the Continent, from the juice of the grape; in Germany, from potatoes; throughout the United States, from Indian corn; in Jamaica and other rum-producing countries, from molasses. In these processes saccharine matter, ultimately converted into grape sugar, is dissolved and exposed at a temperature generally about 65° or 70° to the action of a ferment, usually the yeast fungus—the Torula cerevisiæ—which breaks it up, probably by a somewhat complicated reaction, into alcohol and carbonic acid, as set forth in the following formula :—

$$1 \text{ Equiv. of Grape Sugar } C_6 H_{12} O_6 = \begin{cases} 2\ C_2 H_5 HO \text{ (Alcohol).} \\ 2\ CO_2 \text{ (Carbonic Acid).} \end{cases}$$

Alcohol is believed to be the hydrate of a basylous radical ethyl ($C_2 H_5$), and is hence sometimes termed ethylic alcohol ($CH_3 CH_2 OH$). Ethyl forms various other compounds of

medicinal value—namely, ethyl oxide $(C_2 H_5)_2O$, or common ether; ethyl nitrite, $C_2 H_5 NO_2$, the etherous principle of sweet spirit of nitre; ethyl acetate, $C_2 H_5$, $C_2 H_3 O_2$, or acetic ether.

When a fermented saccharine solution is exposed to a high temperature, the alcohol distils over—mixed, however, with water and various impurities; if distillation be several times repeated, the fluid at 60° reaches the specific gravity ·825, which, according to British excise standard, constitutes alcohol or pure spirit. It still, however, contains seven to ten per cent. of water, which, though inseparable by distillation, may be removed by such water-absorbing bodies as potassium carbonate and quicklime. *Absolute* or real alcohol thus obtained is a mobile, colourless fluid, with a spirituous odour, an intensely fiery taste, and a specific gravity of ·7938. It is entirely volatile, boils at 173°, burns without producing smoke, becomes viscid at —166°, but has never been frozen; has great affinity for water, absorbing it readily from the atmosphere, and mixing with it in all proportions. Next after water it is the most universal solvent, and readily dissolves chloroform, ethers, essential and concrete volatile oils, resins, most tar products, and many other medicinal substances. When oxidised, it yields aldehyde and acetic acid; distilled with sulphuric acid, it produces ether; with nitric acid, nitrous ether; treated with chlorine, chloral is formed.

Rectified Spirit, spiritus rectificatus, or spirit of wine, are the terms applied to the alcohol obtained from distillation of fermented saccharine fluids, containing 16 per cent. by weight, or 11 per cent. by measure, of water, with the specific gravity ·838. To absolute alcohol it bears general resemblance, but has less pungency and volatility, and a higher boiling point. It is used for making all the spirits and many of the tinctures and extracts of the Pharmacopœia.

Proof Spirit, the spiritus tenuior of the Phar., 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 42 per cent. by volume, of water, has the specific gravity ·920, and is used for the preparation of many tinctures.

Methylated Spirit is a mixture of alcohol of specific gravity ·830, with 10 per cent. of the pungent disagreeable-flavoured, impure methylic alcohol, CH_4O, obtained from the distillation of wood. (See *Methylic Alcohol.*) This mixture, sold under the name of methylated spirit, proves an immense boon to pharmaceutical chemists and many other manufacturers; for the addition of the pungent methylic spirit, although it prevents the mixture being used for drinking, does not interfere with its value in pharmacy or the arts.

The following alcoholic fluids, employed both dietetically and medicinally for man, are occasionally also prescribed for the lower animals:—*Wine*, the fermented juice of the grape, contains from 5 to 17 per cent. of excise alcohol (specific gravity ·825), and owes its peculiar bouquet to œnanthic ether; *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; whilst *Hollands*, *Geneva*, and *Gin*, a little weaker than these, are prepared from fermented malt, with a small quantity of juniper berries. *Ales* and *Porter*, convenient stimulants in almost everyday use, are made by infusing malt in water at about 180°; allowing it to stand for a few hours until the starch is in great part converted into dextrine and sugar; boiling the solution with the requisite hops; 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 (spec. grav. ·825).

Impurities.—Excess of water, the common sophistication of alcoholic fluids, increases the specific gravity, which is ascertained either with a hydrometer or with marked beads. Commercial spirits are apt to be contaminated by ill-flavoured, pungent volatile oils, and especially by fusel or grain oil, also called amylic alcohol or potato spirit. The presence of this fusel oil imparts an empyreumatic burning flavour; produces a yellow coloration when shaken in a test tube with a fragment of potassium iodide, and causes blackening on addition of

sulphuric acid, or by exposure to the action of silver nitrate and light. To remove grain oil, the rectifier, previous to each distillation, mixes the spirit with water, or digests it with animal charcoal; but neither of these processes is very effectual, while admixture before distillation of burnt alum, calcium chloride, potassium permanganate, or the addition of silver nitrate, although greatly better, are not available on the large scale.

Actions and Uses.—Alcohol is a narcotic poison of the inebriant class; it first stimulates, then deranges, and subsequently depresses and paralyses the functions of the brain and spinal cord; it kills usually by paralysis of respiration. Medicinal doses are diffusible stimulants, anti-spasmodics, cardiac tonics, and antiseptics. Properly regulated doses are readily assimilated and are convertible into nervous, muscular, or gland force. The unconsumed excess, during excretion, exerts diuretic, diaphoretic, and expectorant effects. Locally applied alcohol is irritant, refrigerant, and antiseptic. Its solvent and antiseptic properties lead to its extensive use in pharmacy.

General Actions.—Strong spirit, applied to the skin or to a mucous surface, abstracts water, coagulates albumin, and increases topical heat, redness, and irritability; but these primary stimulant effects soon give place to diminished vascularity and sensibility. Similar opposing effects occur when alcohol is taken in full doses internally; the general excitement first observed is followed by deranged and depressed action. Alcohol exerts similar effects by whatever channel it enters the body. Moderate doses, given by the mouth, induce superficial congestion of the parts with which they come in contact, and cause increased gastric secretion and improved digestion. But large doses and strong solutions irritate and inflame the mucous surfaces and interfere with absorption; they moreover precipitate pepsin, diminish its activity, and arrest its secretion. Alcohol has a high diffusive power, and is speedily absorbed through the veins of the stomach and duodenum. Occasional moderate doses, carried direct by the portal vein, increase activity of the liver cells; but continuous excessive doses, by over-stimulation, lead to faulty secretion of bile, and atrophic, and fatty degeneration—results which are,

however, less common in veterinary than in human patients. While in the circulation, it appears to diminish the capacity of the red globules to give off oxygen; it retards combustion both of albuminoids and starch, and hence lowers temperature. Its prominent distinctive action is, however, its affinity for and power over nervous matter, and especially that of the cerebro-spinal system. In cases of poisoning, relatively larger amounts of alcohol have been extracted from the cerebro-spinal axis than from other tissues. On these nerve centres, it exerts its primary stimulant and secondary sedative actions. By them its effects are propagated, exciting, deranging, or depressing according to dose or modifying conditions, the various bodily functions. Moderate doses in health give fulness and quickened movement to the circulation; but in debilitating disorders and convalescence from acute disease, the weak heart is strengthened and dilated arterioles are contracted. Poisonous doses, after a brief stage of excitement, cause imperfect automatic control, muscular relaxation, unconsciousness, gradual failure of the heart, and paralysis of respiration. The treatment of such poisoning consists in emptying the stomach by emetics or the stomach-pump, and warding off deadly stupor by keeping the patient moving, by cold affusion, ammonia, and hot coffee, and by the faradism of the muscles of respiration.

There has been much controversy as to the dietetic value of alcohol. It contains no nitrogen, and hence it is not available for building up albuminoid colloidial structures. But, like sugar, starch, or fat, it undergoes oxidation or combustion, supplies force and heat, maintains or increases the weight of the body, although, when used in excess, it sometimes causes accumulation of fat or fatty degeneration. Men and animals kept on somewhat deficient diet, on which weight would be lost, maintain their weight when receiving in addition daily small doses of alcohol. In health, alcohol can readily be dispensed with as an article of food alike for men and animals; it has the disadvantage of diminishing oxidation. But throughout many typhoid complaints, and during convalescence from reducing disease, alcohol judiciously administered conjoins the good effects of food and medicine. Entering the circulation by simple osmosis, its heat and force producing powers are quickly

and readily available, digestion is improved, tissue waste is diminished, and moderate doses are almost wholly consumed within the body.

On animal temperature, as in so many other of its effects, the action of alcohol is not uniform. Moderate doses in healthy subjects cause inappreciable change. But full doses given either to men or animals, concurrently with excitement, whilst the heart's action is increased, the capillary vessels are relaxed, and blood is driven to the surface, have been shown by Professor Binz of Bonn, Dr. B. W. Richardson, and other physiologists, to produce a rise of external temperature, sometimes amounting to one degree. But this temporary surface glow is accompanied with diminished tonicity of the surface capillaries, increased radiation results, and the cooling process is hastened. In the second stage of alcoholism, marked by excitement, with some muscular inability and deficient automatic control, temperature goes steadily down, the decline is quickened and increased if the animal is in a cold atmosphere, and an undue interval has elapsed since food has been taken. When the advanced stage of unconsciousness is reached, a dangerous reduction takes place, amounting in birds to fully five degrees, in dogs and other animals to three degrees, in rabbits to upwards of ten degrees, in man himself to two or three degrees. (Dr. B. W. Richardson's *Cantor Lecture* for 1874.)

Interesting differences occur in the effects produced by full doses on different animals. On man, with his highly developed cerebral hemispheres, alcohol acts promptly, disturbing and perverting the intellectual functions; but five times the dose is requisite to disturb the motor functions which are presided over by about one-eighth part of the human brain. Alcohol in amount corresponding to 0·4 to the 1000 of the total weight of the body, disturbs human intelligence; whilst 2·40 per 1000 of weight are needed to disturb his motor functions. In proportion to their weight, dogs take larger doses without being affected; 1·5 part to 1000 of body weight is required before notable effects occur, and then instead of perversion of the brain proper, which is as five to one of the dog's motor centres, there is perversion of motor functions. A like prominent motor disturbance—the prancing, striking with the feet, the

unsteady gait, loss of co-ordination, dragging of the hinder extremities—is observed in horses and other lower animals. In fatal cases the stupor is sometimes broken by convulsions.

The effects of alcohol vary greatly, according to dose and degree of concentration. While full doses produce primary excitement, with increased action of the heart and perverted motor function, followed by perverted and depressed reflex action, still larger doses exert very rapid narcotic and sedative effects, with little or no excitation or inebriation. Four or five ounces of whisky quickly swallowed by dogs of about 20 lbs. weight, if not got rid of by vomiting, produce rapid depression, coma, and death within several minutes, and without any appreciable excitement; and cases of this kind occurring in man are recorded in Christison's *Poisons*. Hertwig gave an old but sound horse eight ounces of alcohol, of specific gravity about ·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, and latterly dilated; he rapidly became insensible, and died in about ten minutes. The pulse was little altered, and the heart continued to beat for ten minutes after death. Paralysis of the muscles of respiration, or closure of the glottis, is stated by Dr. Pereira to be the immediate cause of death. (Pereira's *Elements of Materia Medica and Therapeutics*, abridged edition, 1872.) Between four and six ounces produced similar symptoms, but did not prove fatal. One to two ounces destroyed dogs in periods varying between a quarter and half an hour, with similar symptoms, and great inclination to vomit. One or two drachms induced in dogs reeling and stupor, which continued for about half an hour. Dr. Percy injected strong alcohol into the empty stomachs of dogs, which immediately fell over insensible; respiratory and cardiac movements ceased within two minutes; the blood was found highly charged with alcohol. Cattle, sheep, and indeed all ruminants, are less susceptible of its influence than dogs, or even horses; and Hertwig mentions that, when given in the form of brandy to sheep and goats, they soon become very fond of it, taking six to ten ounces at a time, and gradually becoming less easily affected by it.

Chronic poisoning by alcohol, with impaired nervous power and fatty degeneration, common enough in the human subject, is unknown in the lower animals ; but Professor John Gamgee 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 sometimes symptoms of intoxication are manifest. 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.

As a diffusible stimulant alcohol resembles ether and ammonia, but is not so evanescent. Compared with ether and chloroform it is less volatile, incapable of administration by the lungs, and hence has no general anæsthetic action ; its primary stimulant stage is more marked and prolonged ; while its secondary stage of unconsciousness is usually more slowly produced, is caused only by dangerously large doses, and is apt to prove fatal from paralysis of the heart and respiratory movements. Wines containing œnanthic ether differ from spirits

in having part of their alcohol combined with their saline and organic constituents. They are hence less rapidly absorbed; their stimulating effects, consequently, are more slowly produced, and are also more lasting. Whisky and gin containing traces of volatile oil slightly differ from brandy, rectified and proof spirits, in their more rapid removal from the body, and their causing more notable diuresis.

Medicinal Uses.—Few remedies are more frequently and extensively used. Its great function is to rouse and regulate weak or deranged nervous power. In atonic indigestion it stimulates gastric secretion, and improves appetite; in colic it controls spasm; in chills it equalises irregular circulation; in shock, poisoning by sedatives, and prostration from debilitating disease it sustains the flagging action of the heart. In many cases of epizootic catarrh and sore throat amongst hard-worked horses, when the pulse is quick and weak, the breathing accelerated and embarrassed, the temperature ranging from 102° to 105°, no treatment is more successful than a saline draught, a dressing of mustard to the throat, and a couple of ounces of spirits diluted with gruel or water, and repeated every two hours. In one or other of its several forms it proves useful in most typhoid and epizootic diseases, and in chronic complaints connected with or leading to mal-assimilation. With iron salts it improves appetite and assimilation in anæmia. It sustains the powers of life, notably the action of the heart, during the critical and exhausting stages of strangles, typhoid fever, purpura, and occasionally of tetanus. In young and weakly patients, which are readily pulled down by disease, the early use of alcohol is specially advantageous. In pneumonia in horses, towards the third or fourth day, when the earlier acute symptoms are passed, alcohol frequently answers well. Sometimes it is advantageously given earlier. A case of double pneumonia communicated to me by Mr. Israel Print of Clapham illustrates this restorative sustaining power. The horse was seen after twenty-four hours' illness, his pulse 100, scarcely perceptible, his respirations 52, his temperature 106°. He was ordered a wineglassful of whisky in a few ounces of water every two hours; he got a quart in twenty-four hours. His pulse had then fallen to 84, his respirations to 46, his

temperature to 104°. The readily assimilated spirit was persevered with for another twenty-four hours, with continued abatement of fever and distress, and the animal made a steady recovery. In farcy cases, where appetite is indifferent and temperature 105°, a pint of ale or a glass of spirits thrice a day, in conjunction with full doses of iron sulphate, improves appetite, and abates fever.

Cows suffering from puerperal apoplexy, after a full dose of physic, and if the heart is weak and irregular and the surface cold, are often benefited by five or six ounces of whisky, given at intervals of one and a half to two hours; congestion and paralysis of the nerve centres are usually thus relieved. Young cattle, as well as other animals wasting from anæmia, are often successfully treated by ale, conjoined with iron salts. Delicate dogs suffering from distemper, chorea, and other exhausting disorders have their appetite, pulse, and strength improved by small doses of wine, or spirits and water. In their removal from the body by the kidneys, skin, and lungs, spirituous fluids stimulate these secreting organs, and increase their watery discharges. To maintain their curative benefits, and prevent the secondary depression apt to ensue from occasional infrequent administration, repeated doses at intervals of two to three hours are generally required. Of the efficacy of the remedy no doubt need be entertained if the weak pulse becomes firmer, and the dry tongue and skin are rendered moist. Given too frequently or in undue amount, whether in health or disease, alcohol depresses and exhausts nerve force, hinders oxidation, retards excretion of morbid matters, and causes dryness of the skin and mucous surfaces.

In a state of concentration, when rubbed into delicate parts of the skin, alcohol acts as a rubefacient, but is seldom used for this purpose among the lower animals. Coagulating albumin and contracting capillary vessels, strong spirit is occasionally applied to arrest bleeding. As a refrigerant and antiseptic it is employed for surgical purposes. 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, however, ice is generally more convenient and effective. Spirit beat up with white of egg is used in veterinary as well as in human practice, to prevent excoriation of parts exposed to pressure. An admirable and well-keeping solvent for the active principles of many drugs, alcohol is largely used for making tinctures, extracts, and ethers.

Doses, etc.—Of rectified spirit horses take about f℥i.; cattle, f℥j. to f℥iij.; sheep, f℥ss.; pigs, f℥ij.; and dogs, about f℥j. To the larger veterinary patients alcohol is frequently prescribed in the form of spirits, ale, and stout; to the smaller, in the shape of wine. The doses are mainly determined by the condition of the patient, and the purpose they are given to serve; they should be administered in moderate quantity, tolerably diluted, at intervals of one or two hours, and are less apt to flush or disagree with the patient if administered along with food. Properly diluted, they are readily drunk of their own accord 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 usually conjoined with other medicines—with ether where more prompt and powerful stimulation is desired, with opium or chloral hydrate where spasms are to be combated, with digitalis where the full effects of a cardiac tonic and stimulant are sought, with ammonium acetate where diaphoresis is to be encouraged.

ALOES.

Aloe. Inspissated juice of the leaves of various species of Aloë.

Nat. Ord.—Liliaceæ. *Sex. Syst.*—Hexandria Monogynia.

The several species of *Aloë*, which yield the various commercial aloes, are succulent liliaceous plants, having short woody stems; strong, thick, fleshy, amplexicaul light-green leaves, with sharp serrated edges, and a stout spine projecting at the apex; and yellow or white spiked tubular flowers. Under-

neath the leathery cuticle and thick cortical epidermis of the aloe leaf, 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 are allowed to exude spontaneously from incisions made in the leaf. Inferior results are obtained when the leaves are exposed to pressure or heat, which mix the mucilaginous sap of the mass of the leaf with the cathartic juice, while many specimens are deteriorated in the process of concentration by carelessness in separating impurities and exposure to a high temperature.

Varieties.—The most important varieties of aloes met with in commerce and used in medicine are Barbadoes, East Indian, Socotrine, Cape, and Caballine.

Barbadoes Aloes (*Aloë Barbadensis*), the variety of aloes most extensively used in veterinary practice, is produced chiefly by the *Aloë vulgaris*, which has a short cylindrical woody stem; curved sword-shaped leaves, with hard reddish spines, a tough and leathery cuticle, with a light-brown parenchyma; a branched scape, a cylindrical ovate spike, and tubular yellow flowers, at first erect, afterwards spreading. Its preparation is not confined to the island of Barbadoes, but is also carried on in Jamaica and most of the West Indian Islands. A dwarf variety is cultivated; the plants are set out six inches from each other in rows, twelve to eighteen inches apart; the leaves, one to two feet long, are cut off in March or April, in the heat of the day; under good cultivation the plants last for several years. The leaves are chopped off close to the stem, and placed for about twelve to twenty hours in tubs with their cut ends down; from the longitudinal vessels the juice trickles out, is collected in casks, and at convenience is concentrated by boiling 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 varies according to quality, from £4 to £9, 10s. per cwt. Barbadoes aloes has a dark or 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 olive-green, and darker than that of the other commercial varieties. The dark colour, dulness, and opacity of Barbadoes aloes are generally stated to depend upon the presence of water, but may also be owing to the condition of the aloin. When dissolved in weak spirits it leaves an abundant flocculent residue.

East Indian, Bombay, or Zanzibar Aloes, is brought from Arabia, and the coasts of the Red Sea and Persian Gulf, to Bombay and other Indian ports, and thence exported to Europe. It is supposed to be obtained from the *Aloë Socotrina*, and perhaps from other undetermined species. The manner of extraction and purifying is unknown. It comes to the London market in kegs, tin-lined boxes holding 56 lbs., or in skins, of which several are packed into casks or firkins. The quality and the appearance of East Indian aloes are very variable. Superior qualities are brown-red, small fragments are red, sparkling, and tolerably transparent; the powder is red-brown; compared with either Barbadoes or Cape aloes, the fracture is more shining, and odour less disagreeable; the taste, like that of other varieties, is bitter and nauseous. Spirit of the strength of sherry does not fully dissolve it, but leaves a flocculent residue. Aloes native to India is mostly of inferior quality, and is rarely exported. *Hepatic Aloes* is the name usually given to a second-rate opaque, liver-coloured, East Indian aloes. A variety termed *Mocha Aloes*, occasionally met with in drug warehouses, is dark-coloured, fetid, and of inferior quality.

Socotrine Aloes (*Aloë Socotrina*) is of very fine quality, comes in quantities of a few tons annually from the islands of Socotra and Madagascar, is understood to be the produce of the *Aloë Socotrina*, and is imported in skins, kegs, casks, and chests. The juice is allowed to exude spontaneously, or with only gentle pressure, from the freshly-separated leaves, and is

then evaporated by exposure to the heat of the sun. Much of the aloes sold as Socotrine is stated to consist either of selected portions of East Indian aloes, or of a purified extract of that variety. According to Christison and Pereira, Socotrine aloes occurs in red-brown pieces, of variable size, and of a garnet-red translucency when thin. Its fracture is generally smooth, glassy, and conchoidal, but occasionally rough, and resembling that of a tear of myrrh. It has a fragrant agreeable odour, which is increased if the specimen be breathed upon or heated. It is brittle and easily reduced to a golden yellow powder, almost entirely soluble in spirit of the specific gravity ·950. It is quoted at £6 to £13 per cwt. From East Indian it is distinguished by its redder colour, greater lustre, transparency, and solubility. The finer varieties of Socotrine are sometimes called *aloes humida*, *lucida*, or *clear aloes*, which appear also to have been the names applied to varieties now extinct.

The late Professor Pereira described, in the *Pharmaceutical Journal* for April 1852, a soft semi-fluid Socotrine aloes, recently imported in casks containing 6 cwt. by way of Madras, considered to be the raw or unboiled juice of the plant. This Socotrine aloe juice has the consistence of thin honey, a deep orange colour, the strong fragrant odour of Socotrine aloes, and deposits on standing a small quantity of minute prismatic crystals, analogous with the aloin obtained by Messrs. Smith from Barbadoes aloes.

Cape Aloes (*Aloë Capensis*) is brought from the Cape of Good Hope, and is chiefly got from the *Aloë ferox*, *Africana*, or *spicata*, or from hybrids obtained by crossing these and other varieties. Within the last few years increasing quantities of carefully prepared grey-brown opaque aloes have been imported from Natal in wooden boxes. The extraction of the juice, as described by Mr. Lyell in Christison's *Dispensatory*, begins during September and October. The leaves, cut from the plant close to the stalk, are piled, with the cut ends inwards, on sheep-skins or ox-hides spread in holes dug in the ground. The juice slowly drains out, is evaporated in large caldrons, and exported either in chests or skins—the latter generally containing the better qualities. It is sold at the Cape at 2¼d. to 3½d. per lb. Cape aloes is often of very inferior quality,

being black, opaque, vesicular, and of little activity. Those who have seen its preparation are, however, of opinion that this inferiority is not owing to the species cultivated, to the climate or other natural causes, but to carelessness in the extraction and evaporation of the juice, and especially to the commencement of operations before the termination of the wet season. Although sold at less than half the price of average samples of Barbadoes aloes, the better qualities of Cape aloes are little, if at all, inferior to them or to East Indian. Mr. Joseph Gamgee, after comparative experiments, declares a preference for Cape, and adds that, side by side with Barbadoes, they cause equally copious but less watery discharges, while their action was not quite so long kept up.—(*Veterinarian*, April 1856.) 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.

Caballine or Horse Aloes is inferior to the varieties previously noticed, and often consists of the residue or sediment left from the purification of more valuable sorts. It varies considerably in colour, opacity, and general appearance; is black, vesicular, and bituminous, and lacks the compact structure of the better kinds; has a strong and disagreeably fœtid odour; usually contains such impurities as straw, bark, stones, and sand; and should be discarded from veterinary practice.

Properties.—Aloes is the inspissated concrete juice of the leaves of certain species of *Aloë*. The several varieties, although varying in special characters, are amorphous, waxy, somewhat resinous, with a specific gravity when dried of 1·364, are rather brittle, their external surface duller and darker than a freshly-made fracture, with an intensely bitter and persistent taste, and a strong and more or less disagreeable odour, always 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. Exposure to temperatures exceeding 150° alters its composition and impairs its purgative pro-

perty. It is almost entirely soluble in boiling water, which, however, deposits, as it cools, from 60 to 80 per cent. of a brown substance, the so-called resin of aloes. Most specimens are entirely soluble in proof spirit. The watery and alcoholic solutions of the several commercial varieties vary somewhat in colour, those of Cape aloes having the lightest colour, those of Barbadoes the darkest. The watery solution, when cold, reddens litmus, is deepened in colour by alkalies, blackened by iron sesquichloride, and yields a yellow-grey precipitate with lead acetate.

Composition.—The Messrs. T. and 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—aloïn, which is noticed more in detail at the end of this article; about the same proportion of an equally active, soluble, uncrystallisable aloïn 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, which is deposited from watery decoctions as they cool, and is soluble in rectified spirit to the extent of about 85 per cent. This resin occurs in unusual amount in inferior samples, being formed at the expense of the aloïn usually by exposure of the juice during inspissation to high temperatures, and has been found by Dr. William Craig of Edinburgh to possess little purgative activity. Recent investigations fail to discover the aloesic and gallic acids which figured in older analyses.

Impurities.—The adulteration of aloes is chiefly confined to the substitution of one variety for another, or to the mixture of an inferior with a more valuable sort. Such frauds may in general be detected by a knowledge of the characters of the several varieties, and especially by noting their colour, lustre, odour, and solubility. The admixture of stones, earth, straw, and the like must be detected by close inspection.

Actions and Uses.—Considerable doses are purgative; re-

peated small doses, insufficient sensibly to increase the action of the bowels, are tonic; applied externally, it is stimulant and desiccant.

General Actions.—Aloes in the solid form, when given by the mouth, is emulsionised and saponified chiefly by the bile and pancreatic fluids, and then in great part absorbed. The rapidity with which a properly compounded ball is dissolved in the horse's stomach is shown by an interesting experiment made by Mr. Joseph Gamgee, sen. Seven drachms of Cape aloes made into a ball with sixty minims of glycerine, and rolled in white tissue paper, were given to a horse, which, thirty-three minutes later, was killed by dividing the carotid artery. Examination being made 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 has not as yet been detected in the blood; but its disappearance from the part to which it is applied, its impregnating the milk and other secretions, and its frequently acting on the kidneys, are certain evidences of its entering the circulation, whence it is, however, speedily excreted. Insoluble in air, it is not removable by the skin or lungs; in full medicinal doses it is not easily separable by the kidneys, but is specially attracted to the posterior part of the smaller intestines and to the colon, provoking augmented peristaltic movements and increased secretion of the mucous glands and follicles, through which it is eliminated along with the abundant fluid discharges.

Compared with some other purgatives, aloes is rather tardy in its action, and apt to be uncertain when the bowels are irregular or loaded with hard dry food. It is generally, however, a safe and sure purgative for horses. Unlike many other cathartics, and excepting in inflammation of the alimentary mucous membrane, it is not in large amount an irritant poison. Unless given in very large doses, it does not render the dejections so fluid as saline purgatives, but appears to increase in greater degree the peristaltic movements. 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). The cathartic action of aloes, like that of most purgatives, is produced with nearly equal facility by whatever channel it finds access to the blood; by placing the aloes in sufficient quantity in the areolar tissue, applying it to any mucous membrane or other absorbing surface, or injecting it in solution into the veins. 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 of aloes differ somewhat in the degree of their action: Barbadoes is regarded as most energetic, East Indian less so, and Cape the weakest and most liable to cause diuresis. Socotrine is stated by Pereira to have the best tonic effect. In veterinary practice, preference has long been given to Barbadoes aloes—perhaps, however, without sufficient reason; for the better qualties of East Indian or Cape, when given in slightly larger doses, are quite as effectual, and have the advantage of being considerably cheaper. The Caballine, and other inferior kinds, being very uncertain and irregular in their composition, should not be used. 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 160°, applied, whether in the extraction of the juice, or in making it up for use, impairs activity by converting the active aloïn into inert resin. The purgative effect is materially accelerated and increased by giving it in solution, and also to a lesser degree by combining it with iron sulphate, vegetable tonics or bitters. The irritant effect on the rectum, sometimes an objection to its use, especially in the dog, may be mitigated by prescribing it in solution, and prevented by combining it with other purgatives.

In the horse, a cathartic dose of aloes generally causes in

a few hours dryness and increased warmth of the mouth, an advance of one or even two degrees in temperature, a somewhat quickened pulse, and occasionally nausea, colic, and copious secretion of urine. This diuretic effect sometimes occurs even with good Barbadoes aloes, especially when the bowels have been constipated, or otherwise out of order; whilst it is still more common with inferior specimens of Cape and other kinds, in which the aloïn 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, helps to ward off nausea and tenesmus. The time required for the operation of aloes differs much in different horses, and is modified by various circumstances, especially by the dietary. A dose of four to six drachms generally operates in sixteen to twenty-four hours. The degree and continuance of the action are liable to considerable variation. In some horses, purging is over in two or three hours; in others, it extends over twenty-four hours.

In ruminants, aloes is neither a prompt nor a powerful purgative. 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 tardiness and uncertainty in the purgative effect of aloes on ruminants mainly depends on the small effect which it has on the stomach and anterior parts of the alimentary canal; on its acting particularly on the great intestines, which in such animals are not so largely developed as in horses; and on its chiefly operating by increasing the peristaltic movements, which are difficult to excite in ruminants.

As a purgative for the dog, when given alone, it is neither so speedy nor so safe as calomel and jalap, or castor oil. It

has also the disadvantage of occasionally producing irritation of the rectum; but, as already stated, this may in great part be overcome by combining it with other purgatives. The dose required to purge a dog is unusually large as compared with that administered either to human patients or to horses. In the case of many medicines, the doses suitable for the dog and for man are very similar; but in this instance the dog requires eight or ten times the quantity given to man. Aloes is a good purge for swine, but usually takes about twelve or fifteen hours to operate.

Medicinal Uses.—There are few equine ailments in which aloes is not administered. It is given in constipation, indigestion, and colic, and for the expulsion from the intestines of concretions, foreign substances, and worms. In obstinate constipation it is best used in solution, and along with calomel, frequent clysters, hand-rubbing, and fomentations. In atonic torpid states of the bowels it is advantageously conjoined with gentian and strychnine. In indigestion it is prescribed in smaller doses, along with or followed by vegetable bitters and antacids. In the earlier stages of diarrhœa, small doses, controlled in their effect by combination with gentian, and occasionally with hyoscyamus and opium, prove useful in getting rid of irritants, whether lodged in the bowels or in the blood. As a vermifuge, it should be given after a considerable fast, in the fluid state, and with oil of turpentine; whilst, in addition to its exhibition by the mouth, a diluted solution injected into the rectum often destroys ascarides lodged in the lower bowels. For colic in the heavier descriptions of horses, Professor Dick was wont to recommend four or five drachms of aloes rubbed down with 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 in solution thirty to forty minims of Phar. tincture of aconite. When accompanied with abundant evolution of gas, colic is often successfully overcome by giving with the aloes two ounces of ammonia spirit, or an ounce each of medicinal solution of ammonia and ether. The unloading of the bowels overgorged with bulky food is usually more safely effected by linseed oil and calomel than by aloes, which cannot be given

in large or repeated doses without causing dangerous irritation. In jaundice and congested states of the liver and spleen, aloes is usually selected in preference to other purgatives. In the treatment of febrile attacks in horses, it sometimes supersedes the need of blood-letting and sedative medicines, frequently purging away deleterious matters alike from the bowels and blood. A dose of aloes often allays the irritation of wounds and lamenesses. It is a valuable auxiliary in the treatment of most acute inflammatory and many febrile diseases, and owes its efficacy to its clearing the intestines of undigested food and other crudities, which often occasion much uneasiness, and aggravate the original disease; to its removing from the blood noxious matters which have been developed by disease, or accumulated there during its existence; and to its establishing extensive counter-irritation. Aloes is usually effectual in removing œdematous enlargements and dropsies, when they do not depend on debility or disease of important internal organs. Repeated doses lessen the formation of superfluous blood and fat, are given both professionally and empirically to promote condition; an object which is 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 is generally superseded by calomel and jalap, or some of the oils, which 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, it must be used with great caution, and in very small doses; 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 is more suitable.

As a tonic, aloes is little used. Like other bitters, it is occasionally prescribed in weak and relaxed conditions of the alimentary canal, where there is impaired secretion of bile, or suspicion of intestinal worms. It is sometimes applied externally, as a gentle stimulant and desiccant, to suppurating wounds and soft flabby granulations, and is an ingredient of the once famous Friars' balsam. (See Benzoin.)

Doses, etc.—Horses receive ℥ij. to ℥x., 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 ʒi. to ʒij.; sheep, ʒss. to ʒi.; dogs, grains xxx. to ℥iss.; and swine, ℥ij. to ℥v.

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 should be administered two or three times a day, and in combination with aromatics and bitters. 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 for improving the tone of the digestive organs, and removing worms.

In veterinary practice, 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 vaseline. The physic mass of the Edinburgh 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 other 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 tempera-

ture 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. Triturated with strong sulphuric acid, aloes is oxidised, may be made into balls, and is understood to have increased activity. Aloetic balls made with lard, oils, or soap, are only suitable for immediate use, and if kept for any considerable time become dry and hard. This may, however, be temporarily prevented 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 vaseline, is a good purge for a large dog, and will make two doses for a smaller animal. Of fluid preparations, *the watery infusion* is commendable for convenience and cheapness. The aloes should be rubbed down in hot water, on no account exposed to a boiling temperature, and the solution used freshly prepared. *Tincture of aloes* may be made of such strength as is most convenient, is best prepared by the old process of digestion, and, though more expensive, keeps better than the watery infusion. *Extracts,* made with the view of removing a portion of the resin, have nothing to recommend them. As a laxative enema, useful also for the removal of ascarides from the lower bowels, one or two drachms of aloes are dissolved, with half a drachm of potassium carbonate, in a quart of soap and warm water.

ALOÏN.—During the summer of 1850, Messrs. T. and H. Smith, the well-known manufacturing chemists, Duke Street, Edinburgh, discovered, first in Barbadoes aloes, and subsequently in the other varieties, the peculiar crystalline principle Aloïn (C_{17} H_{18} O_7). More recently, Dr. Flückiger obtained from Natal aloes 16 to 25 per cent. of an active sparingly soluble principle, crystallisable in thin rectangular scales, closely allied to Messrs. Smith's Barbaloïn, and to which he gives the name Nataloïn (C_{25} H_{28} O_{11}). Still more recently, an allied active neutral principle, more soluble than Nataloïn, and separable in tufted acicular prisms, has been

isolated by Histed, and received the title Socaloïn (C_{16} H_{18} O_7). Later researches of Tilden and Schmidt render it highly probable that Barbaloïn and Socaloïn are isomeric, both being C_{16} H_{18} O_7. A few particles of these three aloïns are distinguished by Histed as follows:—A drop of nitric acid produces with Barbaloïn a brilliant crimson which rapidly fades; with Nataloïn a brilliant crimson, which is permanent unless heat be applied; with Socaloïn 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 Barbaloïn or Socaloïn, but develops with Nataloïn a fine blue.

Messrs. Smith prepare aloïn as follows (*Monthly Journal of Medical Science*, Feb. 1851):—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 aloïn, 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 aloïn crystallises in radiating masses of prisms of a pale yellow colour, breaking when in mass with a dull short fracture. Messrs. Smith inform me that the crystals are long, slender, four-sided monoclinic prisms, having the oblique rhombic prism for the primary form. Pure aloïn, or, as it should now be specially called, 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 aloïn. The solvent power both of water and alcohol is greatly increased by heat. Barbaloin is also dissolved by acetic acid and alkalies, 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°, the aloïn is oxidised, decomposed, and converted into a resinous substance of little activity. Nitric acid dropped upon the crystals colours them crimson, which, however, quickly gives place to brown-red. Watery solutions of bromine and aloïn, when mixed, produce an abundant yellow precipitate (C_{16} H_{15} Br_3 O_7).

Actions and Uses.—For upwards of twenty years aloïn has been used with growing favour in medical practice, and with some practitioners it has entirely superseded aloes. The dose for an adult is about one grain, or between a fourth and a third of the quantity of Barbadoes aloes usually prescribed. Messrs. T. and H. Smith having liberally supplied me with aloïn, 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 only one bran mash given four hours before the aloïn. 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 aloïn, conjoined with half an ounce each of gentian and ginger, I find serviceable in abating febrile symptoms, and removing heat and fulness of the limbs in hard-worked or grossly-fed horses. Two drachms of aloïn 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 ordinary physic; there was no nausea or griping; the purging usually continued about six or eight hours. In these horses, which were living in the country, it will be noted that two drachms aloïn operated several hours earlier, without impairment of appetite or spirits, and with the certainty and effect which usually follow six drachms of Barbadoes aloes.

Mr. Thomas A. Dollar, of New Bond Street, tried aloïn on

London horses, which are generally more susceptible to the action of physic than country patients. Five carriage horses, 15½ to 16 hands high, prepared by mashes during two days, received two drachm doses of aloïn, 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. Mr. Dollar further reports that three heavy cart horses received each two and a half drachms aloïn, 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. Mr. Dollar concludes that, comparing aloïn with the crude drug, a little less than half the quantity acts in horses with more certainty and equal effect.

On a strong shorthorn cow two drachms, dissolved in hot water, and given with an ounce of ginger, exerted only a mildly laxative effect; but three drachms operated tolerably freely in twenty hours. Two drachms, with half a pound Epsom salt, acted as rapidly and effectually as 1¼ lb. 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 dram of jalap are added, full effects occur in six or eight hours.

Old and knowing horses, familiar with the smell of aloes, and got to swallow it with difficulty, show much less antipathy to the inodorous aloïn. Definite and uniform in composition, more concentrated in form, and now offered by the discoverers, Messrs. T. and H. Smith, at a reduced rate, which renders it scarcely more expensive than the best qualities of the crude drug, aloïn is likely to come into general use as a cathartic for horses.

ALUMINIUM AND ITS MEDICINAL COMPOUNDS.

POTASH ALUM. ALUMEN. Aluminium and Potassium Sulphate. $K\ Al\ 2SO_4 + 12H_2\ O$.
SODA ALUM. $Na\ Al\ 2SO_4 + 12H_2\ O$.
AMMONIA ALUM. $NH_4\ Al\ 2SO_4 + 12H_2\ O$.
ALUMINA. $Al_2\ O_3$.

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 prepared in large amount 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, the sulphur is converted into sulphuric acid, which unites with the iron and aluminium. Water is added; if potash alum is to be made the solution is treated with potassium chloride, obtained as refuse from the soapboilers, saltpetre refineries, and glass houses; double decomposition results; iron chloride remains in solution, and 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° is kept up by steam, and ammonia vapour blown into the chambers, as well as by fire underneath. The solution is drawn off into coolers, agitated to prevent formation of large crystals, and the alum flour washed and re-dissolved 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 gas-works, is added to the roasted lixiviated shale.

Properties.—The alums occur in transparent, colourless, octohedral crystals, or in crystalline masses, have a sweet, acidulous, astringent taste, act like acids on colouring matter, and, when heated, fuse and part with their water of crystallisation. They are soluble in less than their own weight of water at 212°, and in eighteen times their weight at 60°. 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 caustic ammonia, insoluble in excess, but soluble in caustic soda. Moistened with cobalt solution, and heated in the blowpipe, alum salts develop a blue colour.

Impurities.—Alums are apt to be contaminated by iron, discoverable by the yellow colour it imparts, and by the blue precipitate it gives with solution of yellow potassium prussiate. But the presence of iron, though rendering alum unfit for dyeing, does not interfere with its medicinal properties.

Alumina ($Al_2 O_3$), obtained by burning ammonia alum, or treating an alum solution with excess of ammonia, has neither colour, smell, or taste, but exhibits great affinity for water, attracts from the atmosphere one-third of its own weight of moisture, has a singularly 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 and astringent, and is chiefly used externally as an astringent styptic and desiccant. One or two ounces given to dogs cause vomiting. But when the œsophagus was tied, so as to prevent vomiting, Orfila found that two ounces occasioned death in five hours, with great exhaustion and diminished sensibility ; inflammation was discovered throughout nearly the whole extent of the intestines. Devergie (quoted by Pereira) found that four drachms of burnt alum killed a dog when the gullet was tied, whereas in ordinary circumstances two ounces were

required to produce that effect. 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 found it cause phthisis pulmonalis 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 speedily decomposed in its passage through the intestines, and is excreted in the fæces, which are rendered firmer and odourless. Overdoses are decomposed and rendered inert by the small and repeated administration of sodium carbonate, followed by demulcents.

Alum closely resembles zinc oxide and acetate, but is scarcely so active. It coagulates the albumen of mucus and of the tissues themselves; liberally used, it invests them with a protective covering; in powder or strong solution it has an affinity for moisture. This primary chemical action is succeeded and extended by a vital astringent action. The soft animal tissues are constringed, the calibre of their blood-vessels lessened, and secretion checked. When swallowed, alum becomes absorbed, and these topical astringent effects are developed more or less generally; excessive secretions are dried up, and thirst produced. In diarrhœa and dysentery it is sometimes advantageously combined with opium and vegetable astringents, and alternated with glycerine of tannin. At one time it was given in polyuria in horses; but iodine and iron are much more effectual. It is still occasionally prescribed in passive hæmorrhages, and in lead poisoning. Externally, it is used as a mild stimulant and astringent in chronic conjunctivitis, and in many simple injuries of the skin and mucous membranes. In powder and strong solution applied several times daily, it abates irritation and hastens healing of the blisters and ulcers of mouth-and-foot complaint. An injection is useful in ozœna. With a spray-producer, a solution is applied several times daily in irritable and relaxed sore throat, especially of horses. In powder or strong solution it is used to arrest bleeding and the flow of synovia from open joints; for this latter purpose it is mixed with two or

three parts of wheat flour, and dusted over the opening until synovia ceases to flow. It should not, however, be used too freely, for although it coagulates albumen, the soothing protecting coagulum is re-dissolved by excess of the alum.

Doses, etc.—Horses and cattle, ℥ ij. to ℥ iv.; sheep and pigs, grs. xx. to ℥ij.; dogs, grs. x. to grs. xx.; given either as a bolus or in solution. Externally there are used powdered alum or alum flour, a simple watery solution, and an ointment made with one part of alum to three or four of lard or vaseline. The burnt or dried alum of the Phar. is little used. Alums are incompatible with alkalies 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 and mild astringents, much used for dusting over wrung shoulders, harness galls, and simple wounds.

Aluminium Chloride. Chloride of Aluminium. Chloralum.

$(Al\ Cl_3)$.

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 hydrated aluminium chloride—a colourless oily fluid, with a sweet astringent taste, lately brought into notice by Professor John Gamgee.

Actions and Uses.—Like many metallic chlorides, chloralum is corrosive, astringent, tonic, and antiseptic. It has been recommended in influenza, typhoid fever, and farcy in horses, in dysentery in cattle, and in weakness and nervous disorders in dogs resulting from distemper. Drachm doses suffice for horses or cattle, grains v. to grains x. for dogs. It may be used either in bolus with meal or dissolved in water or gruel. Externally it may be applied for the many 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 and cresylic acids, and zinc and iron chlorides. As a deodoriser it was more effectual than alum, but less effectual than tar oils, sodium sulphite, or bleaching powder. Not being volatile, it cannot, like carbolic or sulphurous acids, readily diffuse itself through the air, and attack and destroy floating particles of contagium. Poisonous to the lower forms of animal life, a diluted solution is a serviceable dressing for mange and scab, and for killing fleas and ticks.

AMMONIUM AND ITS MEDICINAL COMPOUNDS.

Ammonium Hydrate. Ammonia. Caustic Ammonia. Hartshorn. Spirit of Hartshorn. Aqua or Liquor Ammoniæ. Gaseous Ammonia (H_3 N) dissolved in water.

Traces of ammonia exist in the air, in dew, and rain, in some mineral springs, and in the juices of most plants, furnishing their nitrogen. It is freely evolved from the putrefaction and destructive distillation of organic matters, and from the bodies of living animals. When water and air are in contact with growing plants nascent hydrogen is believed to be produced, and unites directly with gaseous nitrogen, supplying the ammonia so essential for plant food. But the coal beds are the great commercial source of ammonia and its compounds. The waste liquor of the gas-works yields ammonia chloride or sal ammoniac, from which the other salts are got. When three parts coarsely powdered sal ammoniac are triturated with four of dry slaked lime, the mixture transferred to large retorts, and gradually increasing heat applied, ammonia gas is evolved and conducted into receivers containing water, in which it is so freely dissolved that one volume at 60° absorbs upwards of 700 volumes of gaseous ammonia.

Properties.—The strong solution of ammonia (liquor ammoniæ fortior) is a colourless, pungent, caustic fluid, consisting of 32·5 per cent. of gaseous ammonia (H_3 N) 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 (*Brit. Phar.*). Purity is insured when the sample, diluted with four times its volume of distilled water, does not give precipitates with solution of lime, ammonium sulphide, or copper ammonio-sulphate, and, when treated with an excess of nitric acid, is not rendered turbid by silver nitrate or by barium chloride (*Brit. Phar.*). Unless kept in closely stoppered bottles, it soon increases in density from escape of gaseous ammonia and absorption of carbonic acid. By a sort of catalytic action it prevents and arrests oxidation, and destroys the lower forms of organised life, thus acting as an antiseptic. It has strong alkaline reactions; forms crystallisable salts; unites with fats and oils, forming soaps and liniments. Heated in a small plain retort, it evolves anhydrous ammonia (H_3 N), a colourless, irritant, irrespirable gas, with the pungent odour and taste of the solution.

The volatile gaseous ammonia, exposed to a temperature of -40°, condenses into a clear liquid, which at -103° becomes a white crystalline solid. This ready volatility and liquefaction is taken advantage of in Carré's freezing apparatus, in which a concentrated solution of ammonia is heated in a strong boiler, passes along a pipe into a hollow receiver, where it liquefies by its own pressure. Whenever the boiler is removed from the fire and cooled in water, the liquid ammonia volatilises, rushes back to the boiler, abstracting so much heat that water placed in the cavity of the receiver is congealed. The volatile gaseous ammonia passing back to the boiler, the process is repeated indefinitely. This system of ice-making has been successfully used in the preservation of fresh meat brought from America. This ready volatilisation and condensation of ammonia is being utilised by Professor John Gamgee as a source of power which he expects shortly to employ both for railroad and ocean locomotion.

The strong ammonia, or aqua ammoniæ fortior, is too concentrated for most medicinal and pharmaceutical purposes, and a weaker solution is made by adding two measures of water to one of the stronger ammonia. This diluted solution has the density ·959, and contains 10 per cent. by weight of gaseous ammonia.

Actions and Uses.—Ammonia, in its gaseous state, is irri-

tant; if respired, it violently inflames the throat and bronchi; concentrated solutions are irritant caustic poisons. Whether inhaled or swallowed, ammonia stimulates both the cerebro-spinal and sympathetic systems. It specially affects the respiratory centre, and hence is serviceable in overcoming bronchial congestion. It is used as a diffusible stimulant and antispasmodic; excreted by the kidneys, skin, and bronchial membrane, it is diuretic, diaphoretic, and expectorant. In virtue of its alkalinity, it is antacid; it is antiseptic; it relieves irritation caused by stings of wasps and various insects. It is used externally as a rubefacient and vesicant.

Hertwig found that half an ounce of the strong solution 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 secured 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. Remarkably diffusible, and rapidly absorbed, full medicinal doses probably enter the blood in a free state or only very partially neutralised by the acid gastric juice. Many of its effects are determined by reflex action. As stomach and general antacids, ammonia and its carbonates are not so permanent and effectual as the corresponding preparations of potash and soda. Ammonia stimulates both the cerebro-spinal and the sympathetic ganglia; it increases the action both of the heart and arterioles; it excites the respiratory centre, and hence stimulates respiratory movements; controlling and arresting inordinate nervous force, it proves antispasmodic. Its action on the blood is unknown; as it preserves putrescible materials outside of the body, it has been credited with the like antiseptic powers in various diseases. Its effects, promptly produced, are very transient. It is rapidly removed by the skin, lungs, and kidneys, increasing their secretions. Ammonia compounds differ from alcohol and ether in acting more particularly on the ganglionic system and the spinal cord, and exerting no

direct effect on the brain proper. Applied externally, with brisk infriction, strong ammonia promptly produces redness, vesication, and even sloughing, but, wanting their strong affinity for water, has not such destructive action on the tissues as the fixed alkalies. Ammonia is unsuitable where there is gastric or intestinal irritation, and is also stated to be contra-indicated in low fevers, characterised by alkalinity and excessive fluidity of the blood.

Medicinal Uses.—Ammonia is beneficial in influenza, scarlatina, purpura, chronic bronchitis, and pneumonia—wherever, indeed, there is depression of vital power and tendency to syncope or asphyxia. It relieves congestion of the lungs brought on by over-exertion or exposure. In chronic bronchitis, particularly in horses, whether inhaled or swallowed, besides acting as a general stimulant, it lessens over-abundant secretion and relieves cough. In these and other pulmonary disorders beneficial effects are doubtless mainly due to its special stimulation of the respiratory centre. When inhalation is employed great care must be taken that the pungent gas is not used too freely or too concentrated. Prescribed as a draught it is generally conjoined with some form of alcohol. In indigestion, hoven, and tympanitis, the twofold action of ammonia as a stimulant and antacid renders it especially useful. Controlling irregular or inordinate nervous force, it counteracts the spasms of colic and epilepsy, and in the latter disease may be cautiously inhaled as well as given by the mouth. It is a valuable antidote in poisoning by prussic acid, opium, tobacco, and other sedatives. In these cases, in human practice, intravenous injection has been used, and as much as 45 grains of solution introduced with impunity. A few drops of ammonia are sometimes added to emetics to increase their activity and lessen their depressing effects. It is used both internally and externally in the treatment of snake bites, but its success is uncertain. Diluted solutions neutralise the irritating formic acid and special virus of wasps' stings and bites of gnats, spiders, and other insects. Mixed with oil or other bland fluid, it is applied as a counter-irritant in sore throat and bronchitis, rheumatism, and chronic joint diseases of cattle. As an external stimulant it acts very rapidly, has no tendency to irritate the

urinary organs, and is used either alone or in conjunction with cantharides, mustard, or turpentine. It is an effective antiseptic; meat bottled with a little ammonia gas may be preserved unchanged for a month, slightly darkened in colour, but exhibiting little pungency or unpleasant flavour.

Doses, etc.—Of the strong ammonia, as a diffusible stimulant and antispasmodic, horses take f℥ij. to f℥vi.; cattle, f℥ij. to f℥ x.; sheep and pigs, f℥ j.; and dogs, ℥ v. to ℥ xii. The medicinal solution, being half the strength, is given in double these doses. Prompt but transient in their action, ammonia preparations, if their effects are to be sustained, require to be repeated at intervals of one or two 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 medicinal ammonia, 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. Gaseous ammonia, or the strong solution, dissolved in rectified spirit, is recognised as *spirit of ammonia*, and proves a prompt and powerful stimulant and antispasmodic. For external application, ammonia is used alone; more frequently along with turpentine or oils. A convenient stimulating *liniment* is made with one part each of ammonia, oil of turpentine, and water, mixed with four parts of linseed oil. A drachm of strong ammonia solution mixed with half a pint of soap liniment is a useful stimulant 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 best prepared by heating about one part of either ammonium chloride or of sulphate with two parts of chalk. Mutual decomposition occurs, free ammonia and water escape, the insoluble calcium salt remains, and the resulting sesquicarbonate

consists of two equivalents of ammonium oxide and three equivalents of carbonic acid 2 (H_4 N) O, 3CO_2. It occurs in white, 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, constituting sal volatile; 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 ammonia hydrate, but it is less irritant. It is sufficiently active, however, to produce in small animals the same peculiar irritant poisoning. Orfila records that two and a half drachms given to a dog caused gastric inflammation, tetanic convulsions, and death. No remedy is more effectual in combating chill, loss of appetite, and malaise, so common in hard-worked horses. With an extra rug, a bran mash, and a comfortable box, one or two doses frequently cut short blowing, sore throat, and other premonitory symptoms of disease of the air passages. It stimulates the respiratory centre, and hence increases respiratory movements, promotes expectoration, and relieves bronchial congestion, especially in old and debilitated subjects. Often advantageously conjoined with alcohol, it is employed in influenza, scarlatina, and erysipelas, in the second stages of inflammatory complaints, and in convalescence from debilitating diseases. To maintain the flagging vital powers, Professor Williams recommends it in bolus in puerperal apoplexy in cows. In anthrax in cattle, Continental veterinarians use with some success intravenous injections consisting of ℥ij. ammonia carbonate, ℥iv. glycerine, and f℥xiiss. water. It relieves many atonic dyspepsia cases both in cattle and horses. It frequently averts epileptic fits in weakly dogs. It destroys the poison of wasps' stings and insects' bites.

Doses, etc.—Horses take ℥ij. to ℥iv.; cattle, ℥iij. to ℥vj.; sheep and pigs, grs. xv. to gr. lx.; dogs, gr. iij. to gr. viij. It is given either in bolus with linseed meal, or, better still, dissolved in gruel, which, to prevent volatilising of the ammonia,

must be used cold. Where prompt stimulant and restorative effects are required, ammonium carbonate is frequently conjoined with alcohol, ether, or sweet spirit of nitre; whilst in chronic ailments it is advantageously united with gentian, ginger, oak-bark, or other tonics. The aromatic and fœtid spirits of ammonia of the Pharmacopœia are not needed in veterinary practice. The best smelling salts are made by adding to the sesquicarbonate half its weight of strong ammonia solution, and mixing some bergamot, lavender, or other aromatic oil.

AMMONIUM CHLORIDE. Sal ammoniac. Chloride of Ammonium. Muriate or Hydrochlorate of Ammonia. (H_4 N Cl.)

This salt, from which most of the other ammonium compounds are procured, is chiefly prepared from the ammoniacal liquor of the gas-works, 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 dried, exposed for eight or nine days to a gentle heat in iron pots covered with leaden domes, in the interior of which the salt is sublimed in large hemispherical cakes. Thus prepared, the chloride is colourless and translucent, and of a tough and fibrous structure. It is devoid of odour, and has a saline acid taste, and 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 are irritant, and, like other ammoniacal salts, stimulate the sympathetic ganglia and spinal cord. Two ounces given to a horse caused muco-enteritis (Moiroud); two drachms destroyed a small dog in an hour (Orfila). The symptoms described as occurring in dogs are "muscular weakness, slow breathing, violent action of the heart, and tetanic spasms" (Christison on *Poisons*). Like other ammoniacal compounds it is stimulant, diaphoretic, and diuretic. It imparts firmness to the weak pulse, promotes the action of the skin and mucous surfaces, and is also believed to stimulate glandular secretions. It is stated, moreover, to exert a solvent

effect on albuminoids, and to diminish solid matters in the urine, and hence proves of service in the second stages of inflammation. Being less actively stimulant, it may be used in cases where the liquor ammoniæ and carbonate, are unsuitable. For such purposes it deserves to be more extensively used, and may be given in the same, or slightly larger, doses than the carbonate. Being very diffusible, it proves a useful constituent of stimulant gargles. Dissolved in water or spirit, it is a favourite application for inflammatory swellings, bruises, and sprains. A good cooling mixture, which lowers 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. For ordinary purposes six or eight times this amount of water may be used, and care must be taken that in applying such freezing mixtures, they do not dangerously reduce the vitality of the part.

LIQUOR AMMONIÆ ACETATIS. An aqueous solution of Ammonium Acetate ($H_4N, C_2H_3O_2$). Solution of Acetate of Ammonia. Mindererus Spirit.

A concentrated solution of the deliquescent acrid ammonium acetate is prepared by gradually mixing three and a half fluid ounces of strong solution of ammonia and ten ounces of acetic acid. For medicinal purposes this strong solution is diluted with five volumes of water, or it may be made directly by the formula of the Brit. Phar. :—Reduce 3¼ ounces of ammonium carbonate to powder, and add it, or a sufficiency, to 10 fluid ounces acetic acid, until a neutral solution is formed ; then add 2½ pints of water. The solution is clear and colourless, has a specific gravity of 1·022, is nearly odourless, but has a mawkish, unpleasant taste. It is distinguished by the ammoniacal odour developed by admixture of caustic potash, and the acetous odour produced when treated with sulphuric acid. Diluted or boiled, the medicinal solution should be neutral to test-paper, and give no precipitate with barium chloride, silver nitrate, or hydrogen sulphide.

Actions and Uses.—Mindererus spirit resembles the other ammonia salts. Although not such an active stimulant as the

medicinal solution of ammonia or the carbonate, it is more certain as a diaphoretic and diuretic, and proves a valuable febrifuge. For horses or cattle f℥ij. to f℥iv.; and for dogs f℥ij. to f℥iv. are prescribed in water, spirits, ale, or cold gruel. In febrile or inflammatory attacks, a couple of ounces are often given to horses, in combination of two or three ounces of Epsom salt and an ounce of potassium chlorate. An ounce each of Mindererus spirit, potassium chlorate, and gentian, repeated every three hours, abate fever, improve appetite, and clean the tongue in influenza and other equine typhoid cases. The addition to this febrifuge mixture of half a drachm of extract of belladonna renders it more soothing for cough and sore throat; the addition of an ounce of sweet spirit of nitre or ether makes it more stimulating. A useful febrifuge for dogs is made with liquor ammoniæ acetatis fortior, four ounces, spiritus etheris nitrosi two ounces, spiritus camphoræ one ounce. For large dogs the dose is half a fluid ounce; for small animals a fluid dram, given diluted with five or six parts of water. Like the chloride, the solution of the acetate is sometimes used externally as a refrigerant discutient.

AMYL NITRITE.

Amyl Nitris. Nitrite of Amyl ($C_5 H_{11} NO_2$).

Amylic alcohol, potato spirit, or fusel oil ($C_5 H_{12} O$), is cautiously heated with sulphuric acid, copper wire, and nitric acid. Amyl nitrite distils over, and, when purified by washing with soda and rectification, is a yellow ethereal volatile liquid, with a pine-apple flavour, specific gravity ·877, boiling point 205°; insoluble in water, but miscible in all proportions with alcohol.

Actions and Uses.—It paralyses the motor tract of the cord and the vaso-motor centres and nerves. It is used medicinally to relax vascular tension and spasm, especially in angina pectoris, asthma, and epilepsy. It closely resembles nitro-glycerine.

General Actions.—Doses of one or two minims in human patients within a few minutes induce flushing and warmth, perspiration overspreads the head and neck, and sometimes

extends over the body; there is general vascular relaxation and dilatation; arteries stand out with prominent fulness; arterial pressure is reduced; the pulse is round, soft, but quickened; the breathing accelerated and sometimes panting; but there is no interference with sensation or consciousness. Poisonous doses given to animals, with the effects described, speedily quicken both pulse and breathing, impair reflex irritability, and cause great weakness. They combine with the oxygen-carrying hæmatoglobulin, thus diminish tissue metamorphosis, and lower temperature. In dogs the diminution amounts to 3° or 4°, in rabbits it has reached 13°; both arterial and venous blood acquire a chocolate hue. Death results from arrest of respiratory movements, but without obscuration of brain functions. It produces similar effects whether it is inhaled, subcutaneously injected, or swallowed; but the first method of administration is most certain and effectual.

Medicinal Uses.—Dr. Lauder Brunton, having studied its physiological actions, predicted its curative uses, and applied it in angina pectoris, in which it almost instantaneously removes the agonising spasms. Dr. J. Crichton Browne, experimenting on rabbits made artificially epileptic, found that it not only prevented the impending fit, but cut it short when it had begun. It is successfully used in the treatment of epilepsy both in dogs and in young cattle. To horses it has been given in those cases of loud spasmodic breathing which occasionally occur as sequels of sore throat and bronchitis, but sometimes appear independently of any obvious exciting cause. It is effectual in many cases of asthma in dogs; is worthy of trial in tetanus, and in experiments with rabbits is found to antagonise strychnine poisoning. In rabbits it is observed to produce increased secretion of urine, which contains sugar.

NITRO-GLYCERINE is nearly allied to amyl nitrite. Two or three minims of a one per cent. spirituous solution cause in man vascular fulness and relaxation, flushing, headache, and occasionally free perspiration. In all animals it increases the pulse-beats usually one-fourth in number, and renders the artery full, bounding, and soft. Being less volatile than amyl nitrite its effects are more slowly produced, but are more

lasting; it does not affect the temperature. The curative uses of these two new remedies are similar to those of bromide of potassium, but the manner in which they lower vascular tension and control reflex irritability is very different. They paralyse motor and vaso-motor centres and nerves, while bromides depress sensory and reflex centres and nerves.

Doses, etc.—Horses and cattle take ℥ iij. to ℥ x. of amyl nitrite, dogs ℥ ss. to ℥ ij. A minimum dose should first be tried. Repeated use does not interfere with its efficacy. It is best administered dissolved in thirty to forty parts of spirit and ether, inhaled, or given on a piece of sugar, or in draught with a little water. To secure full activity 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.

ANISE.

Fructus Anisi. Aniseed. Dried fruit of Pimpinella Anisum.
Oleum Anisi. Oil of Anise.

Nat. Ord.—Umbelliferæ. *Sex. Syst.*—Pentandria Digynia.

The natural family Umbelliferæ yields many aromatic, carminative seeds, such as anise, caraway, coriander, and fennel.

Anise is grown in various islands of the Archipelago, and in Egypt; but the English market is chiefly supplied from Spain, Germany, and southern Russia. The anise is a little grey-brown fruit, about the size of a small oat seed, is covered by minute hairs, encircled with ten light-coloured ridges, studded with numerous minute oil-ducts, and possessed of an aromatic odour and a sweet pungent taste. Like other seeds of this natural family, it may be separated into two symmetrical halves. It may be distinguished from the fruit of the hemlock, for which it is sometimes mistaken, by its aromatic odour and its smooth encircling ridges. Anise contains gum, a little sugar and resin, with various salts, three per cent. of a fixed oil, and about two per cent. of a transparent, nearly colourless, volatile oil, which is the active ingredient of the seed, has a strong anise flavour, and consists

of a stearopten, anethol or anise camphor (C_{10} H_{12} O), or methylated allyl-phenol (C_6 H_4, C_3 H_5, O C H_3), which solidifies about 50° into radiating white crystals, and a small amount of a fluid hydrocarbon isomeric with oil of turpentine.

Actions and Uses.—Anise is 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. It was at one time given to females while nursing, in the belief that it increased the quantity and improved the quality of their milk; and some veterinarians have thought that it exerts a similar action in cows.

Doses, etc.—Horses receive about ʒi.; cattle, ʒi. to ʒij.; sheep and swine, ʒij. to ʒiij.; dogs, grains xx. to grains 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 oil of caraway, coriander, cumin, and other umbelliferæ is a cardiac stimulant, diminishes reflex irritability, paralyses the terminations of sensory nerves, and is also antiseptic. These actions explain their stomachic and carminative uses. For ordinary carminative purposes, oil of anise is too expensive, but is occasionally used as a flavouring ingredient, especially for ball masses, and, mixed with a little spirit and bland oil, is serviceable for destroying lice in pet dogs and other small animals.

Caraway, cardamoms, coriander, fennel, and fenugreek, resemble anise in their actions and uses, and may be given in similar doses. Their activity depends like anise on a pungent, antiseptic, stimulating, essential oil. Small quantities of these seeds are sometimes used in England amongst feeders of pigs, sheep, and cattle, and by wagoners and others, for improving the coat and condition of their charges. Fenugreek especially is highly prized for such purposes, enters into the composition of many "nourishing drinks," and, with ground peas, locust bean, and linseed cake, constitutes the bulk of several much-vaunted "nourishing foods."

ANTIMONY AND ITS MEDICINAL COMPOUNDS.

ANTIMONY OXIDES. Antimonii Oxidum. Oxides of Antimony.

The native oxide, found in small quantity in Saxony and Hungary, is known as white antimony or flowers of antimony. The medicinal sesqui- or ter-oxide ($Sb_2 O_3$), often used in painting instead of white lead, is got on the large scale by roasting the sulphide; but for experiment is more readily prepared by decomposing the chloride with water, and carefully washing the precipitate of basic chloride with water and a solution of an alkaline carbonate, and igniting. The oxide thus purified is a greyish-white, tasteless, heavy, crystalline powder, insoluble in water, but soluble in hydrochloric, tartaric, and acetic acids. It is permanent in air; fuses at a red heat; above 212° oxygen is absorbed, and higher oxides are formed. Antimony pentoxide, or antimonic acid ($Sb_2 O_5$) is, however, more conveniently obtained by dissolving the metal in strong nitric acid. The Brit. Phar. imitation of the patent James' Powder is made by mixing thoroughly one ounce of antimony sesquioxide and two ounces of calcium phosphate.

Actions and Uses.—Antimony sesquioxide 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 ($Sb_2 S_3$), the most valuable and abundant ore of antimony, is popularly known as grey or black antimony. When purified by fusion, it 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 crude antimony. The orange-red sulphurated antimony of the Pharmacopœia is got by boiling black antimony with 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 is represented by the formula, $5\ Sb_2 S_3, Sb_2 O_3 + H_2 O$. Of the many sulphides at various times used in medicine, the most important are glass of antimony, a red transparent body, consisting of eight

parts of sesquioxide and one of sesquisulphide; liver of antimony, a double sulphide of antimony and potassium; Kermes mineral, a red-brown powder containing a variable proportion of sesquioxide and sesquisulphide; crocus of antimony, a compound of one of sesquioxide and two of sesquisulphide.

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. The irregularity of their action probably depends in great part on their variable composition and their insolubility in water. They are considered to be alterative and anthelmintic, and when given to horses are usually prescribed in doses of one to three drachms, along with sulphur or nitre. They cause emesis in dogs.

ANTIMONY TERCHLORIDE SOLUTION. Chloride, Terchloride, or Muriate of Antimony. Liquor Antimonii Chloridi. Oil or Butter of Antimony. $Sb. Cl_3$.

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 oxychloride (Sb O Cl), which, if washed for a long time, yields the sesquioxide. The true butter of antimony—a hard, white, crystalline, fusible solid—is got by evaporating and then distilling the commercial solution.

Action and Uses.—Although less used than formerly, the chloride solution is still employed as a caustic for fistulæ, thrushes, canker, and luxuriant granulations; and is, besides, an especial favourite with many practitioners in foul in the feet of cattle, and foot-rot, the analogous complaint 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. $K\ Sb\ O,\ C_4\ H_4\ O_6 + H_2\ O$.

For the preparation of tartar emetic the native sulphide is converted into chloride by heating with hydrochloric acid; the chloride is decomposed by water, and the resulting oxide purified by washing with water and an alkaline carbonate. With this moist oxide is mixed an equal quantity of cream of tartar and water sufficient to form a paste. To insure complete combination, the mixture is set aside for twenty-four hours; it is then boiled with water for fifteen minutes, and filtered; the clear filtrate deposits, as it cools, crystals of tartar emetic. In explanation of the last stage of this process, it may be stated that cream of tartar, the acid potassium tartrate, is a tartrate of potassium and of hydrogen, which, in the above reaction, is displaced by the radical oxide (Sb O, Roscoe), leaving the tartrate of antimony and potassium, as expressed by the following formula:—$K\ Sb\ O,\ C_4\ H_4\ O_6 + H_2\ O$.

Properties.—Tartar emetic is sold as a white powder, and in colourless transparent crystals, short square prisms, of which the ends are triangular facets. Slowly evaporated, rhombic octahedra with striated lateral planes are produced. The crystals become opaque when exposed to the air, and crepitate when heated. Tartar emetic is devoid of odour, and has a sweetish, styptic, metallic taste. It is insoluble in strong alcohol; sparingly soluble in wine and proof spirit; in about fifteen parts of water at 60°, and two at 212°. 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. Purchased in crystals instead of powder, impurities are more readily discoverable.

Tests.—Tartar emetic is easily identified by its acidulated solution giving with hydrogen sulphide an orange-red precipitate of amorphous antimony sulphide, blackened by heat, and,

unlike the arsenicum sulphide, soluble in strong hydrochloric acid. From the solution of the chloride, water precipitates the oxychloride, yielding the oxide by washing. When tartar emetic or other antimony salt occurs in coloured organic solutions, they may be boiled with hydrochloric acid and copper clippings, as in Reinche's process for separating arsenic. Metallic antimony deposits 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 arsenic oxide, is amorphous, insoluble in water, and unaffected by silver ammonio-nitrate. Another ready method of separating antimony, corresponding to Marsh's arsenic process, is to add to the solution zinc and sulphuric acid, which cause evolution of antimoniuretted hydrogen ($Sb\ H_3$), 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 easily identified by its colour, by its insolubility in a solution of bleaching powder, in which the analogous arsenicum spot is freely soluble, and also by dissolving it in acidulated water, and treating the solution with hydrogen sulphide.

Actions and Uses.—Tartar emetic is a topical irritant. Applied to the skin it causes redness, pain, the eruption of papules, which shortly become vesicles, and then pustules. Poisonous doses produce gastro-intestinal inflammation. In dogs and other carnivora, medicinal doses are emetic, expectorant, cardiac sedative, and diaphoretic; for horses and cattle it is still occasionally prescribed as an alterative and sedative. It is excreted by the intestines and kidneys. It is occasionally employed externally as a counter-irritant.

General Actions.—It operates very differently on the different domestic animals. Dogs, cats, and pigs, are affected much in the same way as men. Vomiting is produced whether the emetic is placed in the areolar textures, injected into the veins, or given by the mouth. When swallowed it irritates the stomach and develops those reflex movements, which, in periods varying from five to thirty minutes, expel the contents of the stomach. (See Emetics, p. 50.) But a portion of a

medicinal dose is also absorbed, and is attracted, as when injected directly into the veins, to the vomiting centre of the medulla, which it irritates. Ordinary doses, doubtless, act in both these ways. Like other emetics, it also stimulates the respiratory centre, which lies in close proximity to the vomiting centre, and hence causes increased ciliary movements and bronchial secretion—the explanation of the efficacy of small doses given to human and canine patients in the dry stages of catarrh and bronchitis. Dogs left to themselves speedily get rid by vomiting of doses varying from six grains to half an ounce; but if the gullet be tied so as to prevent vomiting, such doses cause nausea, accelerated and difficult respiration, fluid dejections, intestinal irritation, 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 cause death in eight or ten hours, with redness and irritation of the alimentary canal, especially of its lower parts. Hertwig mentions that it is not so active in pigs; 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 killed it within twenty-four hours.

Tartar emetic, like many other metallic salts, probably undergoes conversion in the blood into an albuminate; the changes it effects in the blood are not yet known; the nature and extent of its actions differ considerably in different classes of patients. Dr. Sidney Ringer believes that, like potash salts, arsenious acid, and aconite, full doses act as a protoplasmic poison, destroying the functions of all organs in the order of their vital endowments. It exerts, he believes, notable depressing effects on the cardiac ganglia and nerves, and eventually on the muscular substance (*Handbook of Therapeutics*, ninth edition.) The heart cut out of a frog loses its irritability with unusual rapidity when placed in a solution of tartar emetic. Frogs appear, however, particularly sensitive to its actions; even moderate doses soften and gelatinise their skin. In most animals, full and poisonous doses lessen the force and frequency of the contractions of the heart, diminish

arterial pressure, relax muscles, and increase secretion of the skin and mucous surfaces ; carbonic acid and urea are eliminated in augmented amount, but whether from increased production or merely from increased excretion, has not been determined. (Ringer.) The continued use of antimonials causes fatty degeneration of internal organs, and the geese in the Duchy of Brunswick, fed for their fatty livers, receive daily a portion of antimony oxide. (Dr. H. C. Wood.)

In poisoning by tartar emetic the post-mortem appearances consist of inflammation of the stomach and intestines, involving usually the rectum, with congestion and inflammation of the lungs. Chronic cases exhibit ulceration of the solitary and agminated glands of the intestines. The poison has been detected in the blood and most of the soft tissues, especially in the liver and kidneys, from the latter of which it is chiefly excreted. When overdoses have been swallowed, endeavours should immediately be made to get rid of any portions remaining in the stomach by promoting vomiting, or using the pump and subsequently by giving warm demulcent drinks. Tannin or oak bark solutions are occasionally administered to diminish the solubility of unabsorbed portions. Messrs. T. and H. Smith advise a mixture of ferric chloride and calcined magnesia ; whilst to abate irritation of the stomach and vomiting centre, morphine and chloral are prescribed.

Tartar emetic, although notably irritant and emetic in man and carnivora, exhibits negative effects when given in medicinal doses to horses, cattle, sheep, or rabbits. Horses and cattle resist entirely its emetic action, and are brought under its irritant and cathartic effects only by administration of three or four ounces given in solution. Quantities of half an ounce have very slight effects on horses, even when repeated two or three times daily during several days. They do not induce nausea ; they improve rather than injure the appetite ; they neither augment nor diminish the evacuations, and disturb neither circulation nor respiration. These statements, although somewhat at variance with the generally received opinion, and with the results of various experiments made at Alfort, and reported in the *Veterinarian* for 1847, are fully borne out by a number of experiments made at the Edinburgh Veterinary College by the

late Mr. Barlow and myself. Some 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.

10*th*.—The pulse was 40, the respirations 7, appetite good, bowels and kidneys regular. A dose of four drachms was given morning and evening.

11*th*.—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.

12*th*.—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.

13*th*.—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.

14*th*.—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.

15*th*.—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 sub-arachnoid 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 Majendie's experiments.

These cases, with others of a similar kind, demonstrate that single doses of tartar emetic, sufficient, if retained in the stomach, to destroy from thirty to forty men, or as many dogs, may be given to horses with impunity; that doses of one to four drachms may be administered to them in the solid form for days, or even weeks, without producing any very obvious physiological effects; and that several drachms, even when given in solution, in which the medicine is certainly more active, fail to depress the action of the heart or diminish the frequency of the respirations.

Cattle, like horses, take very large doses of tartar emetic without suffering from any of its physiological actions. Hertwig and Viborg gave quantities varying from two to ten drachms, and Gilbert gave ten drachms in solution—all without effect.—(Hertwig's *Arzneimittellehre.*) I have repeatedly administered an ounce twice a day to cattle affected by pleuro-pneumonia, and, except in a few cases where purgation occurred, have watched in vain for any evidence of its action. Mr. Balfour, V.S., Kirkcaldy, informs me that he has given half-a-pound in solution without any very obvious effects.

Sheep are equally insusceptible to the action of tartar emetic. Viborg gave one drachm, and Gilbert three drachms in solution, and four in the solid state, without effect. (Hertwig.) But Gilbert found that four drachms in solution destroyed a one-year-old sheep. The insusceptibility of horses, ruminants, and rabbits to some of the actions of tartar emetic may probably be explained as follows:—their anatomical structure shows that they were not intended to vomit (p. 51); the vomiting centre thus being unnecessary is unlikely to be developed; hence the non-effect of medicines which, in man and carnivora, act specially upon it.

Medicinal Uses.—Tartar emetic is still occasionally prescribed as a sedative and febrifuge for horses and cattle, in febrile complaints, pneumonia, pleurisy, bronchitis, and most local inflammations, except those of the alimentary canal, and is stated to be effectual, especially when the more acute symptoms are partially subdued by bleeding, or other fitting treatment. But most observant veterinarians, both in England and Scotland, have now entirely abandoned its use amongst horses and cattle, and rightly consider it useless. It appears highly improbable that it can exert therapeutic effects either in horses or cattle while in these animals, as already mentioned, it is devoid of marked physiological action. The curative effects with which it is credited probably mainly result from the effectual medicinal and hygienic remedies with which it is commonly conjoined. Although not possessing special vermicide action, it is sometimes given with Epsom salt, or other purgatives, to remove lumbrici and ascarides; and the mixture is often tolerably effectual, from the smart purgation induced when tartar emetic is given along with a cathartic. In febrile and inflammatory complaints, it favours vascular relaxation, and thus facilitates absorption of medicines with which it is combined.

Among dogs, cats, and pigs, when the stomach is to be emptied of undigested food, irritants, or poisons, mustard or zinc sulphate, being more prompt, is preferred. But tartarised antimony is useful as a nauseating emetic at the outset of febrile and inflammatory complaints, relieving engorgement of the stomach, liver, throat, and chest, and causing copious

secretion from the respiratory and gastric mucous surfaces. It mitigates the early acute catarrhal symptoms of distemper, checks bilious attacks in pampered dogs, cuts short epilepsy in plethoric patients. Doses sufficient to produce only slight nausea, but keeping up diaphoresis and expectoration, are given every two hours in pneumonia and other acute inflammatory attacks; and, in feverish colds, and where there is annoying cough, are advantageously combined with opium.

As an external irritant, tartar emetic is seldom used. 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 in chest diseases and chronic rheumatism. Unlike cantharides, it has no tendency to act on the kidneys; but occasionally it is absorbed, and produces in dogs, cats, and pigs the same effects which follow its administration by the mouth.

Doses, etc.—As an alterative and sedative for horses or cattle, ʒi. to ʒiv. are administered three or four times daily, either in bolus or solution. 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. Doses considerably less than one grain, regulated so as to produce diaphoresis, with very slight nausea, are prescribed for carnivora as alteratives and antiphlogistics in inflammatory and febrile complaints. For similar purposes in horses and cattle, tartar emetic was wont to be conjoined with nitre, calomel, Epsom salt, or aloes. Tartar emetic and aloes with some practitioners have long been a favourite purgative in acute febrile complaints. 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 depression. Tartar emetic is used as an external irritant 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. A few grains of tartar emetic are occasionally scattered over Burgundy

pitch and other warming plasters. Antimonial wine is made by dissolving forty grains tartar emetic in a pint of sherry.

ARECA-NUT.

Arecæ Semina. Seeds of Areca Catechu. Betel-nut.

Nat. Ord.—Palmaceæ. *Sex. Syst.*—Monœcia Hexandria.

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 soluble in hot water and spirit. It consists chiefly of tannic, with a little gallic acid, a fixed oil, and a red insoluble matter. A portion of areca-nut rolled up with a little lime in the aromatic pungent leaf of the Piper betel, constitutes the celebrated betel or pawn so extensively chewed in Eastern countries.

Actions and Uses.—Areca-nut is an astringent resembling catechu, and an effective vermicide, especially for dogs, proving destructive alike to tape and round worms. Previous to its administration to a verminous patient the bowels should be cleared out by any simple laxative, and their further emptiness insured by several hours' fasting. The parasite, thus starved, greedily swallows the poison prepared for it. Half a nut, or about sixty grains of the powder, suffices for a pointer. It is convenient to note Mr. Mayhew's observation, that the dose of powder is about two grains for every pound of the animal's weight. The nut is always given powdered, and the powder is either made into bolus or more commonly given in milk or soup. In a few hours worms are generally discharged. In the *Veterinarian* for May 1862, Mr. Hanley states that he gave a bitch, which had fasted for 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 being 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 where the symptoms indicating their presence remain after one or two doses of the nut have been given, another may still be tried after the interval of a week; while, if the patient be vigorous and the bowels not unduly relaxed, it is advisable, a day or two subsequent to the use of the areca-nut, to give a moderate dose of castor oil and turpentine. By thus following up with another medicine the action of the areca-nut, worms that previously appeared immovable will sometimes be speedily and entirely evacuated.

Doses, etc.—For dogs, grs. xv. to ʒij.; for horses, ʒiv. to ʒvi., administered in mucilage or milk, to which worms are particularly partial.

ARNICA.

Arnicæ Radix. Dried Rhizome and rootlets of Arnica montana. Collected in the mountainous parts of middle and southern Europe (*Brit. Phar.*) Leopards' Bane. Mountain Tobacco.

Nat. Ord.—Compositæ. *Sex. Syst.*—Syngenesia, Polygamia æqualis.

Arnica montana is a perennial, growing in many of the cooler parts of Europe, Asia, and America, with a hairy stem about one foot high, composite yellow flowers, obovate leaves, and cylindrical contorted brown root, one to three inches long, two or three lines thick, distinguished by a peculiar aromatic odour, an acrid, peppery, nauseous taste, and containing extractive matter, volatile oil, and an active bitter yellow amorphous principle, arnicin. The flowers, leaves, and root are occasionally used powdered, especially for making poultices; an infusion is sometimes employed; but the most common preparation is the tincture, usually made with an ounce of the coarsely powdered root to a pint of proof spirit.

Actions and Uses.—Arnica is alterative, irritant, and stimulant. Viborg gave a horse six drachms of infusion of the flowers, and noticed quickening of the pulse and diuresis. In human medicine it has been recommended in debility and torpor of the bowels; but is stated to be inferior to elecampane or serpentary (Royle's *Materia Medica*, sixth edition.) It is a

favourite homœopathic remedy. Amongst the lower animals, it has been given as an alterative and stimulant in the second stages of pleurisy, in weakness of the loins, in muscular strains, and in rheumatism; but Mr. Dollar, of New Bond Street, London, has repeatedly tried it, without benefit, in horses suffering 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 both externally and internally.

Externally, arnica is a popular healing remedy 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 each of arnica tincture and lead acetate diluted with ten or twelve ounces of water. Mr. Dollar uses arnica tincture, one drachm; two drachms zinc sulphate, dissolved in ten ounces of water. For painful or irritable wounds the tincture is employed with an equal quantity of 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, and the healing properties ascribed to it in great part depend on the spirit astringents or even cold water, with which it is generally used.

Doses, etc.—Horses take f℥ iv. to f℥ i. of the tincture; cattle, double that quantity; dogs, ♏ v. to ♏ viij., mixed with water, ale, or gruel.

ARSENIC.

Arsenicum Album. Arsenious Anhydride. Arsenious Acid. White Arsenic. Oxide or Sesquioxide of Arsenic. $As_2 O_3$.

Arsenic is present in many ores of iron, tin, cobalt, and sulphur. Its most common source is the arsenic pyrites ($Fe_2 S_2 As$), chiefly obtained from the mines of Silesia and Cornwall, where it is roasted in ovens; oxidation occurs; iron oxide and sulphate remain; sulphurous and arsenious acids

are conducted into condensing chambers; the crude arsenious acid, purified by sublimation, yields the arsenious oxide or acid, the white or common arsenic of the shops, much used, not only in medicine, but in the manufacture of glass, colouring matters and shot.

Properties.—From being sublimed into conical cast-iron moulds, it is sometimes met with in transparent vitreous concavo-convex masses, which gradually become opaque. The more common form is that of a heavy white powder, obtained when the arsenious vapours are condensed in a current of air. This powder, consisting of minute glassy fragments and octahedral crystals, has a snow-white lustrous appearance, a specific gravity of 3·73, a slightly sweet taste, is rough and gritty when between the teeth, and if kept in the mouth for a short time causes irritation. It has no odour. When long kept it loses its transparency, and becomes opaque. Sprinkled on a red-hot shovel, the oxide is decomposed; the metallic arsenic in vapour gives off a characteristic odour of garlic. Arsenic is very sparingly soluble, either in water or alcohol. A pint of cold water at 60° 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 believed to be 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. Dissolved with alkalies, definite, mostly soluble, poisonous arsenites are produced (M_3 As O_3). When the familiar sesqui- or tri-oxide (As_2 O_3) is acted upon by nitric acid, arsenic pentoxide, or arsenic acid, is produced (As_2 O_5), which forms a series of arseniates (M_4 As O_4), those of the alkaline metals being soluble, those of the other metals insoluble, but none being such active poisons as the corresponding arsenites. In its properties and alliances with other bodies the metal arsenicum (As) resembles on the one hand phosphorus and nitrogen, and on the other such triatomic metals as antimony and bismuth. (Roscoe.)

Special Tests.—Arsenic is readily discovered—(1) by sublimation, producing the characteristic crystals of sesquioxide; (2) by reduction develop-

ing 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°, sublime unchanged, and condense again in the cool part of the tube in shining crystals, which, when 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 arsenic oxide, and metallic arsenicum volatilises as a colourless gas with a strong odour of garlic, 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, put into a common test tube, and heated, the arsenicum regains the oxygen it 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 sesquioxide 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 arsenic sulphide (As_2 S_3) or orpiment. Arsenic sulphide differs from the yellow persulphide of tin in being soluble in ammonium carbonate, and unlike the only other yellow metallic sulphide, that of cadmium, 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 re-dissolved) gives a primrose-yellow precipitate of the silver arsenite (Ag_3 As O_3). (*c*) Cupric ammonio-sulphate (prepared in a similar manner to the silver ammonio-nitrate) gives an apple-green precipitate of copper arsenite (Cu H As O_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, when 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 white arsenic, and afterwards reducing them to the metallic state.

When arsenic, in any form of combination, is present in the contents of the stomach, the tissues of the body, or in any coloured organic mixture, the tests mentioned are quite inapplicable until the arsenic be isolated. To effect this, the following *processes* are in common use :—

1*st*. 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 arsenicum 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.

2*d*. The mixture is acidulated with pure hydrochloric acid, and boiled for some time with a few clean copper clippings, on which there collects a dark crust, which was at one time regarded as metallic arsenic, but is now ascertained to be a mixture of an alloy of copper and arsenic, containing 68 of the former to 32 of the latter. The clippings are then 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.)

3*d*, 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 ($As H_3$) 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, whilst a piece of glass or porcelain held over the flame soon becomes incrusted, 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 very 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.

4*th*. 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 an irritant corrosive poison. It is administered as an alterative and tonic. Properly regulated doses promote constructive metamorphosis, are distributed mainly to the parenchymatous glands, the skin and mucous surfaces which they stimulate; they excite the respiratory centre and pulmonary terminations of the vagi; and are excreted chiefly by the kidneys. Arsenic is applied externally as a stimulant, caustic, antiseptic, and parasiticide.

General Actions.—Poisonous doses, in all animals, cause irritation, inflammation, and sloughing of any mucous or

abraded skin surface with which it is brought in contact. Although not absorbed from the sound skin, or from an inflamed membrane, it is taken up from the stomach and intestines. It exerts its effects with nearly equal certainty by whatever channel it enters the body. Although it does not interfere with the activity of pepsin and pancreatine, it destroys the germs of yeast and kills some micrococci. Somewhat indefinite and conflicting accounts are given of the manner of its absorption, whether by veins or lacteals, of its effects on the stomach and digestion, and of its condition in and action upon the blood. Repeated full doses are stated by Dr. S. Ringer (*Handbook of Therapeutics*) to act as a protoplasmic poison, to paralyse first the nervous centres, then the nerves, and lastly the muscles; motor are believed to suffer before sensory or reflex functions. The heart is early and directly affected; blood-pressure is diminished; the activity of the respiratory centre is lowered; oxygenation is impaired; in dogs and rabbits temperature is reduced 4° to 7° Fahr. In frogs it produces, like tartar emetic, death and desquamation of epidermal cells. Chronic poisoning is accompanied by fatty degeneration, which in pigs, fowls, or rabbits, in three or four weeks attacks even the bones. It is excreted chiefly by the kidneys, but also by the stomach, intestines, and liver, in which it is recorded to arrest formation of glycogyn.

All arsenical compounds are poisonous; and, as usual with other poisons, the most soluble are the most active. Most deadly of all is arseniuretted hydrogen, which has occasioned the death of three chemists, who were so unfortunate as to inhale 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, oxygen, and various bases, that it speedily acquires poisonous activity.

White arsenic, like other mineral poisons, has been given to horses in considerable doses with impunity. Berthe gave a mare affected with inveterate mange two, and afterwards three, drachms without injury.[1] Beissenhirz gave a horse one, four,

[1] *Recueil de Médecine Vétérinaire*, Oct. 1825. Quoted by Moiroud, p. 466.

three, two, and eight drachms, on successive days; but death occurred on the ninth day after the last dose.[1] 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.[2] 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.[3]

But although such large doses sometimes have little effect, much smaller doses occasionally act with greater violence. Thus Gerlach saw twenty grains cause active diarrhœa; 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.[4] 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 very large doses 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

[1] Pereira's *Elements of Materia Medica.*
[2] *Praktische Arzneimittellehre für Thieraerzte*, Berlin. 1847, p. 656.
[3] *Veterinarian* for 1843, p. 347.
[4] *Ibid.* pp. 349-351.

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 active purging, the pulse was 72 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 Edgeware in August 1874, from drinking water containing arsenic (*Veterinarian*, Sept. 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 these 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.

It requires somewhat larger quantities to destroy cattle than horses, mainly because their stomachs are generally filled with food, which interferes with the action of the poison. An ounce of arsenic given with a handful of salt to a strong sheep caused most of the symptoms above mentioned as occurring in horses, and death after five days (*Veterinarian*, 1843, p. 345.) Hertwig, quoting from a report of the French Academy, mentions that five to ten grains given to healthy sheep produced the usual symptoms of poisoning; that a second dose of ten to twenty 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 carcases of sheep poisoned by arsenic have been eaten by dogs with impunity. (*Veterinarian*, 1843, p. 345.)

A chronic form of arsenical poisoning, with symptoms of indigestion, thirst, gradual sinking, 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 poisoned, and sheep to have died, and especially two or three horses I know to have died. 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, and necrosis of the bone 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, poisoned by eating green paper, in three hours. (*Veterinarian*, June and July 1865, and July 1871.)

Arsenic is greatly more active in dogs and cats than in horses or cattle. I find that a quarter of a grain to a grain, given twice daily, and continued during periods varying from eight to fourteen days, causes gradually diminished appetite and vomiting. From the sixth to the tenth day, diarrhœa, lowered temperature, rapid emaciation, and painful cough ensue, and death occurs in twenty to thirty days. Three to ten grains, mixed with water, and administered to dogs, caused in a few minutes nausea, vomiting, short moaning, difficult breathing, a wiry rapid pulse of 120 or upwards, and black evacuations made with considerable pain. These symptoms were accompanied by a look of extreme anguish and blunted perception; while death with convulsions followed in from six to thirty hours. Arsenic produces similar effects both on pigs and poultry. 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 1½ 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 the healthy dog getting arsenic reached 110 to 120 grains (*Centralblatt für die Med. Wiss.* No. 18, 1876).

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. The carcase, when opened, generally evolves large quantities of fœtid gas. In the horse the cuticular part 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 extend into the duodenum, and are also observable in the colon, cæcum, and rectum. The lungs are usually congested, and their mucous membrane, with that of the urino-genital organs, is red and vascular. Dr. Harley states that in animals poisoned by arsenic the heart ceases to beat sooner than when death has resulted from mechanical causes. These appearances present themselves not only when the poison has been swallowed, but also when it has been absorbed from the surface of the skin, or introduced in any other way into the system. The bodies of animals poisoned by arsenic do not undergo the usual form of putrefaction, but become dry and mummified, whilst the areolar tissues, brain, lungs, liver, and other organs become greasy and tallow-like, from a species of fatty degeneration which is established even during several hours' illness.

In treating arsenical poisoning, the first object is to get rid of any unabsorbed poison, by administration of emetics; or, where, as in horses or cattle, these are ineffectual, by the use of the stomach-pump. Iron sesquioxide is the best chemical antidote, and is most active when prepared by precipitating an iron sesquisalt 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 iron perchloride 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 arseniate (Fe_4 2As O_4). Dialized iron, which has the

advantage of being ready in most pharmacies, is now shown to be as effectual as the sesquioxide 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. Certain insoluble powders, as charcoal and clay, act mechanically, enveloping the particles of the poison, and protecting the stomach; but to be of use, such antidotes 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. Opium and demulcents are freely given to combat inflammation or diarrhœa; oleaginous laxatives and clysters counteract constipation and griping; in chronic cases, easily digested nutritive food help to sustain the powers of life; occasional diuretics, highly recommended by Orfila, hasten excretion of the poison by the kidneys.

Medicinal Uses.—Arsenic has no restorative action like iron, and no immediate neurotic effect like aconite or strychnine. It is administered as a stomachic in irritative dyspepsia; as an alterative, tonic, and antiperiodic; and as a stimulant of the skin and mucous surfaces. In chronic eczema, psoriasis, impetigo, scab, and mange it stimulates the dermis, hastens removal of morbid epidermal cells, and is fittingly used both internally and externally. In mallenders and such scaly skin complaints Professor Williams recommends it in conjunction with mercury and iodine (*The Principles and Practice of Veterinary Surgery*, by Professor Williams, Gayfield College, Edinburgh). Small doses combined with iron are sometimes useful in anæmia. A similar combination often holds farcy in check. In solution frequently along with opium arsenic allays chronic peristalsis and hurried passage of imperfectly digested food through the intestines. It is prescribed in

ozœna and other relaxed states of the mucous membranes. Stimulating the respiratory centre and pulmonary terminations of the vagi, it benefits many cases of thick wind. Chronic irritable cough in horses, remaining after influenza and sore throat, is often relieved by a daily draught of an ounce of Fowler's solution united with an ounce of potassium chlorate and a drachm of belladonna extract. It is occasionally prescribed in chronic rheumatism in all patients, and in epilepsy and chorea in dogs. In canine practice small repeated doses are also used to abate ulcerations in the mouth, irritability of the stomach, asthmatic symptoms, and chronic cough. Properly regulated doses are safely persisted with until some of its earliest physiological effects are developed—until the eyelids are slightly swollen and reddened, the stomach irritable, or cough set up. Indeed, some practitioners aver that curative results seldom occur until physiological action is established. Arsenic is unsuitable when the patient is feverish, the bowels constipated, the urine scanty or high-coloured, as well as in the inflammatory stage of eruptions.

In some countries it is eaten by the peasantry, in the belief that it improves the complexion, prevents breathlessness in running or ascending hills, and increases general vigour. In various parts of England, as well as in some parts of southern Europe, it is regularly given to horses in small doses, and is said to maintain condition and impart strength and endurance. 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, it is withdrawn, they fall off in appearance, and for many months are 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 are, however, attended with so much risk of poisoning, and are, moreover, so likely to injure the horse's constitution, that they should not be tolerated.

Arsenic, generally used as a paste made with starch or lard, is applied to eradicate warts, and to produce the sloughing and removal of malignant tumors; in solution it is

employed for stimulating unhealthy ulcers, removing the scurfiness of psoriasis, poisoning the acari of scab and mange, and destroying other parasites infesting the skin. For such purposes it must, however, be used cautiously, for animals have been destroyed by its injudicious application both to wounds and to the skin; while many have been permanently blemished by the excessive sloughing produced when it is applied to raw surfaces in any considerable quantity. Arsenic is a powerful antiseptic: in preserving blood and other such putrescible substances, it is second only to zinc chloride, and stands on a par with corrosive sublimate and blue vitriol.

Arsenic enters into the composition of many sheep-dipping mixtures. For the destruction of ticks and other vermin infesting the wool, it is more effectual than solutions of tobacco, spirit of tar, and simple alkaline dips sometimes employed; it is safer and as effectual as the mercurial baths or ointments; and is used more extensively than the various non-poisonous dipping mixtures which have lately been in favour both in England and the Colonies. Inquiry in various parts of the country indicates that the usual allowance for a hundred sheep is two pounds of arsenic dissolved in a hundred gallons of water; but three, four, and even five pounds dissolved in the same quantity of water are used without evil effects. A safe and convenient sheep-dipping mixture is made with three pounds each of arsenic, soda ash, or impure sodium carbonate, soft soap, and sulphur. 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 farmers double or quadruple the quantity of the soap, which, with the alkaline carbonate, aids in dissolving the arsenic, whilst the sulphur whitens and softens the fleece, and also for a considerable time prevents attacks of flies, which are further kept in check 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 bath, 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.

Arsenical dipping mixtures sometimes produce serious, and even fatal consequences. A Lincolnshire correspondent informed me several years ago that, after dipping 150 half-bred Leicester hogs, eleven of them died in twenty hours, and several after some days. But a greatly more serious case occurred at Burton, in Northumberland, during the summer of 1858, and created so much interest among chemists and veterinarians, as well as amongst agriculturists, that I subjoin a short account of it. Mr. Black of Burton purchased from Mr. J. Elliot, chemist, Berwick-on-Tweed, 15 packets of dipping mixture. Every packet contained 20 ounces each of arsenic and soda ash, and 2 ounces of sulphur, and was directed to be dissolved with 4 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 and other work performed with great care. In two days, however, the sheep began to die; they were seized much in the same order in which they had been dipped, and within a month 850 had perished. The symptoms frequently came on very 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, bloodshot 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. On post-mortem examination, the bowels were found to be inflamed, and were covered with black 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 some 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 used, without any bad effect whatever, 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 on the subject, using, in two instances, arsenic in the proportion of 28 and 68 ounces for 50 sheep, instead of the 20 ounces present in Mr. Elliot's dip. Mr. Browning, a professional sheep-dipper in Oxfordshire, who annually passed through his hands several thousand sheep without losing one, for years employed 2½ lbs. of arsenic for 50 sheep, which is exactly double the strength of Elliot's mixture. I made in 1859, and have repeated and verified them since, several 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.

The inference is plain that arsenical sheep-dipping mixtures are not absorbed through the sound, healthy skin. The risk of using such dip depends, not on their being absorbed by the skin, but on a quantity of the poisonous fluid being retained by the fleece, from which it drips on the grass or other food over which the animal strays. This, I believe, explains the

serious mortality at Burton. The sheep were rapidly dipped at the rate of 80 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.

The sheep are turned out hungry, and at once begin to eat; while the drippings, falling, contaminate the grass, which in the Burton case appears to have been still further impregnated, owing to a shower falling during the night, and thus washing a larger quantity of the poisonous solution out of the fleeces on to the pastures. Here it was found in three sods taken up ten days after, and examined by Professor 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, the two oxen, and the 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 an arsenical dipping mixture with its 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. Some years ago I knew of two colts which were poisoned by eating a few vetches carelessly left in a yard where some sheep had been placed to drip.

The following important practical conclusions are deducible from this and other such cases. Yards into which newly dipped sheep are to be turned should be previously 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 open, 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 drying weather. On no account should sheep be returned to their grazings until they are dry, and the risk of poisoning the pastures has passed.

Doses, etc.—Horses and cattle take grs. iv. to grs. viij; sheep, gr. j. to grs. ij.; and dogs, gr. $\frac{1}{15}$ to gr. $\frac{1}{10}$. To lessen its irritant effects it is administered after meals, occasionally along with a little laudanum; it is usually repeated twice daily, and persisted with for a week or longer. When it causes acceleration or hardness of the pulse, tenderness of the conjunctiva, indigestion, diarrhœa, or other physiological actions, its administration must be carefully watched, and the doses diminished. With all animals, and in all doses, it is most active when administered in solution, and hence it is best given in acidulated water, or in the form of the *liquor arsenicalis* or Fowler's solution, which is thus made :—Heat eighty grains each of arsenious acid, in powder, and carbonate of potash, in ten fluid ounces of water in a flask, until they are dissolved. When cold, add five fluid drachms of compound tincture of lavender, and as much water as is needed to make the solution measure one pint.—(*Brit. Phar.*) Every ounce of Fowler's solution contains four grains of arsenic, partly free and partly combined. An *ointment*, generally made with six grains to an ounce of lard, is used externally. It cannot be too often repeated, that all arsenical preparations, whether for internal or external purposes, must be used with great circumspection. Under the Act which now regulates 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; whilst, 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 (Corymbiferæ). *Sex. Syst.*—Pentandria Syngenesia.

The artemisiæ are low shrubby plants, found throughout Europe, characterised by their aroma and bitterness, and comprising the familiar southernwood and tansy, the mildly anodyne lettuce, and the harmless dandelion.

The dried Artemisia absinthium contains a volatile camphoraceous oil, two bitter resins, a bitter extract, and a neutral principle, absinthin. It is an aromatic bitter tonic, a popular remedy for worms, is present in the liqueur absinthe, and is occasionally mixed with spent or inferior hops.

The unexpanded minute flower-heads of Artemisia maritima are imported from Russia, contain a volatile oil, resin, and one to two per cent. of a crystalline neutral principle santonin (C_{15} H_{18} O_3), which alkalides convert into santonic acid (C_{15} H_{20} O_4). Santonin is a vermicide, is without effect on tæniæ, but destructive to round and thread worms, and less effective in horses than in dogs, to which it is given in doses of three or four grains.

ASAFŒTIDA.

A Gum-Resin obtained in Afghanistan and the Punjab, by incision from the living root of Narthex Asafœtida. (*Brit. Phar.*)

Nat. Ord.—Umbellifera. *Sex. Syst.*—Penandria Digynia.

The *Narthex Asafœtida* has a black perennial root, several inches in diameter, large pæony-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 clusters of flowers. The plant, all parts of which emit a penetrating fœtid 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. Fœtid milky juice exudes from the freshly-cut surface, and two days later concretes and is scraped off. The root is then protected from the sun by a covering of leaves; within the next two days the operation is twice repeated, and after an interval of eight or ten days, the slicing is resumed, and several times repeated, when the plant is exhausted, after yielding from a half to two pounds of juice, worth 2s. to 4s. per pound. Another plant, the Scorodosma fœtidum (Bange), is also believed to yield a portion of the asafœtida of commerce. The yellow-brown tears first collected are mixed with soft earth and made into irregular lumps, which have externally a red-brown colour, and within a white waxy surface, which, however, becomes purple or red-brown from exposure. Asafœtida has a disagreeable, penetrating odour of garlic, and an intensely bitter, acrid taste. It is pulverised with difficulty, forms an emulsion with water, is dissolved in rectified spirit, and also in potash and ammonia. Besides water and earthy matters, it contains 50 to 60 per cent. of resin; 25 to 30 of gum; about 10 of earthy matters; 5 to 8 of a strong-smelling sulphurised volatile oil; which, with the resin, constitutes the active part of the plant, and traces of a peculiar acid, the ferulaic (C_{10} H_{10} O_4).

Action and Uses.—Asafœtida is a mild diffusible stimulant, expectorant, carminative, and vermifuge. It is speedily absorbed; is generally diffused, its disagreeable odour indicating its presence in the various textures; it is eliminated from the pulmonary mucous surfaces, the skin, and kidneys, gently stimulating their secretions. It is occasionally given to horses and cattle in colic and chronic cough, and to dogs in chorea. Like other substances containing odorous volatile oils, it is vermifuge, but is not very active. The two gum-resins, ammoniac and galbanum, are closely analogous to asafœtida, but scarely so active, and are chiefly used for making charges and plaster.

Doses, etc.—Horses take ℥ ij. to ℥ iv.; cattle, ʒ ij.; sheep, ℥ i.;

and dogs, grs. x. to grs. xx. Its effects being transient it is given usually every hour or two, often administered in a watery or alcholic solution of ammonia. It may be conjoined with camphor and ammonium carbonate, and is sometimes added to alcoholic and ethereal preparations intended for veterinary patients, to prevent their misappropriation.

AXUNGE.

Adeps. Adeps preparatus. Hog's Lard. The purified fat of the pig.

On account of its greater firmness and density, the fat about the pig's internal organs and loins is preferred for making lard. To get rid of soluble and membranous matter, the fat, cut into small pieces, is 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 212° 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°, forming a clear transparent fluid, which is a good solvent for wax and resins, and when boiled with alkalies forms soap. 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 properly 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 with lard, and alum and lime added to secure whiteness and add to weight. Benzoated lard, used on account of its agreeable odour and diminished liability to rancidity, is made by melting purified lard over a water bath, and stirring in 10 grains of benzoin to the ounce of melted

lard. Suet—the fat around the kidneys of sheep or oxen—is sometimes used instead of lard, and differs from it chiefly in being firmer, harder, and more difficult to melt. Horses' 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, which are merely fluid fats, 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, various 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 important organs. Fats are emulsionised by the alkaline digestive 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, in cases of parturition, and occasionally in choking in cattle. In congested, inflamed, thickened, and indurated states of the skin, when the sebaceous and sudoriparous glands act tardily, the in-rubbing of lard or simple oils or vaseline is useful. The deficient natural oil is thus beneficially replaced, while abraded surfaces are protected from action of air and of acrid discharges.

Such oily applications, freely used and remaining long in contact with the warm skin, are apt, however, to spoil by oxidation and irritate from rancidity. A little benzoic acid added to them retards this change, which is obviated by the substitution of the mineral vaseline for the animal fats. Hog's lard is occasionally used as a dressing in mange and scab, but is ineffectual in destroying the acari on which these diseases depend. It is much used for making ointments and liniments.

BARLEY.

Hordeum. Pearl Barley. Malt. Yeast.

Nat. Ord.—Graminaceæ. *Sex. Syst.*—Triandria Digynia.

Barley is used for feeding most of the domesticated animals; and, when stripped of its outer husk, is recognised by the Phar. as pearl barley. Ground to meal, it is used for making poultices and infusions. Good barley-meal contains 68 per cent. of starch, 14 glutin and albumen, 2 fatty matter, 2 saline matters, and 14 water. When moistened and exposed to a temperature of about 100°, barley germinates; and, if germination be arrested by drying, the altered barley is converted into malt.

Malt—a sweet mucilaginous substance, which is more easily digested, but weight for weight is rather less nutritive than barley—forms a palatable and useful 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 mashes prove especially serviceable in febrile cases both in horses and cattle, where tissue change is excessive, and where rich hard dry food, not being assimilable, has to be got rid of, adding greatly to the overwork already thrown upon the liver, spleen, and excretory organs.

When a solution of malt is fermented, as in the preparation of beer, ales, 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 Brit. Phar., 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 still occasionally used as a purgative, especially for cattle, and is given in quantities of about a pint. Antiseptic and deodorising poultices are sometimes made with boiling water and two parts of bran or linseed meal to one part of yeast.

BELLADONNA.

Belladonnæ folia. Deadly Nightshade. Fresh leaves of Atropa Belladonna, with the branches to which they are attached; also the leaves separated from the branches, carefully dried, gathered from wild and cultivated British plants when the fruit has begun to form. (*Brit. Phar.*)

Belladonnæ radix. The dried root of Atropa Belladonna, cultivated in Britain or imported from Germany.

Nat. Ord.—Atropaceæ. *Sex. Syst.*—Pentandria Monogynia.

Belladonna grows wild in most parts of Great Britain, especially about old walls, edges of plantations, and ruinous shady places; but so great is the demand for its preparations, that it is now largely cultivated at Hitchin and elsewhere, and the cultivated are found as active as the wild specimens. It has a fleshy, branching, perennial root; a round, branched, reddish, downy, annual stem, three to five feet high; smooth, ovate, acuminated leaves, four or five inches long, supported on short leaf stalks, lateral, often in pairs of unequal size, of a sombre-green colour, and a faint bitter taste; pendulous dark-purple, bell-shaped flowers, appearing in June and 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 preparations. 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. In addition to the leaves and branches the Phar. recognises the dried root, which is about eighteen inches long, an inch thick, and is cultivated in Britain or brought from Germany, the small and younger roots being most active. Besides ordinary plant constituents,

belladonna contains the neutral crystalline principle asparagine, and rather less than one half per cent. of a colourless crystalline poisonous alkaloid called atropine, of which further notice will be found at the close of this article.

Actions and Uses.—Belladonna or atropine, applied to the web of the frog's foot, stimulates the vaso-motor nerves and adjacent ganglia, contracts arterioles, and increases the flow of blood. But this stimulation, when excessive or prolonged, is succeeded by paralysis, dilatation, and diminished circulation. This twofold local effect is repeated remotely (Harley). Full doses are excitants of a large part of the central nervous system; they specially stimulate the cardiac acceleratory nerve and centre, the inhibitory centre, the vaso-motor and respiratory centres. The number and force of the heart-beats are accordingly increased, blood-pressure is heightened, temperature raised, the number and depth of the respiratory movements are increased. These effects, like those in the frog's foot, when violent or long-continued, are succeeded by the usual effects of over-stimulation; the heart's action is weakened, arterioles are dilated, blood-pressure is abnormally reduced, and temperature lowered. Excessive doses fatally exhaust the heart's action, and death results with symptoms of paralysis, torpor, delirium, or coma, and in certain cases with tetanus. But, while acting generally and primarily as a stimulant, belladonna has secondary and subsidiary actions as a paralyser. It paralyses the termination of the vagi, the secretory nerves of the salivary and sweat glands, and those motor nerves especially presiding over involuntary muscles. Belladonna is prescribed as a stimulant of the heart and vascular system, and as a relaxer of the contractor fibres of the hollow viscera and glands. Excreted by the kidneys, it increases both the quantity of the urine and the amount of its solids, and is moreover an anodyne of the urino-genital tract. Stimulating or paralysing nerve tissue and antagonising hyperæmia, it is used topically for the relief of pain. Whether applied locally to the eye, or absorbed and carried thither, it dilates the pupil.

General Actions.—Medicinal doses, usually within an hour, acting as indicated upon the cardiac ganglia, increase both the

force and number of the heart-beats; but the pneumogastric terminal filaments being paralysed, inhibitory control is lessened. The respiratory centre being similarly stimulated, the number and depth of the respirations are increased; but circulation is earlier and more prominently acted on than respiration. Stimulation of vaso-motor centres and their effects are well illustrated in the web of the frog's foot, moistened with a solution of atropine, when the ramifications of the arteries are seen to contract, often to three-fourths of their former calibre, inducing such increased movement of the red globules that about twice the former quantity of blood passes along them (Meuriot and Harley). Tone is thus imparted to dilated congested capillaries; congestion and stasis are thus relieved; nutritive changes are more rapid; temperature is elevated. Excessive sweating is controlled alike by administration and local application of belladonna. Secretion of saliva and of mucus from the mouth, fauces, and nostrils is checked, in part explaining the efficacy of belladonna in combating colds and sore throat. A like diminution of secretion is effected in the udder, and belladonna applications in garget have the twofold advantage of checking lacteal secretion and relieving congestion. Dr. John Harley considers that belladonna is a chologogue. The scarlatina-like rash produced in human patients by frequently repeated doses is not noticed in veterinary patients. Excessive or long-continued action, as with other stimulants, leads to exhaustion; the heart's action is weakened, respiration becomes slower and shallower, the capillaries are flaccid and dilated. These paralysing effects extend to the cerebro-spinal axis; vertigo, delirium, and even tetanus ensue. The functions of sensory nerves are not so much impaired as those of motor. Impaired excitability of motor nerves and end-organs account for the motor paralysis induced by large doses. Involuntary muscles under control of the sympathetic system are notably acted on, and their spasms combated; but the voluntary are much less affected by medicinal doses. It is very readily absorbed and diffused; its precise action on the blood is unknown. Dr. John Harley believes that it peroxidises nerve tissue; the atropine is rapidly excreted unchanged, and wholly by the urine.

Belladonna resembles the other Atropaceæ, hyoscyamus and stramonium. Combating pain and spasm, it is allied to opium, but it acts specially on the sympathetic, and less on the cerebro-spinal axis, notably stimulates circulation, has less soothing and soporific influence, and dilates instead of contracting the pupil. In its secondary effects it paralyses motor functions like hemlock. In stimulating circulation and combating congestion it approaches alcohol, ether, and ammonia. In contracting unstripped muscular fibre it resembles ergot. Its physiological antagonists are Calabar bean, prussic acid, and jaborandi.

Moiroud records that a horse consumed upwards of six pounds of the leaves without any bad effects, and that a donkey ate a pound of the berries with equal impunity. Münch says that goats and sheep devour belladonna with apparent satisfaction, and without obvious harm. Vegetable feeders are certainly less susceptible than animal feeders; but the negative effects of such large quantities point to the plants being injured, as is not unfrequently the case, by long and bad keeping. Hertwig, experimenting on upwards of twenty horses, observed tolerably decided effects. Four to six ounces of the dry pulverised herb were 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. These observations closely agree with the more recent investigations of Dr. John

Harley, who states that cardiac and cerebral excitement is the prominent result of full doses in the horse.[1]

Hertwig considers that belladonna is rather more active in cattle than horses; and records that doses of the root varying from two to four ounces caused in cows violent symptoms lasting forty-eight hours, and that larger doses were dangerous. In dogs, thirty to fifty grains of the dried herb or root caused, in fifteen to thirty minutes, whining and continuous moaning. In thirty minutes the iris had contracted so much as to be quite out of view, and the eye had also become insensible to bright light. Hearing and sensibility remained unimpaired. Vomiting sometimes occurred, the nose became dry and hot, and the gait tottering from inability to move the hind extremities. After some time the animals were drowsy. In one to three hours the symptoms began to abate, but contraction and diminished irritability of the iris still remained, even after twenty-four hours (Hertwig). Dr. Harley states that dogs bear proportionally larger doses than horses, exhibit less marked cerebral, but more pronounced and prolonged cardiac effects. Half an ounce of the watery extract kills dogs in about thirty hours when given by the mouth; half that quantity in twenty-four hours when introduced into a wound; and even smaller doses are more speedily fatal when injected into the jugular (Christison). Rabbits resist its effects and require fifteen grains of atropine to poison them. Pigeons, particularly sensitive to the action of sedatives and anæsthetics, are curiously insusceptible to the effects of belladonna, two grains of atropine being required to kill them, even when it is used hypodermically (Ringer). Pigeons, as well as other birds, are also insusceptible to the mydriatic action.

Poisoning by belladonna appears to depend upon exhaustion chiefly of the heart—the result of previous over-stimulation (Harley). This tendency to fatal exhaustion of the circulation can be demonstrated in frogs subjected to subcutaneous injection; the arteries of the web are seen to become flaccid, dilated, and weakened. After death the blood remains fluid; the ventricles are empty and firmly contracted, the right auricle

[1] *The Old Vegetable Neurotics.* By John Harley, M.D. London: Macmillan and Co., 1869; and *St. Thomas's Hospital Reports for* 1875.

full of dark blood; the lungs, liver, and kidneys, with the brain and its membranes, are free from congestion; no inflammatory appearances are anywhere detected. Excessive doses whilst still remaining unabsorbed are removed by emetics or the stomach-pump. No trustworthy chemical antidote is yet known, but lime-water partially neutralises the atropine. The poisonous action of moderate doses is partially controlled by Calabar bean. Artificial breathing, and ammonia cautiously swallowed and inhaled, help to sustain flagging respiration and circulation; opium in small amount quiets nervousness and restlessness; diuretics hasten expulsion of the poison.

Medicinal Uses.—In sore throat, bronchitis, and pneumonia in all classes of patients, and in influenza and purpura amongst horses, belladonna imparts vigour and firmness to the weakened heart, braces lax capillaries, combats congestion, and soothes excitability. By moderating excessive mucous secretion and stimulating the respiratory centre, it antagonises the abnormal discharges and irritability of catarrh and sore throat in horses. In such cases, while fever continues, it is used with aconite; in later stages with alcohol, ether, ammonia, or camphor. In laryngitis in horses, especially when used subcutaneously, no medicine so immediately relieves the spasmodic cough, and quiets the roaring noisy respiration which accompanies some cases of epizootic sore throat. Along with ether or ammonium carbonate, belladonna extract greatly relieves the distressed breathing and cough which so often occur in distemper in dogs. In enteritis, neuralgia, and rheumatism, it allays nervous excitability, assuages pain, and in these and other diseases is most rapid and certain, when applied as near as possible to the seat of disease, or when the alkaloid is introduced hypodermically, whilst it is often advantageously conjoined with opium, to intensify and prolong its effects. Full doses abate secretion of milk and, combating congestion of glands, moderate the inflammation of garget; prevent formation of abscess, and have their results increased by the external use of the medicine. Amongst the lower animals excessive sweating chiefly occurs in horses overworked when in poor condition, but this profuse perspiration, especially when depending upon relaxed sudoriparous vessels, is abated by repeated doses or topical applications. In tetanus,

hydrophobia, epilepsy, and chorea, it is given without success. During its elimination by the kidneys it develops its characteristic vaso-motor stimulation, increases the secretion of urine and proportion of urea phosphates and sulphates, exerts besides its topical anodyne effect, and hence is of value in nephritis, cystitis, and irritable conditions of the urinary organs. It is occasionally applied to relax spasm of the os uteri. In torpidity of the bowels depending upon want of tone, it is combined with purgatives; where there are irregular and spasmodic peristaltic movements it is conjoined with opium, alcohol, or laxatives. In these and other cases it owes its value to its antagonising hyperæmia, and to its contracting involuntary fibres of the hollow viscera.

Used externally, belladonna relieves irritable and painful wounds, the raw surfaces following frost-bite, the erythema of mud fever, over-sensitiveness of the skin and subjacent muscles, such as sometimes result in horses and hounds after severe exertion. In combination with aconite or opium, it abates and sometimes removes neuralgic and rheumatic pains. In all stages of garget it not only abates pain, but diminishes the troublesome secretion of milk. Applied to the skin, it checks undue perspiration (Ringer). Injections allay irritation of the bladder and rectum, and counteract spasmodic contraction of the uterus.

In common with hyoscyamus and stramonium, belladonna and atropine dilate the pupil of all animals, birds, it is said, excepted, and do so by whatever channel they are introduced into the body. The effect is accompanied by diminished intra-ocular pressure, by increased sufferance of light, and other stimuli; is apparent usually within half an hour after the use of the medicine, often in shorter time; is developed most rapidly, and with least impairment of vision, by applying the preparation round the eyelids, or dropping the solution of atropine into the conjunctival sac, and continues often for a day, especially if full doses have been used. These effects depend upon the mydriatic stimulating the sympathetic nerve and adjacent ganglia; the accommodating power of the third nerve is thus gradually overpowered. Diametrically opposite results are produced by Calabar bean, which contracts the

pupil by paralysis of the sympathetic nerve. Inflammation of almost any part of the eye is relieved by belladonna and atropine, which regulate circulation and allay irritability and pain. In ulceration of the cornea, occurring in delicate puppies, irritation is abated, and the protruding iris withdrawn. In specific ophthalmia in horses, and iritis in all animals, adhesions between the iris and lens are prevented or broken up, and are sometimes got rid of even when of long standing. Mydriatics are also used for facilitating the discovery and examination of cataracts, and the performance of operations on the eye. For such purposes a few drops of a four-grain solution of atropine are dropped into the conjunctival sac.

Doses, etc.—Of the dried powdered leaves horses and cattle take about ʒij.; dogs, grs. v. to x. The plant is, however, seldom used in this crude state, but is made into extract succus or tincture. From exposure to elevated temperature, belladonna preparations vary in strength, and are sometimes perfectly useless. An active well-keeping *extract* may, however, be made by the Brit. Phar. process, which orders bruising the fresh leaves and young branches, gradually heating the juice, getting rid of albumen, which interferes with keeping, and evaporating on a water bath to the required consistence. 100 lbs. of trimmed leaves and young branches yield nearly 7 lbs. of good extract. The dose for horses is ʒj. to ʒij.; for cattle ʒjj. to ʒijj.; for sheep, grs. xx. to grs. xxx.; for dogs, grs. ij. to grs. v. The *succus* or *juice* 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, ♏ x. to ♏ xx. for the smaller. The *tincture*, given in similar doses, is conveniently made by digestion and subsequent percolation of one ounce of belladonna leaves with a pint of proof spirit. For external application the juice or tincture, as well as ointments and plasters, are used; whilst Mr. Squire has introduced a soothing liniment styled *chloroform of belladonna*, made by mixing about one-seventh part of chloroform with the tincture.

Atropine or Atropia (C_{17} H_{23} NO_3) concentrates the whole activity of belladonna, is uniform and certain in its composi-

tion, and its expense alone prevents its use to the exclusion of all other belladonna preparations. It occurs in the plant in combination with malic acid. To prepare it, the leaves and branches or root are macerated in spirit; the residue is further exhausted in a displacement apparatus; from this tincture, containing the atropine bimalate, the alkaloid is precipitated by lime; after filtration diluted sulphuric acid is added to get the readily decomposable atropine in the condition of the more stable sulphate. One pound of root yields twenty grains of alkaloid. Pure atropine is in colourless, silky, acicular crystals, devoid of odour, with a nauseous bitter taste, volatile, sparingly soluble in water, soluble in one and a half part of cold alcohol, and manifesting alkaline reactions. It is recognised by its solution yielding a yellow precipitate with gold perchloride, and promptly dilating the pupil of the eye. Artificial atropine, identical in all respects with the vegetable product, in 1879, was obtained by Professor Ladenburg by heating tropate of tropine with hydrochloric acid. This was the first case of the synthesis of a true alkaloid. Daturine, the active alkaloid of Datura stramonium, or thorn apple, is understood to be identical with atropine.

Actions and Uses.—Atropine possesses in concentrated form the poisonous and medicinal properties of belladonna. It has more than one hundred times the activity of the best extract. Its action on horses and dogs was, in 1867, carefully investigated by Dr. John Harley and Messrs. F. and J. Mavor, the eminent veterinarians of Park Street, London, and their experiments and conclusions embodied in *The Old Vegetable Neurotics*, by Dr. John Harley. A healthy six-year-old horse and a weakly two-year-old thoroughbred were the subjects of experiment. Atropine sulphate dissolved in water was injected subcutaneously. One-twelfth of a grain 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

subcutaneously injected 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 was 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. From these and other admirable experiments of Dr. Harley's, it appears that the maximum stimulation of the heart results from doses insufficient to produce nervousness; medicinal doses quiet the cerebro-spinal nervous system, but over-doses cause undue sensibility to external impressions, wakefulness, and, in extreme cases, delirium.

Dogs bear relatively larger doses than horses; their brains are less, and their hearts more readily acted upon. Half a grain in the horse doubled the pulsations, one quarter of a

grain in dogs trebled them. Doses of one ninety-sixth to one-fourth of a grain raised the 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, 16 lbs. weight, 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 dry, the animal excited and whining; the effects continued four hours. Dogs 15 lbs. and 16 lbs. weight 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. Four to six grains subcutaneously injected caused in rabbits dilatation of the pupil, uneasiness, enfeebled respiration, and acceleration of the cardiac impulse. Double these doses caused, besides paralysis, muscular quivering, drowsiness, and in fatal cases diminution both of the frequency and force of the action of the heart and respiratory movements. Professor Fraser found that frogs receiving hypodermically 1000th or 1200th of their weight of atropine sulphate suffered from tetanus, but the appearance of this symptom was usually deferred for one, two, or even three days.

Atropine and Calabar bean are antagonistic as regards their action on the iris, but only partially so in their general effects. In a limited degree, and especially as to the cerebral symptoms, atropine and morphine are antagonistic.—(*Report on the Antagonism of Medicines.*) Professor Binz of Bonn has recently shown that morphine quiets the excitement produced in dogs by large doses of atropine; and that conversely atropine stimulates the cardiac and respiratory functions, and thus enables the patient to survive until the narcotic is excreted or decomposed (*Practitioner*, May 1877). Dr. Lauder Brunton has pointed out the antagonism between atropine and muscarin, the active prin-

ciple of poisonous fungi, especially as regards their effects on the heart and lungs. Comparison of jaborandi, bromal, and aconite with atropine discovers various points of antagonism. Like other tetanising alkaloids, atropine when combined with ethyl or methyl is shown by Professor Fraser to lose its stimulating and tetanising power, and become a paralyser of motor nerves.

Medicinal Uses.—Atropine, like belladonna, is prescribed as a heart stimulant and tonic, an excitant and regulator of capillary circulation, an antidote for nervous pain and spasm, a certain mydriatic, and occasionally as a diuretic. Stimulating the respiratory centre, it increases respiratory efforts, and, soothing the sensory nerves of the lungs and heart, it diminishes irritability and cough. Controlling capillary congestion and stasis, repeated hypodermic doses afford the best prospect of arresting the deadly muco-enteritis of heavy horses. In these and other cases, the subjugation of inflammation and pain is often helped by combining with the atropine one-fourth of a dose of morphine. With frequent in-rubbing of belladonna liniment into the tender inflamed udder, the administration or hypodermic injection of atropine is most valuable in garget in all animals. The concentrated form of atropine specially adapts it for subcutaneous injection, which proves so valuable on account of its directness, rapidity, and power. One-twelfth of a grain of atropine sulphate, used subcutaneously for horses, is stated by Dr. Harley to be equivalent to four grains given by the mouth, and these doses of the alkaloid correspond to one ounce of vacuum extract of belladonna.

Doses, etc.—Atropine sulphate is the most stable and convenient form in which to use the alkaloid. The dose in bolus or solution for horses or cattle is gr. ss. to gr. j.; for sheep, about gr. $\frac{1}{10}$; for dogs, gr. $\frac{1}{30}$ to $\frac{1}{20}$. One-fifth of these quantities suffices when the medicine is used subcutaneously. Conjoined with morphine its effects in overcoming congestion and relieving pain are increased and prolonged.

BENZOIN.

Benzoinum. Gum Benjamin. A Balsamic Resin obtained by making incisions into the bark of Styrax Benzoin, and allowing the liquid which exudes to concrete by exposure to the air. Imported from Siam and Sumatra. (*Brit. Phar.*)

Nat. Ord.—Styracaceæ. *Sex. Syst.*—Decandria Monogynia.

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, annually yields about 3 lbs. of resin. Incisions are made through the bark, when the thick white resinous juice exudes, concreting 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. Good benzoin is made up of yellow white tears, imbedded in an amber-brown transparent resin ; it 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. Benzoin is dissolved by alcohol, alkalies, and acids, but imperfectly by water. Inferior qualities are dark-brown or nearly black, and devoid of amygdaloid structure. Besides traces of volatile oil, moisture, and impurities, benzoin contains about 80 per cent. of three resins distinguished by differences of solubility, and from 14 to 18 of benzoic acid ($HC_7 H_5 O_2$),—an acrid, feathery, crystalline acid, prepared by dry distillation of benzoin, or by boiling it with lime and decomposing the calcium benzoate. Large quantities of benzoic acid are now prepared artificially from naphthalin ($C_{10} H_8$). Some samples of benzoin contain as much as 10 per cent. of the allied cinnamic acid ($HC_9 H_7 O_2$).

Actions and Uses.—Benzoin is a mild stimulant, expectorant, and antiseptic. It belongs to a group of resins and volatile oils, including storax, balsams of Peru and Tolu, eucalyptus, and cajuput oils. Benzoin was formerly in high repute for coughs, pectoral complaints, and consumption ; it is excreted mainly by the kidneys, part of the benzoic acid being converted into

hippuric acid; but it is now seldom used internally. Its stimulant and antiseptic properties have long rendered it a popular vulnerary. Like carbolic, salicylic, and boracic acids, it removes fœtor and destroys the irritating micro-organisms lodged in foul sluggish wounds. 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 macintosh covering, recent wounds may thus be maintained aseptic. Benzoin is chiefly used in the form of *Friar's Balsam*, or of its pharmaceutical imitation, *the compound tincture*, which is thus prepared :—Take of benzoin, in coarse powder, two ounces; prepared storax, one and a half ounce; balsam of Tolu, half an ounce; Socotrine aloes, 160 grains; rectified spirit, one pint. Macerate for seven days with occasional agitation, then filter, and add more rectified spirit to make one pint of the tincture. (*Brit. Phar.*) The well-keeping benzoated lard, now used for ointments, is made with ten grains of benzoin to each ounce of lard. Benzoic acid is occasionally prescribed in acute rheumatism along with, or alternated with, salicylic acid. Professor Rutherford has demonstrated that it acts as a mild stimulant of the liver; it is excreted by the kidneys in the form of hippuric acid, causing slight diuresis and soothing the irritable bladder in cystitis. Storax and Peruvian balsam, which belong to the benzoin group, are both serviceable for destroying lice and even acari. As an effective antiparasitic, soothing to the irritable skin, eight parts of storax are dissolved in two parts each of rectified spirit and oil.

BORACIC ACID.

Acidum Boracicum—Boracic Anhydride.

Boracic acid is obtained from sodium biborate by the action of sulphuric acid. In volcanic parts of 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, yielding transparent scale-like crystals of boracic acid. They have a feeble

acid taste, dissolve in twenty-six parts of cold water, in three parts of boiling water, in still less alcohol, and communicate a green colour to its flame. Aiding the fusion of other bodies, it is much used as a blow-pipe test; mixed with seven 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 boracic acid remains (B_2 O_3).

Actions and Uses.—Boracic acid is a non-volatile, unirritating, cheap antiseptic, similar to salicylic acid, differing from carbolic acid in being neither irritating nor volatile. It arrests fermentation and putrefaction. The carcase of a horse, which had lain for four months in a Californian soil rich in borax, was found completely preserved and free from odour (Robottom.) For surgical purposes, it is not so powerful or penetrating as carbolic acid; it is bland and unirritating; it is not absorbed, producing poisoning, as carbolic, freely used, occasionally does; applied howsoever liberally to recent wounds, it does not interfere with their healing by first intention. Its non-volatility limits its operation to the parts to which it is actually applied, and prevents the need of frequently changed dressings. It is specially suitable for superficial wounds which for some time have been under carbolic treatment, and on which granulation is tardy. A foul wound or ulcer, after being thoroughly washed with zinc chloride, or strong carbolic solution, or dusted with iodoform, in order to render it aseptic, may then be advantageously treated with the milder boracic acid. Bland and unirritating, it is particularly serviceable, whether as lotion or ointment, for burns. Alternated with zinc ointment, it promotes healing and relieves itching of the cracked irritable eczematous heels of horses. Catarrhal and purulent conjunctivitis are benefited by wetting the irritable surfaces three or four times daily with solutions of three to five grains to the ounce of water, alternated with atropine lotions.

A saturated *solution* is made with one part of acid to twenty-six of water, and is used diluted as required. A few grains of salicylic acid are sometimes added. An *ointment* is prepared by mixing in a mortar one part of powdered acid with five parts of basis made with two of paraffin and one of vaseline.

Boracic *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 the familiar carbolic lint, eight or ten folds are applied, either wet or dry, over the wound; being unirritating, no protection is needed; a piece of macintosh is laid on with the oiled surface inwards to prevent evaporation and access of the ubiquitous aërial disease-germs; 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 macintosh, acts as an antiseptic poultice, and its effects can be kept up by pouring the lotion from time to time between the folds of lint.

BUCKTHORN.

Rhamnus Succus. The recently-expressed juice of the ripe Berries of Rhamnus catharticus. (*Brit. Phar.*)

Nat. Ord.—Rhamnaceæ. *Sex. Syst.*—Pentandria Monogynia.

Buckthorn is a shrubby, thorn-like tree, which reaches eight or ten feet in height, and grows in the woods in various parts of this country. The berries, the only officinal part, are black, globular, about the size of black currants, and contain an acrid, bitter, nauseous juice, at first green, but soon becoming red from production of acetic acid. Besides sugar, colouring matters, acetic and malic acids, it contains two crystalline glucosides, rhamnine and rhamnegine (C_{48} H_{66} O_{29}); but the active purgative principle does not yet appear to be discovered. The succus or fresh juice soon spoils with keeping, and the chief officinal form is the syrup, which is thus prepared:—Evaporate four pints of the fresh juice of buckthorn berries to two pints and a half, add three quarters of an ounce each of sliced ginger and pimento, digest at a gentle heat for four hours, and strain. When cold, add six fluid ounces of rectified spirit; let the mixture stand for two days; then decant off the clear liquor, and in this dissolve five pounds or a sufficiency of refined sugar with a gentle heat, so as to make the spec. grav. 1·32. (*Brit. Phar.*)

Actions and Uses.—Buckthorn syrup is cathartic, but so mild as to be useless either for horses or cattle. Even in dogs or cats it is only mildly laxative, and its use is chiefly confined to young or delicate animals, and to cases of distemper. The dose for dogs is f℥i. to f℥ij., for cats f℥ iv. to f℥ i. Tolerably prompt and certain effects are obtained by combining with an ounce of the syrup two or three drachms of senna confection, ten or fifteen grains of jalap, or an ounce of castor-oil. These formulæ are convenient laxatives for medium-sized dogs; half the quantities suffice for cats.

CALABAR BEAN.

Physostigmatis Faba. Seed of Physostigma venenosum. Ordeal Bean of Old Calabar.

Nat. Ord.—Leguminosæ. *Sex. Syst.*—Diadelphia Decandria.

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 brown seeds, about the size of the ordinary bean. The kernel consists of starch and legumin, a small amount of a fatty oil, and in the granular protoplasmic particles is an amorphous, tasteless, active alkaloid, physostigmine, (C_{30} H_{21} N_3 O_4), and a crystalline alkaloid, eserine (C_{15} H_{21} N_3 O_2), soluble in alcohol, chloroform, acids, and partially in water.

Actions and Uses.—Calabar bean is a depressor of the motor tract of the spinal cord. It impairs, and in large doses destroys its reflex action. It depresses the functions of the respiratory centre, inducing slow and shallow breathing, and poisonous doses kill by respiratory arrest. It paralyses the cardiac sympathetic, diminishing the number of the heart's contractions, lessening the duration of each systole and in very large doses arresting action in diastole (Professor Fraser). It exerts its effects tolerably uniformly on all animals, but birds are particularly susceptible, while frogs require as much as dogs. It is quickly absorbed, promptly induces trembling, the hind extremities are first affected, muscular movements are impaired

and gradually cease, the muscles become soft and limp, paralysis overtakes the involuntary muscles, reflex action is destroyed, respiration becomes slower, and is usually arrested before the heart ceases to beat. Solutions applied to nerve trunks destroy conductivity; sensory impressions are first impaired. In all animals, and howsoever applied, it contracts the pupil, probably by depressing the sympathetic, and stimulating the motores occuli, producing exactly the opposite effects of atropine. It does not affect the brain, the special senses, excepting as regards accommodation of vision, the sensory nerves, or the muscles, which retain their contractility after death. Allied to other motor depressants, and especially to hemlock and curara, it differs from them in acting directly on the motor tract of the cord, while their effects are expended upon motor nerves. It has special power of contracting the pupil, and increasing peristalsis of the bowels and uterus. It is the physiological opposite of strychnine, and partially of chloral hydrate and atropine, a mixture of which, hypodermically injected at the same time, or shortly after a fatal dose of Calabar bean, successfully antagonises it.

Medicinal Uses.—Professor Fraser, who has zealously and thoroughly investigated the action of Calabar bean, considers it valuable in tetanus, serviceable in some cases of chorea and epilepsy, and, if promptly used, an antidote in strychnine poisoning. In tetanus, he enjoins its administration early, before the nervous system is extensively implicated, and the violently contracting muscles produce increased amounts of the acid stimulant which begets still more serious contraction. It should be given by the mouth, or, where that is difficult or impossible, the alkaloid is used hypodermically; the doses are repeated every hour or two hours; and the patient kept distinctly under its paralysing influence. It has proved serviceable in a few cases of paraplegia depending upon myletis. Dilatation of the pupil from affections of the third nerve is removed by a few drops of a solution of a grain of alkaloid to an ounce of water.

Doses.—Horses and cattle take grs. v. to grs. viij. of the powdered bean; dogs, gr. i. to grs. ij.; of the spirituous extract one-fifth or one-sixth of these doses are given; of the alkaloid

the dose for the larger quadrupeds is about gr. $\frac{1}{8}$; for dogs, gr. $\frac{1}{20}$ to $\frac{1}{10}$; but half these doses suffice for subcutaneous injection.

CALCIUM AND ITS MEDICINAL COMPOUNDS.

Calcium Oxide. Lime. Quicklime. Calx. CaO.

When limestone, chalk, marble, or other form of calcium carbonate (CaO CO_2 or Ca CO_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 a great affinity for water. It combines with about 24 per cent. of water, giving off much heat, and forming the hydrate or slaked lime (CaO, H_2O). A pint of water at 32° dissolves 13·25 grains of lime; a pint at 69°, 11·6 grains; a pint at 212°, 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 the undissolved matter to subside, and pouring off the clear solution. It is colourless, has an alkaline taste and reaction, and unites with the acids of oils to form soaps. As it readily absorbs carbonic acid it should be kept in closely stoppered bottles. Calcium oxide and its compounds are readily detectable in solution, by their yielding no precipitate with 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. Lime salts give a reddish-yellow tinge to flame.

The several calcium compounds being slowly absorbed and diffused, and having little affinity for animal textures, are not so active as those of many other metals. The oxide and carbonate, as is usually the case, nearly resemble each other, and are antacid and desiccant. The phosphate is a restorative. The chloride is a useful alterative, diminishing enlarged

lymphatics, solidifying tubercular deposits, and promoting the healing of ulcers. Calx chlorata is stimulant, astringent, and antiseptic.

Actions and Uses.—Lime is irritant, corrosive, desiccant, and antacid. It is a natural constituent of the animal textures, in which it occurs mainly in combination with phosphoric and carbonic acids. 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. Its effects are chiefly local. Lime, especially when unslaked, and in contact with mucous and abraded skin surfaces, attracts water, forms a coating of carbonate, and in larger amount irritates and superficially corrodes. Orfila mentions that 1½ drachm 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. Lime resembles potash and soda in its antacid properties and in promoting oxidation and quickening retrograde metamorphosis, but differs from them, and is allied to zinc and aluminium salts, in diminishing rather than increasing secretion; but its desiccant action is mechanical, and unaccompanied by true astringency.

Medicinal Uses.—Slaked lime and lime-water are used as antacids in indigestion, hoven, and diarrhœa, especially among cattle. One-fourth or one-third of lime-water given with the milk often prevents indigestion, flatulence, and diarrhœa amongst young calves and lambs by counteracting undue acidity, and preventing coagulation of the casein in large tough lumps. When acidity concurs with constipation, sodium bicarbonate is substituted for the lime in the proportion of a drachm to the pint of milk. To combat stomach derangement and acidity lime-water is appropriate; while the less soluble chalk, retaining its antacid and desiccant properties during its longer journey, is better adapted for intestinal acidity. Lime-water is occasionally given as an antidote in poisoning by the

mineral acids and by oxalic acid. By itself, but better still when conjoined with turpentine, it destroys bronchial filariæ, often so troublesome in calves and lambs, and, as a clyster, brings away ascarides lodged in the lower bowels. Mixed with oil or glycerine, it checks the discharge and abates the itching of eczema, but for such cases zinc preparations are usually more effectual. Scalds and burns are often treated by Carron oil, which consists of lime-water, mixed with an equal quantity of linseed oil. A more recent mode of cure consists in immediately protecting the parts from air and moisture by layers of cotton wadding applied with gentle and equable pressure. In powder, and still more frequently in solution, lime is used for cleansing and deodorising stables, cow-houses, and piggeries.

Doses, etc.—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 ℨ iv. to f ℨ v.; and the smaller, f ℥ ij. to f ℨ 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 is given diluted according to convenience.

CALCIUM CARBONATE. Calcis Carbonas. Carbonate of Lime. Chalk. $CaCO_3$.

Calcium carbonate occurs in the several forms of calcareous spar, limestone, marble, and chalk. The last, the only variety of much medical importance, abounds in the south of England in beds, mixed with silica, alumina, and iron oxide. These impurities are removed by trituration with a little water, agitation with a larger quantity of water, allowing the coarser fragments and foreign matters to subside, and pouring off the clear liquid, which slowly deposits a fine impalpable powder, which, when dried in blocks, constitutes whiting; when in smaller conical rolls is prepared chalk, the *creta præparata* of

the Phar. It is a dull white, earthy, crystalline 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 coral. 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 heated, the carbonic acid gas is driven off, and calcium carbonate deposited in the kettles and boilers. The presence of calcium carbonate does not, however, render the water unfit for drinking.

Actions and Uses.—Chalk is the cheapest and most convenient of antacids, and is much used for all the domesticated animals in the treatment of indigestion, chronic diarrhœa, and dysentery. It resembles lime, but is less local in its effects; its action extends throughout the whole of the digestive canal, neutralising acidity, absorbing irritants, and, during its absorption, leaving a film of lime salt which protects the intestinal surfaces. Excessive and faulty secretion is thus diminished. It is a good antidote for oxalic, carbolic, and the mineral acids. In a dry and finely divided state, it is used as a desiccant for external wounds and skin irritation, absorbing irritating discharges, and protecting from air and the ferments suspended in it.

Doses, etc.—For horses, ʒ i. to ʒ ij.; for cattle, ʒ ij. to ʒ 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 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 the horse, 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 ʒ i., opium ℥ i.,

creasote ♏ x., made into bolus; or again, half an ounce each of chalk, catechu, and ginger are conjoined with one drachm of opium. For either horses or cattle such prescriptions are more effectual when given dissolved in starch solution as prepared for the laundress, or in spirit and water, administered according to circumstances, either hot or cold. For sheep, similar combinations are used in about one-fourth of the doses mentioned. 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.

CALCIUM PHOSPHATE. Calcis Phosphas. Phosphate of Lime.

$Ca_3\ 2PO_4$.

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 is soluble without effervescence in hydrochloric and nitric acids.

Actions and Uses.—Calcium phosphate is present in bones and other 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 is useful for young, rapidly-growing, rickety subjects; conjoined with iron, is of service in anæmia and chronic diarrhœa, so common in badly-nourished young cattle and sheep; it benefits various chronic wasting and hectic complaints, although in many such cases the salt is often in excess in the urine. 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, etc.—Horses and cattle take ℥ i. to ℥ ij.; sheep and

dogs, grs. v. to grs. x. Small doses are preferable to large, which sometimes derange the bowels, and may be conveniently given, mixed with food, and in combination with an iron salt.

CALCIUM CHLORATA. Calx Chlorata. Chlorinated Lime. Chloride of Lime. Bleaching Powder. A mixture of Calcium Hypochlorite and Calcium Chloride, ($Ca\ 2Cl\ O + Ca\ Cl_2$), with lime hydrate 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 changes occurring are not well understood ; but the lime, after being exposed to the chlorine gas for about four days, is found to have absorbed nearly half its weight of it, and has become the familiar bleaching powder. It consists of about 28 per cent. of calcium hypochlorite, 25·5 of chloride, 23 of lime hydrate, and 24·5 of water (Fresenius).

Properties.—It is a soft, grey-white powder, with a feeble odour of chlorine, or rather of hypochlorous acid, and an acrid, bitter 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. Large quantities should not be kept in closely stoppered bottles, since such bottles sometimes explode owing to evolution of oxygen. It is partially 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. Careless preparation or bad keeping injures its quality. The intensity of its odour and the degree of its solubility are simple approximative tests of its strength and purity, and a good specimen should yield at least thirty-five per cent. of chlorine.

Actions and Uses.—Bleaching powder is irritant, stimulant, alterative, and astringent ; it is seldom given internally, but is

used externally as a desiccant, a weak antiseptic, an excellent deodoriser, and also as a disinfectant, and owes its several effects partly to the free lime it contains, but mainly to the hypochlorous acid and chlorine it so readily evolves.

Hertwig has given 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 from two to five hours. Considerable doses, when given repeatedly, did not impair appetite, but caused thirst and gradual emaciation. These and other symptoms depend upon the medicine yielding chlorine, which, like iodine and bromine, hastens tissue changes, and diminishes the amount of fibrin in the blood (Headland).

Mr. 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 Bastile, 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 noisome wounds, fistulæ, thrush, and canker; is one of the approved remedies for mange and grease; in diluted solution has been recommended for checking conjunctival ophthalmia, and other circumscribed and superficial inflammations, but is not so effectual as a lead or zinc lotion. It is a feeble antiseptic, inferior to zinc chloride or other metallic salts, or

to carbolic or the tar acids. But although it does not arrest putrefaction, or prevent fungous growth, it readily attacks and breaks up the products of putrefaction, and hence proves an effectual deodoriser and a tolerable disinfectant. 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 active chlorine and hypochlorous gases is desired, plates 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 kept 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 diminishes the agricultural value of any manure to which it is added. Scattered about stables or cow-houses, it keeps away flies; whilst neither rats nor mice frequent places where it is sprinkled, especially when mixed with sulphur.

Doses, etc.—Horses take ℥i. to ℥ij.; cattle, ℥ij. to ℥iv.; sheep, about ℥i.; dogs, grs. ii. to grs. v., given either in bolus, or with cold gruel, mucilage, or milk.

CAMPHOR.

Camphora. A concrete volatile oil obtained from the wood of Camphora officinarum. Imported in the crude state from China and Japan, and purified by sublimation in this country (C_{10} H_{16} O). (*Brit. Phar.*)

Nat. Ord.—Lauraceæ. *Sex. Syst.*—Enneandria Monogynia.

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 in which they have been sublimed. It is white, translucent, and crystalline, with a bitter, pungent, cooling taste, and a strong, peculiar, aromatic odour. It floats on water, and its density varies with the temperature, from about ·985 to ·996. Exposed to the air, it slowly evaporates; heated, it takes fire, and burns with a 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 alcohol, in eight times its weight of milk, and in 1300 times its weight of water. Camphor (C_{10} H_{16} O) is closely related to the family of hydrocarbons passing under the name of terebene (C_{10} H_{16}), present in turpentine, chamomile, cardamoms, cloves, valerian, and other such oil-yielding plants, and to methyl-propyl-benzol cymene or cymol (C_{10} H_{14}), an essential oil derived from cumin, thyme, and ajowan.

Sumatra or Borneo Camphor (C_{10} H_{18} O) is found in minute crystals 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 got from several different trees, nearly resembling Borneo camphor in composition, and containing the terebene, isomeric with oil of turpentine (C_{10} H_{16}). Artificial camphor (C_{10} H_{16} HCL) is got by the action of hydrochloric acid on oil of turpentine. A small quantity of

Japan camphor may be obtained, according to Berthelot, by oxidising oil of turpentine with permanganate of potash. The same chemist has converted Borneo camphor into ordinary camphor by the action of platinum black. On the other hand, ordinary camphor is reduced to Borneo camphor by the action of alcoholic potash.

Actions and Uses.—Excessive doses are irritant and narcotic; medicinal doses are stimulant, anodyne, diaphoretic, and slightly diuretic; externally it is stimulant, irritant, and feebly antiseptic.

Its poisonous action varies with the dose and the temperament of the patient. Swallowed in coarse powder, it acts chiefly topically, causing irritation, and even inflammation of the alimentary canal. When finely powdered, or in solution, it is absorbed, undergoes decomposition, is probably oxidised into the odourless camphoric acid, stimulates, and in large doses deranges, and subsequently depresses, the functions of the spinal cord, diminishes reflex action, and induces giddiness, delirium, convulsions, and stupor. It is stated to be excreted chiefly by the skin and bronchial membrane, and in less amount by the kidneys (Bartholow). Moiroud states that two ounces produced in horses convulsive movements and acceleration of the pulse, unaccompanied, however, by fatal results. Hertwig mentions that doses ranging from 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 also 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. Either in vapour or solution it prevents development of the lower vegetable organisms (Dr. Harley, *Practitioner*, October 1872).

Medicinal doses are believed to conjoin stimulant and anodyne effects, and to be useful in allaying, especially in young animals, the nervous irritability of chronic cough, diarrhœa, and spasmodic diseases. The credit it enjoys in

great part results from its being generally given in conjunction with such active medicines as opium, belladonna, ammonia, or other stimulants. A drachm each of camphor and belladonna extract, dissolved in one or two ounces of sweet spirit of nitre, and given in a pint of water or of cold gruel, may be repeated several times a day, in bronchial irritation of horses and cattle. Five grains each of camphor and belladonna extract, with ℥ xx. arnica tincture, in a few ounces of water, is prescribed, to quiet the cough and bronchial irritation accompanying distemper in dogs. In diarrhœa it is prescribed with chalk and opium, or with gentian aromatics and a few drops of hydrochloric acid; or two drachms camphor are combined with a drachm of iron chloride tincture and an ounce of ether. For influenza and other exhausting disorders, either in horses or cattle, a stimulating and soothing draught is made with two drachms each of camphor and ammonia carbonate and an ounce of ether, given in ale or cold gruel. Equal quantities of camphor nitre and belladonna extract, with three or four parts of treacle, form a soothing electuary very serviceable in sore throat in horses. A small portion is placed on the tongue at intervals of two or three hours. Diuresis occurs only after large and repeated doses of camphor. On dogs getting even half a drachm twice daily, I have not been able to perceive any aphrodisiac effects. It is popularly but erroneously believed to repel the secretion of milk in women and animals that carry fragments of it about with them; and, on equally insufficient grounds, has been regarded as an anthelmintic and disinfectant. Some veterinarians combine it with cantharides, under the impression that it lessens the irritant action which that substance has on the kidneys. Externally it is applied, either in oily or spirituous solution, to allay the irritation of skin diseases, wounds, and articular rheumatism, as well as chilblains in human patients.

Doses, etc.—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. Required for anodyne, and not for irritant effects, it is best made into an emulsion with eggs or dissolved in milk or oil. For external use, it is dissolved in six or eight parts of alcohol, in diluted acetic acid, linseed oil, or oil of turpentine.

CANTHARIDES.

Cantharis Vesicatoria. Lytta Vesicatoria. Blistering or Spanish Fly.

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 night-fall 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, and kill them by exposure to the fumes of oil of turpentine, or by immersion in boiling vinegar, and quickly dry them either in the sun or by artificial heat. Most of the flies used in this country were formerly brought from Spain (and hence their vernacular name of Spanish flies), but they 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 one to two 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 golden 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 greyish-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, especially strong while the animal is alive. When 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°. Its vesicant

action, and the brilliant green appearance of the wing-covers, are its distinguishing tests.

Cantharides contains fatty and other animal matters, and the acrid volatile crystalline *Cantharidin* ($C_5 H_6 O_2$), which is confined to the soft parts of the body, is present particularly in the female sexual organs, and constitutes about four or five parts to the thousand. It also occurs in the Mylabris Cichorii, common in India, and in most other vesicant insects. It is slowly deposited, when an alcoholic solution of cantharides is concentrated; when pure, it is a crystalline solid, melting at 482°, 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, the flies should be purchased entire. Attention to their characters will discover admixture of other insects. Damp, long-keeping, and the attacks of mites, moths, and beetles, often impair their activity. Such parasitic attacks 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.—Poisonous doses inflame the gastro-intestinal and urino-genital organs; medicinal doses are irritant, stimulant, and diuretic; external applications are rubefacient and vesicant.

General Actions.—Cantharides irritates and inflames any part with which it comes in contact. After primary topical irritation, large quantities, becoming absorbed and diffused, depress circulation, arterial pressure, and temperature. 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). In poisoning by cantharides, the post-mortem appearances are congestion and inflammation of the alimentary canal and urino-genital organs, the latter being usually most affected when the animal lives for some days after administration of the poison. Congestion of the brain, and effusion into its cavities, have also been recorded.

When cantharides has been given in excessive dose, or been largely absorbed from the skin surfaces, gastric and urinary irritation are combated by mucilaginous fluids, and opiates freely given by the mouth and rectum; by sodium bicarbonate or other alkalies; by tepid fomentations applied to any recently blistered surfaces; and, in the horse, by fresh sheep-skins laid over the loins.

When cantharides is swallowed, the active principle appears to be dissolved by the alkaline secretions of the digestive canal, and thus enters the blood. Whilst combined with the alkali, it is in part deprived of irritant properties, which are, however, recovered as it passes through the kidneys, where excess of acid probably neutralises the alkali, and the liberated cantharidin acts as a diuretic, or, in still larger amount, causes so much irritation that secretion is arrested and inflammation produced (Headland). Absorbed in full or repeated doses, it corrugates the red corpuscles, diminishes the contractile force of the heart and the blood-vessels, increases the number of the heart-beats and the temperature, induces hyperæmia and stasis, and even inflammation of various organs, especially of the bowels and urino-genital organs (Cantieri). Small and repeated doses are stimulating and tonic, but, unless used with caution, are apt to irritate the urino-genital organs, and produce diuresis. Given continuously, little vesicles usually appear on the skin, owing probably to small quantities of cantharidin being thus excreted. It stimulates the sexual appetites, and in North Germany is given to cows which are tardy in coming in season; but this

aphrodisiac action is uncertain in either sex, and seldom produced except by dangerously large doses. It is occasionally prescribed in relaxed states of the digestive and urinary organs; and in human patients to relieve dropsy, arrest chronic mucous discharges, and control psoriasis.

According to the strength and quantity of the preparation used, the period during which it is applied, or the sensitiveness of the skin, cantharides acts externally as a rubefacient or a vesicant. It causes irritation, pain, and swelling, with some redness, and subsequent eruption of vesicles or blisters, usually appearing in three to twelve hours, according to the strength of the preparation and the state of the part to which it is applied. They vary much in size, and, after a variable but usually short time, they burst, discharging a yellow serous fluid, which soon becomes sticky, and dries into scurfy cicatrices. Their being opened or broken causes unnecessary exposure and consequent pain of the raw surface. In a fortnight or three weeks the blistered part is usually healed, and all mark nearly obliterated. Sometimes, however, when the inflammation has affected the deep-seated tissues, the hair is removed, and does not readily grow again. This most commonly results from the excessive strength of the blister, from its containing corrosive mineral substances, or from its injudicious application to parts in a state of undue irritability. The blistering action of cantharides differs somewhat in the different domesticated animals, being most powerful in horses, rather weaker in sheep and dogs, and still weaker in cattle and swine. It is more prompt and efficient in young, well-bred, and thin-skinned animals, than in old, coarsely-bred, and hard-hided subjects. When applied directly to wounds, ulcers, or parts in an inflamed or erysipelatous state, it usually causes excessive irritation, and sometimes extensive sloughing. On the other hand, when there is much vital depression or active inflammation near the blistered part, the action is apt to be slow and imperfect. Compared with some other vesicants, cantharides acts slowly and gradually, but tolerably permanently: it causes a large amount of serous effusion, and is occasionally absorbed, inducing diuresis, strangury, and other constitutional symptoms—effects which occur especially when

it is applied in large quantity over an extensive surface, when the skin has been abraded, or when the local action is slow and imperfect. As a revulsive for overcoming acute congestion of internal organs by rapidly warming an extensive skin surface, mustard, ammonia liniment, or even smart friction, is more prompt, effectual, and safe than cantharides.

Medicinal Uses.—Diluted solutions, occasionally applied, stimulate the skin and hair bulbs, and thus favour growth of hair. Applied to skin surfaces, which are near to or overlie textures in a state of disease or pain, stronger dressings, by reflex action, counteract dilatation and paralysis of the capillaries occurring in congestion and in the early stages of inflammation. In later stages, when many capillaries are occluded, the blister by stimulation probably develops a higher nutrition; whilst in still more advanced stages it helps recovery by hastening liquefaction and removal of morbid matters. It abates pain, and relieves the breathing in pleurodynia and pleurisy, and also but less notably in bronchitis and pneumonia. In these cases and in ordinary epizootic sore throat, Principal Robertson prefers it to mustard, as causing less irritation and pain. Although of no use in removing general dropsies, fly blisters often abate local effusions, such as hydrothorax; and besides draining away the fluid, they also, in such cases, exert a wholesome effect in restoring normal nutrition. Similar good results also occur in colic; but in such cases mustard, being more prompt, is preferable. In arresting phlebitis, nothing is so effectual as a fly blister, which, in inflammation of the jugular vein of the horse, should be well rubbed in throughout the course of the tense corded swollen vessel. A mild blister, kept open for a week or ten days, benefits some cases of chronic paralysis; alternated by a gentle dressing of mercury biniodide ointment, it sometimes relieves chronic rheumatism; it either dissipates or brings to a head tardy abscesses, such as those of irregular strangles. As stimulants and vesicants, cantharidine blisters are largely used to combat irritation and inflammation of joints, bursæ, ligaments, tendons, cartilages, and bones; and in such cases probably act beneficially by rousing vitality, and determining reparative instead of destructive inflammation. For inducing these more permanent deep-seated effects, mer-

cury red iodide ointment is often substituted. Cantharides dressings sometimes promote healing of old unhealthy wounds, and weak and callous ulcers; remove scurfiness and thickening of the skin, as in mallenders and sometimes in inveterate mange; and stimulate the growth of hair. In open joints, where the breach of continuity is small, as from perforation by a stable fork, a cantharides dressing usually causes swelling and exudate sufficient to prevent further escape of joint oil. Cantharides blisters must not be applied directly to any part in a state of exalted vascularity and sensibility, nor to the skin where there is tendency to erysipelas. They are more serviceable in controlling inflammation of a limited and subacute type than of an extended and acute character. They seldom require to be persisted with until they produce wasteful serous discharges; more good usually results from a milder continuous action. In tetanus, in which they are still sometimes used, they are singularly unsuitable. Their liability to become absorbed and stimulate the urinary organs forbids their use where these parts are irritable or inflamed.

Doses, etc.—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, gr. ss. to gr. 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 chiefly in the form of powder, tincture, ointment, liniment, or 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 small quantities of euphorbium, liquor ammoniæ, or oil of turpentine. The tinctures in common use act more speedily than the ointments, but their effects are less powerful and of shorter duration. 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 are much used in veterinary practice. Their oleaginous constituents render them easy of application, and insure the solution of the cantharidin. 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 vaseline. Such an ointment, when well made and applied with smart friction, acts very efficiently, is little apt to blemish, and hence is preferable to more complex preparations. One part each of powdered cantharides, Venice turpentine, and resin, with four parts of vaseline, palm oil, or lard, carefully melted together, also makes an excellent ointment. Amongst the many irritant substances which needlessly enter into the composition of the blistering ointments of the shops, are euphorbium, sulphuric acid, and occasionally even corrosive sublimate and arsenic. The two former are present in the following common preparation:—Powdered cantharides, one ounce; powdered euphorbium, one ounce; oil of thyme, two drachms; sulphuric acid, two drachms; resinous ointment, four ounces. For horses such a preparation must be used with much caution; for, besides enough of cantharides alone to render it an active blister, it contains a very unwarrantable amount of euphorbium and sulphuric acid, each of which ingredients, if used at all, should never exceed in quantity one-eighth part of the active principles of a blister. In larger amount they are apt to cause unnecessary pain, sloughing, and permanent blemishing. 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 twelve ounces of lard. In preparing cantharidine ointments, the oleaginous and resinous substances are melted together over a slow fire, or, better still, over a water bath, the powdered cantharides and any other ingredients stirred in, the heat, which should not exceed 200°, continued for ten or fifteen minutes, and the mass stirred until cool. The ointment (*unguentum cantharidis*) of the Brit. Phar. is thus directed to be made :—"Take of cantharides and yellow wax of each one ounce; olive oil, six fluid ounces. Infuse the cantharides in the oil in a covered vessel for twelve hours, then place the vessel in boiling water for fifteen minutes, strain through muslin with strong pressure, add the product to the wax previously melted, and stir constantly whilst the mixture cools." To insure the full vesicant effect of cantharides, the hair, where rough or long, should be clipped or shaved off; the skin, if dirty, washed with soap and water; and the ointment then spread over the part, and well rubbed in. The extent of the surface to be covered must depend of course upon the nature, seat, and extent of the malady. Too large a surface, such as all four limbs, freely blistered at once, sometimes induce serious irritative fever, and occasionally tetanus (Professor Williams). 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 much 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 the cradle, or tying up the tail when required; in the dog, by the use of the muzzle. On the second or third day after the blister has been applied, the part should be fomented with warm water, and dressed with oil, lard, vaseline, or carron oil; but if a sufficiently powerful effect has not been produced, a little more of the blister may 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 also 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 not much used in veterinary practice, being difficult of application, and very apt to be displaced by the powerfully corrugating action of the panniculus carnosus. They are made in the same manner as ointments, but rendered more strongly adhesive by the addition of resin or pitch. 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. Phenyl Hydrate. H, $C_6 H_5 O$.

Carbolic acid was discovered by Runge in 1834; it is an ordinary constituent of the urine of herbivora, and one of the many interesting products obtained from coal-tar. Cannel coal is its most prolific source, but it is also present in other coals, as well as in bitumen and petroleum. The commercial supply is obtained from the black heavier coal-tar oils, which are shaken with caustic soda or milk of lime, the watery portion decanted, and the resulting carbolate decomposed by a mineral acid. The impure carbolic acid, when rectified, occurs at the temperature of 40° in colourless needle-like crystals, which absorb moisture from the atmosphere, melt at 104°, boil at 370°, have a specific gravity of 1·065, with a pungent creasote odour and taste. It is devoid of acid reaction, dissolves in about twenty parts of water, but is more soluble in glycerine, oils, alcohol, ether, and acetic acid. It coagulates albumen. It destroys the particulate animal or vegetable cells which produce the several sorts of fermentation. With sulphuric acid, it unites to form sulpho-carbolic acid, which produces a series of definite stable, soluble, crystallisable salts—the sulpho-carbolates, which exhibit in mild degree the actions of carbolic acid. With nitric acid, it forms picric acid ($C_6 H_3 (NO_2)_3 O_4$)—an antiseptic, and much used as a

yellow dye. When carbonic anhydride is passed through dry powdered phenol-sodium, another valuable antiseptic is produced—salicylic acid.

Carbolic acid is distinguished by its odour. Bromine water affords the most delicate test, and forms, even in very dilute aqueous solutions, a yellow precipitate of tribromophenol. Concentrated oil of vitriol, containing a little nitrous acid, gives a green coloration with phenol (Liebermann). An aqueous solution, even if containing $\frac{1}{1000}$ part, when treated with a drop or two of iron perchloride solution, produces a beautiful mauve colour. The Brit. Phar. gives an easy but less delicate test: a slip of deal dipped in a carbolic acid solution, and afterwards in hydrochloric acid, and allowed to dry in air, acquires a greenish-blue colour. As a test for purity, Mr. W. Crookes gives the following instructions:—"A wine-glassful of the liquid is placed in a bottle and mixed with half a pint of warm water; if the greater part dissolves, it is an adulterated article; if the liquid tested with litmus paper is strongly acid, sulpho-carbolic acid will probably be present; if alkaline, caustic soda has probably been used as a solvent." A good specimen is dissolved in twice its bulk of caustic potash, in which oil of tar is insoluble. Creasote, apt to be mistaken for impure carbolic acid, is distinguished by its lesser solubility in water, by boiling and drying up at 212°, instead of at 370°, and by not solidifying at 40°.

Cresylic acid occurs along with carbolic acid in coal-tar, has a creasote odour, is not crystallisable, develops a violet colour with sulphuric acid, has antiseptic properties quite as marked as those of carbolic acid, and, like it, is an alcohol in its chemical affinities, its composition (H, C_7 H_7 O), and also in its physiological effects.

Actions and Uses.—Carbolic acid is an irritant narcotic poison. It is administered as a stimulant and antiseptic. It effectually destroys the animal and vegetable cells which produce the several forms of fermentation and putrefaction. It is the most widely used surgical antiseptic, is a topical anæsthetic, an antiparasitic, and, in a state of concentration, a superficial caustic. It is an effectual disinfectant.

General Actions.—A strong solution applied to the skin or

mucous surfaces acts as a topical irritant, coagulates albumen, and leaves a white, dry, roughened surface, more or less deprived of sensation, from which the shrivelled epidermal scales subsequently peel off. When swallowed, besides exerting this local action, with increased salivation, and in carnivora usually causing vomiting, it is readily absorbed, partly unchanged, partly as a carbolate, and produces inebrient effects analogous to those of alcohol. Like alcohol and oil of turpentine, it acts on the cerebro-spinal axis; in the lower animals more notably on the spinal cord, stimulating, deranging, and paralysing its functions, and destroying life by respiratory arrest. Moderate doses stimulate the respiratory centre and end-organs of the vagi, both in the lungs and heart. Like the other bodies of the alcohol series, considerable doses notably reduce temperature, owing mainly to diminished blood-pressure and retarded oxidation. Two drachms prove immediately fatal to dogs, two drachms killed a full-grown cat 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). Half-drachm doses given to small dogs caused immediate trembling, agitation, frothing at mouth, sometimes vomiting, staggering, occasionally convulsions, and recovery in about an hour. Three or four drops placed under the wings of sparrows caused excitement, restlessness, and death in half an hour; toads, earth-worms, 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. Ounce doses have only slight and transient effects on horses. Poisonous doses immediately cause dogs, rabbits, and other animals to reel, move in jumps, and fall as when intoxicated; they tremble and show muscular weakness, cough, froth at mouth, and are paralysed, the fore extremities being usually first affected; albuminuria and hæmaturia are occasionally present; there is more or less anæsthesia and unconsciousness; gasping, difficult breathing, and convulsions precede death.

Poisoning is produced by whatever channel the acid is

introduced into the system. Dressings used in human surgery sometimes cause nausea, vomiting, giddiness, the urine is high-coloured, and has a smoky smell. Scabby sheep too freely dressed occasionally suffer from congested and inflamed lungs, linger for weeks, and even then die. Dogs are particularly susceptible, even a single dressing incautiously applied over a large surface produces dulness, trembling, and disinclination for food, often continuing for several days. Stronger dressings too freely used, within a few minutes cause excitement, blowing, unsteady gait, and occasionally even fatal coma. 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, fœtor 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*). Poisoning from the dark impure acid results from the homologous cresylic acid, which is greatly more irritant than pure carbolic acid. Both poisonous and medicinal doses are excreted by the lungs and skin, but chiefly by the kidneys, converted in part into indican and oxalic acid, causing olive discoloration of the urine, and preserving it for a long period from putrefaction. The urine of animals receiving carbolic acid, or to whose skins it has been freely applied, gives off a tar odour when treated with a drop or two of sulphuric acid, whilst a blue colour is developed on adding to it a little iron perchloride solution (Dr. S. Ringer).

The post-mortem appearances are, brown discoloration and corrugation of the mouth and fauces, and sometimes of the stomach; strong solutions leave patches of redness and inflammation in the stomach and small intestines; where death has occurred within a day after the poison has been taken a smoky creasote odour pervades the body; but where life has been prolonged the volatile poison will in great part have escaped; the internal organs are congested; the vessels of the brain are full of fluid blood; serous effusion is generally observed on the surface of the brain and within the ventricles (Dr. Cullen); the lungs, in cases that have survived several days, are ecchymosed; the blood is feebly coagulated, but the corpuscles are

unchanged (*The Antiseptic System*, by Dr. Arthur E. Sansom. 1871).

The most reliable chemical antidote is lime saccharate, but it is ineffectual in arresting constitutional symptoms. Any unabsorbed acid should be got rid of by emptying the stomach by an emetic or the stomach-pump. Topical irritation is combated by white of egg, mucilaginous drinks, and glycerine, and by inhalation of steam medicated with a little laudanum. Elimination of the poison is hastened by stimulating the functions of the skin and kidneys. Dr. A. C. Post, of New York, has demonstrated by experiment that atropine antagonises the systemic symptoms of carbolic acid.

A great proportion of the manifold uses of carbolic acid depend upon its destroying the living cells which excite and maintain fermentation and putrefaction. It readily kills the germs of yeast and mould. One part added to 200 or 250 parts of vegetable solutions arrests growth of germs. Serum, blood, milk, and other albuminoids require, however, larger proportions of carbolic acid to prevent their molecular change. Milk is maintained unchanged by $\frac{1}{54}$ part of acid (*Antiseptic Surgery*, by W. W. Cheyne). Meat steeped for an hour in a one per cent. solution is effectually preserved; a sparrow suspended in a corked bottle wetted with the acid remained sound for a month, the feathers showing no disposition to separate. Not only does carbolic acid destroy the minute cells or germs which excite fermentation and decay, but oats, barley, beans, and lentils, when soaked in a one per cent. solution, do not germinate; plants watered by it die, the flowers suffering before the leaves. The vapour or solution promptly poisons not only bacteria, and micrococci, but such creatures as fleas, moths, ticks, earth-worms, ascarides, and lumbrici. Sprinkled on the doorway, it alarms and turns aside the advancing armies of ants which in Mexico and other parts of America sometimes cause much annoyance and destruction. On the threshold of wounds it is equally effectual in warning off and killing those ubiquitous germs, which, floating in the atmosphere, are ever ready to drop upon, irritate, and disorganise surfaces deprived of their protecting covering. A minute amount mixed with vaccine lymph deprives its granu-

lar matter of its characteristic activity. Mr. W. Crookes's experiments indicate that the virus of cattle plague loses its reproductive powers when exposed to carbolic vapours (Report to Cattle Plague Commissioners). The subtle, actively-reproducing germs given off during the progress of other catching diseases, are also destroyed when brought into contact with carbolic acid ; indeed, no substance proves so generally serviceable as a disinfectant.

Medicinal Uses.—The administration of carbolic acid is indicated in those diseases characterised by the production of specific germs, and in which tissue-change is unduly violent. It has proved of value in cattle plague, lowering advancing temperature, and prolonging even where it did not actually save life. One hundred and five grains of acid in six ounces of water were injected by Mr. William Crookes into the blood of a cow suffering from cattle plague, with little apparent injury beyond what might have been expected from any simple fluid ; the patient gradually recovered. M. Bouley, president of the commission appointed by the French Academy of Sciences to investigate malignant pustule, reports that in attacks produced by inoculation every patient died ; but when cattle, inoculated in the same manner, were dosed with two or three drachms daily of carbolic acid, four out of five animals recovered. A like favourable result also followed the use of the acid in horses and sheep inoculated with pustule. In the Texas cattle-fever the remedy most relied on has been twelve ounces each of carbolic acid and sodium bicarbonate, mixed with four fluid ounces of glycerine ; the dose of the mixture being two table-spoonfuls thrice daily in a quart of water. In the malarial fevers of man its value has been tolerably conclusively established. In tedious malignant cases of strangles and putrid sore throat, in typhoid fever, purpura hæmorrhagica, and farcy amongst horses, carbolic acid has been used with success. In some of these cases it has been advantageously conjoined with equal quantities of iodine. Two drachms of carbolic acid given thrice daily to horses with farcy and glanders afforded only temporary benefits. It deserves further trial in checking hectic fever, septicæmia, and pyæmia, and allaying the fever and pain of weed. By Mr. Priestman and

others, it has been used with some benefit in the treatment of the contagious pleuro-pneumonia of cattle. In black quarter in young cattle it appears to stave off a fatal issue, and, given to subjects breeding the disease, it should operate as a preventive. It mitigates the severity of mouth-and-foot disease, and, when given in this and other contagious diseases, it probably checks reproduction of the specific virus, and thus prevents or reduces its risk of spreading. In all animals it is effectual in counteracting dyspepsia and flatulence, especially when depending upon atony and liability to fermentative changes. A few drops added to the ordinary prescriptions used in diarrhœa and dysentery help to arrest undue secretion, and further deprive the excreta of their acridity and fœtor. Inhaled, diluted with air or steam, it diminishes excessive secretion and reflex irritability in chronic bronchitis, folicular pharyngitis, and even in phthisis, and in such cases probably kills septic germs, or deprives them of their reproductive powers. Caution must, however, be exercised in using carbolic acid, whether by inhaling, injection, or as an external dressing, for it is liable, as above mentioned, to become absorbed and develop its irritant narcotic properties.

Surgical Uses.—Professor Lister has inaugurated the successful use of carbolic acid and other antiseptics in surgery. He has demonstrated that no wound or injury exhibits irritation and suppuration, that blood-clot and exudate undergo no putrefaction until exposed to the dust particles bearing the particulate micro-organisms constantly present in the atmosphere, but especially abundant and of an unusually injurious character in the neighbourhood of putrefying remains and septic wounds. While the skin continues unbroken, as in simple fractures of bones, and in muscular and ligamentous strains, or in abscesses carefully opened antiseptically with the canula and trocar, wounds are unaccompanied by noisome discharges or wasteful suppuration, septicæmia is unknown, and even erysipelas is very rare. Not only is the comfort and health of the individual promoted, but annoyance and injury to adjacent animals are also prevented. Professor Lister's great aim is to bring all wounds into these favourable conditions of protection from septic materials and perfect rest. Surgical wounds in

human patients, made with fitting precautions from the first, can be maintained aseptic, with the beneficent results of obviating pain, hastening convalescence, and reducing the mortality of capital operations by greatly more than one-half. The fullest benefits of antiseptic treatment are, however, secured only when it is adopted so soon as the surface skin is broken. Within twenty-four hours, often in much less time, the irritating aërial germs will have found entrance into the wound, their work of disintegration will have begun, preservation of blood-clot and serum will be impracticable, and mischief ensues which, although comparatively easy to prevent, is not always easy of cure.

Even in such cases antiseptics afford the best prospect of limiting the evil. The multiplying organisms which irritate and soften the granulations, which provoke suppuration, and are, moreover, liable to become absorbed, producing constitutional mischief, are destroyed by thoroughly cleansing the wound with a one to twenty solution of carbolic acid, or with a solution containing two or three grains of zinc chloride to the ounce of water. When thus rendered aseptic, the wound must be kept so by the careful systematic use of antiseptics. An aseptic wound is, however, maintained in its healthful state by comparatively weak antiseptics. Micro-organisms cannot survive in carbolic vapour or penetrate through carbolised dressings.

Following Professor Lister's instructions, a wound, whether incised, lacerated, punctured, or contused, whether made by accident or by the surgeon's knife, should, if possible, be maintained in the aseptic state, and at once protected from the ubiquitous contaminating organisms. If it has been exposed, even for a few minutes, organisms will already have got access, and, even at the risk of adding to the irritation, it should be washed with a watery solution containing one part of acid to twenty of water. Any lacerated or envenomed portions should be irrigated with an oily or glycerine solution of double this strength, or with a strong zinc chloride solution. Where the wound cannot be effectually covered up, it should be kept constantly wetted with a two or three per cent. solution. Where strappings can be kept on—not always an easy matter

with veterinary patients—and where the wound is extensive, and likely to be irritated by continuous contact of considerable amounts of carbolic acid, there is first applied a protective of oiled silk varnished with copal and coated with dextrine, which allows the silk to be uniformly wetted with the antiseptic solution. Over this protective, or in ordinary cases directly upon the wound, is laid six or eight folds of carbolic lint, made of coarse unbleached gauze or muslin, which has been thoroughly impregnated by prolonged soaking with a mixture of one part of crystallised carbolic acid, four of resin, and seven of paraffin. Through these dressings, the air, before reaching the raw surface, is filtered and deprived of those organisms which produce putrefaction. To retard undue evaporation of the volatile antiseptic, and prevent discharges soaking through the dressing, a piece of macintosh cloth is then applied with the india-rubber coating next the wound, and wetted with the carbolic solution. Over this, and underneath the appropriate strappings, are placed, as required, folds of carbolised lint tow or oakum. During surgical operations to insure the wound being kept aseptic, Professor Lister has a steam spray-producer continually directing carbolic spray over the wound and dressings. The spray-producer is again used when the dressings require renewal, which is needful after one or more days, and is indicated by irritation and pain of the injured part, or by discharge having extended beyond the gauze. Anything brought in contact with a wound may introduce the ubiquitous destructive organisms, hence the hands of the operator and of his assistants, before commencing, must be thoroughly washed with a one to forty carbolic solution, while instruments, the silk, horse-hair, catgut, or wire for sutures, the tow, sponges, etc., should be kept close at hand in a vessel containing a one to twenty carbolic solution. With these precautions to maintain wounds in an aseptic state, various operations on the lower animals, previously unjustifiable, may now be undertaken with greatly improved prospects of success. Such are the opening of the horse's abdominal parietes for the reduction of strangulation and intussusception of the bowels, or even for the removal of enormous masses of ingesta, the removal of hydatid and other tumours from

the liver and other internal organs, the opening of joints and bursæ, and the removal therefrom of lymph or faulty synovia.

Carbolic acid is in daily use for many purposes amongst all classes of patients. It is used, as already indicated, for all wounds from which the injurious micro-organisms are to be removed, or from the attacks of which they are to be protected. Badly broken knees and open joints, unless perfectly recent, require thorough washing, not only of the injured part, but of the surrounding skin, with a saturated watery solution, while the antiseptic dressings, applied as above described, are usually kept irrigated with weaker solutions. So effectual is the preservative power of carbolic acid that portions of damaged or dead muscle, tendon, or bone, if they cannot be safely separated, when kept wet with carbolic solution, and drainage is provided for discharges, are frequently absorbed, or when large become mummified and cease to irritate. Fistulæ of the poll, withers, or lateral cartilages, cleansed of micro-organisms, provided with a dependent opening, and protected from fresh incursions of the irritating organisms, are often radically cured without operation. Serous abscesses and bursal enlargements opened with antiseptic precautions, and at once covered in by antiseptic dressings, heal up usually by first intention. Tuberculous deposits are shown by Koch to contain specific bacilli, and cancerous and melanotic tumours, doubtless connected with analogous organisms, where they cannot be dissected out, may be injected with strong carbolic solutions, which will destroy these as they do other lowly organisms. Farcy buds and ulcers are often stimulated, and healing promoted by thorough soaking with strong carbolic. The noisome eczematous eruption known as grease is often benefited by a daily dressing of strong acid, repeated for several days, when the improvement thus induced is usually further promoted by solution of zinc sulphate, or ointment of zinc oxide. A one to two per cent. carbolic oil solution, with a little acetate of lead lotion, constantly applied, allays pain and prevents or limits suppuration of burns and scalds, and is usually followed up by dressing the abraded surface with the bland, unirritating boracic ointment. 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, which may be left undisturbed for a couple of days. Similar treatment is serviceable in carbuncle of the cornory band occurring in hard-worked horses in wet, cold weather. A saturated watery solution answers well in foot-rot amongst sheep, but in chronic cases, and where reparative power is deficient, it is usefully alternated with turpentine and oil, or, where granulations are superabundant, by copper sulphate ointment.

The impure brown carbolic acid, or a strong solution containing more than one part of acid to eight of oil, glycerine, or diluted acetic acid, is an active stimulant and superficial caustic, and is occasionally used as a rubefacient in sore throat and scrofulous swellings of joints, and further exerts a benumbing or local anæsthetic effect sufficient to abate topical irritation. A ten per cent. solution, which some practitioners prefer to make with diluted acetic acid, destroys the epiphytic growths of ringworm, and is also suitable for certain cases of psoriasis and prurigo, and for chronic eczema. The application of carbolic solution speedily removes the itching and swelling occasioned by stings of bees, wasps, and scorpions, and, promptly used, prevents mischief from dissection and post-mortem wounds. Diluted solutions, such as that known as M'Dougall's Sheep Dipping Composition, is used for destroying ticks and the acari of scab and mange, and has been favourably reported on by the Australian Government Commissioner appointed to inquire into the spread and cure of scab in that colony. After thorough scrubbing with soap and water, preceded (where the hair is thick or matted) by shaving, one part to twenty of oil is with care used for mangy dogs, but to avoid dangerous absorption too large a surface must not be dressed at a time. Injections or spray prove useful in atonic conditions of the fauces, and urino-genital mucous membrane, especially when accompanied by noisome discharges. In injury of the uterus or vagina during parturition in any veterinary patients, carbolic injections are very valuable. A saturated watery solution seldom causes undue irritation, and generally arrests bleeding, straining, and fulsome discharges, mainly by de-

stroying, as they do elsewhere, the special organisms, and exerting also topical anæsthetic action. No treatment is so effectual in metritis in ewes. Such cases, however, would be much less common if shepherds would observe greater cleanliness, and thoroughly cleanse their hands with carbolic solution before rendering assistance in lambing. Such precautions are doubly 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 bacteria.

The prevailing error in the surgical employment of carbolic acid is its use in too concentrated form. This is specially injurious when application is made of the impure acid, which contains the more irritating cresylic acid. But even pure carbolic, dissolved in 10 to 15 parts of oil, or 20 to 25 of water, is too strong for continued use. One or two dressings of any such solutions sometimes encourage reparative hyperæmia, but if persisted with, and more particularly if applied without some oiled silk kept over the wound, they excite undue irritation, repress granulations, prevent skin growth, and are liable to become absorbed. When wounds or ulcers for ten days or a fortnight have been regularly dressed with the more penetrating and volatile carbolic solutions, it is usually desirable to change the application, and healing is then often hastened by milder dressings of sulphurous, boracic, or salicylic acids, of sanitas, or eucalyptus oil. The volatility and ready absorption of carbolic acid necessitates the substitution of other antiseptics, or its being used with great caution in extensive wounds, such as large burns, or where, as in wide-spread mange, a large surface has to be dressed with the antiparasitic.

As a disinfectant, carbolic acid is extensively used for the purification of stables, cowhouses, piggeries, and poultry pens, of railway horse-boxes, cattle-trucks, and loading-places, and of cattle-vessels and landing-stages. For such purposes it is often conveniently used in the form of M'Dougall's or Calvert's disinfecting powders, which are sprinkled daily throughout the stables of some of the extensive omnibus, cab, and carrying

establishments of London, Liverpool, and other large towns, at an annual cost of 5s. for each horse. Carbolic acid, when thus employed, is not injurious or distasteful either to the animals or their attendants: it drives away flies and fleas; arresting decomposition, it prevents unpleasant smells; conserving and fixing ammonia, it increases the value of manure with which it has been mixed; with other germs it destroys those given off from cases of contagious disease. To insure thorough 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. The vapour is readily got 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 particulate germs. Along with carbolic acid, sulphurous acid or sulphites may be fittingly used. To destroy the germs so soon as they are formed, or if possible limit their formation, animals infected with contagious disorders should have the acid given internally, and may also be lightly sponged over daily with a solution containing not more than one per cent. The daily use of the antiseptic, both internally and externally, prevents, with tolerable certainty, healthy animals in near proximity to those diseased from absorbing or suffering from any infecting particles which may happen to reach them.

For preserving sewage or other fermentescible matters, when freely mixed with water, carbolic acid is not so effectual as copper sulphate or zinc chloride; for arresting the decomposition of night-soil, it is proved by Mr. W. Crookes's experiments to be inferior to common salt; for neutralising or destroying offensive gases, it is not nearly so effectual as chlorine bleaching-powder or potassium permanganate. No other antiseptic is, however, so effectual in preserving or disinfecting hides, skins, or wool, or subjects for anatomical examination, which keep for two months if injected and subsequently occasionally wetted with a solution containing one per cent. A similar solution preserves natural history specimens from mildew and moths. Mixed with the earth of vine

borders it prevents oidium. Boned meat is brought in good condition from Monte Video and elsewhere, compressed and packed in canvas bags wetted with carbolic solution, and subsequently coated over with tar oil.

Doses, etc.—Horses and cattle take ℥ xv. to ℥ xl.; sheep and pigs, ℥ v. to ℥ viii.; dogs, ℥ i. to ℥ ii. The crystallised acid is best for internal use. It is made into bolus with meal; but is more readily absorbed, more regular in its effects, and less likely to develop local irritation, when given dissolved either in water or glycerine. 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. An *ointment* is made by rubbing in a mortar fifteen to twenty grains of acid with an ounce of benzoated lard. The *liniment* usually contains one part of acid shaken up with twenty of rapeseed oil, which is preferable to the drying linseed oil. For external purposes it is often useful mixed with soap. Watery solutions are most penetrating and best fitted for cleansing wounds or skin surfaces; but simple watery solutions, on account of comparative insolubility in water, do not contain more than five per cent. of acid. For dusting over irritable surfaces it is mixed with starch, lycopodium, and occasionally with charcoal and plaster of Paris. M'Dougall's Disinfecting Powder, much used for cleansing and purifying, contains 33 per cent. calcium carbolate, 59 per cent. magnesium sulphate and water. Calvert's Powder, also a valuable antiseptic, consists of 20 per cent. carbolic acid, mixed with the powdered refuse of alum works. Calvert's No. 5 Carbolised Fluid contains 80 per cent. carbolic and cresylic acids, and, like all other carbolic solutions, loses strength unless kept in stoppered bottles.

Sulpho-Carbolic or Sulpho-phenic Acid (H,C_6H_4O,HSO_3) is prepared by mixing, with the aid of heat, equivalent proportions of carbolic and sulphuric acids. When slowly crystallised, it forms thin, colourless, deliquescent needles; it has less odour than carbolic acid; at 400° it becomes red; at 540° it boils. It is soluble in water, alcohol, and ether. When the acid in solution is saturated with the oxides or carbonates of the alkalies, earths, or metals, there are obtained crystalline,

soluble, almost odourless, usually colourless, stable sulpho-carbolates, which possess in mild degree the actions of carbolic acid, and have been examined chiefly by Dr. A. E. Sansom (*Antiseptic System*, 1871). The sodium salt (Na C_6 H_5 SO_4) is a tasteless antiseptic and alterative, given to horses and cattle several times daily, in doses of grs. xx. to grs. lx., and to dogs in grs. v. to grs. xv. The lime salt has been used in human practice in indigestion, diarrhœa, and dysentery. The iron salt is tonic and antiseptic. The zinc and copper salts conjoin the antiseptic and astringent properties of their components. These sulpho-carbolates are excreted by the kidneys in great part unaltered, and Dr. Sansom records that so effectual are their antiseptic properties that the urine of animals receiving medicinal doses has been kept for six months without undergoing putrefaction. But although useful for topical purposes, they probably do not readily give up their carbolic acid in the body, and certainly have not fulfilled the expectations formed of them as internal antiseptics.

CASCARILLA BARK.

Cascarillæ Cortex. The Bark of Croton Eleuteria.

Nat. Ord.—Euphorbiaceæ. *Sex. Sys.*—Monœcia Monadelphia.

Cascarilla Bark is principally imported from the Bahama Islands in quilled pieces about the size of a drawing pencil, and varying from two to four inches in length. Its structure is dense and brittle; its outer surface fissured, and usually covered with a light-coloured lichen; its inner surface smooth and light brown. Its powder has the same colour, with a strong, pungent, but not disagreeable taste, and a peculiar aromatic odour, which is increased by heat, and recommends it as a constituent of fumigatory pastilles. Besides woody fibre, gum, and tannin, it contains 15 per cent. of two descriptions of resin; 1·5 of a pungent volatile oil isomeric with oil of turpentine; and the neutral crystalline bitter cascarillin (C_6 H_9 O_2).

Actions and Uses.—Cascarilla is an aromatic and bitter

tonic, allied to chiretta and resembling cinchona, but less active, and occasionally used in indigestion, diarrhœa, and convalescence from exhausting diseases.

Doses, etc.—For horses, ℥ij. to ℥iv.; for cattle, ℥i.; for sheep and swine, ℥i. to ℥ij.; and for dogs, grs. x. to grs. xl., given as bolus, infusion, or tincture.

CASTOR OIL.

Ricini Oleum. The oil expressed from the seeds of Ricinus communis. Imported chiefly from Calcutta. (*Brit. Phar.*)

Nat. Ord.—Euphorbiaceæ. *Sex. Sys.*—Monœcia Monadelphia.

The Castor Oil plant, or Palma Christi, generally considered to be Jonah's gourd, is indigenous to various parts of the world. 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, Central Africa, and various parts of North and South America, it becomes a large tree. The Euphorbiaceæ, besides the castor oil and croton plants, include a tall Brazilian tree, the coco-purgatif, which yields the oil of Danda or assu juice, resembling castor oil, but greatly more active, and devoid of colour and taste.

The officinal part of the castor oil plant are the seeds, three of which are contained in each capsule. Two varieties are met with, the 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 about one-fourth of their weight of ligneous husk, 8 per cent. of moisture, and nearly 70 per cent. of kernel, which contains about 50 per cent. of a fixed oil—the castor oil—associated with 20 of albumen, 18 of cellulin, 2·4 of sugar and mucilage, traces of œnanthic aldehyde, and a small quantity of an acrid purgative principle, which has not been isolated, and mostly remains after expression of the oil. Professor Tuson, of the Royal Veterinary College, London, exhausting the seeds with boiling water, extracted a crystalline alkaloid, devoid of active purgative property, which he named ricinine.

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 albumen 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 albumen 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, however, yields 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, imported since the Exhibition of 1862, commands the highest price (Pereira, 1872). Cold drawn castor oils, prepared by expression alone, or with only a very slight degree of heat, are generally preferred; for when a high temperature is employed, either in roasting the seeds or boiling the oil, the purgative principle is volatilised or acrid matters are developed.

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° 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 exert a mutually solvent action on each other; the oil is soluble in two parts of rectified spirit and in ether, but not in water; is easily miscible with other oils; saponifies with alkalies, yielding glycerine, palmitic, and other fatty acids, and the special ricinoleic acid

(HC_{18} H_{34} O_3). It also contains œnanthic aldehyde, and ricinine, believed by Professor Tuson to be an alkaloid, but possessed of little if any purgative activity.

Impurities.—Castor oil is adulterated with croton oil to increase its activity, with lard and suet oils to reduce its cost. Pure oil is distinguished by entirely dissolving in its own weight of alcohol, and in two of rectified spirit. (*Brit. Phar.*) Inferior sorts are dark coloured, but become translucent by exposure to sunlight, and filtration through animal charcoal; whilst disagreeable acrid taste and odour may be in great part removed by repeated agitation with water containing calcined magnesia and coarse animal charcoal.

Actions and Uses.—Castor oil seeds are irritant and purgative, and have repeatedly caused fatal gastro-enteritis in man. They appear to be more powerfully 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 secretion of milk.

The oil is a mild purgative, closely resembling linseed and the other fixed oils. It is emulsionised by the alkaline bile; a proportion undergoes absorption, but the greater amount, little changed and occasioning slight irritation, passes through the bowels. Although it increases the peristaltic motions more than the secretions, it rarely causes griping; when excreted, its oily flakes give the dejections a glazed appearance. When injected into the veins of man, it causes catharsis, and produces in the mouth the same disagreeable oily taste as when swallowed. In horses, castor oil, like other oleaginous substances, is a mild cathartic; full or repeated doses fail to produce the dangerous irritation or superpurgation resulting from overdoses of aloes or salts; it is accordingly valuable for young and delicate subjects, and where the bowels or urino-genital organs are irritable. It is more used for cattle and sheep than for horses. In cattle practice, however, it is often superseded by the less expensive rape or linseed oil. 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 occasional activity as an emetic in dogs results not

from any specific emetic action, but merely from its nauseous oleaginous taste, and is obviated by giving the oil free of rancidity, and beat up with an egg, with mucilage, a little spirit, ether, or some aromatic.

Acting with little irritation or griping, it is useful in young animals in irritation and inflammation of the digestive organs, as in diarrhœa, dysentery, enteritis, and peritonitis, in hernia, advanced pregnancy, affections of the kidneys and bladder, wherever more drastic purgatives might unduly irritate, and where reiterated doses require to be given. Its anthelmintic effects have sometimes been over-estimated, are in reality slight, and entirely dependent upon its purgative action. In cattle practice it proves 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. It proves a safe and easy purge for pigs. The bruised seeds are much used by the native Indian farriers for the cure of mange; and Mr. Thomas Pritchard, V.S., of Madras, informs me that two or three dressings usually suffice to remove the disease. As a clyster, it is generally superseded by rape or linseed oil. As an external demulcent, it is unsuitable on account of its tendency to become rancid.

Doses, etc.—Castor oil seeds are conveniently 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, f ℥ij. to f ℥iv.; for dogs, f ℥i, or f ℥ij., for cats, about f ℥i. 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 conjoined with laudanum and warm starch gruel. For delicate or pampered dogs, a good laxative consists of an ounce each of castor oil and syrup of buckthorn, and a few minims of nitric ether, which, when shaken together, form a palatable emulsion.

CATECHU.

Black or Brown Catechu. Catechu Nigrum. Cutch or Terra-Japonica; the aqueous extract of the wood of Acacia Catechu, and of Acacia Suma.

Grey Catechu; Catechu Palidum; Gambier; the aqueous extract of the leaves and young shoots of Uncaria Gambier.

The Acacia Catechu is a leguminous East Indian tree, found also in Africa; the wood is used for domestic purposes and for making charcoal, the bark for tanning. 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 made. The wood of these trees, cut into chips, is boiled with water; the decoction concentrated either by fire or the heat of the sun; and the extract cut into square cakes or run into clay moulds. The brown or black catechu (*cate*, a tree, *chu*, juice) comes chiefly from Bengal and Burmah, in masses sometimes weighing half a hundredweight, packed in mats, bags, or boxes.

The Uncaria Gambier, producing the pale catechus, is a stout climbing shrub, of the natural order Rubiaceæ, inhabiting the islands of the Indian Archipelago, and cultivated in plantations for its astringent juice. A decoction made of the leaves and young roots is evaporated, worked into light brown earthy-looking masses, and is made up of cubes with surfaces about an inch square.

Both the brown and pale catechus are porous and opaque; brittle, breaking with a granular fracture; under the microscope, are seen to contain minute needle-like crystals; they are without odour, but have a sweet astringent taste, and are free from grittiness. 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 equal portions of catechu-tannic acid, soluble in cold water, and of catechin or catechuic acid (C_{19} H_{18} O_8), deposited from a boiling watery solution in acicular crystals, (C_{19} H_{18} O_8 $3H_2$ O), soluble in ether, and decomposed by

fusion with potash into proto-catechuic acid and phloroglucin. Solutions of catechin give a green colour with feric salts. Catechu further contains traces of quercetin (C_{27} H_{18} O_{12}).

Actions and Uses.—Catechu is astringent. Like other tannin-containing substances, it combines with the gelatine and albumen of the tissues, lessens their calibre, and diminishes their solubility and tendency to putrefaction. Hence its value in the preparation of tanno-gelatine or leather. Catechu, being less astringent than oak-bark or galls, is more suitable for some internal uses. It is given to the several domestic animals in excessive mucous discharges from the alimentary canal; is combined with aromatics, to remove flatulence; with opium to relieve irritability; with chalk, magnesia, or an alkali, to counteract acidity. A convenient mixture for diarrhœa, is made with three ounces each of catechu, prepared chalk, and ginger, and six drachms of opium, made into mass with treacle and linseed flour. This will make six doses for a horse, four for a cow, and eight or nine for a calf or sheep. For these ruminants the dose is conveniently given suspended in starch gruel. Catechu is occasionally applied to sluggish sores and ulcers, to excoriations on the udder of cattle, and for the ordinary purposes of a vegetable astringent. It nearly resembles, but is more powerful than kino, the inspissated juice of an East Indian tree, the Pterocarpus Marsupium, and other leguminous and myrtaceous trees; than rhatany, the dried root of a Peruvian shrub, the Krameria triandra; and than logwood, the heartwood of the Hæmatoxylon campechianum.

Doses, etc.—For horses, ℥i. to ℥iij.; 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 astringent 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. A good *tincture* is made by the following Pharmacopœia process:—"Take of catechu, in coarse powder, two ounces and a half; cinnamon bark bruised, one ounce; proof spirit, one pint; macerate,

with occasional shakings, for seven days in a closed vessel; 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 flowers of the Anthemis nobilis, wild and cultivated. (*Brit. Phar.*)

Nat. Ord.—Compositæ. *Sex. Syst.*—Syngenesia, Polygamia superflua.

Chamomile flowers are extensively cultivated in the warmer parts of England; are gathered during dry weather; exposed for a short time on trays in a shady place; and carefully stored and kept very dry. The large-sized double white flowers are preferred, and 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; 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 containing a hydrocarbon isomeric with oil of turpentine, present in cardamom, caraway, and other aromatics, capric acid (C_{10} H_{20} O_2), and an azure blue liquid polymeric with camphor.

Actions and Uses.—Chamomile flowers are mildly stimulant, aromatic, stomachic, and tonic; full doses produce emesis in dogs. They are occasionally given to horses and cattle in doses of one to two ounces; to calves, sheep, and swine, in doses of a drachm; are sometimes used as fomentations and poultices; but as external applications they are little better than linseed or oatmeal.

CHARCOAL.

Two varieties of charcoal, or carbon, are used in medicine and pharmacy—wood charcoal, or *carbo ligni*, and animal charcoal, or *carbo animalis*. The former is prepared by piling pieces of the harder woods 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 moisture of the wood, its oxygen, hydrogen, and nitrogen are dissipated; it is reduced to about one-fifth of its original weight. Carbon and mineral matters remain. The charcoal varies in composition with the wood from which it is prepared, but contains, on an average, about 87 per cent. of chemically-pure carbon, 2 of ashes, and 11 of volatile matters. 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 first boiled to separate fatty matters, and then heated in close vessels until vapours cease to be disengaged. The fixed residue, besides carbon, contains about 80 per cent. of calcium phosphate and carbonate (Graham), and 2 per cent. of iron carbide and silicide —mineral matters, which separate the particles of the charcoal, and greatly enhance its value for the removal either of colours or odours. For some pharmaceutic purposes the mineral ingredients are got rid of by digesting the commercial article, at a moderate heat, with hydrochloric acid, collecting the undissolved carbon, thoroughly washing it, and heating it to redness in a covered crucible. (*Brit. Phar.*)

Both vegetable and animal charcoal are of a brown-black colour, are insoluble and inodorous, readily absorb moisture, gases, and most vegetable colouring matters. Animal charcoal is the more valuable, and may be distinguished by its greater density, its incombustibility, its bitter taste, and its large proportion of phosphates.

Actions and Uses.—Charcoal is a desiccant, antiseptic, disinfectant, and deodorant, and is used as a decoloriser in pharmacy, sugar-refining, and other arts. So great is its absorbing power, that one volume of good boxwood charcoal takes up 100 volumes of ammoniacal gas, 55 of hydrogen sulphide, and 10 of oxygen. This retained oxygen decomposes and deodorises noxious gases which come into contact with the charcoal. Air from sewers, or that has been in contact with the bodies of patients affected with noisome or contagious disease, if passed over trays of charcoal, is occasionally deprived

of odour, and also of contagious germs. The colouring particles of brown sugar and other organic solutions are absorbed when filtered through charcoal or boiled with it. Drinking water, filtered through it, is deprived 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 medicine—a property which, however, renders it serviceable as an antidote in poisoning with arsenic, aconite, strychnine, and even prussic acid. The charcoal mechanically envelops and combines with the poisonous particles; half an ounce neutralises a grain of morphine or strychnine; but, like other insoluble substances, it is effectual as an antidote only when given promptly, and before the poison has been absorbed.

Sprinkled over meat or game, or in barrels of water intended for long keeping, it attracts and retains septic matters and hence retards putrefaction. Unlike carbolic acid, zinc chloride, or other powerful antiseptics, it does not, however, attack or destroy organised germs. Lacking volatility, its usefulness as a deodoriser or disinfectant is greatly more limited than that of chlorine, sulphurous, or carbolic acids. Being insoluble in water, charcoal, when swallowed, exerts chiefly topical effects; only very minute quantities enter the blood. Whilst passing through the intestines it checks, however, fermentative changes, and lessens acrimony and fœtor of the fæces. It is not now used as an anthelmintic. In a finely divided state it is sometimes applied as an absorbent and deodoriser to suppurating noisome sores, being sprinkled by a dredger directly on the unhealthy surface, or mingled with poultices.

Doses, etc.—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. Its absorbing powers are increased by raising it to a low red heat shortly before it is used, whilst by exposure to a high temperature, entangled organic matters are burned out of its pores, and the charcoal fouled in sugar-refining and other processes is thus again cleansed for use.

CHLORAL—CHLORAL HYDRATE.

Chloral was discovered by Baron Liebig in 1832, but continued for many years merely a chemical curiosity. Its hydrate was first introduced into English medical practice, as a soother of pain and producer of rest, in August 1869.

Chloral is prepared by passing dried chlorine gas into absolute alcohol so long as the spirit will absorb it. The oily-looking, pungent, liquid chloral, or trichlorinated aldehyde, (C_2 HCl_3 O) is purified by distillation with sulphuric acid, and when mixed with water becomes the solid hydrate (C_2 HCl_3 OH_2 O), which occurs in colourless crystals, is transparent, aromatic, bitter, pungent, permanent in air, melts at about 133°, and boils at 205°. It is soluble in less than its own weight of water, and in alcohol, ether, petroleum, and oil of turpentine.

The caustic alkalies, with ammonia, and in a less degree the alkaline carbonates, decompose it with formation of chloroform. 100 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 chloroform. (*Brit. Phar.*) Besides being of imperfect strength, inferior specimens are apt to contain chlorinated organic impurities, which render them yellow and cloudy, acrid and irritating, imperfectly soluble, and forming oily drops with water, whilst instead of hypnosis they produce nervous excitement.

Actions and Uses.—Chloral hydrate is a depressor of the cranio-spinal axis; it acts primarily on the brain and motor centres; large doses destroy life, as chloroform does, by paralysis of the motor tract of the medulla. Medicinal doses are anodyne and hypnotic, lessen reflex spinal action, and thus resemble opium and bromide of potassium. Applied locally, it is irritant; hence, when swallowed, it sometimes causes vomiting and purging; but properly regulated diluted doses are anodyne. It is an effectual antiseptic.

General Actions.—Dr. B. W. Richardson has made with it an extended series of experiments on the lower animals; fishes and pigeons were narcotised by 1½ 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 stupid. 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 hour, 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*).

Chloral hydrate is readily absorbed, and quickly diffuses itself throughout all parts of the body. It is given off unchanged chiefly by the lungs—a proof that its effects are not dependent, as was once supposed, on its conversion into chloroform, which is not found in the blood or excreta of animals poisoned by chloral hydrate, although readily discovered when animals are poisoned by chloroform itself. It resembles chloroform, however, in contracting the red globules, causing their diffluence, and giving the plasma a red colour (Dr. Harley). All doses, however administered, act primarily on the brain and motor centres. Moderate doses, after brief cerebral congestion, cause anæmia, and hence sleep. Somewhat larger doses, with occasional and slight excitement,

depress the cerebro-spinal functions; they depress the respiratory centre, slowing breathing, the cardiac ganglia weakening heart action, the vaso-motor centres relaxing arterioles and lowering temperature sometimes to the extent of several degrees. In a rabbit Dr. Richardson observed a depression of 6°. This fall of temperature Dr. Lauder Brunton considers sufficient to account for death. Poisonous doses cause besides narcosis and anæsthesia, paralyse the respiratory centre, and arrest the heart in diastole.

Chloral hydrate resembles opium in its hypnotic and anodyne properties. Although more effectual in paralysing involuntary muscular fibre, it has less action on sensory nerves, and hence is less valuable in antagonising pain resulting either from nervous irritation or from inflammation. In its power of relaxing spasm, lowering animal temperature, and diminishing arterial pressure, it resembles amyl nitrite. Its solid form prevents its being inhaled, and its anæsthetic properties are developed only when dangerous doses are swallowed. Even as a local anæsthetic it is less effectual than chloroform or ether.

Bromal hydrate is more active and more irritating than chloral hydrate; four grains kill a 4 lb. rabbit, which would take twenty grains of chloral. The bromine constituent appears to assert its irritant action, and, according to Dr. Dougall's experiments, there are induced restlessness, difficult breathing, imperfect sleep, and finally coma, broken by convulsions.

Croton chloral hydrate is prepared by passing a stream of chlorine for twenty-four hours through acetic aldehyde, separating and purifying the dense oily liquid, and converting it into the solid, bitter, crystalline hydrate ($C_4 H_3 Cl_3 O, H_2 O$). It paralyses the spinal sensory nerves and the sensitive branches of the fifth nerve (Liebreich), but does not, like chloroform and ether, produce hypnosis or anæsthesia. Its effects on the pulse and respiration are less marked than those caused by corresponding doses of chloral hydrate. It kills, however, like it, by paralysis of respiration. It is prescribed in human medicine in neuralgia, megrims, and cough (*British Medical Journal*, 1873 and 1874).

Medicinal Uses.—Chloral hydrate is given to quiet general irritability and produce sleep. Small repeated doses, especially if conjoined with morphine, allay pain, lower temperature, and sometimes save life in those deadly cases of muco-enteritis in heavy draught horses. I have had good results from the hypodermic injection of forty grains chloral hydrate, immediately followed by three grains morphine, and repeating both injections in about an hour. Colic in horses is generally removed by chloral. Small doses benefit asthma in dogs, and violent paroxysmal coughing either in dogs or horses. It antagonises the spasms of chorea and epilepsy, and temporarily relieves those of tetanus and hydrophobia, especially when used hypodermically. 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. Having notable effect in soothing irritability, and quieting maniacal tendencies in man, it may prove useful in chronic phrenitis of horses. It is the best antidote for strychnine, when promptly given arresting both the force and frequency of the tetanic convulsions, and sometimes saving life; but conversely, strychnine is not so certain an antidote for chloral hydrate, for, although it antagonises the depressed state of the spinal cord, it does not relieve the comatose brain (*Report of Edinburgh Commission of British Association on Antagonism of Medicines*). Chloral is likewise antagonistic to Calabar bean, and also to 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 the quicker acting Calabar bean. For allaying the intolerable itching sometimes affecting horses' eczematous limbs, and depending upon irritation of the peripheral terminations of the spinal cutaneous nerves, few dressings are so effectual as one part each of camphor and chloral hydrate diluted with two of oil or vaseline. A ten per cent. aqueous solution of chloral hydrate, besides relieving itching, removes scurf, and favours growth of hair. For combating straining depending upon irritation, whether of the lower intestines or the urino-genital organs, injections and suppositories of chloral hydrate are often serviceable, especially

when conjoined with opium. As an antiseptic, dissolved in spirit and water, it is recommended by Dr. William Craig for preserving natural history specimens and subjects for dissection, and as an antiseptic and anodyne dressing for wounds. Chloral hydrate is contra-indicated in typhoid cases on account of its causing vascular excitement, impairing oxygenation, and lowering temperature.

Doses, etc.—For horses and cattle, ℥i. to ℥ij.; for sheep and pigs, ʒi. to ʒiij.; for dogs, grs. x. to grs. xx.; repeated every two hours, or even oftener, and conveniently administered in syrup. It is more effectual when the animal has been fasting for two or three hours. For clysters and for hypodermic injections about half the dose given by the mouth suffices, and in animals there is little risk of producing the erysipelatous inflammation which has sometimes followed its hypodermic injection in human patients. The narcotic paralysing effects of overdoses are combated by free use of ammonia and alcohol, by hypodermic injection of strychnine and atropine, and by warmth.

CHLORINE.

Chlorine is prepared by heating sulphuric acid with common salt and manganese black oxide. For fumigating the Millbank Penitentiary, Professor Faraday used one part of salt intimately mixed with one part of manganese black oxide, and two parts of oil of vitriol, previously diluted with two measures of water. The ingredients were stirred together in shallow earthenware vessels, and where slow evolution of gas was desired, heat was not used. For gradual evolution, Dr. Angus Smith advises admixture of one pound bleaching powder with one and a quarter pound of potash alum. Chlorine is a chemical element (Cl), a yellow-green gas, with a peculiar suffocating odour, an astringent taste, two and a half times as heavy as air, soluble in less than half its volume of water at 60°. 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.

Actions and Uses.—Chlorine, whether as gas or in solution, is irritant, antiseptic, deodorant, and disinfectant. Applied to the skin or mucous surfaces, it causes redness and eruption, relieved by lime-water, white of egg, soap, or diluents. Irritation of the imperfectly diluted gas is counteracted by inhaling ether, weak ammonia, the vapour of warm water or of alcohol. Cautious inhalation usually abates sore throat in horses, the cough, difficult breathing, and fœtor of the breath in contagious pleuro-pneumonia of cattle, and destroys bronchial filaria in calves and lambs. When a considerable quantity of the gas is to be cheaply evolved for breathing by a number of animals, salt, manganese black oxide, and diluted sulphuric acid are mixed, in the proportions above recommended by Professor Faraday, gentle heat applied, and the fumigation effected in a box or closed shed, much care being taken that the gas before it is breathed be sufficiently diluted. Destruction of these bronchial parasites is however as effectually accomplished by the less irritant sulphurous acid gas, or by oil of turpentine drenches. The liquor chlori diluted is occasionally applied to wounds as a stimulant, antiseptic, and deodorant. Its uses are the same as those of chlorinated soda and lime.

The bleaching and antiseptic properties of chlorine chiefly depend upon its affinity for hydrogen. Seizing the hydrogen which vegetable colouring matters contain, it breaks them up, the resulting chlorinous compounds being colourless; decomposing water, it produces hydrochloric acid and nascent oxygen or ozone, which attack organic particles. Colour, smell, and septic power are thus destroyed. Fresh meat bottled with chlorine gas was found by Dr. Angus Smith to be bleached externally, but continued red within and unchanged, at the end of twenty-eight days. Dr. C. Calvert's careful comparative experiments with various antiseptics demonstrate, however, that albuminous solutions are not so long or so effectually preserved by chlorine solution as by zinc or mercury chlorides, or by the tar acids. Dr. Angus Smith, in his cattle-plague reports, speaks favourably of chlorine as a preventive of cattle plague. Used daily throughout premises adjacent to those infected by mouth and foot

disease, it has apparently arrested extension of the disorder. Cholera and erysipelas in man are stated, however, on the authority of Dr. Pereira, to propagate themselves readily even when the patients were kept almost constantly surrounded with fumes of chlorine. Although a good deodoriser, it is inferior as a disinfectant either to sulphurous or the tar acids. It has the practical disadvantages of being somewhat troublesome to evolve in unskilled hands; overdoses are dangerously irritant; combining with the ammonia so often present in farm premises, it produces nitrogen chloride, a very irritant gas; attacking other ammoniacal compounds, it reduces the value of the manure heaps; lime-washed walls are further rendered uncomfortably moist by it. 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 of the chlorine; 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. $C\,H\,Cl_3$.

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.

Preparation.—Chloroform is prepared by distilling together either rectified or methylic spirit, bleaching powder, and water, and washing the crude product to free it of deleterious matters.

The *Brit. Phar.* gives the following explicit directions for making and purifying:—Mix thirty fluid ounces of rectified spirit with three gallons of distilled water in a capacious still;

add ten pounds chlorinated lime thoroughly mixed with five pounds of slaked lime. Let the condenser terminate in a narrow-necked receiver, and apply heat so as to cause distillation, taking care to withdraw the fire the moment the process is well established. When the distilled product measures fifty ounces, remove the receiver and pour its contents into a gallon bottle half filled with water; shake well together, and set at rest for a few minutes, when the chloroform will subside; pour off the water, and thrice wash the chloroform in a smaller vessel, with successive portions of three ounces of water. Agitate the washed chloroform for five minutes with an equal volume of sulphuric acid, then, after subsidence of the latter, transfer the chloroform to a flask containing two ounces of chloride of calcium in small fragments, mixed with half an ounce of perfectly dry slaked lime. Mix well by agitation. After the lapse of an hour, connect the flask with a Liebig's condenser, and distil the pure chloroform by means of a water bath. Preserve the product in a cool place, in a well-stoppered bottle. The lighter liquid which floats on the crude chloroform after its agitation with water, and the washings with distilled water, should be preserved and employed in a subsequent operation.

In this process the chief changes which occur are—(1) evolution of oxygen and chlorine from the chlorinated lime; and the reduction of alcohol into aldehyde; (2) formation of hydrochloric acid and trichloraldehyde or chloral, by the action of the chlorine; and (3) decomposition of the chloral by the caustic lime with evolution of crude chloroform, calcium formiate and chloride remaining in the retorts. These three stages are thus formulated:—

(1.) $C_2 H_6 O + O = H_2 O + C_2 H_4 O$ (Aldehyde).
(2.) $C_2 H_4 O + Cl_6 = 3 H Cl + C_2 H Cl_3 O$ (Chloral).
(3.) $2 C_2 H Cl_3 O + Ca H_2 O_2 = Ca\ 2 CHO_2 + 2 CH Cl_3$ (Chloroform).

As to the purification: repeated agitation with water washes away saline acid and organic impurities; shaking with sulphuric acid, which must be scrupulously free from nitric acid, chars and removes the last traces of organic oils; admixture with slaked lime and calcium chloride gets rid of acid and water.

Properties.—Chloroform is a transparent, colourless, neutral,

oily-looking, mobile fluid, with a density of 1·49, a sweet taste, and a fragrant, ethereal, and apple-like odour. At ordinary temperatures it volatilises entirely, and boils at 140°. 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 scarcely takes up more than $\frac{1}{200}$ part, a pint only holding sixty minims in solution. It readily dissolves volatile oils, wax, resin, and alkaloids. Chloroform, to the extent of five per cent., added to fresh-drawn blood, renders it liquid, and imparts a bright arterial hue; crystals form after a time; the amount of oxygen is augmented, that of carbonic acid diminished; the red blood discs are shrunk, their power of absorbing oxygen is impaired, they deliquesce and disintegrate.

Chloroform is marsh gas or methane (CH_4), in which three of the atoms of hydrogen have been replaced by chlorine ($CH\ Cl_3$). When one atom only is so replaced methyl chloride ($CH_3\ Cl$) is produced; when the chlorine is replaced by hydroxyl, the result is methylic or wood spirit, the hydrate or alcohol of methyl ($C\ H_3\ H\ O$ or $C\ H_4\ O$). Other anæsthetics belonging to this series have already been referred to (p. 101). Iodoform ($C\ H\ I_3$) is a yellow solid, prepared by adding to an alcoholic solution of iodine an alcoholic solution of potash, until the mixture is yellow, and distilling to dryness. Free solution limits its topical irritant effects, and in all animals it causes narcosis; toxic doses induce paresis of respiration and circulation; although producing only imperfect anæsthesia, when swallowed or inhaled it is a tolerably effectual topical anæsthetic. Pulvis iodoform compos. is recommended as an alterative and antiseptic in nasal catarrh, and, mixed with vaseline or cocoa butter, as dressing for fistulæ. (*Veterinarian*, May 1881.)

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 alcohol have a low specific gravity and lose bulk when shaken with water. The presence of water, besides

affecting the specific gravity, causes cloudiness at temperatures approaching 32°. Traces of sulphuric acid are discovered by the usual barium test; chlorine and hydrochloric acid by silver nitrate. The purity of chloroform is 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.—Full doses, by whatever channel they enter the body, paralyse and narcotise the cerebro-spinal nervous system; death results from asphyxia, chiefly depending upon respiratory arrest. The vapour inhaled speedily causes anæsthesia. Swallowed in medicinal doses, it is stimulant, antispasmodic and anodyne. Undiluted it is a topical irritant. According to the manner of its application, it is a topical rubefacient, refrigerant, anodyne, and local anæsthetic.

General Actions.—Paralysing narcotic effects, very analogous to those of alcohol or ether, are readily caused by large doses introduced into the stomach, or quickly inhaled without sufficient admixture of air. An ounce rapidly swallowed by a dog 15 lbs. weight, or half an ounce injected into the pleural cavity, causes a sudden cry, gasping respiration, a run of feeble pulsations, and death in 70 to 80 seconds. Similarly rapid fatal effects result when small animals are introduced into a large glass jar containing seven per cent. of vapour (Dr. Anstie, *Stimulants and Narcotics*). Although not very soluble, it possesses a high diffusive power, and rapidly enters the blood. The changes it produces there, are, however, at present unknown. Dr. Harley believes that it acts specially upon the blood globules, interferes with their absorption of oxygen, produces their partial deliquescence and disintegration, hence follow sluggish capillary circulation and impaired function of the brain and nervous centres (Royle's *Materia Medica*, sixth edition). It is removed from the body mostly by the lungs, but in smaller amount by the skin and kidneys. Its effects, according to the late Dr. Snow, are observable so soon as the blood takes up $\frac{1}{56}$th part of the amount it is capable of dissolving. It acts directly on the brain and nervous centres, briefly exciting and perverting, and then paralysing and extinguishing, their several functions. Its influence extends

from the periphery to the centre; from the hind extremities forwards. An ordinary anæsthetic dose affects these centres in tolerably regular order; involving first those presiding over special sense and volition; next, those of motion and common sensation; and lastly, where the influence is unduly prolonged, those of the sympathetic system. The action of the heart, at first quickened, is subsequently steadily depressed; the pulse eventually becomes rapid and weak; the respirations, at first retarded, become quicker, but, as narcosis increases, are more slow, shallow, and irregular. The pupils, at first contracted, gradually dilate. In dogs, cats, and rabbits, as in man, apparently from paralysis of the sympathetic, the functions of the liver are deranged, and sugar is found in the urine—an effect also occurring with alcohol and ether. In these and other effects of chloroform, functional activity is succeeded by functional paralysis.

The symptoms of anæsthesia having been described in detail in a preliminary section (p. 98), it may suffice here to mention that chloroform produces first temporary excitement, with many of the symptoms of inebriation, succeeded by gradually diminishing consciousness of external objects, weaker and less regular respiration, diminution of animal temperature, muscular relaxation, and insensibility to pain. This stage of anæsthesia, usually produced within five minutes, is that required for the performance of serious operations, and may with caution be safely maintained for an hour or even longer. Danger, however, is to be anticipated whenever the breathing becomes slow, shallow, or noisy; the pulse slow, weak, or suddenly irregular; the pupils dilated; the conjunctiva, if touched, provoking no reflex movement. With such warnings, artificial respiration must be instantly resorted to, great care being used to prevent any rough handling, which might entirely paralyse the weakened heart. Cold water should be thrown over the head and neck; windows or doors opened to secure fresh air; the tongue drawn forward, lest it interfere with inspiration; the head thrown a little back, so that access of air to the lungs be left unimpeded. The galvanic current applied over the phrenic nerve has been advised; but, if used at all, it must be with the greatest caution.

Death results usually from chloroform being given too rapidly, from insufficient dilution with air, which should always constitute nineteen-twentieths of the safe mixture, or, where cumbrous apparatus is used, from actual suffocation. Chloroform usually kills animals by arresting respiration; but, if given rapidly and in large amount, the cardiac sympathetic ganglia are paralysed, and arrest of the heart precedes arrest of respiration. Post-mortem examinations discover that the blood coagulates normally; the lungs are not usually much congested; the heart continues to beat for a considerable time after respiration has ceased, its left side being nearly empty, but its right filled with semi-solid, dark-coloured blood. The veins of the head, neck, and chest are distended with black fluid venous blood; the membranes of the brain are sometimes congested.

Between chloroform, ether, and chloral there are many points of resemblance, some of difference, studied by M. Arloing, and communicated in 1879 to the Académie des Sciences. Injected into the veins of horses and dogs, moderate doses of the three anæsthetics accelerate cardiac pulsations, but this is most promptly effected by chloroform. The force of the heart's contractions are augmented by ether and chloroform, but lessened by chloral. Pulmonary circulation is reported to be quickened by chloral and ether, but retarded by chloroform. Capillary circulation, scarcely affected by chloroform, is first lessened and then increased by chloral and ether. The sleep of chloroform is stated to be accompanied by anæmia, that of ether and chloral by hyperæmia of the brain. (*Lancet*, September 6, 1879).

Chloroform bears favourable comparison with other anæsthetics in being more pleasant and less irritating to inhale, more powerful and regular in its action, and less apt to cause preliminary excitement, or leave unpleasant effects. Compared with ether, smaller quantities are required. Owing, however, to its depressing the functions of the heart, chloroform is dangerous whenever there is weak or imperfect action of the heart. In such cases, in virtue of its stimulating instead of depressing the cardiac ganglia, ether is preferable. The anæsthetic effects of chloroform are not so alarmingly rapid as

those of methyl bichloride, which anæsthises a man in two minutes; it is more manageable, and does not require the cumbrous apparatus requisite for nitrous oxide. Sir James Y. Simpson considered that chloroform saves the life of six persons in every hundred subjected to surgical operations. With proper precautions, it has been used many thousand times in Scotch and English, as well as foreign hospitals, without a single mishap; during the Crimean war, 30,000 French soldiers inhaled it without a single casualty; whilst on the English side, with probably 50,000 inhalations, there were but two deaths; during the American campaign, it was given without accident 22,000 times. The various deaths connected directly and indirectly with its administration do not average more than one in 17,000. In the lower animals it cannot, however, be so conveniently used. During the earlier stages of inhalation horses sometimes struggle violently and get excited, and when, to avoid this, the chloroform is given too rapidly, and in concentrated form, fatal effects occur. Similar results are also observable among dogs and rabbits. The author has had little experience of its effects on either cattle or sheep. Bees exposed to it speedily become insensible, and while under its influence may be safely removed from full hives. Plants exposed to its vapour lose their irritability.

Medicinal Uses.—Chloroform is not so extensively used in veterinary as in human medicine. It is occasionally given to horses to procure insensibility during castration, firing, and other painful operations; but it is wise to warn the owner of the risk attending its administration, to have a competent person to regulate the administration, and to hold in readiness for waste and other contingencies an ample supply of the drug in good condition. Among the lower animals, parturition is usually performed so easily, and with so little apparent pain, that the administration of chloroform, in the great majority of cases, is unnecessary. Where false presentations have to be rectified in the mare, it is sometimes, however impossible, without chloroform, to keep the animal quiet, or to abate violent uterine throes; whilst in bitches it is also occasionally useful when the pups have to be reduced in size 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 in such cases often effectually relaxes the rigid muscle, and delivery is promptly and safely accomplished. In facilitating the reduction of hernia, chloroform is often invaluable. Besides affording temporary relief, it also occasionally removes strangulation of the bowels in horses. Although its inhalation has been recommended in tetanus, and relief is obtained so long as anæsthesia continues, the spasms speedily return with their former severity, and any benefit derived is usually more than counterbalanced by the disturbed and excited state into which the animal is apt to be thrown by administration of the chloroform. In diseases accompanied by violent exhausting pain, as in enteritis, peritonitis, and acute rheumatism, as also in the spasms or after-pains of parturition or abortion, a slight degree of anæsthesia is of service in all animals in blunting pain, and allowing time for the beneficial operation either of medicines or of the conservative powers of nature. In such cases chloroform may either be inhaled or given in solution by the mouth or rectum. In the form of clysters, in combination with opium, it merits more extended use in internal diseases, in which it often relieves pain, especially of an irritative type. Its inhalation three or four times a day, in quantities sufficient to cause slight anæsthesia, has little, if any, curative effect in contagious pleuropneumonia of cattle. Small doses, either inhaled or swallowed, frequently arrest violent chorea and epileptic fits in dogs.

When swallowed, it proves in all animals a useful antispasmodic in colic, asthma, and paroxysmal nervous cough. It is more prompt, but more evanescent, than alcohol. After epizootic sore throat, horses sometimes have violent spasmodic cough, which is benefited by diluted chloroform or chloric ether, given in ounce doses, with a drachm of belladonna extract, or an ounce of laudanum, dissolved in about a pint of cold linseed gruel, and swallowed very slowly, so as to insure more prolonged topical effect on the nerve endings. Its rapid absorption renders it more effectual in removing flatulence and spasm from the anterior than the posterior portions of

the alimentary canal. Its antispasmodic effects are greatly increased by combination with opium. In chronic irritability of the bowels in young weakly calves, after castor oil has been given, nothing proves more serviceable than chloric ether and a little laudanum repeated twice or thrice daily in cold starch gruel.

Dropped upon a mucous or delicate cutaneous surface, chloroform causes irritation, evaporates rapidly, leaves a sense of coolness, and, where freely used, dulls or removes sensation. For local anæsthesia, ether, being more volatile, is, however, more rapid and effectual. Chloroform often allays neuralgic, rheumatic, and other pains, and is effectually applied either alone or with other anodynes. Diluted with six or eight parts of oil, it abates the irritation of eczema, urticaria, and prurigo; but such soothing effects are transient, and are usually best secured by frequently changing the remedy. Mixed with a little spirit, it is a ready, cleanly, but somewhat expensive means of removing lice and fleas. Its high diffusion power, which it retains when mixed with spirit, renders it a useful vehicle for the rapid introduction into the system of morphine, atropine, and other such medicines. Chloroform is a solvent for gutta percha, and the solution is occasionally employed as a substitute for collodion.

Doses, etc.—It is somewhat difficult to fix the precise quantity of chloroform necessary to produce anæsthesia. Three to six ounces are generally effectual for horses or cattle, one to two ounces for sheep and pigs, four drachms to an ounce for dogs. In carnivora, to prevent vomiting, the previous meal, given three or four hours before, should be light and easy of digestion. Inhalation is most simply and safely effected in small animals with a piece of sponge or lint, wetted with the chloroform, and held near the nostrils; in the larger animals, by placing a saturated sponge in a nose-bag, perforated with holes to admit a sufficiency of air, and attached to the head. Care should be taken previously to secure a strong animal, lest he become unmanageable during the early stages of excitement; to supply fresh quantities of chloroform by a tube or other means; and to insure the entrance into the lungs of an adequate supply of air along with the chloroform. Three to five per cent. of

chloroform vapour suffices; upwards of five per cent. is unsafe, being apt, as above stated, to cause death by sudden arrest of the heart. The Medico-Chirurgical Society, in 1864, recommended as the best anæsthetic mixture two parts of chloroform, three of ether, and one of rectified spirit. The Austrian Government more recently advised one part of chloroform and six parts of ether in cold weather, and eight parts of ether in warm weather. C. Bernard has shown that the subcutaneous injection of morphine prolongs and intensifies the action of chloroform, but increases greatly its risks. While anæsthesia continues, respiration, pulse, and reflex sensibility of the conjunctiva must be carefully watched. If undue effects be produced, the inhalation must be immediately stopped, free access of fresh air allowed, water thrown over the head and neck, the tongue drawn forward, and artificial respiration at once adopted.

As a stimulant, antispasmodic, and anodyne, the dose of chloroform for horses or cattle is f℥i. to f℥ij.; for sheep and swine, ♏ xx. to ♏ xl.; and for dogs, ♏ v. to ♏ x. These doses are best given in weak spirit, at intervals of one or two hours.

Chloric Ether, also called spirit of chloroform, is made by dissolving one fluid ounce of chloroform in nineteen fluid ounces of rectified spirit. It has the specific gravity ·871, a warm ethereal odour and taste, proves an effectual stimulant, antispasmodic, and anodyne, and nearly corresponds in its uses and doses to ether and sweet spirit of nitre. Diluted with water, or any bland cold fluid, it is prescribed for horses in doses of f℥i.; for cattle, f℥ij.; for sheep and pigs, f℥ij. to f℥vi.; and for dogs, f℥i. to f℥ij. Conjoined with opium, its effects are intensified and increased, and the mixture constitutes one of the most effectual antispasmodics, anodynes, and nerve soothers.

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).

CINCHONA.

Bark of different species of Cinchona.

Nat. Ord.—Cinchonaceæ. *Sex. Syst.*—Pentandria Digynia.

The Cinchonaceæ, nearly allied to the Rubiaceæ, are evergreen trees, or tall shrubs, with fine foliage and fragrant pink or white flowers. They abound on the slopes and valleys of the Andes ; extend from about 10° N. latitude to 22° S. latitude; occur chiefly in groups or solitary trees; and thrive best with a good deal of moisture, a mean temperature of about 60°, and an elevation of four to ten thousand feet above the sea-level. Of the thirty-six known species, of which there are numerous varieties, about twelve yield the barks of commerce. In 1639 cinchona was brought from Peru to Madrid, distributed by the Jesuits, and hence received the vernacular names of Peruvian and Jesuits' bark. It is collected during the dry season from May to November; the outside rough cortical bark of full-grown trees is usually first beaten and trimmed off. The inner bark or liber, in which the active bitter principles reside, is stripped off as high as can be reached, the tree felled, and peeling completed. Trees partially barked, and left standing, have their wood next season covered with an exudate stated to be specially rich in alkaloids (J. E. Howard). The bark is dried in the sun, or on hurdles over fires ; by careful stacking and pressure the thick pieces from the trunk are kept flat; the thinner portions from the branches curl into single or double rolls or quills. The bark is packed in boxes or serones, formed of hides or coarse cloth, and containing from 70 to 150 pounds. The improvident destruction of the American cinchona forests has diminished the supplies of bark, enhanced the price of quinine, and led to the introduction of the plants in other regions, and especially into India, Ceylon, Java, and Jamaica, where they are now successfully cultivated.

Varieties.—The different barks met with in commerce are recognised as pale, yellow, and red barks.

The Pale Cinchonas (Cinchonæ pallidæ) are usually in thin fibrous rolls or quills, stripped from branches or young

trees of C. officinalis. One of the best is Crown or Loxa bark, from the C. Condaminea, occurring in single or double quills, six to fifteen inches long, about the size of the finger, somewhat thicker than stout paper, invested with a grey or tawny epidermis, marked with longitudinal furrows and transverse cracks, and covered with lichens. Its inner surface is orange or cinnamon brown, and its powder light brown, slightly bitter, and very astringent, from presence of cincho-tannic acid, of which the pale barks contain more than the yellow or red. The pale barks are further remarkable in containing more cinchonine than quinine.

The YELLOW CINCHONAS (Cinchonæ flavæ) are mostly obtained from the C. Calisaya, a tree forty feet high, often three feet in diameter, found in the warm climates of Bolivia and South Peru, and distinguished by its stout naked stem and leafy summit overtopping the rest of the forest. They occur occasionally in quills, more commonly in flat pieces, usually eight to fifteen inches long, two to three wide, and two to five lines thick. The brown, rough-fissured periderm is usually removed before importation, and the compact pieces generally consist almost entirely 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 CINCHONAS (Cinchonæ rubræ) include several commercial varieties, are the produce of different species, frequently of the C. succirubra, are collected on the western slopes of Chimborazo, and owe their distinctive colour chiefly to the manner in which they are procured and dried. They are sometimes in quills, but usually in flat, compact, heavy pieces, twelve to twenty inches long, one to three inches wide, two to six lines thick; made up chiefly of liber; are red, rough, and wrinkled externally; finely fibrous, with granular fracture, and red or orange-brown internally; have an agreeable odour, and a bitter, astringent taste. They yield three to ten per cent. of alkaloids, of which one-third is quinine, with ten per cent. cinchona red—a larger proportion than in other barks.

Properties.—The cinchona barks have certain common characters. They occur either in quills or flat pieces, have an aromatic odour, and a bitter, usually astringent taste. Their colour varies through the shades of yellow to red, and is deepened by moisture. In full-grown trees, the epidermis is replaced by the corky layer which is often thrown off as bark scales, while strips extend into the inner bark. Outside the liber are peculiar soft, elongated, unbranched lactiferous vessels. The inner bark is of two layers, the parenchyme and liber, the latter traversed by medullary rays, separating it into wedges. The liber fibres are short, in small bundles of three, five, or seven, accounting for the short granular fracture (Flückiger). 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. For mixing with the superior pale, yellow, and red barks, inferior sorts, such as ash, rusty, and Carthagena bark, are collected. The tests of value are 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, and mineral matters—cinchona bark contains a thick, acrid, volatile oil, tannic acid, a saponifiable fat, colouring matters, and, deposited in the liber in combination with chinic acid, several alkaloids, quinine and cinchonine being the most important. By digesting the bark with weak hydrochloric acid, the alkaloids are dissolved, and are precipitated from such solution by an alkali. Their yield is much affected by climate, situation, and cultivation, is greatest in old trees, reaches sometimes to twelve per cent.; a variable proportion of the several alkaloids is obtained from different barks.

Quinine or quina (C_{20} H_{24} N_2 O_2, $3H_2$ O) is most abundant in the yellow barks, which yield five to six per cent. When a solution of the disulphate is treated with ammonia solution, the alkaloid is precipitated as an amorphous white powder. By slow evaporation of a concentrated solution, it may be got

in delicate silky prisms. The annual manufacture of quinine is about 240,000 lbs., of which one-fourth is made in America, one-fifth in Germany. It has an intensely bitter taste, perceptible even when diluted with 100,000 parts of water; requires for solution 350 parts of cold water, 21 of ether, and still less of absolute alcohol, oils, and diluted acids. It forms colourless, bitter, crystallisable, rather insoluble salts, remarkable, like the alkaloid, for tonic and antiperiodic properties. Aqueous solutions of the alkaloid and its salts acidulated with sulphuric acid exhibit blue fluorescence, even when diluted with 200,000 parts of water; treated with chlorine gas, the solution passes through various changes of colour, from pink to purple, finishing with dark red; treated with chlorine water or bromine, and then with a drop of liquor ammoniæ, a green coloration is produced; precipitates are yielded by galls tincture, gallic, tartaric, and oxalic acids, and by silver nitrate. From quinine acted on by caustic potash, Professor M'Kendrick and Dr. Ramsay of Glasgow have recently obtained chinoline, of which three grains hypodermically injected into the body of a rabbit cause anæsthesia in eight minutes (*Medical Press and Circular*, December, 1877). Chinoline, which is closely related to the hydro-carbon naphthalin in composition, has recently been prepared by artificial means.

Quinidine or quinidia ($C_{20}\,H_{24}\,N_2\,O_2$, $2H_2O$) is isomeric with quinine, is found in most barks, is precipitated from solution, and thus, separated from the other alkaloids by potassium iodide, deposits from an ethereal solution in rhombic efflorescent prisms; is less bitter, less soluble, but nearly as powerful as quinine. An alkaloid has been isolated from C. succirubra, allied to quinine, and termed quinamine ($C_{19}\,H_{24}\,N_2\,O_2$)

Cinchonine or cinchonia ($C_{20}\,H_{24}\,N_2\,O$) is present to the amount of four or five per cent., especially in the pale barks. Its colourless four-sided prisms have a feebly bitter taste. It is distinguished from quinine by being anhydrous, scarcely soluble in ether, but readily dissolved in alkaline solutions; its acidulated watery solution shows no fluorescence, and no green colour or precipitate with chlorine, whilst it turns a ray of polarised light to the right instead of to the left, as quinine does. As a tonic, it is given in about double the

dose of quinine (Bartholow). Another alkaloid, cinchonidine, has been obtained isomeric with cinchonine.

Quinodine or quinoidine is the name given to the uncrystallisable alkaloids. When undue heat or excess of mineral acid is used in abstraction of the cinchona alkaloids, or when the bark has been carelessly dried or unduly exposed to sunlight, the proportion of the amorphous quinodine is increased much in the same manner as excess of uncrystallisable treacle occurs in the careless preparation of crystallisable sugar. Quinodine contains a mixture of modified quinine and cinchonine, is at first brown and brittle, but can be readily freed of colouring matters, and its combinations with sulphuric and hydrochloric acids are now sold as colourless powders. Being considerably cheaper than the pure crystalline alkaloids, and of like activity, they deserve the attention of veterinarians.

Chinic or quinic acid ($C_7 H_{12} O_6$) is present in many allied barks, occurs in cinchona in combination with the alkaloids and earthy bases, and from its aqueous solution crystallises in transparent, large, rhombic prisms, soluble, and acid to the taste. By destructive distillation it furnishes hydro-quinine, phenol, and benzoic acid, which it resembles in its action, and when taken internally it is excreted by the kidneys as hippuric acid. Chinovic or quinovic acid, probably a modified condition of chinic acid, forms tasteless, insoluble, hexagonal scales, and is associated with the bitter tonic quinovin.

Cincho-tannic acid, present to the amount of two or three per cent., is amorphous, deliquescent, soluble in water, alcohol, and ether; precipitated from its solution by iron perchloride, gelatine, and tartar emetic. Alkalies convert it into cinchonic red.

Cinchona red, or cincho-fulvic acid ($C_{28} H_{22} O_{14}$) is an amorphous hygroscopic insipid colouring matter, partially soluble in water, more soluble in spirit, and forming an intensely red solution with alkalies (Royle's *Mat. Med.*, seventh edition).

Actions and Uses.—Cinchona bark is a topical antiseptic and astringent. Excessive doses of bark or its alkaloids produce nausea, giddiness, and delirium—a train of phenomena recognised in human patients as cinchonism. Medicinal doses are antiseptic, astringent, stomachic, tonic, and antiperiodic. The

bark in part owes its activity to its cincho-tannic acid, which is astringent, and closely resembles tannic acid; to its chinic acid, allied to benzoic acid; but its special tonic and anti-periodic virtues are due to its alkaloids.

General Actions.—The bark, and in still greater degree, its alkaloids, are valuable antiseptics. Quinine is scarcely inferior to carbolic acid, arsenic, corrosive sublimate, or strychnine, in arresting fermentation and putrefaction, and destroying vegetable and animal micro-organisms. About one part in 300 preserves, for upwards of a week, meat, butter, milk, and even blood. Diluted with 800 parts of water, it destroys vegetable and animal micro-organisms. It is readily absorbed and diffused; half-an-hour after administration, it is found in the urine of men and dogs. It is slowly removed from the body; it is excreted from the kidneys unchanged, excepting that it is reduced from the crystalline to the amorphous form. For three days after administration of a single full dose, quinine continued to be detected in the urine. Its effects vary considerably, according to dose and condition of patient; small doses increase excretion, large doses diminish excretion; small doses increase, large doses depress, cardiac action; small doses stimulate, large and repeated doses depress vaso-motor centres; moderate doses diminish abnormal temperature, whether caused by exertion or disease. It is also stated to counteract alkalinity and death of the blood (Schutte and Binz).

The manner in which these effects are produced is still matter of speculation. Arguing from its effects outside the body, Professor Binz, of Bonn, teaches that quinine hinders the hæmato-globulin of the red corpuscles from yielding oxygen to the tissues, and hence diminishes wasteful oxidation and tissue change; that it paralyses the amœbiform movements of the white corpuscles; and that, in curing ague and malarial fevers, it attacks and destroys special disease-germs or unstable albuminoids (*Practitioner*, December 1876 and August 1877). Stimulation of vaso-motor and trophic nerves is probably also exerted, for quinine solutions directly applied to the frog's foot distinctly narrow arterioles. Dr. Harley believes that cinchona and quinine act mainly as tonics and astringents on the nervous system; give strength to the circulation by

their stimulating vaso-motor centres and nerves; produce cinchonism by direct effect on the nerve vesicle; their beneficial influences, he adds, "are seen in those cases where, so to speak, the nervous system is unstrung—where, from sheer debility and relaxation of the nerve vesicles, the nerve currents are jarring and painful" (Royle's *Mat. Med.*, sixth edition). Its stomachic and tonic properties ally cinchona with calumba and Berberis barks, with the root of Hydrastis Canadensis, and with salicylic acid. Powdered bark, swallowed in large amount by dogs, irritates and constringes the alimentary mucous membrane, and from its bitterness causes vomiting. An ounce and a half of a strong decoction, injected into the jugular vein of a dog, produced in fifteen minutes vomiting, violent palpitations, and spasms; the injection of half an ounce more caused tetanic convulsions and death. Thirty grains swallowed by rabbits induced debility; and sixteen grains death (Christison on *Poisons*).

Medicinal Uses.—Cinchona bark is prescribed for all animals, exerting primary effects as a bitter stomachic, and, when absorbed, acting as an antiseptic and tonic. It checks abnormal gastro-intestinal fermentation, and counteracts that relaxed over-secreting state of the alimentary membrane which proves a favourable harbour for worms. Foals and calves troubled with diarrhœa, after a dose of oil, are often much benefited by a mixture of cinchona, hydrochloric acid, and spirit. It is one of the most reliable antipyretics, often controlling rising temperature in fever. It is prescribed in convalescence from most debilitating complaints, in pulmonary consumption and other forms of tuberculosis, in diabetes, glanders, and liver rot in sheep. Its antiseptic virtues dictate its use in cases of septicæmia and pyæmia, in purpura in horses, and in puerperal metritis in cows and ewes. Its antiperiodic properties recommend it in malarial and intermittent fevers, in chorea in weakly dogs, in periodic ophthalmia or moon-blindness in horses, in which it is highly extolled by French veterinarians, and in those rheumatic affections both of horses and cattle which exhibit periodicity. To arrest such intermittent attacks, a full dose should be given four or five hours before the seizure is anticipated. Persons exposed to malaria are protected from febrile

attacks by the daily use of bark or its alkaloids. Cinchona is contra-indicated in inflammatory attacks, where the stomach is irritable, and the bowels constipated. For topical astringent and antiseptic purposes the powdered bark is superseded by cheaper tannin-containing bodies, or by the tar acids.

Doses, etc.—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 continuously. If nausea or vomiting supervene, as occasionally happens in dogs, the dose should be considerably reduced, and given immediately after a meal. It is usually administered in the form of bolus, and is often conjoined with camphor, gentian, ginger, spirit, or ether. The *infusion* is made by digesting for some hours, or boiling for ten minutes in a covered vessel, one part of powder with ten or twelve parts of water, and straining. The *tincture* is made by maceration and percolation with four ounces of yellow bark and one pint of proof spirit.

Quinine Sulphate or Disulphate (Quinæ sulphas) possesses in concentrated form the chief properties of cinchona bark, and is the quinine salt generally used in human medicine. The proportion yielded by different barks varies from one to six per cent. As it is procured from the manufacturing chemist, minute details regarding preparation are unnecessary. The yellow bark is usually preferred, is reduced to coarse powder, and treated with hydrochloric acid; the alkaloids thus dissolved are thrown down by solution of soda or lime, washed repeatedly with water to remove saline and other impurities, redissolved by very diluted sulphuric acid, filtered, evaporated, and crystallised, leaving in solution any other alkaloids present. The salt contains two atoms of quinine, one of sulphuric acid, and eight of water of crystallisation ($2\ C_{20}\ H_{24}\ N_2\ O_2, H_2\ SO_4, 8\ H_2\ O$).

Properties.—Quinine disulphate occurs in fine, silky, colourless, odourless crystals, adhering together in tufts, and having an intensely bitter taste. Exposed in dry air it effloresces, giving off five atoms of its water of crystallisation. It is soluble in 740 parts of cold water, 30 of boiling water, and 60 of rectified spirit; a few drops of sulphuric acid convert it into the neutral sulphate, which is freely soluble. Its acidulated watery solution, when diluted, has a faint blue tint, and exhibits

on its surface a peculiar fluorescence, noticeable even when $\frac{1}{200000}$th part is present. With alkalies and alkaline carbonates, it yields white precipitates of quinine. When a faintly acidulous solution is treated first with chlorine or bromine water, and then with liquor ammoniæ, a green-coloured solution is produced, from which a green precipitate shortly separates. With iodine is also formed a beautiful green crystalline compound.

Impurities.—The most common adulterations are calcium sulphate, which with other earthy impurities is detectable by incineration; sugar, discoverable by the sweetness of the residuum left on evaporation; fatty matters, insoluble in water acidulated with sulphuric acid. When sugar, starch, salicine, or other organic matters are present, cold concentrated sulphuric acid produces a coloured, instead of a colourless or slightly yellow solution. Vapour of ammonia gives a beautiful blue colour with any sample containing phloridzin—a bitter-sweet silky, crystalline body, obtained from the bark of pomaceous and amygdalaceous trees. Cinchonine and quinidine are detected by throwing down the alkaloids from solution by liquor ammoniæ, and adding ether, which redissolves the quinine, but leaves the other alkaloids floating undissolved between the two liquids; the cinchonine appears crystalline, the quinidine of an oily aspect.

Actions and Uses.—Quinine disulphate, quinidine, cinchonine, and the uncrystallisable alkaloids or quinodine, differ only in the degree of their action, and are applied to the same uses. They differ from the crude bark mainly in their concentration and absence of astringency. Quinine sulphate and quinodine sulphate, which is cheaper, and when pure is equally trustworthy, are the most powerful and certain vegetable tonics, and are effectual antiseptics and antiperiodics. They stimulate Setschenow's centre of inhibition of reflex movements, and hence diminish reflex irritability (Dr. Lauder Brunton). Their expense alone precludes their more extended use in veterinary practice. Medicinal doses increase the gastro-intestinal secretions, improve the appetite, and are prescribed for all animals suffering from weak digestion connected with debility; in convalescence from acute complaints; or in chronic

exhausting disease. They have marked effect in increasing weak or slow pulsation and lowering abnormal temperature—effects dependent either on their action as nerve stimulants or as antiseptics, and observed in horses suffering from strangles, influenza, purpura, and typhoid fever. No tonics are better adapted for badly-nourished dogs, especially when suffering from distemper; they allay irritation, counteract perverted and inordinate nervous action; given along with port-wine or ether, they prevent untoward complications and expedite recovery. Similar treatment answers well in chorea. Ten grains dissolved in ether, repeated several times daily, have been used with benefit by Mr. Thomas A. Dollar, in sciatica in the horse. Quinine given with cathartics is believed to increase their activity; but its actions in combination have as yet been imperfectly studied.

Doses, etc.—Of quinine disulphate, or the cheaper uncrystallisable quinodine sulphate, horses take grs. x. to grs. xx.; cattle, grs. xx. to grs. xl.; sheep and pigs, grs. v. to grs. x.; and dogs and cats, gr. i. to grs. v. Quinidine and quinovin are used in the same doses; cinchonine in double the quantity; are repeated thrice a day; and, as tonics, should be persevered with for some days, and alternated with other tonics. They are given in the form of pill, conveniently administered to the dog in a spoonful of thick gruel or a piece of meat. The solution in water, acidulated with a few drops of sulphuric acid, is the form preferred in human medicine. It is frequently conjoined with ginger, gentian, camphor, valerian, or iron, and medical men sometimes combine the best mineral and best vegetable tonic by using citrate of iron and quinine.

COD-LIVER OIL.

Morrhuæ Oleum. Oil from the fresh liver of Gadus morrhua.

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°. The oil floating to the top is filtered, cooled to 50°, and again filtered before being stored in casks.

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 temperature, or from the oil being extracted from stale putrid livers. Its specific gravity is ·928; ether dissolves it readily; cold alcohol dissolves 2 to 3 per cent., hot alcohol 3 to 7 per cent. It consists of 80 per cent. of oleïn and 15 per cent of palmitin, small portions of cholic and butyric acids, and other biliary matters; acetin, a compound of acetic acid and glycerine; less than one-half per cent. of phosphorus, iodine, bromine, and chlorine, with phosphoric and sulphuric acids, lime, magnesia, and soda. (Royle's *Mat. Med.*) 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 cholic acid, 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; but small and repeated doses are saponified and assimilated, become sources of heat and of force, nourish the nervous and other organs, increase intercellular fat, and usually add to the patient's weight. 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 interesting experiments, made by an Essex agriculturist, regarding the fattening action of cod-liver oil on pigs, sheep, and cattle. Twenty pigs, separated from a lot of three hundred, averaging in weight from five to fifteen stones, received two ounces of oil daily, with as much meal as they pleased. 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 on an average 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 deserve to be repeated. As they stand, they confirm the fact, admitted by all scientific agriculturists, that a certain quantity of oleaginous material is essential to speedy and economical fattening. They do not, however, suffice to establish the individual superiority of cod-liver oil. Equally satisfactory results would probably be obtained from the use of linseed, lard, rape, or other mild fixed oil.

As a nutrient tonic, cod-liver oil, in human patients, is, however, preferred to other oils, mainly on account of its ready assimilability and its aiding digestion of albuminoids,—properties probably depending upon the associated biliary matters. It is prescribed in debilitating and wasting complaints, accompanied by faulty nutrition, in the several forms of tuberculosis, in epilepsy, chorea, and various debilitating nervous disorders. I have given two-ounce doses twice daily to delicate horses, thriving badly after influenza and strangles. It helps recovery of cattle from pleuro-pneumonia and chronic rheumatism; but for such disorders among cattle, sheep, and horses, it is usually superseded by linseed or oil cakes. Dr. Pollock's Essex correspondent mentions that, like other oils, it materially relieves broken-winded horses. Along with iron, it often assists regeneration of consolidated lung. For dogs and cats it is particularly useful in protracted cases of distemper, rickets, inveterate skin disease, epilepsy, chorea, and chronic rheumatism, especially that variety known as kennel lameness, and depending upon damp, bad feeding, and faulty nutrition.

Doses, etc.—Horses take f ℥ ij.; cattle, f ℥ ij. to f ℥ iv.; sheep about f ℥ j.; pigs, f ℥ iv. to f ℥ i.; dogs, f ℥ i. to f ℥ iv.; cats, about f ℥ i. The doses may be repeated twice a day, and persevered

with, if required, for weeks. To remove disagreeable flavour, and prevent nausea, it is given in milk, mucilage, or gruel, beat up with an egg, conjoined with some aromatic, mixed with lime water, or, better still, with ether, and is best digested along with or immediately after other food.

COLCHICUM.

Autumn Crocus. Meadow Saffron. Fresh Corm or bulb and seeds of Colchicum autumnale.

Nat. Ord.—Colchicaceæ or Melanthaceæ. *Sex. Syst.*—Hexandria Trigynia.

The autumn crocus grows wild throughout middle and southern Europe and on many 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, brown, bitter, acrid seeds, about the size of millet; and a biennial root, which, towards June, and when about a year old, produces near its lower end a small bulb. This offshoot gradually increases in size, sends up in autumn a flowering stem, and in spring the familiar crocus leaves with the seed vessel. By July it attains its full growth, being about the size of a walnut, and beginning in its turn to form a young bulb. Meanwhile the parent bulb has been gradually wasting, until, during the second summer of its own existence, it becomes a dry, shrivelled, shapeless mass, attached to the lower surface of its full-grown progeny. Previous to this, generally during the spring months, it sometimes produces one or two small immature bulbs, which, after separation from the parent bulb, probably require several years to come to perfection. The corm or bulb, the chief officinal part of the plant, is usually taken up in June or July, when plump, rich in starch, and about a year old. But although more shrivelled and watery, it is now believed that medicinal activity is greatest in autumn during or after inflorescence, and that they then keep for years, if dried entire in the sun or air (Flückiger and Hanbury). The bulbs in their plump state are generally sliced transversely, dried at a temperature not exceeding 150°, and stripped of their brown integument. The slices are

kidney-shaped, about two 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, which is their cheapest and handiest solvent. The bulbs contain about 70 per cent. of water, 10 of starch, with lignin, gum, and a bitter, crystallisable, poisonous alkaloid, called Colchicine (C_{17} H_{19} N O_5), present also in other parts of the plant, and 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. It resembles veratrine, but is more soluble and crystallisable, and does not cause sneezing.

Actions and Uses.—Colchicum in large doses is a gastro-intestinal irritant and sedative; medicinal doses are emetic, cathartic and chologogue; its diuretic, and diaphoretic actions are uncertain. It resembles the other Melanthaceæ, Veratrum album, V. viride and cevadilla, and is allied to aconite, which without preliminary irritation exerts more immediate sedative effects.

The powdered corm or seed, or any active preparation, irritates the skin, or other part to which it is applied. Eaten, whether in the green or dried state, it excites gastro-intestinal irritation. Mr. Broad, of Bath, in the *Veterinarian* for April 1856, records two cases of horses dying from eating in their hay the stalks, leaves, pods, 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* for 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. In the *Veterinarian* for August 1864, three cattle eating colchicum are reported to have shown 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. Rabbits and frogs are stated to be much less susceptible to the action of colchicum, but men and dogs are readily brought under both its irritant and sedative effects. Two drachms of the dried bulb caused in dogs vomiting, bloody evacuations, diuresis, tremors of the limbs, depression of the action of the heart, 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. Post-mortem examination disclosed inflammation of the stomach and bowels, with extravasation of blood (Christison on *Poisons*).

Medicinal Uses.—Large doses of the fresh corm given to fasting dogs, and prevented from being expelled by vomiting are found by Professor Rutherford to increase secretion of bile, and also purge powerfully. But increased secretion from the gastro-intestinal membrane is more safely effected by other medicines. Like other sedatives it slows the action of the heart and dilates arterioles. 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 also prescribe it in constitutional ophthalmia. Although excreted chiefly by the kidneys it does not usually increase either their watery or solid parts.

Doses, etc.—For horses, the dose of the powdered corm or seed is ℥ ss. to ℥ j. ; for cattle, ℥ j. to ℥ ij. ; for sheep, grs. x. to grs. xxv. ; for dogs and pigs, grs. ij. to grs. viij. The powder is given with small doses of nitre, and a convenient solution is made with one part of colchicum, six or eight of vinegar, and a little spirit.

COPPER AND ITS MEDICINAL COMPOUNDS.

Copper. Cuprum. Cu.

Copper is a brilliant red metal, found native near Lake Superior in North America, crystallised in octahedrons or cubes. It has a spec. grav. of 8·95, a nauseous styptic taste, and an unpleasant odour, especially when rubbed. It is malleable and ductile, constitutes 95 per cent. of the material of our bronze coinage, which consists of about four of tin and one of zinc. Brass contains about two-thirds of copper and one-third of zinc. Its principal ores are the copper pyrites, a double sulphide of copper and iron, and the carbonate or malachite; its chief officinal salts are sulphate, iodide, and acetate. Copper forms two series of salts, the cupric containing one, the cuprous two, atoms of copper. The cupric salts, when hydrated, have a green or blue colour. In acidulated solution copper is distinguished by the following tests:— Hydrogen sulphide and ammonium hydrosulphide give black precipitates of copper sulphide (Cu S); potash or soda, a greenish-blue precipitate of cupric hydrate (CuO, H_2 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 (Cu SO_4, $2H_3N$); and potassium ferrocyanide, a chocolate-brown precipitate of copper ferrocyanide (Cu_2 Fcy). Another good test is to place in the solution of the copper salt a piece of polished iron or steel, which quickly becomes coated with a red crust of metallic copper.

Actions and Uses.—Large doses of salts of copper are irritant and caustic; medicinal doses are antiseptic, astringent, tonic, and emetic. The activity of the several salts differs according to their solubility. They resemble compounds of silver, gold, zinc, and arsenic. Copper is a constant constituent of the parenchymatous organs even of the fœtus. So long as it remains metallic it is devoid of poisonous action. Drouard gave an ounce of finely divided copper to dogs of different sizes and ages, but none experienced any inconvenience (Pereira). Two drachms of oxide had no effect

on dogs beyond occasional vomiting and diarrhœa. But as with other metals, so soon as copper is converted into a soluble salt, it produces irritant and astringent effects. Dogs tolerate for several weeks daily doses of 10 to 15 grains of sulphate or acetate ; but 40 to 60 grains induce loathing of food, diarrhœa, and in some instances death, usually from exhaustion. (*Practitioner*, July 1877.) The soluble salts are absorbed ; are diffused as albuminates ; like other metallic poisons, accumulate in the liver, spleen, kidneys, and even in the bones ; besides irritating, they attack the blood globules, and increase tissue waste ; they are slowly eliminated, partially by the liver and skin, but mainly by the intestines and kidneys. Animals depastured in the neighbourhood of copper-smelting works are occasionally affected by loss of appetite, impaired digestion, failing condition, hectic fever, and diseases of the bones—effects depending partly on the ingestion of small quantities of copper, but chiefly upon the arsenic which these smelting furnaces evolve in considerable amount. (See p. 207.) The symptoms specially traceable to the copper salts are muscular trembling, paresis of the limbs, defects of co-ordination, with bronchial and gastro-intestinal irritation. Injurious effects, such as frequently take place in the human subject, have also occurred in the lower animals, especially in pigs and dogs, from the use of food or drink which has acquired cuprous impregnation from being boiled in copper vessels, and allowed to remain in them while cooling. Acid and fatty matters are most apt to become thus contaminated, and especially if kept long in contact with copper, exposed at the same time to air and moisture.

Copper Sulphate. Cupri Sulphas. Cupric Sulphate. Blue Vitriol. Blue Stone. Vitriol of Copper. $Cu\,SO_4, 5H_2O$.

Copper sulphate is got by dissolving the black oxide in sulphuric acid, by boiling metallic copper with diluted sulphuric acid, and on the large scale by roasting copper pyrites ($Cu\,Fe\,S_2$), 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 spec. grav. 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°, loses water of crystallisation, becomes a yellow-white powder ($Cu\ SO_4$), and is used for testing alcohol and other liquids for water, which it seizes, regaining its blue colour.

Actions and Uses.—Large doses produce fatal gastro-enteritis. Repeated full doses induce vomiting in carnivora, and cause intestinal irritation, with paralysis not unlike that of lead poisoning. Medicinal doses are antiseptic, astringent, tonic. For carnivora it is a prompt emetic, its effects depending upon gastro-intestinal irritation rather than upon stimulation of the vomiting centre. Externally it is used as a stimulant, astringent, and caustic ; it is an effectual antiseptic.

Hertwig mentions 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 diarrhœa; the evacuations are tinged green or blue, and mixed with blood ; and there usually follows fatal inflammation of the stomach and intestines. 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, milk, and other albuminoids, which form insoluble innocuous albuminates ; iron filings, which attract and fix the copper; or potassium ferrocyanide, which produces an insoluble harmless salt.

Medicinal Uses.—Copper sulphate is much used in cases of atony and excessive mucous discharges, and especially amongst cattle, in which milder tonics and astringents are sometimes comparatively useless. Small frequently repeated doses are particularly effectual in inordinate discharges or hæmorrhage from the bowels. In glanders and farcy, purpura and typhoid fever in horses, it usually arrests abnormal secretion, improves appetite, increases general vigour, and, where it does not cure, it often retards a fatal result. It is often conjoined or alternated with spirituous or ammoniacal stimulants, and with iron salts. Where the bowels are much relaxed, as in chronic diarrhœa or dysentery, it is prescribed with opium. Given in bolus, administered fasting, and repeated daily for a week, it is a useful general vermifuge for the horse, especially effective when followed by a dose of physic. Amongst dogs and cats, in narcotic poisoning, either the copper or zinc sulphate is resorted to as the most prompt and active of emetics. As a nerve tonic and antispasmodic, small repeated doses are serviceable for dogs affected with epilepsy and chorea. Applied externally, like silver nitrate, it stimulates mucous or abraded skin surfaces, and forms with their albuminoids a protecting pellicle, under which healing goes on satisfactorily. It is a useful antiseptic stimulant and astringent in chronic purulent ophthalmia, morbid conditions of the Schneiderian and other mucous membranes, diphtheritic sore throat, scurfy affections of the skin, and superficial hæmorrhage from minute vessels. As a stimulant and escharotic, it is used in fistulous wounds, farcy buds, exuberant granulations, and foot-rot in sheep. It is a capital antiseptic, standing next in efficacy to zinc, iron, and mercury chlorides, and especially serviceable where foul organic matters are largely mixed with water. On account of cheapness, zinc chloride is, however, generally preferred.

Doses, etc.—As a tonic and astringent horses take from ℥ i. to ℥ ij.; cattle, ℥ i. to ℥ iv.; sheep, grs. xx. to grs. xxx.; pigs, grs. v. to grs. x.; and dogs, gr. ¼ to grs. ij. These doses, repeated twice a day, 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 dogs, grs. vi. to grs. x. are given dissolved in water; and about double that amount for pigs. For external purposes, the powder or a watery solution is used. Shepherds make a useful ointment for foot-rot by mixing 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 three of tar.

Copper Ammonio-Sulphate. Cuprum Ammoniatum. Cupric Ammonio-Sulphate.

Ammonio-sulphate is generally prepared by triturating copper sulphate and ammonium sesqui-carbonate until effervescence ceases, wrapping the mass in bibulous paper, drying it, and preserving it in closely-stoppered bottles. It is a mixture of the double sulphates and carbonates of copper and ammonium, with an excess of ammonium-carbonate, which renders the double salt soluble. It may be prepared in a hydrated state by adding ammonia to a solution of copper sulphate until the precipitate first thrown down is nearly re-dissolved, and in this condition it is used as a test for arsenic. The dried salt has an azure-blue colour, a metallic coppery taste, and a powerful ammoniacal odour. Unless carefully protected from the air, it speedily loses ammonia.

Actions and Uses.—Its actions and uses resemble those of the sulphate. It is rather less irritant and astringent, and may be used in the same or somewhat larger doses. Two to four drachms are administered to horses and cattle in influenza, pleuro-pneumonia, consumption, and other complaints accompanied by atony and debility; and one or two grains to dogs as a stimulating nervine tonic in chorea and epilepsy.

Copper Iodide. Cupri Iodidum. Cuprous Iodide.

Although not mentioned in the *Brit. Phar.*, copper iodide is noticed in Morton's *Veterinary Pharmacy*, and in Professor Tuson's *Veterinary Pharmacopœia*. It is the by-product remaining from the preparation of iodine, by mixing copper

sulphate with the familiar iodine ley; and is also obtained by mixing solutions of copper sulphate and potassium iodide. It is a fawn-coloured salt, has a disagreeable, styptic, coppery taste, evolves an odour of iodine, and consists of a mixture of copper iodide and free iodine. It was introduced into practice in the belief that it possessed the conjoined actions of its two constituents. But its effects in large doses, in which its characteristic actions should be most obvious, resemble those of other copper salts, and bear no analogy to those of iodine. 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*). There is, however, no sufficient evidence of its superiority to the sulphate.

COPPER SUBACETATE. Copper Oxyacetate. Verdigris. Blue Verdigris. Ærugo. $Cu\ 2C_2H_3O_2, Cu\ O, 6H_2O$.

Chemists describe five acetates of copper. Of the sub- or di-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, verdigris is formed as a paste on the copper plates.

Properties.—It occurs either in amorphous masses or powder, is either blue or green according to the mode of its 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. Treated with hydrochloric acid, it should not leave more than five per cent. of residue undissolved.

Actions and Uses.—Like other copper salts, verdigris is an irritant poison. It is emetic, astringent, antiseptic, and tonic, but is rarely used internally. It is employed externally as a caustic, stimulant, astringent, and antiseptic. Drouard

exhibited twelve grains to a strong dog while fasting, and observed aversion to food, efforts to vomit, diarrhœa, listlessness, and death in twenty-two hours. In some cases paralysis of the hind extremities was also observable, but in none was the stomach much inflamed. The neutral acetate ($Cu\ 2C_2H_3O_2, H_2O$) appears even more active; for, 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 observed 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 are the same as those of the sulphate. The external uses are also the same. It is applied in the form of powder, solution, and ointment, which is made with one part of verdigris and eight or ten of lard or of resinous ointment. The acetate, like the sulphate, forms an active dressing for foot-rot in sheep when mixed with three or four parts of lard, oil, or tar.

CREASOTE.

Creasotum. Kreasote. A mixture of Volatile Oils obtained by the distillation of wood tar. (*Brit. Phar.*)

Creasote is one of the products of the distillation of wood tar, is present in wood and peat smoke, and confers on these substances their well-known antiseptic properties. Tar from hard woods, especially from beech, yields more creasote than that from the coniferæ. Coal-tar yields the analogous body carbolic acid, now generally preferred on account of its cheapness. The tedious and complex process by which creasote is generally obtained from wood tar is followed only on the large scale. A simpler process consists in distilling tar into a barrel half filled with water, removing the lighter oil which floats on the water, adding sulphuric acid to the heavier residue, boiling the mixture, exposing it to the air for three days, with frequent

stirring, and distilling it repeatedly. Tar of good quality contains 20 to 25 per cent. of creasote (Gregory).

Properties.—Creasote is a mobile, oily, neutral fluid, with the spec. grav. 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 consists chiefly of kresole ($C_7 H_8 O$), with smaller amounts of phenic acid, and several allied oils. It requires for solution 130 parts of water, but readily dissolves in alcohol, ether, acetic acid, and volatile oils. It coagulates albumen, whitens and corrodes the skin and other animal tissues, and forms with them insoluble compounds, which resist putrefaction. A slip of deal dipped in creasote, and afterwards in hydrochloric acid, on exposure to air shortly acquires a greenish-blue colour ; dropped on white filtering paper, and exposed to a heat of 212°, it leaves no translucent stain. (*Brit. Phar.*) Impure carbolic acid and other coal-tar oils, sometimes mixed with or substituted for wood creasote, are distinguished by their greater solubility in water, glycerine, and potash solution ; by their solidifying at low temperatures ; by their not affecting a ray of polarised light, which creasote turns to the right ; by their producing a jelly when shaken with collodion, which does not affect wood creasote ; by their watery solution giving a blue colour, with a neutral iron perchloride solution which does not discolour the watery solution of wood creasote (Professor Attfield).

Actions and Uses.—Creasote is an irritant narcotic poison ; it is a special sedative of the terminal nerve-fibres of the mucous membrane of the stomach, and hence relieves gastric irritation and pain ; it is also antiseptic and astringent ; externally it is escharotic, stimulant, astringent, insecticide, and antiseptic. Its actions and uses are those of carbolic acid. Its irritant, inebriant, and antiseptic properties ally it to alcohol and oil of turpentine.

Three drachms given to horses caused slight and temporary feverishness, and imparted to the breath a creasote odour (Hertwig). Thirty drops given to dogs by Sir J. R. Cormack caused uneasiness, copious salivation, vertigo, muscular twitching, convulsions, 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 Creasote, Harveian Prize Dissertation*, 1836). It is rapidly absorbed, undergoing, however, slight change; poisonous doses stimulate, derange, and eventually paralyse the spinal cord, and destroy life by arresting respiro-cardiac functions. In fatal cases the heart and lungs are much engorged with blood. The stomach and intestines are slightly inflamed, particularly when the animals have survived for some hours. It passes unchanged from the body by most of the excreting channels, but chiefly in the urine, to which it communicates its odour, and furnishes indican. In poisoning the treatment is the same as for carbolic acid.

Medicinal Uses.—Small repeated doses soothe the irritated ends of the nerves distributed to the stomach, arrest undue fermentative changes in the partially digested food, and hence are useful in some forms of indigestion, and in dogs in chronic vomiting. A few drops inhaled with steam prove soothing in bronchitis and chronic lung complaints, especially when accompanied by excessive and fœtid discharges. At the Edinburgh Veterinary College some years ago creasote was used in many cases of contagious pleuro-pneumonia among cattle, in doses varying from twenty to eighty drops, dissolved in volatile oil or acetic acid; and with some temporary advantage in relieving the distressed breathing and irritable bowels. Like almost every other article of the materia medica, it has been tried in glanders in horses, but without any very striking results. Cases of farcy and nasal gleet, with enlarged glands and fœtid discharge, are sometimes, however, benefited by giving daily a drachm of creasote, with thirty minims of sulphuric acid, made into a ball with linseed meal. In that form of diabetes insipidus common in horses it usually does harm rather than good. With chalk and catechu mixture, or a little laudanum

and some aromatic, it is useful in checking diarrhœa and dysentery.

Carbolic acid has superseded creasote as an antiseptic, stimulant, and astringent for wounds, as well as an escharotic in caries, scrofulous tumours, fistulæ, canker, thrush, and foot-rot. Diluted with spirit and water or vinegar, it is still occasionally used both externally and internally to relieve itching and remove scurf in chronic eczema, prurigo, and psoriasis. It destroys vermin infesting the skin. For mange and scab, Gerlach advises an ounce of creasote, 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. Bunting advises the inunction of a mixture of one part of creasote with seven of olive oil, to which two parts of caustic potash solution is subsequently added. Human patients suffering from toothache depending on caries, are often relieved by a drop of creasote cautiously placed in the hollow of the tooth, where it unites with albuminoid matters protecting the irritable nervous pulp from air and irritants. As an antiseptic, it stands next in order after cresylic and carbolic acids, and is believed to have been the essential agent used in embalming the Egyptian mummies. Although a reliable antiseptic, it has little power as a deodoriser.

Doses, etc.—For horses, ℥ xx. to ℥ xl.; for cattle, f℥ ss. to f℥ ij.; sheep, ℥ x. to ℥ xx.; pigs, ℥ v. to ℥ x.; dogs, ℥ i. to ℥ iij. It is given in bolus with syrup, or in solution with mucilage, acetic acid, volatile oils, or alcohol. As an escharotic or astringent, it is applied with a camel's hair brush; is used in solution in spirit or acetic acid, or as an ointment, made with a drachm of creasote to an ounce of lard. For skin diseases, equal parts of creasote and sulphur may be made into an ointment with lard, or a liniment with oil. A little creasote is sometimes added to turpentine, hartshorn, or other embrocations.

CROTON SEEDS AND OIL.

Croton Seeds. Crotonis Semina. The seeds of Croton Tiglium.
Croton Oil. Crotonis Oleum. Oil expressed from the seeds of Croton Tiglium. (*Brit. Phar.*)

Nat. Ord.—Euphorbiaceæ. *Sex. Syst.*—Monœcia Monadelphia.

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 fruit or nut is somewhat larger than a hazel, of an oval triangular form, and contains three seeds about the size of French beans, resembling the castor-oil seeds in size and shape, and, when shelled, weighing on an average three grains each. They are brown, 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 oleaginous seed kernel contains 50 to 60 per cent. of a fixed oil, which, when separated by expression and purified by straining, constitutes the officinal croton oil. It is mostly extracted in London, is slightly viscid, of a brownish-yellow colour, with a peculiar nauseous odour and a persistent acrid taste. It is imperfectly dissolved in cold alcohol, but completely soluble in boiling alcohol, ether, the fixed and volatile oils. Besides ordinary fatty acids, it contains acetic, butyric, valerianic, and other volatile acids, with the special crotonic ($C_4 H_6 O_2$) and methyl-crotonic acids ($C_5 H_8 O_2$), but neither of these acids are believed to be purgative. The active principle, obtainable also from the wood and leaves, has not yet been isolated (Flückiger and Hanbury), but is believed to be developed by a process of saponification within the alimentary canal. The residuum from which the oil has been expressed is sometimes used under the name of croton cake ; but as the amount of oil retained is very variable, its effects are irregular and uncertain.

Impurities.—Croton seeds should be plump and well shaped, not dry, shrivelled, or musty. The seeds of other less active species are sometimes substituted for those of C. Tiglium. The oil is occasionally of inferior quality and dark coloured, on account of the seeds from which it has been extracted being old or musty. It is occasionally adulterated with other oils, usually with castor oil, which is distinguished by its perfect solubility in cold alcohol.

Actions and Uses.—Croton is an irritant poison; it is used internally as an active cathartic, and externally as a counter-irritant.

Toxic Effects.—Forty seeds destroy a horse in seven hours, with acute gastro-enteritis; half that quantity usually produces fatal inflammation (Hertwig). Mr. Morton administered to two different horses sixty grains, or twenty bruised seeds, and observed super-purgation, accelerated pulse and respiration, injected mucous membranes, cold extremities, prostration, and death in eighteen and twenty-four hours. I have frequently seen even full medicinal doses cause, alike in horses and dogs, very unexpected and serious irritation. In India the seeds are occasionally given to poison horses. Orfila gave a dog three drachms, which killed him in three hours, but one drachm also caused fatal effects; and even ten or twelve grains induce violent purgation, gastro-enteritis, and death in from four to seven hours if the œsophagus is tied to prevent rejection of the irritant by vomiting (Hertwig). About the same quantity of the bruised seed or oil, which proves fatal when given to any animal 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, whilst two drops killed a dog. Moiroud says that twelve drops injected into the veins of a horse produced in a few minutes alvine evacuations; and that thirty drops caused speedy death. 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 a similar effect on sheep, fifteen to twenty on dogs (Hertwig). The irritant action of croton is often exerted

on those employed in shelling the seeds, frequently inducing swelling and inflammation of the face and other parts exposed to the croton dust. In poisoning by croton, the alimentary canal is inflamed throughout; in horses 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.*)

The cathartic action of croton is developed in all the higher animals. The only purgatives comparable with it in activity are 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 to be very safely or generally used. For cattle it is sometimes valuable, operating with certainty when most other purgatives are ineffectual, and when carefully used 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. In contact with the alimentary mucous membrane, it induces topical irritation; mixed with the biliary and pancreatic juices, these alkaline fluids, reduce it to an emulsion which is mostly absorbed through the villi into the lacteals, and carried by the thoracic duct into the general circulation, from which it is shortly excreted through the intestinal glandular apparatus, rousing it to increased action. Professors Rutherford and Vignal have shown that although causing great dilatation of the vessels of the intestinal mucous membrane, croton has no special cholagogue action.

Medicinal Uses.—Croton is used as an active cathartic for cattle suffering from fardel-bound and other forms of constipation, from torpidity of the bowels dependent on disordered states of the nervous system, and from phrenitis and parturient apoplexy. 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 subsequently by stimulants to counteract depression.

Croton oil is sometimes used externally as a counter-irritant. Like tartar emetic, if freely applied, it speedily produces an eruption of minute crowded vesicles, soon assuming the character of pustules, and attended by considerable irritation, inflammation, and swelling of surrounding parts. Applied freely, especially if the skin be thin or abraded, the oil becomes absorbed, and produces its usual cathartic action. Although too irritating either for horses or dogs, it is sometimes applied to cattle, which are less apt either to be purged or blemished. It is chiefly used in laryngitis, chronic glandular enlargements, and tedious rheumatic lameness, in which I have seen the affected joints benefited by repeated dressings, at intervals of three or four days.

Doses, etc.—Ten or twelve seeds, which, allowing three grains for each, weigh from thirty to thirty-six grains, is the dose for the horse, fifteen to twenty seeds for cattle, three or four for sheep, two or three for pigs, and one or two for dogs. Compared with other medicines, a croton bean corresponds in activity with about an ounce of Epsom salt, two croton beans, or six grains of ground seeds, with one drachm of Barbadoes aloes. The dose of croton oil for the horse is ♏xv. to ♏xxv.; for cattle, f℥ss. to f℥ij.; for sheep and swine, ♏v. to ♏x.; and for the dog, ♏ii. to ♏iij. The dose of the so-called croton cake is generally set down as double that of the fresh croton bean; but, as already stated, it is an uncertain preparation. The bruised seeds and the oil are generally administered made into bolus with linseed meal, or dissolved in linseed oil. Although occasionally used alone, 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 advantageously given with one or two scruples of calomel, a pound of salts, or a pint of linseed oil; and few purgative

mixtures are more effectual. Some practitioners drop the oil in an undiluted state on the tongue; but this is not advisable, as it is apt to adhere to the tongue and fauces, causing irritation and inflammation. For external purposes, the bruised seeds or the oil may be dissolved in six or eight parts of oil of turpentine or of soap liniment. Croton oil, added even in small quantity to blistering ointments, greatly increases their activity.

DIGITALIS.

Foxglove. The dried leaves of Digitalis purpurea, collected from wild indigenous plants, when about two-thirds of the flowers are expanded. (*Brit. Phar.*)

Nat. Ord.—Scrophulariaceæ. *Sex. Syst.*—Didynamia Angiospermia.

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, alone recognised by the Pharmacopœia. 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 best dried in baskets in darkness over stoves, and are then of a dull-green colour, with little smell, and a nauseous, bitter taste. They should be used when fresh; twelve months' keeping greatly diminishes their activity. Examination of their botanical characters will detect admixture of leaves of other plants. Both the roots and seeds are bitter and probably active (Sir Robert Christison). The several parts of the plant owe their activity to the presence of digitalin or other crystalline bodies.

Digitalis appears to contain more than one active principle. Digitalin, long regarded as *the* active constituent, has been the

term applied to more than one substance, and, as usually met with, probably consists of several active principles. A very potent, well-defined crystallisable body, called digitoxin (C_{31} H_{33} O_7) has been precipitated by basic lead acetate from a diluted tincture made with the dried powdered leaves, of which 10,000 parts yield only one of alkaloid. When purified, it occurs in colourless scales or needles; it is intensely bitter; insoluble in water, but soluble in both cold and hot alcohol. It is not saccharogenous. Warmed with concentrated hydrochloric acid it assumes the yellow or green colour attributed to commercial digitalin. Diluted acids and fusion convert it into toxiresin, which is also an active cardiac poison (Flückiger, 1879). The digitalin of the Brit. Phar.—not now regarded as a definite compound—occurs in porous mammilated masses or small scales, white, inodorous, and intensely bitter, readily soluble in alcohol and chloroform, but almost insoluble in water, dissolves in acids, but does not form with them neutral compounds; its solution in hydrochloric acid is of a faint yellow colour, but rapidly becomes green. It leaves no residue when burned with free access of air. (*Brit. Phar.*)

Actions and Uses.—Digitalis acts on the heart and arterioles. Medicinal doses are cardiac stimulants and tonics; they increase the force and co-ordinating power of the heart, contract arterioles, and increase arterial pressure. Excessive doses, after stimulation, disorder, exhaust, and arrest the movements of the heart, dilate arterioles, and hence diminish blood-pressure. The crude drug besides induces gastric irritation. It is also diuretic. These diverse effects result from stimulation, and in excessive doses from paralysis, of the cardiac ganglia and nerves, the vagus and its terminations in the heart, the vaso-motor nerves, and the vaso-motor ganglia. Diuresis results from stimulation of the Malpighian tufts.

Toxic Actions.—Two ounces of dried powdered leaves destroyed an adult horse in twelve hours (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

about 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 intermittent beat, the pulse, as death approached, numbering 120 to 140. Smaller doses, after slight acceleration, were found to lower pulsations to 20 or 25, and render the several cardiac sounds particularly distinct. One or two drachms given to dogs cause nausea; and, when vomiting is prevented, moaning and other evidences of abdominal pain, diarrhœa, with green-coloured dejections, feebleness and indistinctness of the pulse, irregular and distressed breathing, spasmodic efforts to empty the bladder, muscular debility, and death (Tabourin). Pigs 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 experiments with frogs, the heart's action became irregular, pulsations were arrested, the ventricle was rapidly contracted and pale. Hearts of frogs removed from the body and placed in solutions of digitalis contracted with increased force. In such a solution, the arterioles of the web of the frog's foot are distinctly contracted (Fothergill and Brunton). 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. of hay, 5 lbs. of oats, and 5½ lbs. of 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 22d one drachm at 6 A.M., at 12 noon, and 6 P.M.; and on the 23d 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 22d she became dull, and refused her feed. 23d, 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 dulness. 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.

23d, 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,	. . $7\frac{1}{2}$.
23.	. .	120,	. . 20.
24.	. .	120,	. . 25.

Towards the evening of the 22d the mare became dull, and would not feed. 23d, 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 the 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.

Digitalis and digitalin are absorbed and exert their action by whatever channel they gain access to the body. They produce their effects, as already indicated, specially on the cardiac ganglia. They stimulate disorder or paralyse accord-

ing to dose and manner of using them. Poisonous doses powerfully stimulate the heart, throwing it into tetanic spasms. Excessive or too frequently repeated doses apparently, by prolonged stimulation, destroy co-ordinating power, render the pulse irregular and intermittent, increase its frequency, in horses raising it to 130 or 140 beats per minute, and dilate arterioles; while carefully regulated medicinal doses, exerting moderate stimulant or tonic effects, quiet and control the irritable, irregular, or weakly heart, and contract arterioles. Regulating and slowing circulation, combustion is retarded, and temperature is lowered. Dr. Fothergill's experiments appear to indicate that the ventricles are more readily affected than the auricles, and that the left ventricle is earlier and more forcibly contracted than the right.

Upas antiar and helleborus viridis resemble digitalis in their effect alike on the heart and arterioles. Casa or doom, an ordeal plant of South Africa, prepared from one of the leguminosæ, and examined by Dr. Lauder Brunton, is believed by him to have even more decided effect on the heart and arterioles than digitalis (*Pharmacology and Therapeutics*). In contracting arterioles, digitalis is allied to ergot, which has moreover special effects on the fibres of the uterus. It differs from strychnine in not contracting voluntary muscles.

Medicinal Uses.—Dr. Ringer believes that digitalis exerts curative effects in one or more of the following ways:—1st. By strengthening the action of the heart; 2d, by reducing the strength of the beats of a heart acting too powerfully; 3d, by lessening the frequency of the heart's beats; 4th, by correcting irregular action of the heart (*Handbook of Therapeutics*, ninth edition). 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 greater co-ordination and expulsive power to the ventricles, and greater tone to relaxed capillaries, and thus renders the irregular and weakened circulation steadier, slower, and stronger. It further usually relieves difficulty of breathing or dropsical effusion which has resulted from imperfect action of the heart. In such cases digitalis in usefully conjoined with

potassium chlorate or nitrate, with alcohol, ether, or ferric chloride. Palpitation in horses, resulting from over-exertion, to which the animals are unused, or from fast work performed shortly after a full meal, occasionally persists for several days; the violent noisy impulse of the heart, accompanied by lifting of the flanks, comes in paroxysms; frequent small doses of digitalis usually effectually control such inordinate, tumultuous functional disturbance. In dilatation of the heart, with insufficiency of the mitral valves, carefully-regulated doses of digitalis abate dyspnœa, the 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 with 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. With nutrients frequently administered, it sustains the action of the heart, and sometimes reduces excessive temperature in continued and typhoid fever in horses. Quieting and regulating the action of the heart, and contracting arterioles, it is recommended in hæmorrhages, especially from the lungs and stomach. Professor Dick's celebrated recipe for thick and broken wind consists of thirty grains each of calomel, digitalis, opium, and camphor, and the efficacy of the prescription in great part depends upon the the calomel regulating the bowels, whilst the other three ingredients 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 usually advised the omission of the calomel. Digitalis relieves many cases of dropsy, by regulating the heart action, and contracting dilated capillaries, as well as by its direct diuretic effect, which Dr. Lauder Brunton ascribes to special action on the Malpighian tufts.—(Dr. L. Brunton on *Digitalis*, 1868.) Diuresis is readily determined

when digitalis is given with salines—a combination often useful in anasarca, ascites, and œdema, especially when connected with obstructed cardiac circulation. Applied locally, it contracts the small arteries (Dr. Fothergill).

The chief indications for the use of digitalis are an irritable, jerking, irregular, or enfeebled action of the heart, deficient arterial pressure, venous obstruction, and regurgitation. It is more suitable for chronic than acute cases, for combating functional rather than organic mischief. It is of little use in difficulty of breathing or dropsical symptoms 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. As with other tonics, it is best tolerated in those weak and irritable states of the heart in which it is most serviceable. It has no cumulative properties; the idea that it had resulted from its effects being comparatively slowly produced, and prolonged for ten or twelve hours, and in the case of full doses for even longer periods. The effects of over-doses are combated by emetics or the stomach-pump, by small doses of ammonia and alcohol, by mustard to the sides, friction, and external warmth, and by the subcutaneous injection of atropine (Dr. John Harley).

Doses, etc.—Of the powdered digitalis leaves, horses take grs. x. to grs. xxx.; cattle, ℥ss. to ℥j.; sheep, grs. viij. to grs. xv. pigs, grs. ij. to grs. x; dogs, grs. i. to iv. Irregular activity of specimens of digitalis and of many of its preparations, and varying susceptibility of patients to its action, necessitate the giving of small doses and the careful watching of their effects. Its full operation is sometimes not observed for two or even three days, and hence small doses, repeated twice daily, should at first be prescribed. Nausea or irritability of the digestive organs, coldness of the extremities, unwonted force or fulness of the pulse-beats, indicate that the medicine should be stopped, or given in reduced amount. The dried powdered leaves, which, it is to be remembered, lose much of their activity when heated or kept over twelve months, are prescribed, made into bolus, or dissolved in hot water or spirit. The Brit. Phar. orders the *infusion* to be made by digesting for

an hour thirty grains of dried leaves with ten fluid ounces of distilled water; the *tincture*, by maceration and subsequent percolation of two and a half ounces of dried leaves with one pint of proof spirit. The well-prepared *succus* or juice is one of the most reliable preparations. Digitalis is given conjoined with salines, stomachics, alcohol, and other stimulants, and alternated with iron salts. Half a drachm, dissolved in a pint of coloured water, with two drachms of nitre, constitutes the ordinary cough and fever draught used by many veterinarians. Stonehenge advises, as a diuretic and febrifuge for a medium-sized dog—digitalis, gr. ss.; nitre, grs. v.; ginger, grs. iij. made into bolus with liquorice powder and syrup, or with linseed flour and water.

The Pharmacopœia digitalin is about a hundred times more active than the dried herb. For human patients the dose is $\frac{1}{60}$ to $\frac{1}{30}$ of a grain. Its concentrated form renders it very convenient for hypodermic use. Poisonous doses cause gastric derangement, throw the heart into violent and disorderly contractions, and shortly arrest its movements; animal temperature is reduced. Medicinal doses regulate and quiet irritable, enfeebled heart-action, sometimes reduce by one-fourth, and even by one-half, the number of beats, and contract arterioles.

ERGOT OF RYE.

Ergota. Spurred or Horned Rye. Secale cornutum. Ergot. The sclerotium (compact mycelium or spawn) of Claviceps purpurea (Tulasne), produced within the paleæ of the Common Rye—Secale cereale. (*Brit. Phar.*)

Nat. Ord.—Graminaceæ. *Sex. Syst.*—Triandria Digynia.

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 honeydew, 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 paleæ, 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 early 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 produces fruit heads of the perfect fungus, the Claviceps purpurea, which, after a few weeks, is again ready to distribute its spores. Close damp weather and undrained 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. Ergot is brought chiefly from Vigo in Spain, from Teneriffe, and from Southern and Central Russia. About thirty cwts. are imported annually. (Pereira.)

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. It contains 30 per cent. of a non-drying saponifiable fixed oil, 3 of albumen, 7 of a feebly-irritant resin, a volatile camphoraceous substance, small

quantities of cholesterin, sugar, lactic acid, and red-colouring matter. The chemistry of its active ingredients is still unsettled. Ergotine, long regarded as the active principle, as usually prepared, appears to be a mixture of several substances. Recent investigations have isolated a crystallisable colourless alkaloid ergotinine ($C_{35}H_{40}N_4O_6$) and a very active acid, the sclerotic (Flückiger, 1879).

Impurities.—Ergot is apt to be of inferior quality from long keeping, especially when in powder, and from attacks of acari. The stock should be renewed every two years or oftener, and preserved, excluded from the air, in closely stoppered bottles. Sulphur and camphor, sometimes mixed with it, are of little avail in preventing deterioration.

Actions and Uses.—Ergot stimulates and contracts involuntary muscular fibre, notably of the blood-vessels and of the uterus. It is not yet determined how much of these effects result from direct action on the muscular tissues themselves, and how much on stimulation of the vaso-motor centre and ganglia. Brown-Séquard states that ergot contracts the vessels of the spinal cord. It is used as a general and local styptic, and to promote expulsive action of the uterus. Large and continuous doses so narrow the arterioles that the tissues become starved and paralysed, and the limbs sometimes gangrenous.

Toxic Actions.—Horses, cattle, sheep, and rabbits are less susceptible than carnivora, alike of its medicinal and poisonous action. 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.) Six to twelve drachms given to small dogs produce vomiting, tenesmus, and shortly dulness, prostration of muscular power, enfeebled pulse, convulsive twitchings and spasms, inebriation and coma. (Tabourin.) Three ounces proved fatal to a terrier bitch in twenty hours. Contraction of involuntary muscle is illustrated by full doses promptly emptying the stomach of carnivora, causing increased intestinal peristalsis, frequent micturition, with contraction of the uterus occasionally

so violent that its fibres have been torn, the fœtus prematurely expelled, while at the full period of gestation natural labour pains are intensified and quickened.

Chronic poisoning occurs especially in patients placed in unfavourable sanitary surroundings, and mainly from gradual narrowing of the blood-paths, and consequent starving of the textures. 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, diarrhœa, 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. A dog getting two or three ounces daily survived for seven weeks, when it had consumed in all fifty-six ounces of ergot. 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 very 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.

The diversity of opinion which still prevails regarding the power of ergot to expel the contents of the uterus doubtless depends upon the imperfect condition of some of the preparations used. Even ergotine is not uniform in composition or activity, while some animals, notably rabbits, are curiously tolerant of its actions. Dr. Samuel Wright (*Edinburgh Medical and Surgical Journal*, vols. lii. liii. liv.), records that large and even continuous doses can be given to rabbits without apparent effect upon the uterus. Two and three drachms respectively were administered daily to two female rabbits from the day after impregnation until parturition, which occurred at the usual time. During the whole period they

continued to all appearance in a healthy state; and the young were born of good size and well nourished. Many of the bitches experimented on exhibited no notable effects even from large doses. Half an ounce was given daily to a terrier bitch five weeks gone with young (Experiment 37), and the same quantity to another bitch within a few days of pupping (Experiment 35); both animals carried their pups the usual time. A bull-terrier bitch had half an ounce daily during the last three weeks of pregnancy, but she also went her full time (Experiment 38). Selecting fresh, well-kept ergot many experimenters have, however, produced abortion in guinea-pigs, swine, cats, bitches, cows, and even rabbits. (Stillé, *Therapeutics*, second edition.) Youatt declares that both in monogastric animals and in ruminants he has never known ergot fail in its action on the uterus of the parturient female. Ergoted grasses not unfrequently lead to abortion in cows, ewes, and deer. Obstetricians are tolerably unanimous in declaring that, with few exceptions, expulsive action soon follows its use in the human female. Ergot resembles digitalis in constricting arterioles, but, with less effect on the heart, exerts more marked action on the digestive and urino-genital organs. It is allied to such vascular constrictors as belladonna, cold, and electricity. Cimicifuga or black snake root—the root of cimicifuga racemosa, along with bitter stomachic properties, has constricting powers on unstriped muscular fibre, but they are much less energetic than those of ergot. In its special action on the uterus, ergot resembles savin and rue.

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 by the hand or forceps, and brought away with gentle traction. When used 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 fœtus, where the position of the fœtus prevents its ready expulsion, and sometimes also in first pregnancies, where the uterus, roused to violent contractions,

may become injured or torn. It is sometimes prescribed to get rid of uterine cysts, and hasten expulsion of the placenta, which in the lower animals may usually, however, be safely and readily removed by the hand. In carefully regulated small doses it is prescribed internally, as well as applied locally, to give tone to the weakly relaxed uterus, and to ward off threatened abortion. (*British Medical Journal*, Sept. 1872.) In conjunction with ice-bags, or other cold and styptic applications, it is administered to constringe bleeding vessels in uterine and other hæmorrhage. In sudden violent post partum hæmorrhage, occasionally occurring both in cows and ewes, the hypodermic injection of ergotine affords the best prospect of success.

Doses, etc.—As a parturient or styptic, for the mare or cow, ʒss. to ʒi.; for sheep, swine, and bitches, about ʒi. These doses, repeated at intervals of half an hour or an hour, are given in the state of watery infusion, tincture, or liquid extract. The simple *decoction* swallowed, dregs and all, is the most economical and convenient preparation for veterinary practice. The *oil*, although rejected by the Brit. Phar., is still occasionally used in human practice, in lingering parturition, and also externally as a styptic and anodyne in rheumatism and toothache. The power of the so-called ergotine in contracting the unstriped muscular fibres of the small arteries and capillaries induced Dr. George W. Balfour, of Edinburgh, to use it hypodermically in five-grain doses, dissolved in ten minims of distilled water, for arresting hæmorrhage from the lungs, stomach, and uterus. The hypodermic injection of ten or twelve grains appears to answer in purpura in horses, and is worthy of trial in those deadly cases of muco-enteritis in heavy draught horses, in which blood is rapidly and abundantly outpoured from the membrane of the large intestines. In such cases ergotine may be conjoined with digitalin, which has a similar power of diminishing the calibre of capillary vessels.

ETHER.

Æther. Sulphuric Ether. Æther Sulphuricus. A volatile liquid, prepared from alcohol, and containing not less than 92 per cent. by volume of pure ether. ($C_4 H_{10} O$) or ($C_4 H_5 O_2$). (*Brit. Phar.*)

Ether is prepared by heating alcohol with about one-fourth of its bulk of sulphuric acid, purifying the crude product by agitation with calcium chloride and quicklime, and redistilling. The British Pharmacopœia gives the following detailed instructions:—"Mix 10 fluid ounces of sulphuric acid with 12 fluid ounces of rectified spirit in a glass matrass of at least two pints capacity, and whilst the mixture is still hot, adapt the matrass to a Liebig's condenser, and distil with a heat sufficient to maintain the liquid in brisk ebullition. As soon as the ethereal fluid begins to pass over, supply fresh spirit in a continuous stream by means of a tube passing through a cork in the matrass, and communicating with a reservoir of spirit, on a higher level, and furnished with a stop-cock to regulate the flow, so that the quantity of alcohol admitted may equal that of the ethereal fluid distilled. When 38 fluid ounces of the spirit have been thus added, and 42 fluid ounces have distilled over, the process may be stopped. Agitate the impure ether in a bottle with 10 ounces of chloride of calcium dissolved in water, and mixed with half an ounce of slaked lime. Leave the mixture at rest for ten minutes, then pour off the supernatant fluid, and distil it with a gentle heat until a glass bead of spec. grav. ·735 placed in the reservoir begins to float. The ether and spirit retained by the chloride of calcium, and by the residue of each rectification, may be recovered by distillation, and used in a subsequent operation."

When alcohol and sulphuric acid are heated together at a temperature of about 140°, the radicle ethyl ($C_2 H_5$) unites with the sulphuric acid, forming hydrogen ethyl sulphate, or sulpho-vinic acid and water, thus (Williamson):—

Alcohol and Sulphuric Acid yield Water and Hydrogen Ethyl Sulphate.

$$\left.\begin{matrix} C_2 H_5 \\ H \end{matrix}\right\} O + \left.\begin{matrix} H \\ H \end{matrix}\right\} SO_4 = \left\{\begin{matrix} H \\ H \end{matrix}\right. O + \left.\begin{matrix} C_2 H_5 \\ H \end{matrix}\right\} SO$$

Further supplies of alcohol acting upon the boiling hydrogen ethyl sulphate separate it into ether, which distils over, and sulphuric acid which remains behind, ready again to repeat the process of breaking up the alcohol :—

Alcohol and Hydrogen Ethyl Sulphate yield Ether and Sulphuric Acid.

$$\left.\begin{matrix} C_2H_5 \\ H \end{matrix}\right\} O + \left.\begin{matrix} C_2H_5 \\ H \end{matrix}\right\} SO_4 = \left.\begin{matrix} C_2H_5 \\ C_2H_5 \end{matrix}\right\} O + \left.\begin{matrix} H \\ H \end{matrix}\right\} SO_4$$

From the crude ether which first distils over, alcohol, water, sulphurous acid, and ethereal oils are removed, as directed by the Pharmacopœia process, by agitation with calcium chloride and slaked lime, and by redistillation. The commercial ether thus obtained has the spec. grav. ·735, boils below 105°, but contains about eight per cent. of alcohol, which may be removed by shaking with half its bulk of water, standing for twenty-four hours on pure dry calcium chloride and caustic lime, and then redistilling with gentle heat. Anhydrous or absolute ether, with a spec. grav. not exceeding ·720, is thus obtained.

Properties.—Absolute ether is a mobile, colourless, neutral fluid, having a peculiar ethereal odour, and a warm pungent taste. It is exceedingly volatile, vaporises without residue, and from its rapid evaporation speedily reduces the temperature of any part to which it is applied. It boils at 94°·8, and remains liquid —146°. Its vapour is half the weight of that of chloroform, but two and a half times heavier than air, is exceedingly inflammable, forms explosive mixtures with air, and hence much care should be used in approaching it with a light. It is miscible with alcohol in all proportions, and soluble in about eight parts of water. It readily dissolves volatile oils, balsams, resins, and, next after chloroform, is the best solvent for morphine and other alkaloids.

Ethereal oil, oil of wine, or oleum ætherum, is a yellow, oily, 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 hydro-carbons, and possessed of anodyne and hypnotic properties.

Acetic ether (*æther aceticus*, C_2H_5, $C_2H_3O_2$), scarcely ever

used by veterinarians, is prepared by distilling sodium acetate, rectified spirit, and sulphuric acid; is a colourless, volatile liquid, with a pleasant cider-like flavour, and soluble in alcohol and water. It has no anæsthetic action; as a stimulant is less prompt and powerful than sulphuric ether, but is more decidedly diaphoretic.

Impurities.—When badly prepared or long kept, ether becomes acid. The presence of alcohol or water increases the spec. grav., and causes a diminution, exceeding five or six per cent., when the impure article is agitated with dry calcium chloride and quicklime. Gently distilled with water, any ethereal oil remains floating on the surface, and such a specimen when evaporated from the back of the hand evolves a peculiar odour, which the practised sense readily distinguishes. Absolute pure ether, poured upon white blotting-paper, laid on the warm hand, should evaporate rapidly, leaving neither moisture nor unpleasant odour.

Actions and Uses.—Poisonous doses are inebriant and narcotic; ether inhaled causes rapid anæsthesia; it kills by paralysing the respiratory centre. Besides being inhaled as an anæsthetic, it is administered as a stimulant, antispasmodic, diaphoretic, and diuretic. It is applied externally as a refrigerant, anodyne, local anæsthetic, and antiseptic, is used as a solvent, and for other pharmaceutic purposes.

General Actions.—Like chloroform, alcohol, and oil of turpentine, which it closely resembles, it is rapidly absorbed, acts upon the brain, spinal axis, and sympathetic system, stimulating, depressing or narcotising according to the dose and mode of administration. It rapidly impregnates the several tissues with its odour and taste, and is excreted by the lungs, skin, and kidneys, exciting them to increased action. In veterinary practice it is chiefly valued for its stimulant action, which, though transient, is prompt and powerful. Large doses cause brief preliminary excitement, quickened pulse and breathing, followed by narcosis and paralysis. Orfila gave a dog four drachms, securing the œsophagus to prevent vomiting, and in ten minutes observed inability to stand, and after fifteen minutes complete insensibility, which continued with occasional and partial awakenings for about three hours, when death

occurred. The coats of the stomach were red and inflamed, the posterior part of the intestines were not affected, the lungs were gorged with black blood, the heart contained dark venous blood, only partially coagulated (Christison on *Poisons*).

Ether inhaled in a gaseous state causes in all animals brief excitement, accelerated pulse and breathing, and within two or three minutes, rapidly deepening unconsciousness, occasionally disturbed by clonic convulsions and muscular rigidity, which disappear as inhalation proceeds. Anæsthesia spreads from the periphery to the centre; the posterior extremities are affected before the anterior; sensation is paralysed earlier than motion; when a fatal effect is produced by full doses rapidly inhaled, the heart beats often for several minutes after respiration has ceased. Anæsthesia is produced, although more slowly and less effectually, when ether is rapidly swallowed or otherwise introduced into the body. Four drachms injected into the peritoneal cavity of a large cat produced fatal collapse in a minute and a half. Further details as to anæsthesia are given in the preliminary section, p. 98. Etherisation has been maintained for upwards of an hour in horses, dogs, and other animals. A two-year-old thoroughbred filly, experimented on by Mr. Barron of Newmarket, was fully etherised in four minutes, and continued so for about twenty-nine minutes, during which time the operation of neurotomy was performed on both forelimbs without the animal evincing any pain. A donkey was 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* for 1847).

In veterinary practice anæsthesia, however, is not always so rapidly and successfully effected; some well-bred horses require to be cast before they can be got to inhale the anæsthetic; the preliminary state of excitement is occasionally prolonged for some minutes; whilst for several hours afterwards, and even for a couple of days, some patients continue dull and off their feed. Dropped upon the skin, especially when in a finely divided spray, it rapidly evaporates, abstracts heat, and causes local blanching and anæsthesia. An ounce of ether thus applied, in about three minutes anæsthises a horse's limb sufficiently for the painless performance of neurotomy.

Applied with infriction, it causes redness and even vesication.

Ether closely resembles chloroform. Its vapour being half the weight of that of chloroform, it is more rapidly diffusible, but more transient in its effects. As an anæsthetic it requires to be inhaled in somewhat larger quantity, and usually for a longer time. It develops rather more preliminary excitement, has a less agreeable flavour, but is stated by American and some English authorities to be safer than chloroform, as it stimulates instead of paralysing the heart. While chloroform, even in moderate amount, occasionally kills by cardiac failure, ether never does so, and in poisonous doses destroys life by respiratory arrest. Ether is more diffusible and actively stimulant than sweet spirit of nitre, acetic ether, or oil of turpentine, none of which are anæsthetic. From alcohol it is distinguished by its anæsthetic properties, and by the rapidity with which it is excreted, and which accounts for its less notable restorative or nutrient action. It is hence more suitable for combating sudden emergencies rather than exerting, like alcohol, continuous restorative effects. Compared with ammonia, it stimulates more notably the brain and cerebro-spinal axis, has narcotic and anæsthetic properties, but is not antacid.

Medicinal Doses.—As a prompt and powerful diffusible stimulant, ether combats violent and dangerous depression. It removes pain of the nervous and irritative type, especially when unaccompanied by vascular excitement. It overcomes those shiverings which so frequently usher in and accompany attacks of disease. Rousing and steadying the action of the heart, and stimulating capillary circulation, it often counteracts congestion. Hard-worked horses, especially in towns, when struck down by any of the forms of catarrhal fever, are roused by ether; it gives tone to the enfeebled heart, it equalises irregular circulation, restores imperfect action of the skin and kidneys, and helps to relieve cough. In such cases it is usefully conjoined with alcohol, sometimes with ammonia, gentian, or potassium salts. Overcoming nervous derangement or torpidity, it relieves cramp, colic, tympanitis, and stomach-staggers. In colic, asthma, and other spasmodic affections, it is often combined with opium or belladonna.

In the later stages of inflammatory diseases, in many chronic or subacute cases, where there is prostration or irritability depending on weakness, in continued and typhoid fevers, ether is of service. Amongst cattle and sheep it may be given even more freely than to horses or dogs. It may be safely persisted with wherever it reduces the number and increases the strength of the pulsations, lowers excessive temperature, and favours secretion. Ether is sometimes effectual in the expulsion of intestinal worms, and especially of ascarides, which may usually be dislodged from the rectum by giving it freely diluted as a clyster. Thus administered it often relieves spasmodic affections of the intestines. The use of ether must be avoided where there is much vascular excitement, inflammatory fever, or sthenic inflammation.

As an anæsthetic it is used in the same cases as chloroform (p. 295). It is poured on a sponge placed in the bottom of a nose-bag perforated with holes for admission of a sufficiency of air, and attached to the patient's head. For local anæsthesia, ether is applied by a spray-producer; an ounce suffices to develop the requisite effect in horses or cattle; pure ether is necessary, as any watery contamination gets frozen, and blocks the tube of the instrument. It is applied topically for opening abscesses and fistulæ, removing tumours, for neurotomy, tenotomy, firing, and occasionally for castration, but it must be applied with much caution; for when the part has been rapidly or deeply frozen, violent painful reaction sometimes ensues, and healing of surgical and other wounds is apt to be tardy and unsatisfactory. It proves an effectual but expensive refrigerant for sprains and bruises, and is occasionally employed for the reduction of herniæ. It is a solvent for oils, resins, balsams, crystalline organic bodies, and gun-cotton. Like other substances of the alcohol series, it is antiseptic, and fresh meat suspended in stoppered bottles, in an atmosphere of ether, is preserved almost unchanged for several weeks.

Doses, etc.—The cheaper commercial ether, containing eight per cent. of alcohol and water, answers well enough as a stimulant for veterinary patients, and for many pharmaceutic purposes. As a stimulant, horses take f ℥i. to f ℥ij.; cattle, f ℥ij. to f ℥iij.; sheep and pigs, f ℥ij. to f ℥iv.; dogs, f ℥ss. to f ℥i.

As an anæsthetic, absolute ether made with pure ethylic alcohol has been generally recommended; but recent observations indicate that the cheaper article, made with methylated spirit, is fully as effective and safe. The larger animals take f ℥ iij. to f ℥ viij.; the lesser, f ℥ iv. to f ℥ i. As a stimulant, ether is usually given with water or diluted spirit, is sometimes sweetened with sugar or treacle, or flavoured with aromatics, while, to lessen volatilising, the menstrua must be cold. On account of its transient effects, which pass away in about an hour, it requires to be repeated at frequent short intervals, or given in conjunction with alcohol and ammonia; opium and belladonna increase its antispasmodic and anodyne effects.

SPIRIT OF ETHER, the spiritus ætheris of the Pharmacopœia, is made by mixing one volume of ether with two of rectified spirit. Eight ounces of this spirit of ether, mixed with a drachm of ethereal oil, constitutes Hoffmann's Anodyne, frequently prescribed in human medicine.

COLLODION is prepared by mixing one ounce of gun-cotton with thirty-six fluid ounces of ether, and twelve fluid ounces of rectified spirit. The solution, preserved in well-corked bottles, is clear, colourless, inflammable, and evolves a strong ethereal odour. As a substitute for sticking-plaster, it is applied with a fine brush, the ether evaporates, leaving a delicate film of cotton, which, by repeated applications of the solution, at intervals of a few minutes, produces a protective covering, and holds together the edges of slight wounds. The flexible collodion adheres still more firmly, gives support without splitting or cracking, is made by mixing six fluid ounces of collodion, 120 grains Canada balsam, and one drachm of castor oil, and is kept in well-corked bottles. A styptic, antiseptic protective is made by thoroughly mixing with 100 parts of collodion five 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 two of glycerine and one of carbolic acid. Collodion is occasionally used for coating boluses, but it is now greatly more important in photography than in pharmacy or surgery.

EUPHORBIUM.

An acrid resin obtained from Euphorbia resinifera (Berg.).

Nat. Ord.—Euphorbiaceæ. *Sex. Syst.*—Dodecandria Trigynia.

The natural family Euphorbiaceæ includes the shrubs yielding croton, 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 into 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 and persistent taste, is without odour, but its minutest particle in contact with the nostrils provokes immediate and violent sneezing. Indeed, so irritating is the dust, that those who collect or work amongst the acrid resin are obliged to cover their mouths and nostrils with cloths. 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_{10} H_{16} O_2); 22 of the colourless, tasteless, euphorbon, allied to lactucerin, a constituent of lettuce; 18 of mucilage, 12 of calcium and sodium malates; and 10 of inorganic compounds (Flückiger and Hanbury, *Pharmacographia*).

Actions and Uses.—Euphorbium is a violent irritant. 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 same effect in twenty-six hours. Inflammation of the intestines, and occasional patches of little ulcers, are the usual post-mortem appearances. So intensely irritating, indeed, is euphorbium, that the workmen employed in grinding it, although wearing masks or handkerchiefs over their faces, and using other precautions, often

suffer severely from headache, inflammation of the eyes, and sometimes even delirium.

Applied externally, it produces an abundant crop of pustules. It is used to increase the potency of blisters, but is apt, especially in horses and dogs, to inflame the deeper layers of the skin, destroy the hair roots, and induce sloughing and blemishing. On these accounts, if used at all, it should not amount to more than one-fourth part of the active ingredients of any counter-irritant applied either to horses or dogs. For cattle, however, it may with impunity be employed in rather larger quantity. Unlike cantharides, it has no tendency to act on the kidneys.

FERN ROOT.

Dried Rhizome, with the bases of the footstalks and portions of the root fibres of Male Shield Fern (Aspidium Filix-mas). (*Brit. Phar.*)

Nat. Ord.—Filices. *Sex. Syst.*—Cryptogamia 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 constituents of plants, it contains about 4 per cent. of resin, nearly 7 of a green fixed oil, a small amount of a volatile oil, and prussic acid, with about eight of the colourless crystalline filicic acid (C_{14} H_{18} O_5), regarded as its most active constituent. The root should be collected late in autumn, preserved in stoppered bottles, and the supply renewed annually; for when longer kept its virtues are lost. This deterioration from keeping, and the substitution of the roots of inactive ferns, in great part explain the depreciatory accounts sometimes given of its efficacy.

Actions, Uses, and Doses.—Male shield fern is vermicide and laxative. It is one of the most effectual remedies for tape-worm, especially in dogs. Kuckenmeister considers it quite as poisonous to the genus bothriocephalus. Dr. John Harley believes that male fern resembles ergot in stimulating the involuntary muscular fibre of any hollow viscus in which it is placed. It is without topical irritant effect; but an hour or two after a full dose of liquid extract has been given, active gastric contractions ensue, with vomiting, or increased movements of the bowels; similar contractions occur when it is injected into the urinary bladder. The peristaltic movements, induced when it is swallowed, detach and cast out adhering worms (Royle's *Mat. Med.*, sixth edition). It is used especially for removal of tæniæ. A dose given fasting sometimes dislodges tape-worms in dogs, within three hours. The discharges should be examined to find the head, which, if expelled, or left with only a small piece of neck adhering, does not develop another worm. A pound of the powdered root is used for horses and cattle; ʒiij. to ʒv. for sheep; ʒii. for dogs and cats (Gamgee's *Vet. Vade Mecum*). But the powder is inconveniently bulky, and less certain than the *fluid extract* or oil, which the Brit. Phar. 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. Recover the ether by distillation in a water bath, and preserve the oily extract." These quantities should yield three ounces of the oily extract, of which the dose for horses or cattle is fʒi. to fʒij.; for sheep, ♏xxv.; for dogs or cats, ♏v. to ♏xx. 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; a dose of physic, if requisite, after a few hours, may be given; if the parasite is not expelled the medicine may be repeated in three days, or another vermicide substituted.

GALLS.

Galla. Oak Galls. Excrescences on Quercus infectoria, caused by the punctures and deposited ova of Diplolepis Gallæ tinctoriæ. (*Brit. Phar.*)

Nat. Ord.—Cupuliferæ. *Sex. Syst.*—Monœcia Polyandria.

Galls, or gall-nuts, found on the young branches and shoots of a shrubby species of oak, are caused by a small insect, the female of a species of Cynips, which punctures the buds, and deposits its ova. Irritation follows, the punctures become surrounded by woody matter, and within this globular abode the larva passes through the various stages of growth, 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 semialata; large Mecca galls, called Dead Sea apples, are imported from Bussorah. Home-grown galls from the common oak (Quercus pedunculata) are in some seasons abundant throughout the southern and midland counties of England, but seldom contain more than half the percentage of tannic acid 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. The central hollow, in which the insect may generally be found, is sometimes empty, from the death of the larva, or its escape in a perfect form, when the small hole may be found, through which the creature has liberated itself. These white galls have a smoother, duller appearance, a lower density, lighter colour, and less astringency, than the ordinary or blue galls. Galls are easily reduced to a yellow-grey powder devoid of odour, but having a powerful astringent taste. They yield their properties to water and proof spirit, forming with the latter a dark red tincture. Iron persalts, added to a watery solution, slowly precipitate the dark blue or black iron tannate, the basis of writing ink. An aqueous solution of gelatine throws down a grey flocculent precipitate of tanno-gelatine,—the essential

principle of leather. These reactions, and the other important properties of galls, depend on the presence of 60 to 70 per cent. of tannin or gallo-tannic acid, about 4 of gallic acid, with about 10 of fibre, 11 of moisture, 5 of gum, sugar, and starch, together with lignin, resin, chlorophyll, volatile oil, albumen, and salts (Guibour).

Actions and Uses.—Galls are powerfully astringent, occupying, as regards activity, a mediate place between tannic acid and oak-bark. They have little effect upon the unbroken skin, are not readily absorbed, but, like other tannin-containing substances, coagulate albumen and gelatine; and hence constringe mucous, muscular, and vascular textures with which they are brought into contact. They are prescribed to brace weak and relaxed membranes, to dry chronic mucous discharges, to check passive hæmorrhages, and to form insoluble precipitates in poisoning by tartar emetic and vegetable alkaloids. In relaxed sore throat in horses, powdered galls are occasionally swallowed, made into a draught with mucilage or cold linseed gruel. But in such cases spraying with alum or zinc sulphate solutions, or with glycerine carbolate, is usually more effective. They are used in prolapsus of the uterus and rectum, for piles in dogs, and for the several purposes of topical astringents aud styptics.

Doses, etc.—For horses, ℥ iv. to ℥ vi.; cattle, ℥ i. or ℥ ij.; sheep and swine, ℥ ss. to ℥ i.; dogs, grs. v. to grs. x.; cats, gr. i. to grs. iij. The powder is made into bolus, or dissolved in warm water or proof spirit. A *tincture*, much used as a chemical test, and diluted and sweetened as required for internal administration, is made with 2½ ounces powdered galls and a pint of proof spirit, by maceration and subsequent percolation. For external purposes there are used—the simple powder, infusions of various strength, and an *ointment* made with one part of powdered galls to six of lard, and to which half a part of opium is sometimes advantageously added.

Tannic Acid, or Tannin (C_{14} H_{10} O_9), is the principle 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, mixing with ether, pressing the pasty mixture in a linen cloth; the residue rubbed to powder is again mixed with ether, to which a little water has been added, and pressed as before; the expressed liquids are slowly evaporated. The resulting tannic acid, when carefully dried, is in pale yellow vesicular masses, or thin glistening scales, with a strongly astringent taste and an acid reaction; readily soluble in water and dilute alcohol; very sparingly soluble in ether. The aqueous solution gives a yellow-white precipitate with gelatine, white insoluble precipitates with lead and antimony salts; and blue-black precipitates with iron persalts. Tannic acid is also precipitated by, and hence is incompatible with, the alkalies and their carbonates, with most metallic salts, the mineral acids, and the vegetable alkaloids. It leaves no residue when burned with free access of air. Exposed to air and moisture, in the presence of a ferment, or boiled with diluted sulphuric or hydrochloric acid, it is decomposed, yielding gallic acid and glucose; and hence is termed a glucoside.

Actions and Uses.—Tannic acid is the active principle of most vegetable astringents; it is more powerful than oak-bark, galls, or other vegetable astringent. It unites with albumen and gelatine, thus condensing muscular and membranous textures, and forming upon them insoluble protecting films. It contracts capillary blood-vessels, and thus relieves hyperæmia, and lessens secretion. These effects are most notable when tannic acid is topically applied; but when swallowed, and converted in part into gallic acid, it is gradually absorbed and slowly diffuses into the blood; its astringency thus widely extended combats fluxes, atony, chronic discharges, and hæmorrhage. It is excreted by the intestinal canal and kidneys as gallic and pyrogallic acids. Compared with gallic acid it has more direct and powerful topical effects, but being less soluble is not so successful for systemic purposes. In diarrhœa and other excessive discharges, it is conjoined with chalk acids and opium. In hæmorrhage it is combined with ergot and digitalis, and alternated with

metallic salts or mineral acids. Externally it is used as a stimulant and astringent in conjunctivitis, in irritable relaxed sore mouth and throat, in tender cracked teats in cows and ewes, in abating itching and discharge in eczema and impetigo, in drying and healing flabby ulcers.

Doses, etc.—Horses take grs. xx. to ℥ ij.; cattle, ℥ i. to ℥ iij.; sheep and pigs, grs. xv. to grs. xxx.; dogs, grs. ij. to grs. xx.; prescribed in the form of pill, infusion, or tincture, as a draught, clyster, or spray, with starch-gruel, opium, carbolic acid, or glycerine. A drachm each of tannin and opium, with two ounces of lard, makes an excellent ointment for piles in dogs. *Glycerine of tannin*, a convenient form for keeping or prescribing tannic acid, is prepared by rubbing together in a mortar one part of the acid with four of glycerine, and furthering complete solution by gentle heat. It proves a soothing astringent for soft relaxed over-secreting conditions of the throat, for chronic otorrhœa, not uncommon in dogs, and for the weeping stages of eczema, in which it allays itching and discharge, and promotes desquamation when carbolic and tar dressings become appropriate. *Styptic colloid* is usually prepared with one of tannin and eight of alcohol, mixed with about four of collodion.

Gallic Acid ($HC_7 H_5 O_5 H O_2$).—Tannic or digallic acid, when boiled with diluted sulphuric or hydrochloric acid, or when exposed during six weeks to air and moisture, takes up water, and yields gallic or trioxybenzoic acid.

$$\begin{array}{lcl} \text{Tannic Acid} + \text{Water} & = & \text{Gallic Acid.} \\ C_{14}H_{10}O_9 \quad + H_2O & = & 2\ C_7 H_6 O_5. \end{array}$$

Gallic acid is crystalline, occurs in acicular prisms, or silky needles, sometimes nearly white, generally pale fawn. It requires for solution about 100 parts of cold water and 3 of boiling water; is soluble in rectified spirit, and sparingly so in ether. Its aqueous solution gives a blue-black precipitate with iron persalts. From tannic acid it is distinguished by not precipitating solutions of albumen or gelatine, and by sulphuric acid giving a crimson instead of a black solution. 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). Gallic acid is converted into tannic acid by boiling with dilute arsenic acid (Schiff).

The actions, uses, and doses of gallic acid are the same as those of tannic acid; but it is scarcely so active as a topical astringent, although usually preferred as a general astringent. Solutions of gum or grape sugar increase its effects, probably reconverting it into tannic acid. Three to six grains, with about half that amount of opium, form a useful pill for dogs suffering from chronic diarrhœa or dysentery. A drachm each of gallic acid and opium mixed with an ounce of lard soothes and reduces irritable piles in dogs, and may often be advantageously varied by a dressing of calomel ointment. Pyrogallic acid mixed with about eight parts of lard or vaseline and cautiously applied over a limited area, is often effectual in persistent psoriasis, and in tanning, shrivelling, and crumbling away sarcomatous growths.

GAMBOGE.

Gambogia. Camboge. A gum-resin obtained from Garcinia Morella, var. pedicillata. Imported from Siam. (*Brit. Phar.*)

Nat. Ord.—Guttiferæ. *Sex. Syst.*—Monœcia Monadelphia.

Gamboge is the produce of a moderate-sized dicœcious tropical tree; is imported from Singapore, Siam, and Ceylon; is obtained from incisions into the special vessels which run in the middle layer of the bark, or by breaking the leaves and branchlets, when the yellow milky juice exuding is collected in leaves of the tree, 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, has little taste, but leaves, when chewed, acridity in the throat. It is feebly soluble in water, but more so in alcohol and ether, consists of 15 to 20 per cent. of soluble gum, and about 80 of an active orange-yellow resin, insoluble

in water, but soluble in alcohol, and still more so in ether and alkalies. It is largely used as a pigment.

Actions and Uses.—It is a powerful irritant and purgative, 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 irregular 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, it is, like all purgatives acting on the small intestines, 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 is diuretic, especially when given in small doses dissolved in alkalies. In ruminants it proves safe, speedy, and manageable when in combination with other purgatives. With half a pound each of Epsom and common salt, an ounce of gamboge proves a prompt and effectual purgative in indigestion, fardel-bound, and parturient apoplexy 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, etc.—For cattle, ʒ ss. to ʒ j.; for sheep, grs. xx. to grs. xxx.; given in combination with other purgatives, and in solution.

GELATINE—GLUE.

Nitrogenous matters extracted by the action of hot water from bones, tendons, and animal membranes.

Gelatine is chiefly made from damaged hides and skins, and from 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

gelatine, is made from similar materials less carefully purified; size is an inferior, weaker variety of glue; isinglass, a natural colourless gelatine, is the swimming bladder or sound of the sturgeon, and various species of Accipenser, prepared and cut into shreds; chondrine is the gelatinous matter extracted from cartilage; osseine, the title given to that obtained from bones. Gelatine, 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.—Gelatine, although a product of the disintegration of albuminoid tissues, cannot build up the albuminoid or even the gelatinous tissues; but being tolerably easily digested and broken up, it appears to economise the more valuable albumen. Men, dogs, and even horses, recovering from exhausting disease, in which disintegration and excretion of albuminoids is great, exhibit the dietetic value of gelatine when 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 often employed in veterinary practice for securing the broken horns of cattle, and occasionally for making adhesive plasters. For the closing of wounds, 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, these approximating uncut margins are sewed together, whilst, to prevent the plaster slipping with the movements of the skin, a few narrow strips of calico may then be applied with the glue in various directions over the injured spot. Large wounds may be thus secured by non-professional persons who cannot use sutures or needles; and even where a serious wound is properly sewed or sutured, such plasters immediately applied are sometimes useful in keeping the parts in position, giving support, and preventing the annoyance of flies; a dependent opening must, however, be left for egress of discharge. Glue plasters are often effectual in reducing and

retaining umbilical hernia, both in calves and foals; and in these, as in other cases, the chief requisites for their successful application are to cut the cloth into ribbons or tails, to smear both cloth and skin with the melted glue, and keep the plaster smooth and firm until it is thoroughly dry: the admixture with the glue of one-third or one-half of pitch greatly increases adhesiveness. The familiar court sticking-plaster consists of a strong solution of isinglass painted over thin silk. In pharmacy, gelatine is used for clarifying or fining, and as a neat and cleanly envelope for pills and boluses.

GENTIAN.

Gentianæ Radix. The dried root of Gentiana lutea. Collected in the mountainous districts of Central and Southern Europe. (*Brit. Phar.*)

Nat. Ord.—Gentianaceæ. *Sex. Syst.*—Pentandria Digynia.

The Gentiana lutea, or yellow gentian, has a perennial, often forked root, and an annual herbaceous stem, which rises three or four feet high, and bears spikes 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 is brought to this country in bales, chiefly from Switzerland, the Tyrol, and Auvergne, usually by way of Marseilles and other Mediterranean ports. It occurs in cylindrical, usually more or less branched, often twisted, pieces, marked by transverse annular wrinkles and longitudinal furrows, varying in length from a few inches to a foot, and in thickness from half an inch to an inch. Externally the root is brown, and yellow within; its texture is tough and spongy. 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, and two crystalline bodies —gentianin or gentianic acid (C_{14} H_{10} O_5), which is inert, and about 0·1 per cent. of the neutral gentian bitter or gentiopicrin (C_{20} H_{30} O_{12}).

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 the type of a pure and simple bitter, and is prescribed as a stomachic and tonic. It resembles quassia, calumba, chiretta, and the New England gold thread or coptic. As a tonic it has been considered little inferior to cinchona; it is devoid of astringency.

Gentian stimulates the peripheral filaments of the nerves of the tongue and mouth, increases secretion of gastric juice, but, unlike the volatile oils and gum resins, has no appreciable effect upon the pulmonary mucous membrane. The bitter principle reaches the blood, but whether it acts as a restorative or nerve tonic is not known. It improves the appetite and general tone, especially of the gastric mucous membrane. Amongst horses suffering from febrile catarrhal attacks, 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 many 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 may be advantageously united 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. Such a combination hastens recovery from exhausting disorders, and has an almost magical effect in restoring horses that are jaded, overworked, or suffering from loss of appetite or slight cold. In simple indigestion, especially in young animals, it is frequently combined with antacids or aromatics. Half an ounce each of gentian, ginger, and sodium carbonate constitutes a useful stomachic and carminative for horses or cattle, and may be made either into bolus with treacle, or into a drench with gruel or ale. In relaxed and irritable bowels, especially in young animals, it is advantageously conjoined with opium. By promoting a healthy state of the digestive mucous membrane it counteracts the development of worms; whilst its bitterness and slight laxative tendency sometimes cause their expulsion. Its supposed utility in jaundice is mainly owing to the laxatives with which it is usually combined. For cattle the above formulæ are as serviceable as for horses, but require to be given in somewhat larger doses. For sheep, gentian is a most 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. Like other tonics, gentian is contra-indicated in irritation of the intestines, and in the earlier stages of acute inflammatory diseases. As an infusion, it is occasionally applied externally as a mild stimulant and antiseptic.

Doses, etc.—For the horse, ʒss. to ʒi.; for cattle, ʒi. to ʒij.; for sheep, ℥i. to ℥iij.; for pigs, ℥ss. to ℥i.; for dogs, grs. v. to xx., repeated twice or thrice daily. The carefully-prepared Pharmacopœia extract infusions and tinctures, flavoured with bitter orange-peel and aromatics, are little required in veterinary practice. The powdered gentian is prescribed either as a bolus prepared with treacle, glycerine, and meal, or as an *infusion* made by digesting the powder during several hours in hot water and decanting off the clear fluid. A small addition of proof spirit insures more thorough solution and better

keeping. Gentian is often given with ginger, cardamoms, antacids, alcohol, ether, and mineral tonics.

GINGER.

Zingiber. The scraped and dried rhizome, or underground stem, of Zingiber officinale, from plants cultivated in India, in the West Indies, and other countries. (*Brit. Phar.*)

Nat. Ord.—Zingiberaceæ. *Sex. Syst.*—Monandria Monogynia.

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, which reach to the height of three or four feet, are invested with smooth sheathing leaves, and terminated by a spike of purple flowers. For making green or preserved ginger, the rhizomes are gathered when about three months old, and while still soft and juicy. For other purposes they are taken up when about a year old, when the aerial stems have withered down, but while the rhizome is still plump and soft. They are scalded to check vegetation, usually scraped to remove the dark-brown wrinkled epidermis, and dried in the sun.

Properties.—Several sorts are recognised :—The Jamaica in large plump pieces or races, pale, 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, many samples of which are 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 met with in irregular lobed knotted zigzagged pieces or races, from two to four inches in length, with a marbled soft resinous texture, 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 sunlight, to sulphurous acid, or to calx chlorata; but such bleaching or whitewashing cannot impart the soft

resinous structure, short mealy fracture, aromatic odour, and hot taste, which distinguish good specimens. Besides the usual plant constituents, ginger contains an acrid resin and 2·2 per cent. of volatile oil (C_5 H_8), concentrating the aroma, taste, and properties of the medicine. These active principles are chiefly located in the delicate felted layer of skin situated between the starchy mealy parenchyma of the rhizome and the brown horny external covering. As a condiment and medicine, Great Britain annually imports nearly 300 tons of ginger.

Actions and Uses.—Ginger is slightly irritant, aromatic, and stomachic. It stimulates the various mucous membranes with which it comes in contact. Blown into the nostrils, it promotes nasal discharge; chewed, it augments the flow of saliva; administered internally in repeated doses, it increases gastric secretion, facilitates digestion, and checks formation of flatus. From these stomachic and carminative properties, as well as from its mild tonic effects, it proves serviceable during convalescence from debilitating diseases, especially when accompanied by atony of the digestive organs. It is, besides, a useful adjunct to many medicines, is prescribed with tonics and stimulants; whilst, conjoined with purgatives, it diminishes their tendency to nauseate and gripe, and also somewhat hastens their effects. To fulfil these purposes, it is used for all the domesticated animals, and especially for cattle and sheep. Allied to ginger, and belonging to the same natural family, are turmeric and galangal, the rhizomes of Southern Asiatic flag-like plants, both aromatic and stimulant,—turmeric much used for dyeing.

Doses, etc.—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. It is given in bolus made with any suitable excipient, or in draught, made with hot water, the infusion being sometimes sweetened with treacle or sugar. The *tincture* was highly spoken of by the late Mr. Morton, and ordered to be made with two ounces of ginger to the pint of proof spirit. The better-keeping Pharmacopœia tincture is made with 2½ ounces of coarsely-powdered ginger to a pint of rectified spirit, by the usual process of maceration and subsequent percolation.

GLYCERINE.

Glycerinum. Glyceryl Hydrate. Glyceric Alcohol. A sweet principle, obtained from fats and oil, except spermaceti and wax, by saponification. ($C_3 H_5$, 3 HO or $C_3 H_8 O_3$.)

Glycerine was first 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 the hydrate of the basylous principle of all oils and fats, and is obtained as a by-product from soap and stearine candle-making. In saponification double decomposition occurs; the fats, consisting of glyceryl stearate, palmitate, or oleate, are broken up; their fatty acids unite with the metal; the basylous radicle glyceryl ($C_3 H_5$), thus liberated, being triatomic, unites with the three radicles of hydroxyl previously held by the caustic soda, thus:—

Caustic Soda + Vegetable Oil = Hard Soap + Glycerine

$3\,Na, HO + C_3H_5, 3\,C_{18}H_{35}O_2 = 3\,Na, C_{18}H_{35}O_2 + C_3H_5, 3\,HO.$

Into a distilling apparatus containing palm oil, steam at a temperature of 550° or 600° is introduced; the oil and water are decomposed; and there distil over pure stearic acid and glycerine, which, being the heavier, occupies the lower part of the receiver. For most purposes it is redistilled, reaches a specific gravity of 1·28, and contains 94 per cent. of anhydrous glycerine. It is viscid and colourless, odourless, has a sweet taste; strongly heated in a capsule, it should, if pure, leave no residue; it burns with a luminous flame, evolving irritating vapours; is freely soluble in water and alcohol; is itself an excellent solvent for vegetable acids and alkaloids, takes up one-third of its weight of quinine sulphate, one-sixth of morphine muriate, one-fifth of arsenic.

Actions and Uses.—Glycerine is nutrient, demulcent, emollient, feebly antiseptic, and a convenient solvent for alkaloids, tannic and gallic acids.

It has some of the nutrient properties of cod-liver oil and other fats, and two or three drachms, repeated twice or thrice daily, have been given to delicate dogs. It has been stated

that larger doses exert inebriant effects. It is slowly absorbed, but only in limited amount. Small doses are eliminated by the kidneys, large doses by the bowels, producing laxative effects. Amongst calves and dogs troubled with acidity and flatulence, glycerine given before eating is sometimes useful in checking fermentation without interfering with digestion. Added to milk it certainly delays acetic fermentation. Mixed with a little belladonna extract, it is an effectual emollient in the dry stage of catarrh. It proves a capital emollient for cracked heels, mud fever, blistered or burnt surfaces—indeed, wherever the skin is irritable, dry, rough, or scurfy. When undiluted, it is however too heating and irritant for tender or abraded surfaces, and is best used with water, spirit and water, any bland oil, or as glycerine of starch made by heating an ounce of starch with eight ounces of glycerine. This is a cleanly and useful application for many purposes, notably for sore mouths amongst calves and lambs. For cracked heels, and noisome indolent wounds, antiseptic as well as emollient effects are obtained by using glycerine of carbolic acid, made by rubbing together in a mortar one part of carbolic acid and four of glycerine. Ninety-two parts of glycerine, and sixty-two of boracic acid repeatedly heated, form a definite compound of boro-glyceride. Successfully used by Professor Barff for preserving milk, meat, and other perishable substances, and injected into the blood-vessels immediately before the animal is slaughtered, it is stated to preserve the carcase for months. For soothing, astringent, and antiseptic purposes, equal parts of glycerine and Goulard's extract are used, diluted as required with water. Somewhat similar effects are obtained with glycerine of tannin, which is serviceable in the squamous stages of eczema, especially in young and delicate dogs, in aphtha, and in relaxed sore throat. Glycerine is used as a solvent for tannic and gallic acids, and for alkaloids; as a vehicle for their hypodermic injection; as a preservative of the moisture and soundness of various boluses and masses; and as a convenient and palatable menstruum for giving nauseous medicines, especially to dogs and cats.

GUM ARABIC.—GUM TRAGACANTH.

Gummi Acaciæ. Gum Arabic. A gummy exudation from the stem of one or more undetermined species of Acacia.

Tragacanthæ. Gum tragacanth. A gummy exudation from the stems of Astragalus verus, and probably other species, collected in Asia Minor. (*Brit. Phar.*)

Nat. Ord.—Leguminosæ. *Sex. Syst.*—Monodelphia Polyandria.

Gum is largely present in many plants, but for commercial and medicinal purposes is chiefly got from various species of Acacia. These are stunted, withered-looking trees, usually of medium size, with a grey bark, oblong linear leaflets arranged along either side of the stalk, and a moniliform fruit resembling the laburnum. They abound in dry, warm climates, especially in Nubia and the valley of the Upper Nile, and are most prolific when old and stunted, and during dry, hot seasons. In June and July a viscid juice exudes from natural cracks or artificial incisions in the bark, and concretes by the heat of the sun into round masses or tears, varying in size from a pea to a walnut, brittle, usually shining, when in small fragments of a yellow or brown colour, odourless, and of a bland, sweet taste. Gum dissolves in water, forming an adhesive, viscid fluid or mucilage. The colour and transparency of gum are liable to many variations, being sometimes different in specimens obtained from the same tree, and sometimes identical in those from different species.

Gum Acacia, or Gum Arabic, the most important medicinal variety, does not come from Arabia, as its name might indicate, but 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 tough and difficult to powder, but must not be triturated in iron mortars, as it is apt thereby to become acid and discoloured. When pure, it is soluble in its own weight alike of hot and cold water, is insoluble in and incompatible with alcohol, ether, oils, and most mineral salts. Boiled with dilute sulphuric acid, it is converted into sugar; strong nitric acid con-

verts it into oxalic acid. Gum consists of arabin or arabic acid, which is associated with calcium, magnesium, and potassium, and has the formula $C_{12}\ H_{22}\ O_{11}$, $3\ H_2\ O$. It may be regarded as a calcium magnesium and potassium salt of the feeble arabic acid (Flückiger).

Gum Senegal is similar to gum Arabic, but less brittle, and dissolves only in four or five parts of water. 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 in colour, transparency, and solubility.

Gum Tragacanth, derived from tangled spiny bushes, shrubs, or small trees of the genus Astragalus, is collected in Asia Minor, mostly exported from Smyrna, occurs in thin, semi-transparent, tough, horny lamellæ or plates of a white-grey or yellow colour, and marked with concentric ridges; it is tasteless and odourless. Cold water swells it into a jelly, which readily diffuses through water, and which is tinged violet by iodine tincture, indicating the presence of starch; boiling water readily dissolves it, forming a dense mucilage. Tragacanth is composed of a soluble gum, resembling arabin, and called tragacanthin, and an insoluble neutral gum, bassorin ($C_{12}\ H_{20}\ O_{10}$), which, gelatine-like, swells up, but is not dissolved either by hot or cold water, but is soluble in alcohol.

British gum or dextrin ($C_6\ H_{10}\ O_5$), much used in calico-printing, is made by heating starch with dilute nitric acid, by exposing it to a temperature of 400°, or by acting upon it by diastase or other such ferment.

Actions and Uses.—Gums are the least nutritive of the hydrocarbons; when swallowed they are dissolved by the secretions of the alimentary canal, absorbed, and probably converted into sugar. They are used occasionally as demulcents and emollients for ensheathing mucous surfaces in catarrh and diarrhœa, and for protecting injections in inflammation of the bowels and bladder. Where there are tenderness and irritability, mucilage is conjoined with opium or belladonna; where there is atony, with oak bark, catechu, or tannin. For veterinary purposes mucilage is, however, 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, etc.—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. *Mucilage* is made by mixing, in a covered earthen jar, four ounces of gum in small pieces, and six fluid ounces of distilled water, stirring, and, if necessary, straining through muslin. (*Brit. Phar.*)

HELLEBORE.

Hellebori Niger Radix. Black hellebore rhizome. Dried root-stalk and radicles of Helleborus niger.

Nat. Ord.—Ranunculaceæ. *Sex. Syst.*—Polyandria Polygynia.

The Helleborus niger, Christmas rose, or bear's foot, is cultivated in this country, is indigenous to many parts of continental Europe; the chief supplies come from Germany. It is an herbaceous plant, 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 or root-stalk, 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 fœtidus, often mixed with those of the niger, are very similar in action. Hellebore owes its activity to two irritant glucosides, helleborin (C_{36} H_{42} O_6) and helleborein (C_{26} H_{44} O_{15}). (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, an anthelmintic, and an external irritant. 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). On account of its violence it is very seldom 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 become absorbed, act with unexpected violence, occasionally produce erysipelas, and sometimes cause blemishing. An ounce of powdered hellebore and two ounces of alum, dissolved in a gallon of hot water, destroy caterpillars infesting gooseberry, rose, or other trees.

HEMLOCK.

Hemlock leaves. Conii folia. The fresh leaves and young branches of Conium maculatum. Also the leaves separated from the branches and carefully dried; gathered from wild British plants when the fruit begins to form. (*Brit. Phar.*)

Hemlock fruit. Conii fructus. The dried immature fruit of Conium maculatum.

Nat. Ord.—Umbelliferæ. *Sex. Syst.*—Pentandria Digynia.

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 two to five feet high, round, hollow, jointed, smooth, branching towards the top, and covered with purple spots; the leaves are large bi- or tri-pinnate, smooth, have a dark shining green colour, 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 or clusters; the fruit resembles that of the anise, is round, ridged, of a brown colour, devoid of hairs, 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: 9 lbs. of such fruit produce an

ounce of conine, which, with an essential oil, is found stored chiefly in cubical cells in the endocarp. Dried in thin layers in a warm shady room, at a temperature of 80°, and kept in close-fitting tin canisters, the fruit preserves its virtues for a year. When fully ripened it contains less conine, and besides keeps badly. The leaves should be gathered in July, when the fruit begins to form, should be rapidly dried in stoves at about 120°, 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 *Mat. Med.*). Their properties are readily communicated to water, alcohol, fats, and oils. Exposed even for a short time to a temperature of 212°, their active principle is decomposed, and to this cause, and the careless and long keeping of the fruit and leaves, the inertness of many hemlock preparations is owing.

All parts of the plant, especially the leaves, contain a bitter, nauseous, oleo-resin, and a volatile oil. But the distinctive active principle is a volatile oleaginous alkaloid called conine or conia (C_8 H_{15} N), most abundant in the green fruit, and obtained by distilling any portion of the plant with dilute caustic potash. It has the specific gravity ·89, boils at 340°, 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 conine produces a blood-red colour; sulphuric acid, a purple red passing to olive-green. Hemlock also contains a solid crystallisable alkaloid of less activity called conhydrine, (C_8 H_{17} N O), with methyl-conine, and another allied alkaloid (Flückiger and Royle).

The leaves and fruit of hemlock are distinguished from other leaves and fruit, sometimes mixed with them, by their characteristic appearance, and by triturating with diluted caustic potash solution, which evolves the striking mouse odour. Fool's parsley, *Æthusa Cynapium*, water hemlock (*Cicuta virosa*), the fine-leaved water hemlock (*Phellandrium aquaticum*), the water parsnip (*Œnanthe crocata*, p. 92), are umbelliferæ with similar physiological effects to *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. 187).

Actions and Uses.—Hemlock and its alkaloid conine paralyse primarily the extremities of motor nerves; their trunks and ganglia are subsequently but less notably involved. The brain cord and sensory nerves are only secondarily and indirectly affected. The vaso-motor nerves are not generally or powerfully paralysed. Death results from asphyxia caused by paralysis of the muscles of respiration. Medicinal doses are motor-depressants; they quiet motor irritability, and hence are anodyne and antispasmodic. Hemlock was the State poison of the Athenians, the death potion of Socrates. Many preparations of hemlock, and many commercial specimens of conine contain methyl-conine, which has been shown by Professor Fraser to paralyse not only nerve extremities, but also the nerve trunks, and the motor tract of the cord.

Toxic Actions.—Dr. John Harley and Mr. Fred. Mavor gave a two-year-old thoroughbred colt doses of six, eight, and twelve ounces of succus conii without appreciable effect. Sixteen ounces, corresponding to a pound of the fresh leaves, 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 (*The 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. Asses in Italy eating hemlock are sometimes so thoroughly paralysed that, supposing them to be dead, the peasants have actually begun to skin them (Matthiolus). 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). Even goats and ducks are recorded to suffer from eating hemlock. Fifteen grains succus conii 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; whilst twenty-eight grains poisoned in two minutes when injected into the veins (Christison on *Poisons*). Mr. John Gerrard of Market-Deeping records (*Veterinarian*, February 1873), that a lot of pigs strayed into an orchard and ate growing hemlock. In fifteen hours two died, and two others a few hours later. They lay prostrate and unable to rise, no pulse perceptible, the body cold, the eyes amaurotic, and relapsed when left alone into a comatose hypnotic state. There were no convulsions; no pain was apparent when the patients were pricked with a pin. Examination discovered the blood throughout the body dark and fluid, the result of the fatal asphyxia; the intestines distended with gas; the mucous coat of the stomach, particularly its cardiac portion, was much congested; similar spots of congestion were observed here and there throughout the intestines. The liver and spleen, as well as the lungs, were distended with dark fluid blood. The fitting antidotes are cold water to the head, ammonia to the nostrils, stimulating enemata, the cautious exhibition of stimulants, enforced exercise, and artificial respiration.

Dr. John Harley, experimenting on his own person, found that the paralysis induced by full medicinal doses of hemlock first involved the third pair of nerves, causing drooping of the upper eyelid, indistinct vision, imperfect power of focal adaptation, with moderate dilatation of the pupil. Listlessness, a dragging feeling when walking, and tottering about the knees followed, evidencing paralysis of the nerves of voluntary muscles. Alike in men and animals the lower extremities are affected before the upper. Neither in medicinal nor in poisonous doses are the brain functions directly involved. Unless when methyl compounds are present, or as a secondary result of poisonous doses, the spinal cord is unaffected. There is no action on afferent nerves, or on circulation, secretion,

or excretion; with large doses temperature is reduced owing to failure of respiration. On the unbroken skin no effect is exerted; on wounds large quantities irritate, whilst small quantities soothe and remove pain. The muscles are unimpaired, as shown, even in conine poisoning, by their promptly contracting when acted on by electricity. Applied directly to nerve centres or nerves, it exerts no topical irritation, but destroys their conductivity (Ringer), and, as already stated, expends its force mainly in paralysis of the extremities of motor nerves. Its effects on the blood are not yet made out. Conine appears to undergo rapid decomposition in the blood, for it cannot with certainty be detected either in that fluid, in the urine, or in other secretions. Hemlock is analogous to curara, which, owing apparently to tardy absorption, does not poison when swallowed, although it is very active when injected underneath the skin or into the veins. Some of the conine symptoms resemble those caused by Calabar bean, which attacks however the spinal cord instead of the terminals of motor nerves, and excites more gastro-intestinal irritation. Prussic acid, to which it is also allied, is a general paralyser of the cerebro-spinal system. Its nearest antagonists are nux vomica, strychnine, and other tetanisers.

Medicinal Uses.—Its physiological action demonstrates that the special value of hemlock lies in its soothing motor excitability. It is serviceable in some cases of convulsions, especially amongst young animals; it occasionally quiets the jactitations of chorea, checks epileptic fits, temporarily abates the spasms of tetanus; but has not justified the expectations formed of it as a cure for tetanus in horses. Gullmann's carefully repeated experiments show that it fails to arrest the tetanic spasms caused by strychnine. Spasmodic cough sometimes following epizootic sore throat in horses, and, depending upon muscular irritability, is more under control of hemlock. Some irritable conditions of the respiratory organs in man are benefited by inhalation of steam impregnated by hemlock placed in the boiling water. Used both externally and internally it removes pain in some cases of rheumatism and neuralgia, especially when depending upon eccentric or topical conditions; it abates irritability and pain in specific

ophthalmia in horses; administered by the mouth, and more especially as an injection, it allays irritability of the uterus, bladder, and genital organs.

Doses, etc.—The dried leaves are seldom to be depended upon. The fully-ripened dried fruit possesses little activity. The green but nearly ripened fruit, and the preparations promptly obtained from it without undue heat, are, however, effective. Tinctures and extracts, even when made according to the improved Pharmacopœia processes, are not as active as they should be (Dr. Harley). The most reliable preparation is the *succus* or *juice*, made from fresh plants coming into bloom, which are pulped between finely-ground iron rollers, subjected to hydraulic pressure, and yield 75 per cent. of juice. 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 30 grains of soft extract, and 42 grains of conine. For horses or cattle the dose of succus is f℥ij. to f℥iv.; for sheep and pigs, f℥ss. to f℥ij.; for dogs, f℥i. to f℥ij. The medicine should be repeated twice daily, and persisted with in quantity sufficient to paralyse voluntary motor power. Hemlock combined with opium or hyoscyamus prolongs and intensifies their effects. Few more soothing or effectual pain-relieving mixtures can be used than opium, chloral hydrate, and hemlock. Of the tincture, the dose generally prescribed for horses or cattle is f℥ij. or f℥iij.; for dogs, f℥ij. or f℥iij.; of the extract, ℥i. to ℥ij. for the larger animals, grs. i. to grs. v. for the lesser. But so faulty are most tinctures and extracts, that they fail to produce the physiological action without which curative effects cannot be expected.

Conine—the volatile oleaginous alkaloid of hemlock—is a very powerful poison, scarcely inferior in activity to anhydrous prussic acid. It causes at first local irritation, speedily superseded by swiftly-spreading paralysis, proving fatal by arrest of respiration. One drop applied to the eye of a rabbit caused death 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*). Conhydrine has similar, but not such powerful, effects. The irregularity sometimes observed in the action of conine is explained by its bad preparation, and its proneness to change into methyl-conine, which Professors Crum-Brown and Fraser have shown paralyses the cord as well as the motor nerves, sometimes causing muscular twitchings, and, where in considerable amount, convulsions. This change in composition Dr. Harley proposes to obviate by converting the unstable conine, so soon as made, into acetate or sulphate. Dr. Harley and Mr. F. Mavor found that conine used hypodermically in horses produced local irritation and inflammation, which appeared to prevent its absorption.

HENBANE.

Henbane or Hyoscyamus leaves. The fresh leaves, with the branches to which they are attached, of Hyoscyamus niger; also the leaves separated from the branches and carefully dried; gathered from wild or cultivated British biennial plants, when about two-thirds of the flowers are expanded. (*Brit. Phar.*)

Nat. Ord.—Atropaceæ. *Sex. Syst.*—Pentandria Monogynia.

Henbane is widely distributed throughout the world, grows wild in most parts of this country, and is cultivated at Mitcham and Hitchin. The yellow-brown leaves, the principal officinal part, 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 Pharmacopœia, is larger, stronger, more branched, clammy, and active. The leaves, with the young branches, are gathered when two-thirds of the flowers are expanded, and are carefully dried. 100 lbs. of the fresh herb, when dried, weigh 14 lbs., and yield about 4 lbs. of extract. The active prin-

ciple is a dark-green oily liquid—hyoscyamine or hyoscyamia (C_{15} H_{23} O_3), having a heavy tobacco-like odour and taste, and losing its activity at temperatures over 200°, or when exposed to caustic alkalies. Baryta, in aqueous solution, resolves it into a volatile narcotic alkaloid, hyoscine (C_6 H_{13} N), and crystalline hyoscinic acid (C_9 H_{10} O_3). (Flückiger.)

Actions and Uses.—Henbane closely resembles the other Atropaceæ, belladonna and stramonium. It first stimulates and subsequently exhausts and paralyses the sympathetic and vaso-motor nervous system. Compared with belladonna, poisonous doses have a more marked sedative effect, a greater deranging action on the cerebrum and motor centres, but like it kill by respiratory arrest (Harley). Medicinal doses are cardiac tonics and sedatives, give steadiness to excited irregular heart action, stimulate and contract arterioles, and usually quicken respiration. During their excretion, effected chiefly by the kidneys, they exert on the urino-genital organs topical anodyne and muscle-relaxing effects. Whether given internally, or applied directly to the eye, henbane stimulates the sympathetic ganglia and dilates the pupil.

It first increases and then depresses the force and number of the heart-beats; it causes dryness of the mouth and throat. Excessive doses notably affect the cerebrum and motor centres, causing giddiness, reeling gait, dilated pupils, and delirium. It is rapidly excreted unchanged in the urine (Dr. John Harley, *Old Vegetable Neurotics*). Compared with opium, it acts less on the brain and more on the heart and circulation, does not diminish the secretions of the bowels or kidneys, dilates instead of contracts the pupil, and is less effective either as an anodyne or antispasmodic. Dr. Harley states that its effects closely resemble those of hemlock and opium given together. On cattle and sheep it acts less powerfully than on horses, in which three or four ounces of the infused leaves cause 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 rough and dry, the pulse accelerated, the pupils dilated, the power of walking or springing impaired (Harley).

Medicinal Uses.—Hyoscyamus is occasionally prescribed to quiet excited tumultuous action of the heart, occurring in valvular disease. In such cases it will sometimes reduce the pulse of the horse from 60 to 40 beats per minute. After brain excitement more or less notable and prolonged, according to dose and state of patient, there usually follows sound sleep. Relaxing muscular fibre, and antagonising capillary congestion, it relieves the pain of rheumatism and neuralgia. Given internally, as well as by injection, it abates irritability and spasm of the uterus, bladder, and intestines. As a calmative, antispasmodic, and substitute for opium, Mr. Mayhew prescribes it for dogs suffering from distemper, giving half a drachm of the tincture with a drachm of ether in cold soup. Combined with drastic cathartics, it prevents griping without diminishing purgation. French veterinarians use it in epilepsy, chorea, and amaurosis (Delaford and Lassaigne). As an external anodyne, belladonna or opium is generally preferred.

Doses, etc.—From collecting the plant at unsuitable seasons, from long keeping before being used, or from exposure to high temperature, many preparations of henbane are almost inert. The *succus* or juice should be extracted under 200° from freshly-gathered plants; the *tincture* obtained by maceration and percolation from two and a half ounces of coarsely powdered leaves and one pint of proof spirit; the *extract* made by the cautious evaporation of the expressed juice. f ℥ jss. of succus corresponds with about f ℥ iij. of tincture, f ℥ j. of extract, or grain j. of hyoscyamine. These are suitable doses for horses or cattle; sheep and pigs take about one-eighth, dogs one-twelfth, of these quantities. The effects of full medicinal doses are usually developed in an hour, and are intensified and prolonged by combination with opium. It is occasionally prescribed with belladonna, camphor, and chloral hydrate.

Hyoscyamine, conveniently used as a sulphate, but too expensive for ordinary veterinary use, like atropine and daturine, stimulates, shortly exhausts, and paralyses the sympathetic system. After a brief stage of preliminary excitement, it lowers the force and frequency of the circulation; large doses cause respiratory arrest; it dilates the pupil, parches the tongue and mouth, and dries the skin. Small doses accelerate,

large doses diminish intestinal peristalsis; small doses augment, large doses lower temperature; results are not modified by section of the pneumogastric nerve; excretion takes place chiefly by the kidneys, partially by the intestines, and as it is excreted it exerts its relaxing anodyne effect on the excreting passages (MM. Oulmont and Laurent, in Bartholow's *Mat. Med. and Therapeutics*). Although nearly allied physiologically with atropine, it manifests some points of difference. Animals, like pigeons, tolerant of three grains atropine, are killed by half a grain hyoscyamine; rabbits are readily acted on by one grain, although they stand five grains atropine (E. Prideaux, *Lancet*, September 27, 1879).

HYDROCHLORIC ACID.

Acidum Hydrochloricum. Muriatic Acid. Spirit of Salt. Hydrochloric Acid Gas (H Cl) dissolved in water, and forming 31·8 per cent. by weight of the solution. (*Brit. Phar.*)

When one volume each of hydrogen and chlorine are mixed in sunlight or flame, combination occurs with explosive violence, and there result two volumes of pungent, acrid, irritating, hydrochloric acid gas. Water at 40° dissolves about its own weight, 480 volumes, or 43 per cent. of this gas, and the solution contains approximately one equivalent of acid and three of water. At −40° solid hydrate (HCl $2H_2O$) is formed. The acid of commerce and medicine is mostly got as a by-product in the manufacture of sodium carbonate from common salt. The Pharmacopœia orders the distilling together of about equal weights of sodium chloride, sulphuric acid, and water. Acid sodium sulphate remains in the retorts; hydrochloric acid distils over. It is colourless, intensely sour and acrid, emits white pungent fumes, has the spec. grav. 1·160, and contains 31·8 per cent. of gaseous acid. The diluted hydrochloric acid is made by mixing eight fluid ounces of the stronger acid with water until the mixture at 40° measures 26½ fluid ounces. It has the spec. grav. 1·052, and contains 10·58 per cent. of real gaseous acid. Hydrochloric acid is distinguished by yielding

with silver nitrate a curdy white precipitate (Ag Cl), insoluble in nitric acid, but soluble in ammonia. From careless preparation, it sometimes contains sulphuric and sulphurous acids, nitrous compounds, chlorine, iron, and occasionally traces of arsenic.

Actions and Uses.—Concentrated doses are corrosive and irritant; medicinal doses are astringent, antiseptic, tonic, and antidotes for poisoning by alkalies; small doses properly diluted augment secretion of gastric juice, and aid solution and digestion of phosphates, carbonates, and albuminoids. Being the chief acid of the gastric juice, it is often selected for internal administration, especially in cases of gastric derangement. It is excreted mainly in the urine, increasing its quantity and diminishing its alkalinity. Externally it is used as a stimulant, astringent, antiseptic, and caustic.

Toxic Effects.—Like the other mineral acids and strong acetic acid, concentrated solutions have a strong affinity for the water bases and albuminoids of the tissues. They leave upon them a white stain. Although not penetrating as deeply as sulphuric or nitric acids, it proves an irritant poison, inducing gastro-enteritis when full concentrated doses are swallowed. The fitting antidotes are alkaline bicarbonates, magnesium carbonates, milk, white of egg, and other demulcents. Large or frequently repeated full doses, independently of irritant or corrosive effects, destroy life by reducing the carbonic acid and alkali of the blood. Rabbits and other herbivora 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 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 is 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 *Mat. Med.*, 1882).

Medicinal Uses.—Moderate doses of hydrochloric acid, administered by the mouth, exert, according to concentration, topical, stimulant, antiseptic, or astringent effects, beneficial in relaxed or ulcerated conditions of the mouth or fauces. The acid, in such cases, mixed with glycerine, treacle, or honey, and water, when slowly swallowed, is diffused over the soft diphtheritic, or irritable surface. Stimulating the cerebro-spinal nerves presiding over secretion of saliva, it moistens the parched mouth and abates thirst. Like other acids, it specially stimulates the mucous, salivary, and other alkaline secretions. These effects are intensified by combining the acid with gentian, nux vomica, or other bitters. An acid, bitter mixture, besides moistening the dry, clammy mouth, cleansing the mucus-covered, irritable throat, and promoting insalivation, aids solution and digestion of food, controls acid fermentation common in young animals, especially when feeding on milk, and hence often checks diarrhœa. Where secretion of gastric juice is scanty, as it sometimes is in febrile exhausting diseases, in delicate young animals, and in show beasts that have been systematically over-gorged, small doses of hydrochloric acid are usefully conjoined with bitters or pepsin, and given with each meal. In young calves or foals, digesting their food indifferently and scouring, three or four drops of medicinal acid used with the milk, or given immediately before feeding, sometimes answer better than lime-water and alkalies. Acid treatment is equally appropriate in the totally different gastric derangement where there is undue acidity depending upon excessive secretion, but to check such inordinate secretion the acid should be administered half-an-hour before feeding. Given alone or with iron chloride, it promotes a healthier state of the bowels in animals troubled with worms, and sometimes causes expulsion of ascarides. In its passage through the digestive canal it becomes neutralised, but probably sets free biliary and other acids (Ringer). It has a remarkably high diffusive power, speedily diminishes alkalinity of the blood, exerts in all animals general tonic and astringent effects, in virtue probably of its antiseptic properties, checks retrograde metamorphosis, and is prescribed in convalescence from acute inflammatory attacks and during

exhausting diseases. Administered in rheumatism, it appears to lessen production of lactic acid. The continued use of acids, as above stated, diminishes gastric secretions and neutralises the natural alkalinity of the blood, and hence they must not be too largely or too long persisted with.

Externally, hydrochloric acid is used for the destruction of 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 dry acid skin of febrile patients, and promotes grateful perspiration. Dr. Angus Smith (*Cattle Plague Reports*) testifies to its being "a very efficient, cheap, and penetrating disinfectant." It is suitable for saturating carcases infected with contagious disease, and, as it destroys effectually contagious germs, it enables such remains to be safely utilised for plant food.

Doses, etc.—Of diluted or medicinal acid, horses take f℥ss. to f℥ij.; cattle, f℥ij. to f℥iv.; sheep and pigs, ♏xv. to ♏xx.; dogs, ♏iij. to ♏x., usually prescribed with forty or fifty times its bulk of water; often given along with bitters and iron salts.

INDIAN HEMP.

Cannabis Indica. The dried flowering tops of the female plants of Cannabis sativa, grown in India, from which the resin has not been removed. (*Brit. Phar.*)

Nat. Ord.—Urticaceæ. *Sex. Syst.*—Pentandria Digynia.

Indian hemp is derived from Cannabis sativa or common hemp, modified by climate, aud secreting a larger amount of the special resinous juice. The plant and its resinous exudate are used in India and Arabia as intoxicants and narcotics in the various forms of charas, ganja, bhang, and hashish. The dusky-green aromatic masses, measuring about two inches long, and known as bhang, are made up of the dark-green peculiar-smelling tops, bearing the remains of the flowers, with the small leaves and ripe fruit. The compressed glutinous brown-green shoots sprouting from the stems, from which the leaves con-

stituting bhang have been gathered, are recognised as ganja. From the several forms of hemp, rectified spirit extracts an amorphous brown active resin ; distillation separates a volatile oil, which has been resolved into an odourless liquid—Cannabene (C_{18} H_{20}), and its solid hydrate (C_{18} H_{20}, H_2 O).

Actions and Uses.—It is narcotic, anodyne, and antispasmodic. Its effects on men and dogs are more notable than on horses and cattle, to which I have repeatedly given a drachm of the extract without observing any alteration in pulse, respiration, or temperature. It nearly resembles opium, and Sir Robert Christison stated his conviction that "for energy, certainty, and convenience, Indian hemp is the next anodyne, hypnotic, and antispasmodic to opium, and often equals it" (Christison's *Dispensatory*). Conjoined with hemlock and chloral hydrate, promising results have been obtained in abating the spasms of tetanus in horses. It is prescribed either as an extract or a tincture, the doses being the same as for solid opium and laudanum.

IODINE.

Iodum. A non-metallic element, obtained principally from the ashes of seaweeds. (*Brit. Phar.*)

Iodine is chiefly found in sea-water, and thence passes into the textures of sea plants and animals. It is mostly prepared in Glasgow by breaking kelp—the semi-vitrified ashes of seaweeds—into small pieces, and dissolving in water, when sodium chloride, carbonate, and sulphate, with potassium chloride, crystallise out. The dense dark-brown iodine ley is decanted off, contains the iodine chiefly in combination with sodium and magnesium, and is generally 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 transferred to leaden retorts, heated to 140°, and mixed with manganese binoxide, when the iodine volatilises in violet vapour, and condenses in spherical glass vessels in grey lustrous scales, resembling blacklead. In the retorts there remain sodium and manganese sulphates and water. A drier and purer iodine is sometimes obtained by

adding to the iodine ley a solution containing one part of copper sulphate and two and a half of iron sulphate; the whole of the iodine is thrown down as copper diniodide, afterwards decomposed by sulphuric acid and manganese binoxide. By a recent patent process, the dry seaweed is at once economically subjected to distillation in iron retorts, and yields iodine as well as other products. From the mother waters of the Peruvian saltpetre mines, large quantities of pure iodine are now obtained.

Properties.—Iodine usually occurs in soft friable black or blue-black laminar crystals of a metallic lustre. Its spec. grav. 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 yellow stain, readily removed by alkalies. At ordinary temperatures it slowly evaporates; at 239° it melts; at 392° it boils, volatilising entirely in distinctive, violet-coloured, irritating, antiseptic vapours, nine times as heavy as air. With water it forms a brownish-yellow solution, which contains, however, only one seven-thousandth part of iodine. It is entirely dissolved by twelve parts of rectified spirit, and by still smaller quantities of ether, volatile oils, and many saline solutions, of which the most commonly used is solution of potassium iodide, with which iodine forms a red-brown fluid. It is also readily soluble in chloroform and carbon bisulphide, with which it forms violet solutions. It readily unites with metals, and forms many medicinal compounds. Iodides of the alkalies closely resemble iodine in their actions; iodides of the heavy metals partake chiefly of 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.

Impurities.—On account of its extensive use and high price, iodine is apt to contain intentional adulterations as well as accidental impurities. Blacklead, and other such fixed substances, remain as a residue when the sophisticated article is heated. Water, sometimes present in the proportion of fifteen

or twenty per cent., adheres in minute drops to the iodine scales; which, if rolled in bibulous paper, moisten it, or, if shaken in a dry phial, stick to its sides. The purity tests of the British Pharmacopœia are as follows :—"It sublimes without leaving any residue, and the portion that first comes over does not include any slender colourless prisms (of cyanogen iodide) emitting a pungent odour. 12·7 grains dissolved in an ounce of water containing 15 grains of potassium iodide, require, for complete decoloration, 1000 grain measures of the volumetric solution of sodium hyposulphite."

Actions and Uses.—Large doses are irritant and corrosive. The vapour inhaled insufficiently diluted causes irritation, cough, and spasm of the glottis. Medicinal doses stimulate secreting glands, and quicken their capillary circulation and their metamorphosis, especially of glycogenic materials; they hence are alterative and deobstruent, and exert special effect in diminishing thirst and checking polyuria in horses. Given for a lengthened period, iodine produces wasteful tissue-change, with a debilitated, depraved state, termed iodism. Externally it is used as a stimulant, antiseptic, deobstruent, and counter-irritant. It is a feeble antiseptic, but an effectual deodorant and disinfectant.

Toxic Effects. — Applied to cutaneous or mucous surfaces, it causes an orange-yellow stain, redness, irritation, and subsequent desquamation; placed in the areolar textures, it induces inflammation and abscess; inhaled insufficiently diluted, it excites bronchial irritation. Repeated strong applications penetrate the textures and cause their disintegration and fatty degeneration. When swallowed, contact with alkaline secretions insures solution and conversion into albuminate and sodium iodide. It is readily diffused and detected in the blood, saliva, mucus, milk, bile, and other secretions. Five minutes after administration of a soluble preparation, iodine has been found in the urine, by which it is chiefly excreted; the urine of a horse which had received a single large dose in bolus afforded indications of iodine for three days. In the animal secretions and in combination the presence of iodine is readily determined by adding to them a cold solution of starch, and then a little chlorine or a

few drops of nitric acid, when the blue starch iodide is formed.

Two or three drachms of solid iodine, given to dogs, are speedily evacuated by vomiting; but when the œsophagus is tied, they 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. Horses and cattle are less susceptible, both of the local irritant and general constitutional effects of iodine, probably depending on the presence in their alimentary canal of large quantities of starch, which convert the iodine into the mild, insoluble starch iodide. Hertwig mentions that doses of forty to sixty grains, given to horses twice daily for fourteen days continuously, caused merely slight diarrhœa, with black evacuations and increasing emaciation. Professor Dick repeatedly gave horses large quantities for several weeks, without observing any other symptom than the total refusal of water. In one case, he administered for three weeks doses averaging two drachms per day, and amounting, towards the end of the experiment, 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, must in great part have been neutralised by contact with starch food.

The condition of iodism, produced by prolonged administration, is accompanied 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, languor, inaptitude for exertion, and elevation of temperature. In human patients wasting of the testicles and mammæ are recorded; in the bull, atrophy of the testicles, with loss of sexual desire (Morton); doubts are entertained of its supposed effect in arresting secretion of milk. But alike in man and the lower animals iodism is now exceedingly rare. Where it occurs, it is arrested by withholding the medicine; exhibiting starch, so as to convert any unabsorbed iodine into the

innocuous starch iodide; and giving mineral tonics, bitters, and nutritive diet.

Moderate doses in properly soluble form produce in the several domestic animals well-marked results; they stimulate secretion of nasal mucus and saliva, and of pancreatic and biliary fluids, increase tissue metamorphosis, and removal of waste products, and improve appetite. Various morbid processes are checked, excessive thirst and inordinate secretion of urine are arrested, and glandular enlargements absorbed. Patients having iodine after a short while acquire a tolerance of it. It is not cumulative; it has been given to man in small doses for many months continuously, and even for more than a year, without deleterious consequences, while its effects, unlike those of mercury and lead, cease with its administration. The potassium and sodium iodides retain the chief properties of iodine, but are less irritant, less active as gland stimulants, although more apt to affect the kidneys. The iodides of iron, copper, lead, and mercury exhibit mainly the actions of their powerful bases. Iodine is allied to chlorine and bromine in physiological, as well as in chemical characters. It resembles mercurials in alterative and antiseptic properties, in stimulating glands, and producing specific blood-poisoning. Its stimulation of the skin and mucous surfaces ally it to arsenic and sulphur.

Medicinal Uses.—Iodine is prescribed as an alterative and resolvent in the second stages of inflammation, after acute symptoms are subdued. It aids removal of hydrothorax and ascites, of recent exudations on mucous membranes, and of glandular enlargements, as is well illustrated in its curative effect in diseased thyroid gland—a complaint occasionally met with in human patients, and known as goitre, or Derbyshire neck. Amongst the lower animals it is given in enlargements of the liver and udder, in rheumatism, especially of a chronic nature, and amongst cattle, in disease of the mesenteric glands, enlarged joints, and other scrofulous affections. In very many of these cases, notably in those associated with anæmia, it is greatly more effectual when conjoined with salts of iron. In combination with small doses of carbolic acid, iodine solutions are prescribed by American practitioners to combat

febrile attacks, especially when depending upon malaria. With arsenic and mercury, in the form of liquor hydriodatis arsenici et hydrargyri, Professor Williams uses iodine both internally and externally in the treatment of psoriasis. But in no veterinary cases is iodine of such decided and unfailing advantage as in that variety of diabetes inspidus or polyuria which affects horses. In this disease, twenty to thirty pints of urine are often evacuated daily, the animal suffers intense and insatiable thirst, and rapidly loses strength and flesh. The symptoms, however, even when very aggravated, yield almost immediately to the use of iodine; thirst disappears, the urine is reduced to its normal quantity, and the animal is restored to perfect health, often within two or three days. The *modus operandi* is not very evident, the only physiological actions capable of exerting curative influence is removal of thirst and antiseptic arrest of excessive tissue metamorphosis. Neither iron, quinine, arsenic, nor other effective antiseptic or tonic is, however, to be depended upon in such cases. Potassium iodide is not nearly so effectual as the crude iodine. Iron iodide answers very fairly, but is more expensive and difficult to procure and preserve. Mr. Thomas A. Dollar, of New Bond Street, informs me that although he has experimented in these polyuria cases with various more correct chemical combinations, he finds nothing more reliable than the following old-fashioned formula:—Iodine, half a drachm; iron sulphate, two drachms; powdered gentian, half an ounce,—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 perfect cure. In allaying the irritable cough and profuse discharge of catarrh, sore throat, and bronchitis, especially of a chronic or epizootic type, amongst horses, a useful combination consists of half a drachm each of iodine, potassium iodide, camphor, and belladonna extract. Inhaled in vapour diluted with steam or (better still) with dry air, it soothes irritable respiratory surfaces in catarrh in horses, arrests muco-purulent discharges, and in hoose in calves destroys the filariæ. In such cases in human patients ten to fifteen drops of the following formula are inhaled night and morning:—Two drachms each of ethereal tincture of iodine and carbolic

acid, one drachm of creasote, and one ounce rectified spirits. In chorea and epilepsy in dogs, iodine is of little value.

It is seldom applied directly for irritant or caustic purposes, but concentrated solutions or liniments are used as stimulants and resolvents in chronic synovitis, bursal enlargements, strains of tendons, thickening of periosteum, scrofulous and other tumours, and indurations of the udder. Absorption is often more effectual when the dressing is applied in a zone around instead of immediately over an enlarged gland. It is occasionally applied as a counter-irritant in sore throat in horses; and is rubbed into the chest in pleurisy to arrest formation of exudate, and hasten removal of what may have been outpoured. As stimulating antiseptics and promoters of adhesion, dilute iodine solutions are injected into cysts and abscesses from which serum or pus has been withdrawn. Mixed with tar sulphur or mercurials, or alternated with them, they prove useful in eczema, psoriasis, and lupus, in both the cryptogamic contagious and herpetic non-contagious forms of ringworm; and, like most effectual antiseptics, destroy skin parasites. 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. Excess of iodine must, however, be avoided, otherwise corrosive instead of healing effects are produced. For stimulating and deodorising unhealthy and malignant wounds, Professor Spence used the diluted tincture. Iodine is an expensive but effective deodoriser and disinfectant, decomposing noisome organic compounds by uniting chiefly with their hydrogen, and also destroying the lower forms of vegetable and animal life. It is contra-indicated in high fever, acute inflammation, and derangement of the bowels; and Hertwig considers that in most affections of the eyes, even in those of a chronic kind, it does more harm than good.

Doses, etc.—For horses, grs. xx. to ℥i.; for cattle, ℥ss. to ℥iss.; for sheep, grs. xv. to grs. xl.; for pigs, grs. x. to grs. xx.; for 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 are frequently given with impunity, but usually without increased curative result. Iodine is often administered in bolus; but handy although this form undoubtedly is for horses and dogs, it is less certain than a good fluid preparation, such as is obtained by shaking two parts of iodine and one of potassium iodide in six or eight parts of water. The potassium iodide insures 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 itself. *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 usually suitable. As a counter-irritant, about one part of iodine, with one half of potassium iodide to insure solution, is used with eight of water or of fatty matters; but where gentle stimulant effects are desired, with absorption of iodine, the preparations should be of half this strength. For dressing wounds, ten grains each of iodine and potassium iodide to an ounce of water usually suffice. Half an ounce of iodine, a quarter of an ounce of potassium iodide, an ounce of tar, and eight ounces lard or oil, make a serviceable mange dressing. Professor Williams, in successfully treating the scaly eruptions of psoriasis, after a purgative and softening the hard cracks with oil and alkalies, uses both internally and externally a triple compound of iodine, arsenic, and mercury, which he terms *liquor hydriodatis arsenici et hydrargyri*, and orders to be made as follows: —Triturate of finely levigated metallic arsenic 6·08 grains, mercury 15·38 grains, and iodine 50 grains, with one drachm of alcohol, until the mass be dry and changed in its colour from deep brown to a pale red. Next triturate the mass for a few moments with eight ounces of distilled water; transfer the solution to a bottle, add to it half a drachm of hydriodic acid, and filter, making up to eight ounces by means of distilled water if there is any deficiency. The solution is of a golden yellow colour, and each drachm contains, water 1 drachm, protoxide of arsenic $\frac{1}{8}$ grain; protoxide of mercury

$\frac{1}{4}$ grain; iodine converted into hydriodic acid $\frac{4}{5}$ grain. The dose of this for the horse is from two to three ounces twice a day, care being taken that its effects are not pushed too far. (*Principles and Practice of Veterinary Surgery.*)

IODOFORM (p. 291), dissolved and diluted with vaseline or other bland substance, is applied as a soothing antiseptic in nasal gleet and ulcerated sore throat, as a dressing for ulcers and painful swollen glands, and as a suppository or injection in irritation of the rectum or urino-genital organs.

SULPHUR IODIDE, a useful cutaneous stimulant and destroyer of skin parasites, is prepared by mixing, in a Wedgwood mortar, four ounces of iodine with one of 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 ointments or liniments. Such preparations are particularly suitable for itching scaly skin complaints, for the cure of ringworm, and, not being poisonous, are used for mangy dogs, without risk of injury from being licked or absorbed.

IPECACUAN.

Ipecacuanha. The dried root of Cephaëlis Ipecacuanha. Imported from Brazil. (*Brit. Phar.*)

Nat. Ord.—Cinchonaceæ. *Sex. Syst.*—Pentandria Monogynia.

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, annulated pieces, three or four inches in length, of the thickness of a quill, and covered with a brittle brown bark, which constitutes fully three-fourths of the root, and is of greater medicinal value than the tough, white, internal woody matter. The powder is grey-brown, has an acrid, bitter taste, a faint nauseous odour, and communicates its properties to hot water, alcohol, and weak acid solutions. Besides 30 per cent. of starch, a large amount of pectin, and a little resin, fat, albumen, and gum, it contains an odorous volatile oil,

the amorphous, red-brown, bitter astringent ipecacuanhic or cephaëlic acid, and, in combination with it, about one per cent. of a colourless, uncrystallisable, slightly bitter, irritant alkaloid called emetine or emetia (C_{28} H_{40} N_2 O_5). Emetine is also present in the striated and undulated ipecacuans, neither of which is, however, recognised by the Pharmacopœia.

Actions and Uses.—Ipecacuan is a mild topical irritant. It stimulates the mucous and cutaneous surfaces, and increases or modifies their secretions. Howsoever introduced into the bodies of men or carnivora it causes vomiting by stimulation of the vomiting centre, or, according to other authorities, by irritation of the terminals of the pneumogastric nerve. It stimulates in all animals the respiratory centre, and excites movements of the cilia of the pulmonary membrane, in part explaining its expectorant effects. Professor Rutherford has shown it to be a liver stimulant even in the smaller doses in which its slight cathartic action is not cognisable. Excessive or frequently repeated large doses derange and paralyse the nervous centres and nerves on which its acts, and hence lower the action of the heart and animal temperature, and arrest respiratory movement (Dr. Ornellas). It is excreted through the respiratory and gastro-intestinal membranes and skin, and to a less extent through the kidneys. It is chiefly used as an expectorant and diaphoretic. Whilst full doses stimulate the respiratory and vomiting centres, small and repeated doses abate their abnormal activity, and are given to arrest expectoration and vomiting.

The powdered root or alkaloid applied to a mucous surface, or rubbed into the skin, causes irritation and papular eruption. With irritation and increased secretion of the respiratory and gastro-intestinal mucous membranes, full doses induce in dogs and cats, vomiting, muscular relaxation, failure of the heart's action, reduction of temperature, albuminous urine, and collapse in twenty-four or thirty-six hours. After death, dark-coloured blood is found to fill both sides of the heart, the respiratory and digestive mucous membranes are inflamed, the lungs are congested (Dr. Dyce Duckworth, *St. Bartholomew's Hospital Reports*, vols. v. and vii.) M. Chouppe, recently investigating the action of emetics, finds that, after section of the pneumo-

gastric, injection of emetine does not cause vomiting, but apomorphine and tartar emetic act as quickly and fully as before section of the nerve. He thence concludes that emetime acts mainly by irritation of the terminations of the pneumogastric. These experiments require corroboration, however. (Dr. Ringer, *Hand-book of Therapeutics*, 1882). Professor Rutherford found that 60 grains ipecacuan powerfully stimulated the liver of dogs; even three grains had an effect on a dog weighing 17 lbs.; no purgative effect was produced, but an increased amount of mucus was secreted from the small intestine (*Journal of Anatomy and Physiology*, October 1876). As an emetic for dogs, cats, and pigs, ipecacuan acts more slowly and gently than zinc or copper sulphates; while it produces less nausea than tartar emetic. In emetic and expectorant effects it resembles squill. Bracy Clark states that three ounces will kill a horse.

Medicinal Uses.—Ipecacuan is prescribed to empty the stomach of dogs and other carnivora of undigested food and irritants. Promptly to remove poisons, mustard or zinc sulphate is preferable. Along with the increased secretion the contents of the stomach usually are evacuated, and in ten or fifteen minutes after the emetic has been swallowed there is outpoured a profuse secretion from the respiratory membrane, which often gives relief in the early dry stages of catarrh, and proves useful in cutting short inflammatory attacks, especially of the eyes, brain, and air-passages. Moreover, from the liver and portal system the full action of the emetic also removes and casts out morbid matters. Even where doses insufficient to cause emesis are used, and in patients where emesis never occurs, ipecacuan promotes salutary discharges from dry congested membranes. In mucous catarrh and sore throat amongst horses, where the buccal and Schneiderian membranes are dry and irritable, or their secretions over-abundant and tenacious, Mr. Thomas A. Dollar, of New Bond Street, frequently gives a drachm of powdered ipecacuan, with an ounce of medicinal ammonia acetate solution, in a pint of water, repeating the dose several times daily. Delaford, and other French veterinarians, and some American practitioners, recognising its healthy stimulation of the gastro-intestinal membrane, prescribe half-

drachm doses in acute diarrhœa and dysentery in cattle. Following the practice with human patients, drop doses of ipecacuan wine are given at half-hourly intervals to arrest vomiting in weakly dogs, and for this purpose it is advantageously conjoined with nux vomica or morphine, while the spray is occasionally used to diminish expectoration and irritation of winter cough, and allay some forms of asthmatic dyspnœa.

Doses, etc.—Of the powder, as an emetic, dogs take grs. xv. to grs. xxx.; 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 four grains ipecacuan, quarter of a grain tartar emetic, with a dessert-spoonful of antimonial wine, dissolved in an ounce of tepid water, and repeated every half-hour until vomiting takes place. Some practitioners use the celebrated *Dover's Powder*, or its pharmaceutical imitation, made by triturating together one part each of ipecacuan and opium, and eight parts of potash sulphate. Of this useful expectorant and diaphoretic horses and cattle take ℥ i. to ℥ iij.; sheep, grs. xxx. to ℥ i.; dogs, grs. x. to grs. xv.; cats, grs. ii. to grs. v.; repeated four or five times daily, the patient being supplied with plenty of diluents, and kept in a warm atmosphere or comfortably clothed. The *ipecacuan wine* of the Pharmacopœia is prepared by macerating an ounce of bruised root with a pint of sherry. The *acetum*—more active and cheaper than the *vinum*—is made by macerating 2½ ounces of the coarsely-powdered root for seven days in a pint of diluted acetic acid.

Emetine, when inhaled even in minute amount, irritates the mucous surfaces 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 (Majendie). It is eliminated by the mucous surfaces and liver, causing vomiting and increasing secretion of bile; large doses, moreover, lower temperature, relax voluntary muscles, and paralyse respiration. (Dr. A. E. D. Ornellas, *Pharmaceutical Journal*, January 1874.)

IRON AND ITS MEDICINAL COMPOUNDS.

IRON. Ferrum. Ferrum redactum. Pulvis ferri. Fe.

Iron is a lustrous, grey metal, tenacious, malleable, ductile, readily welded at a white heat, and with a specific gravity of 7·84. It is attracted by the magnet, and becomes itself magnetic. It is a normal constituent of plants and animals. It occurs in small quantities uncombined, and probably of meteoric origin, and exists abundantly in the form of oxide carbonate and sulphide. The metal is extracted by roasting the ore, when the iron is reduced to an impure ferric oxide. In the blast furnace, in contact with burning coal, limestone, and sand, the impurities are transferred to the fusible slag, whilst the metal, retaining four or five per cent. 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; whilst by subsequent pressure under heavy rollers, greater tenacity and more fibrous texture are imparted. Steel is made by heating wrought-iron in contact with charcoal, of which it takes up 1 to 1·5 per cent.

With other elements and radicle, iron unites in two proportions: it forms 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 usually green, and in solution give, with hydrochloric acid and hydrogen sulphide, negative results; with ammonium hydrosulphide, a black precipitate of hydrated sulphide (Fe S, H_2 O); with caustic alkalies, white or grey precipitates of hydrated protoxide (Fe O, H_2 O); with potassium ferrocyanide, a light-blue precipitate, gradually becoming darker by oxidation (Fe_4 Fey_3); with potassium ferridcyanide, a precipitate dark blue from the first (Fe_3 $Fdcy_2$).

The ferric salts are mostly brown or red, and in solution exhibit, with hydrochloric acid, a negative reaction; with

hydrogen sulphide, give a white precipitate of sulphur; with ammonium hydrosulphide, the black hydrated proto-sulphide together with sulphur (Fe S, H_2 O); with caustic alkalies, a brown-red precipitate of ferric hydrate (Fe_2 O_3, 2 H_2 O); with potassium ferrocyanide, a deep-blue precipitate of Prussian blue at once goes down (Fe_4 Fey_3, H_2 O); with potassium ferridcyanide, no precipitate, but a green or olive discoloration; with solution of galls, neutral iron solutions yield a blue-black precipitate—the basis of writing-ink; with potassium sulphocyanide an intense blood-red colour.

Actions and Uses.—Iron appears to have been the first mineral substance used in medicine, and some of its compounds have been administered for three thousand years. It is a constant constituent of the body of all the higher animals, and where its amount has been wasted by hæmorrhage or disease, iron is an appropriate food. Its various salts are astringent, antiseptic, and tonic; large doses of the more soluble per-salts are irritant and corrosive. Although exerting little effect on the unbroken skin, the soluble preparations, applied to mucous or skin abraded surfaces, combine with albumen, coagulate blood, and are astringent. The metal when swallowed in a finely divided state is oxidised; the insoluble salts are dissolved by the hydrochloric acid of the gastric juice; ferrous salts are converted in the stomach and duodenum into the corresponding ferric salt; organic compounds are reduced to carbonates. Iron salts, freely diluted, are absorbed both from the stomach and duodenum as albuminates, perhaps also as carbonates and lactates. Besides being dissolved in the blood serum, iron is specially stored and distributed by the blood globules, which normally contain 0·42 per cent. It is the essential constituent of their hæmatoglobulin, which carries the oxygen for ozonising and tissue metamorphosis. The blood globules, although in health not materially affected by iron, in anæmia, by its proper use, are often doubled and even tripled in number, are increased in size, and deepened in colour. In effecting this important service iron salts act as food or restoratives. But, wherever distributed, they moreover exert general tonic and astringent effects; they stimulate vaso-motor and trophic nerves. Un-

absorbed portions, and the surplus not used for nutrition, reduced in great part to the condition of tannate or sulphide, are eliminated in the various albuminous secretions, in the bile, and, like most other metallic bodies, are removed mostly by the bowels, often communicating a dark colour to the dejections. When iron salts are administered for several weeks to rabbits the blood and tissues gradually become saturated, and excretion with scarcely any loss occurs in the urine (Brücke).

Pereira and other authorities on human materia medica enumerate upwards of forty iron salts; but as these differ mainly in the degree of their action, the saccharated carbonate, ferrous sulphate, and iodide, with the ferric oxide and chloride, suffice for veterinary purposes. Metallic iron, as filings or pulvis ferri, is occasionally given in poisoning with salts of mercury and copper. The soluble ferric salts are more active and irritant than the proto-salts, the organic are less powerful than the inorganic. Iron arsenite has recently 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 prescribed in dog practice, in doses of four to ten grains. Dialysed iron and amorphous quinine have recently been conjoined as a tonic mixture. The phosphate is a mild chalybeate, commended as being the form in which iron occurs in the blood, and supposed to be particularly assimilable, and specially suitable in strumous diseases of the bones.

IRON CARBONATE. Ferri Carbonas. Ferrous Carbonate. $FeCO_3$.
SACCHARATED CARBONATE OF IRON. Ferri Carbonas Saccharata.

The lower or ferrous carbonate occurs in clay iron ore, and in many mineral waters. It is prepared by decomposing a solution of iron sulphate by solution of 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 carbonate anhydride, and becomes converted into ferric oxyhydrate—a change constantly taking place along the banks of chalybeate streams.

To preserve it in a stable form, the saccharated carbonate has been introduced. 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, very feebly chalybeate taste, and should contain at least fifty-seven per cent. of carbonate. (*Brit. Phar.*)

Actions, Uses, and Doses.—On account of its instability, the carbonate itself is not used. Its saccharated form is readily soluble; is a mild chalybeate; especially convenient in canine practice, and administered for the same purposes and in the same doses as the sulphate.

IRON SULPHATE. Ferri Sulphas. Ferrous Sulphate. Green Vitriol. Copperas. $Fe, SO_4\ 7\ H_2\ O$.

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 obtained from a clay shale or alum schist, highly impregnated with iron pyrites or bisulphide ($Fe\ S_2$). Such schists yield both iron sulphate and alum (p. 173). Broken into fragments, they are placed in large heaps, frequently wetted, and exposed to the air for several months. By oxidation and chemical combination are formed iron and aluminum sulphates. Water is freely added, and the solution evaporated, when the iron sulphate crystallises out, leaving in solution the more soluble aluminum sulphate.

Properties.—Iron sulphate occurs in bluish-green, oblique rhombic prisms, which, on exposure to the air, gradually oxidise, becoming opaque, and covered with a brown coating of oxysulphate; an excess of sulphuric acid retards this oxidation. Its specific gravity is 1·82. It has an intensely inky, metallic taste; is insoluble in rectified spirit, but soluble in one-third of its weight of boiling water and twice its weight of cold water. Heated, it fuses, readily parts with six atoms of water of crystallisation, retaining, however, the seventh more tenaciously. Its distinguishing tests are those of other ferrous salts detailed above (p. 393).

Actions and Uses.—When swallowed it is restorative, tonic,

and astringent, and in large doses irritant. Applied externally, it is stimulant, astringent, styptic, and antiseptic.

General Actions.—Two drachms introduced into the stomach of dogs occasioned vomiting and death in twenty-four hours, with redness of the alimentary mucous membrane, and formation of a thick layer of tough mucus; the same quantity applied to a wound, proved fatal in twelve hours (Christison on *Poisons*), These irritant effects are less notable amongst horses and cattle. They are counteracted by solutions of galls, alkaline carbonates, and demulcents. Supplying the iron so essential to the hæmato-globulin, the ferrous sulphate proves a direct restorative. In rapidly-growing weakly subjects, in the several forms of tuberculosis, during recovery from debilitating disease, the blood globules are sometimes notably deficient; they are often reduced to half, and even occasionally to one-sixth, of their normal amount. Iron salts gradually increase their number and size, and shortly impart to the pallid weakly tissues a ruddier hue and robuster vigour. Restoring iron to faulty hæmato-globulin does not, however, explain all the curative virtues of iron. Copper, zinc, and silver salts, with quinine and cod-liver oil, although supplying no iron to red globules, produce analogous tonic effects. Besides furnishing the restorative iron like these other tonics, iron sulphate is a stimulant of vaso-motor and trophic nerves, a chemical astringent, a vital constringer, and an antiseptic. One or more of these physiological actions determine, with other practical curative results, its notable effects in improving appetite, digestion, and assimilation, diminishing excessive discharges, abating irritation and inflammation of lymphatic glands, and contracting and condensing the spleen, mentioned by Weinhold as the common effect of continued exhibition of the iron salt to dogs (Pereira's *Elements*, third edition). Iron sulphate is the cheapest and most convenient preparation of iron, is more soluble and active than the metal or oxides, but less corrosive and astringent than the ferric chloride and nitrate. It is not so irritant or corrosive as the corresponding salts of copper or zinc.

Medicinal Uses.—Iron sulphate is beneficially adminis-

tered to all veterinary patients in anæmia, whether connected with indifferent feeding, unhealthy surroundings, exhausting discharges, reducing diseases, or abnormal conditions of the glands. In many serious anæmic cases it is advantageously conjoined or alternated with small doses of arsenic. In conjunction with readily assimilable nutritive food no remedy is so valuable as iron in those anæmic cases which affect young cattle and sheep kept late in autumn on grass which has lost its nutritive value. No remedy is more effectual in tuberculous disorders, consumption, and dysentery; in relaxed conditions of mucous membranes; in wasteful serous or bloody discharges, as in red-water in cattle, in purpura, and other hæmorrhages; in indigestion and diarrhœa depending upon local atony or general weakness; in antagonising enlargements of the spleen and liver (Cruveiller); in chorea and epilepsy in delicate anæmic patients, and in convalescence from most acute debilitating diseases. With a bottle or two of ale, two drachms are given twice daily to horses to improve appetite and check the progress of farcy, nasal gleet, and chronic relaxed conditions of mucous membranes. Full doses of the powder or strong solution shrivel and destroy intestinal worms, and, further, impart a healthier condition of the bowels unfavourable to the development of parasites; while as an injection it brings away ascarides lodged in the rectum. Although itself devoid of purgative effect, it increases the activity of most cathartics with which it is combined. It is contra-indicated where there is fever, active inflammation, or irritability of the bowels. During early convalescence from inflammatory complaints, milder tonics are often preferable. Externally it is applied for the ordinary purposes of a stimulant, astringent, and styptic, usually in the form of powder or watery solution. Mixed with lime-wash, so as to render it distinctly yellow, it is said to drive away rats and mice. As an antiseptic it is inferior to ferric or zinc chlorides.

Doses, etc.—Horses take ℥i. to ℥ij.; cattle, ℥ij. to ℥iv.; sheep, grs. xx. to grs. xxx.; pigs, grs. x. to grs. xx.; and dogs, grs. v. to grs. x. These doses are made into bolus with linseed meal and treacle, dissolved in water, or mixed with soft food,

and repeated two or three times a day. A diluted solution, being less apt to cause gastric derangement, is preferable as a tonic, and for such purpose iron salts are given with or immediately after food. They are often conjoined, especially with acids and bitters. In atonic torpidity of the bowels, and for removing worms in horses, a drachm of sulphate is given daily with one or two drachms of aloes. A useful tonic bolus for horses is prepared with two drachms of green vitriol and half an ounce each of ginger and gentian, made up with treacle or Canadian balsam, and repeated twice or thrice daily. The same ingredients dissolved in a pint of ale or gruel prove an effective tonic draught either for horses or cattle. These quantities make three doses for sheep, and eight or ten for dogs. Thirty grains, with a drachm each of common salt and nitre, are recommended to arrest the progress of sheep-rot. After iron sulphate has been used for a week or ten days, to prevent gastric derangement, and maintain its continued efficacy, it is advisable to withhold it altogether for several days, or replace it during that time by some other tonic. Care should further be taken that, during its use, the bowels be kept open by an occasional laxative, especially necessary in horses and dogs, on account of their liability to suffer from the astringent and constipating action of iron salts. Irritating and constipating effects are, however, obviated by moderate doses given in solution. The dark colour and disagreeable odour which the fæces usually acquire during a chalybeate course, depend on the production, in the intestines, of tannate and sulphide, and generally indicate that the medicine is being given in unnecessarily large doses, which, when not absorbed, usually do more harm than good.

Iron Iodide. Ferri Iodidum. Ferrous Iodide. $Fe\,I_2,4\,H_2O$.

When iodine, iron wire, and distilled water are gradually heated together, combination occurs; and the solution, filtered and evaporated, yields tabular green crystals with a brown tinge, inodorous, having a styptic metallic taste, and soluble in about their own weight of water and alcohol. The solid iodide contains about 18 per cent. of water of crystallisation,

with a little oxide; when heated, it gives off violet-coloured fumes of iodine; when exposed to the air it deliquesces and acquires a red-brown colour. This oxidation is retarded by keeping the solution secluded from light and in well-stoppered bottles containing portions of 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 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; whilst 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. It may be used for the same purposes and in the same doses as the cheaper sulphate, or in amounts corresponding with the chloride solutions. Securing as it does in anæmia increased number and development of the blood globules, it improves nutrition, and frequently promotes absorption alike of solid and fluid exudate. Mr. Morton specially noted its efficacy in polyuria, and in nasal gleet accompanied by debility. It is also serviceable in glandular enlargements, especially in young or weakly animals. Besides being used in powder and solution, the syrup is prescribed in human and also occasionally in canine practice.

IRON, RED, PER- or SESQUI- OXIDE. Ferric Oxide. Ferrugo. Rust of Iron. $Fe_2 O_3$, H_2O.

IRON PEROXIDE MOIST. Ferri peroxidum humidum. Moist ferric oxide. $Fe_2 O_3$, $2H_2 O$, 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. It is prepared in the hydrated form, 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 solution of ferric sulphate (Fe_2 3 SO_4) by an alkali,—the Brit. Phar. orders solution of soda,—and washing the soft red-brown magma thrown down. This moist ferric oxide is the best antidote for arsenic, but requires to be used freshly prepared, as it gradually loses its efficacy by keeping. Dried on a plate over hot water, the oxyhydrate remains; heated to redness, there is left about 14 per cent. of the red-brown, tasteless ferric oxide.

Actions and Uses.—Ferric oxide and the oxyhydrates are not used medicinally. The hydrate moist and freshly prepared as an antidote for arsenic mechanically entangles the particles of the poison, and further converts it into an insoluble iron arsenite (Fe_4 2As O_3). In human patients doses of a table-spoonful are given every five or ten minutes. Professor Douglas Maclagan states that 12 parts of this hydrate are sufficient to neutralise one part of arsenious acid.

Iron Per- or Sesqui- Chloride. Ferri perchloridum. Ferric Chloride. Fe_2 Cl_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 insure production of the higher chloride. The strong watery solution of the Pharmacopœia, the Liquor Perchloridi Fortior, is orange-brown, odourless, inky-tasted, has a specific gravity of 1·44, and mixes with water and alcohol. Diluted with three measures of water, it constitutes the medicinal solution, which, for ordinary veterinary purposes, is as effective and much cheaper than the Tinctura Ferri Perchloridi, known as tincture of steel, or steel drops, and made by mixing one measure of the strong watery solution with three of rectified spirit. This tincture has a red-brown colour, an ethereal odour, an acid chalybeate taste, and a specific gravity of 0·9922.

Actions and Uses.—Whether in the form of watery solution or tincture, the perchloride is one of the most soluble, irritant, and corrosive preparations of iron; while in properly regulated doses it is a valuable restorative, tonic, antiseptic, astringent, and styptic.

Medicinal Uses.—With proper hygienic treatment, and repeated two or three times daily, the chloride counteracts anæmia and the several disorders connected with it. It hastens convalescence from acute exhausting diseases. It promotes absorption and excretion of inflammatory products. Professor Williams states: "When debility and anæmia are associated symptoms I have found the salts of iron, more especially the tincture of the terchloride, 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 iodide of potassium. The practitioner is, however, at liberty to combine the iodine with the iron."—(*Principles and Practice of Medicine.*) Iron chloride solutions usually relieve many of the symptoms, and often hold in check for considerable periods the retrograde metamorphosis, of tuberculosis, of farcy, and even of glanders. In tubercular stomatitis of the tongue, not uncommon in highly bred cattle, after scraping, the lesions are dressed with a strong solution of the tincture daily, but afterwards with weaker solutions at longer intervals. In rheumatism, especially in anæmic subjects, it is valued. In influenza and purpura in horses, it not only improves appetite and strengthens the pulse, but counteracts the tendency to extravasation. In purpura it is advantageously conjoined with turpentine, and, where the throat is sore and swallowing difficult, with chloric ether, administration being made in cold linseed gruel. Its topical astringent and general tonic effects recommend it in relaxed and diphtheritic throats, such as accompany and follow catarrhal fever in horses. Half-drachm doses of the medicinal solution, mixed with equal parts of glycerine, and dissolved in six or eight ounces of water, in such sore throats, are given every two hours, or even every hour, administered slowly so as to act as a gargle, or applied with an atomiser. It is prescribed in all animals in atonic dyspepsia, where intestinal worms have been present, sometimes for checking hæmorrhage from the alimentary canal, and as an astringent and stimulant of the urino-genital mucous membrane —the tincture, on account of its greater tendency to be excreted by the kidneys, being, in such cases, 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 kennel lameness in 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, according to amount and concentration, it is used as a caustic, astringent, styptic, stimulant, or antiseptic. Kulischer and Rosenstern's experiments with astringents demonstrate the efficacy of iron chloride solution in arresting hæmorrhage from the divided blood-vessels of the limbs of frogs, and in slowing circulation through their mesentery. Solutions of 30 to 50 per cent. of the strong watery solution were most effective in narrowing both veins and arteries, whether injected into the vessels or applied topically. As an antiseptic dressing for wounds, it must, however, be used more diluted, otherwise it causes irritation, which interferes with healing by first intention. Diluted according to circumstances it proves one of the best dressings for erysipelas. French surgeons have used it with some success in reducing erectile and aneurismal tumours, a few drops injected into the sac coagulating its contents. Injected into the rectum, in the proportion of two drachms of the medicinal solution to a pint of water, it destroys and brings away ascarides. One part of medicinal tincture with twenty of water is advantageously injected into the uterus in post-partum hæmorrhage in cows. The watery solution was found by Dr. Angus Smith (*Third Report on Cattle Plague*) to preserve blood and other such albuminous solutions more effectually than any other substance experimented on, with the single exception of zinc chloride. These chlorides, when used in concentrated solution, have, however, the disadvantage of developing in decomposing organic matters disagreeable fatty acids. Devoid of volatility, the ferric chloride, although an effective antiseptic, has little value as a disinfectant or deodoriser.

Doses, etc.—Of the weaker watery, or spirituous, solutions, horses and cattle take f℥ i. to f℥ ij.; sheep, ♏ xx. to ♏ xxx.; pigs, ♏x. to ♏xx.; dogs, ♏iij. to ♏x. Prescribed as a tonic, either solution is repeated two or three times a day, diluted with at least ten parts of water, ale, or gruel; is often conjoined

with hydrochloric acid, gentian, and other bitters or tonics, but cannot be used with ammonia, alkalies, or their carbonates, or with tannin-containing substances. One preparation of iron sometimes suits when others do not; after using one for a week it is frequently well to substitute another; young patients and dogs occasionally do better with the diluted chlorides or the saccharated carbonate than with the sulphate; iron salts in solid form are more irritant than in diluted solution.

JABORANDI.

Leaves and small branches of Pilocarpus pennatifolius and other species. (Lemaire.)

Nat. Ord.—Rutaceæ. *Sex. Syst.*—Pentandria Pentagynia.

The shrubs yielding jaborandi are natives of Brazil; the leaves and bark have an aromatic, bitter, pungent taste, and produce a tingling sensation in the mouth. The leaves, one to one and a half feet long, stalked, impari-pinnate, with leaflets five inches long, are the most active part of the plant, and contain an acrid resin, a dextrogyrate terpene (C_{10} H_{16}), 0·50 per cent. of an essential oil, and an amphorous alkaloid pilocarpine (C_{23} H_{35} N_4 O_4, 4 H_2 O), which forms crystallised salts, the hydrochlorate and nitrate being chiefly used. Dr. William Craïg of Edinburgh has carefully investigated the properties of jaborandi, and shown that hot water extracts all, or nearly all, the active principles, and that an infusion of the fresh leaves is hence the most handy preparation. Unless carefully kept in a dry place the leaves lose their activity in twelve months.

Actions and Uses.—Jaborandi leaves and alkaloid are sialogogue, sudorific, and antipyretic. They paralyse motor centres, dilate arterioles, and provoke discharge from the salivary glands and skin, and in lesser degree from the lachrymal, bronchial, and intestinal surfaces. Full doses paralyse the cardiac excito-motory apparatus and cardiac muscular substance; poisonous doses arrest the heart's action in diastole. Pilocarpine nearly resembles muscarin, the active principle of poisonous fungi, and is antagonised by atropine.

General Actions.—The effects on the salivary glands are

produced in all animals, and within a few minutes of the swallowing or hypodermic injection of the alkaloid or of strong infusions of the leaves. The submaxillary pours forth its secretion even after section of the corda tympani nerve and the sympathetic supplying the gland. (Langley, quoted by Dr. Ringer.) The profuse perspiration, so prominent an effect of jaborandi in human patients, is not so noticeable in horses or dogs. Sweating is caused, as by muscarin, by paralysis of peripheral cutaneous nerves, while increased skin secretion, produced by ammonium acetate, physostigmine, picrotoxin, and nicotine, depends upon their acting on the sweat centres of the medulla and cord. As a result chiefly of increased perspiration there is a fall of temperature, which in man ranges from 0·4° to 1·4°. The effect on the heart is not uniform in all animals. In frogs the pulse-rate is diminished; in men it is usually increased; in horses and dogs moderate doses at first slightly increase, and subsequently slightly diminish both the number and force of the heart-beats.

Mr. Thomas Dollar, junior, of New Bond Street, London, and Mr. I. Print of Clapham, gave horses two to four drachms of the leaves infused in hot water, and in fifteen to twenty minutes profuse salivation occurred, continuing for three hours, but without very notable diaphoresis, altered circulation, or temperature. In several carriage horses to which I have given two to four drachms, abundant salivation continued for two to three hours; slight diaphoresis occurred after twenty minutes, but was never so abundant as in human patients; no change was noticeable in the pulse, temperature, or quantity of urine excreted. Mr. William Dollar injected hypodermically 1½ grains pilocarpine in ten parts water into the shoulder of an aged horse, 15¼ 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. Half a grain to a grain of pilocarpine caused in dogs profuse salivation, continuing for six hours with increased defecation and urination. The mucous membranes

are reddened, and in light-coloured dogs the skin is also reddened. Half a drachm to a drachm of the leaves given infused in water caused, in English terriers 15 lbs. to 20 lbs. weight, profuse salivation, but no notable diaphoresis. Thirty to sixty grains, given as an infusion to human patients, in ten to fifteen minutes cause profuse salivation and perspiration. Upwards of a pint of saliva and the like quantity of perspiration have been collected in three hours; the pulse rises, arterial tension is diminished, and temperature is lowered; the pupils contract; the symptoms continue during four or five hours. In three men salivation and perspiration, caused by sixty grains jaborandi leaves, were very promptly arrested by subcutaneous injection of $\frac{1}{100}$ grain of atropine. (Ringer and Gould.)

Medicinal Uses.—Along with other sudorifics, jaborandi and pilocarpine may prove serviceable antipyretics. Their supposed power of removing urea by the skin has suggested their use in rheumatism. Their action on the sudatory and sebaceous glands has led to their administration in chronic eczema and prurigo, but they are of no use in moist eczema or psoriasis. Repeated small doses are in growing favour amongst French medical and veterinary practitioners for promoting absorption of pleuritic and other effusions.

Doses, etc.—Of the fresh leaves horses or cattle take ℥ij. to ℥iv.; sheep, pigs, or dogs, ℥ss. to ℥i., given as an infusion. Pilocarpine is prescribed usually hypodermically, to horses and cattle in doses of grains i. to grs. ij.; to dogs, grs. $\frac{1}{10}$ to grs. $\frac{1}{2}$.

JALAP.

Jalapa. The dried tubercules of Exogonium purga. (Bentham.) Imported from Mexico. (*Brit. Phar.*)

Nat. Ord.—Convolvulaceæ. *Sex. Syst.*—Pentandria Monogynia.

Jalap derives its name from Xalapa, or Jalapa, a town in Mexico, whence it was first obtained, and from the neighbourhood of which it is still exported. The Exogonium purga is a hardy climber, found on the temperate heights of the Andes, 6000 feet above the sea level. It is cultivated in Southern India, and in sheltered spots in this country flowers and

matures in the open air. It has a smooth, round, brown, twining, annual stem; long-stalked, cordate, and somewhat hastate leaves; salver-shaped crimson or light-red flowers. The perennial root-stock throws off underground shoots, which at intervals send down roots gradually thickening, becoming pear-shaped or ovoid, ranging in size from a walnut to an orange, invested with a brown wrinkled cuticle, but white and fleshy within. These roots or tubercules, although gathered at all seasons, should only be taken up during winter or early spring, when the aërial stem has died. The larger roots are divided, sliced, or gashed to facilitate drying, which is effected in nets in the sun or over a fire. The jalap of the shops varies in appearance with the size of the tubers and the mode in which they have been cut; the larger roots, which remain whole, are round or ovoid, the smaller pear-shaped, usually with fibrils attached. All become hard and brittle with keeping. Good qualities are dark-coloured, dry, heavy, compact, and not worm-eaten. The parenchyme consists chiefly of starch granules, and towards the outer part of each layer are large lactiferous cells containing the semi-fluid resin, and determining the characteristic concentric rings observed on transverse section of the root. Unless mixed with some hard salt, as potassium tartrate or sulphate, jalap is triturated with difficulty. In powder, it 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 about 20 per cent. of starch and cellulin, 19 of uncrystallisable sugar, and 10 of gum, jalap contains 12 to 20 per cent. of a brown brittle resin easily soluble in rectified spirit, from which, after concentration, it is precipitated by pouring into water, and, when washed and dried, constitutes the resina jalapa of the Phar. It is stated to consist of the colourless, amorphous jalapin, which resembles the resin of scammony, and the less soluble but more active convolvulin (C_{31} H_{50} O_{16}). The square or spindle-shaped pieces of the larger-rooted male jalap, or Orizaba root, possess the properties

of ordinary jalap. Similar cathartic properties also belong to the smaller elongated, corky, paler, wrinkled tubercules of the Tampico jalap, sometimes substituted for the officinal jalap.

Actions and Uses.—Jalap is a topical irritant, cathartic, and feeble vermifuge. Its active principle, introduced into the blood, exerts no purgative effect; admixture with bile or actual contact with the intestine appears essential for the production of its effects. Full doses given to dogs or cats usually cause nausea or vomiting, as well as catharsis. When the œsophagus is tied to prevent vomiting, two drachms excite fatal gastro-enteritis in small dogs. Freely rubbed into the skin, or applied to mucous surfaces, it excites inflammation. Its cathartic action is slight either on horses or cattle. Two or three ounces given to the horse have no effect on the bowels, but act slightly on the kidneys (Moiroud). White reports administering half a pound without purging. I have repeatedly given cows four ounces without perceptible effect. It is, however, a good purge for dogs and pigs. Professor Rutherford and Vignal, experimenting upon dogs, found that jalap stimulates secretion of bile, and still more notably secretion from the intestinal glands (*Journal of Anatomy and Physiology*, Oct. 1876).

For dogs jalap is prescribed for most purgative purposes, acts tolerably speedily and certainly, produces full watery discharges, and is especially effective when conjoined with a grain or two of calomel. It is identical in its effects with scammony, the dried root of Convolvulus scammonia; it resembles the kaladana seeds used roasted as a purgative by the natives of Hindustan, and introduced into the Pharmacopœia of India; it is more active than senna, the leaves of Cassia acutifolia; but less powerful and irritant than gamboge, podophyllum, elaterium, or colocynth.

Doses, etc.—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 two or three hours by ℥ss. to ℥i. of jalap, with two or three grains of calomel, made into a 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. *Sex. Syst.*—Diœcia Monadelphia.

The common juniper is a shrubby, evergreen tree, growing in most temperate countries, occurring of several varieties. The leaves are dark green, linear and arranged three in a whorl. The fruit or berries are chiefly brought from the shores of the Mediterranean and the Baltic; 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 geneva about 2 lbs. are added to the 100 gallons of spirit. They contain 20 to 30 per cent. of glucose, and yield, when distilled with water, one to two per cent. of two volatile oils, one of which is polymeric with terpine (C_{10} H_{16}). From the wood of the Juniperus oxycedrus, 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 especially recommended in scaly skin diseases.

Actions and Uses.—The tops, fruit, and oil of juniper are mildly stimulant, stomachic, carminative, and diuretic. They are allied to such volatile oil-containing substances as anise, caraway, and coriander, and balsams of Canada, Copaiba, and Peru; they resemble the turpentines, but are less active. Two ounces of the berries given to horses and cattle act chiefly on the digestive organs; but three or four ounces induce diuresis, and slight diaphoresis. The fruit and oil are 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 sheep-rot. As diuretics they are seldom prescribed. They have been employed for fumigating stables and cow-houses; and their vapour was recommended for the destruction of strongyli in the bronchial tubes of calves and lambs. But for both these purposes juniper has been superseded by more effectual remedies.

Doses, etc.—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., repeated at intervals of two hours till diuresis is induced.

LEAD AND ITS MEDICINAL COMPOUNDS.

Lead. Plumbum. Pb.

Lead is chiefly obtained by roasting galena, the sulphide (Pb S). It has a blue-grey colour, and a peculiar odour when rubbed; is soft and malleable, readily cut or scratched, and has the specific gravity 11·4. Exposed to air it oxidises, loses its metallic lustre, and becomes dull and opaque. It melts at 617°. In ordinary water, with access of air, a hydrated oxide and carbonate are gradually formed. Lead is sometimes quadratomic, but most of its medicinal compounds are diatomic.

Poisonous and Medicinal Actions.—Metallic lead is devoid of medicinal or poisonous action. Shot, an alloy of lead and 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. The metal in frequent doses is apt, however, to be oxidised, dissolved, and exert its characteristic effects. Such soluble compounds as the nitrate and acetates applied locally, coagulate albumen, form a film over mucous or abraded skin surfaces, check discharge, and allay irritation and inflammation; administered in small doses, they are astringent and sedative; in larger doses they are corrosive and irritant, but not so powerful as corresponding zinc or copper salts. The insoluble oxides and carbonates are feebly irritant; the iodide is stimulant and absorbent. All lead compounds, in continuously repeated doses, become absorbed from the stomach as well as by other channels,

chiefly as albuminates and chlorides; like many metallic salts they appear to be attracted to the glands and muscles, are often found deposited in their textures; they check oxidation, impair nerve currents, and cause paralysis and wasting of voluntary and involuntary muscles. The extremities are enfeebled and bent, for the extensors suffer before the flexors; the bowels are torpid from paralysis of their muscles. Lead salts are long retained in the body, and are got rid of through the liver, kidneys, and mucous membranes. Professor John Harley concludes that "the whole of the effects of lead upon the body may be traced to the enfeeblement of the nerve currents, from impairment of the isolating power of the nerve fibres; the presence of lead in the tissues, by increasing their conducting power, tends to cause a lateral diversion of the nerve force, and thus exhausts the currents in their to and fro passage" (Royle's *Mat. Med.*, sixth edition). Bernhardt says that the grey matter of the cord is the part of the nervous system chiefly attacked, and in which lead may be most largely found; but other observers affirm that the intra-muscular extremities of nerves are primarily and chiefly affected (Phillips, *Mat. Med.*, 1882).

Lead poisoning or plumbism occurs not unfrequently in the lower animals. In the end of 1851 Mr. Shenton, a veterinary surgeon practising in Derbyshire, had eleven fatal cases among horses, and several among cattle; and, about the same time, Mr. Mayor, V.S., of Penrith, had two horses that died near the head of Ullswater, in Westmoreland (*Monthly Journal of Medical Science*, May 1852). The symptoms of lead poisoning among the lower animals are analogous to those in man. They usually continue, in more or less aggravated form, for several weeks or even months. Digestion is impaired, appetite becomes capricious, is sometimes entirely gone, at other times is morbidly increased, the bowels are attacked by spasms and are torpid. These symptoms simulate those of stomach staggers and impaction of the third stomach of cattle—disorders for which lead poisoning is not unfrequently mistaken. Special 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. Constipation and colic

are not so invariably present in the lower animals as in human patients. Paralysis and wasting attack the muscles of the extremities and also affect the involuntary muscles of the bowels and blood-vessels. The blood contains an excess of water, the conversion of urea into uric acid is interfered with, and urate of soda is deposited in the joints of animals as well as of men (Dr. Garrod). Nutrition generally is impaired, and epilepsy convulsions or coma are added to the paralysis. In a letter received from Mr. Shenton, he thus describes 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 till 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 but 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 part 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." It may further be observed that, in dogs destroyed in about three weeks by lead poisoning, the muscular system was flaccid, pale, and bloodless (Schwepfer).

Mr. Cartwright, of Whitchurch, Salop, records in the *Edinburgh Veterinary Review* for August 1863, three cases of milch cows poisoned by eating sheet lead which had been used for lining tea-chests, had been carelessly thrown on the manure heap, and thence been spread on the clover fields. 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; whilst the pupils were nearly closed, and were little sensitive to light or to movements of the finger. The gait was weak and tottering; whilst, for an hour or two at a time, the cows, although persistently 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, both 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 the bullet spray from the Rugby rifle butts had fallen. Fragments of the lead were found adhering to the coats of the stomachs, and the poison was also detected by Professor Tuson of the Veterinary College in the intestines, liver, and kidneys (*Veterinarian* for May and August 1864).

Mr. Broad of Bath (*Veterinarian* for 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 records 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 become 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*). As in the human female, lead poisoning proves an occasional cause of abortion amongst cattle.

Mr. Herapath reports, in *The Chemist* for 1855, some 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 $\frac{3}{16}$ 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."

When animals are killed while labouring under the saturnine malady, or die from its effects, lead can usually be found in most parts of the body. It has been detected in the blood, the contents of the stomach and intestines, the brain and spinal cord, the muscles, lungs, and liver. The late Professor George Wilson discovered it in especially large amount in the spleen,—an organ which can always be speedily and easily examined, on account of "its small size, loose spongy texture, and comparative freedom from fatty matter" (*Monthly Journal of Med. Science*, May 1852). To prepare the organs for analysis they are digested in aqua regia, over a slow fire, until soluble matters are separated. The liquid, which should then be clear and pale brown, is cooled, filtered through calico, and evaporated. The dried residue is charred in a Hessian crucible, boiled with diluted nitric acid, filtered, and when dried should yield crystals of lead nitrate. In solution lead salts give with hydrochloric acid a white crystalline precipitate ($Pb\ Cl_2$) freely soluble in caustic potash; with hydrogen sulphide and ammonium hydrosulphide, the black hydrated sulphide $Pb\ S, H_2\ O$; with sulphuric acid and soluble sulphates, the white sulphate, freely soluble in ammonia acetate solution; with potassium

iodide and bichromate, bright gamboge-yellow precipitates of iodide and chromate.

Lead usually enters the bodies of the lower animals in their food or water, or in minute particles licked or picked from paint or portions of lead left in the animal's way. The poison is sometimes brought to the farm in street manure. Water is liable to contamination by conveyance through leaden pipes, or long keeping in faulty leaden cisterns. The hounds at the Royal Kennels at Ascot some years ago 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 one grain to the gallon. Sir Robert Christison stated that any amount beyond one grain in fifteen gallons is dangerous. On lead pipes or vessels the conjoined action of air and moisture is apt to produce a crust of hydrated oxycarbonate, which 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 holding, especially for any length of time, water 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 occasionally, especially when new.

In acute poisoning an emetic or the stomach-pump should be promptly used. The most convenient chemical antidote is diluted sulphuric acid or a soluble sulphate which converts the lead salt into the insoluble white sulphate. Potassium iodide, besides producing an insoluble salt, also hastens elimination

by the kidneys. These antidotes should be given dissolved in such diluents as milk, mucilage, or egg, which have the further advantage of forming insoluble albuminates with the lead salts. The torpid bowels should be opened by saline purgatives, nothing being better than magnesium sulphate. Pilocarpine and amyl nitrite antagonise the arterial tension of chronic cases. Where there is much pain, opium is prescribed; and in all cases good feeding and tonics are necessary to perfect a cure.

LEAD OXIDES. Plumbi Oxidi. Litharge. Red Lead.
LEAD CARBONATE. Plumbi Carbonas. White Lead. Ceruse.

Melted lead exposed to a current of air oxidises, forming a yellow, semi-crystalline powder called massicot (Pb_2 O). This, when fused at a red heat, acquires a foliaceous or scaly structure, a variable grey or yellow-red colour, and is known as litharge (Pb O). At higher temperatures litharge is further oxidised, and produces red lead or minium, one of the varieties having the formula 2 Pb O, Pb O_2. Nitric acid breaks up this complex oxide, leaving undissolved the puce-coloured insoluble peroxide Pb O_2. White lead, so extensively used in the arts, is a soft heavy powder, intermediate between carbonate and hydrate (2 Pb CO_3, Pb O, H_2 O), and is usually prepared by exposing for several weeks coils of lead in pots, wetted with crude acetic acid, and exposed besides to the action of carbonic acid, evolved from spent tan, stable manure, or other decaying organic matters ranged round the coils.

Actions and Uses.—Litharge and white lead are irritant, desiccant, and astringent; frequently repeated doses exert the constitutional effects of lead compounds; their liability to become absorbed induces a preference for the harmless zinc oxide and carbonate. Mixed with linseed oil, glycerine, or vaseline, they are, moreover, less liable to absorption, and form a useful, protecting, antiseptic coating, successfully used in the treatment of burns, herpes, and moist eczema. Litharge decolorises most coloured vegetable fluids with which it is shaken.

LEAD OLEATE. Lead Plaster. Emplastrum Lithargi vel Plumbi.

The common sticking or diachylon plaster is thus directed to be prepared: Boil together gently, by the heat of a steam bath, 4 pounds of litharge in fine powder, one gallon olive oil, $3\frac{1}{2}$ pints of water, and keep simmering for four or five hours, stirring constantly until the product acquires a proper consistence for a plaster, adding more water if necessary. (*Brit. Phar.*) In this process the fatty matter, which is an oleate of glycerine, undergoes a change similar to that occurring in soap-making; its oleic acid unites with the lead, forming lead oleate ($Pb\ 2\ C_{18}\ H_{33}\ O_2$); its sweet basic principle, glycerine, remains in solution (p. 363). 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, nor in this form is the lead liable to absorption. For bringing together the edges of wounds it is generally used spread on linen or calico, when the strapping besides affords protection, healthful pressure, and support, with uniformity of temperature, and a certain amount of stimulation. 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. $Pb\ I_2$.

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; has been prescribed as a gland stimulant in tuberculosis, and applied externally in indolent tumours in the form of ointment or plaster.

LEAD ACETATE. Plumbi Acetas. Sugar of Lead. Neutral Acetate. Pb 2 $C_2H_3O_2$, 3 H_2O.

LEAD SUBACETATE. Plumbi Subacetas. Lead Oxyacetate. Goulard's Extract. Pb 2 C_2 H_3 O_2, 2 Pb O, H_2O.

Of the four acetates, only two are of medicinal value,—the neutral acetate, or sugar of lead; and the subacetate, which occurs in Goulard's Extract.

Sugar of lead is obtained by dissolving litharge in acetic acid; or commonly, on the large scale, by immersing sheets of lead in dilute acetic acid, scraping off the crust of subacetate and subcarbonate which accumulates, dissolving 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°, and in solution unites with different proportions of the oxides, forming subsalts. The officinal liquor plumbi subacetatis, in imitation of Goulard's Extract, is prepared by boiling 5 ounces of acetate of lead, and 3½ ounces of oxide of lead, in a pint of water, for half an hour, constantly stirring, filtering, and, when cold, adding more distilled water, until the product measures twenty fluid ounces. Preserve in stoppered bottles. (*Brit. Phar.*) It is a colourless, transparent, alkaline liquid, has a sweet astringent taste, and 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 is passed through it, and by its producing an opaque white jelly when mixed with gum arabic mucilage.

Actions and Uses.—Like other soluble lead salts, the acetates, in excessive doses, cause gastric irritation, often with convulsions and other evidences of nervous derangement. Continued repeated doses develop the special symptoms of plumbism (p. 411). Medicinal doses are astringent, styptic, and antiseptic; they lower slightly the action of the heart; and they check the escape of albuminoids in the urine, in which they are mainly excreted. Externally they are astringent, styptic, and sedative. On skin-abraded or mucous surfaces

they combine with albumen, leaving a protecting covering. They diminish the calibre of capillary vessels, and thus exert a so-called sedative effect. The several lead acetates are less corrosive and astringent, but more soothing, than zinc or copper acetates. The greater solubility of the subacetates renders them more active than the neutral acetate, and preferable especially for external applications, on account of their not drying up 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 ofter the poison had been given. Early in 1857 a farmer near Glasgow lost eight cows from their boiled food having been prepared in a large tub obtained from a chemical manufactory, and impregnated with sugar of lead. The symptoms were similar to those above recorded. Half an ounce administered to dogs, and retained in the stomach by a ligature round the œsophagus, produced intense intestinal irritation, and death 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. In purpura in horses and red-water in cattle it sometimes stays bleeding and wasteful excretion of albumen in the urine. It dries up abnormal discharges. Half-drachm doses 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. It is used to check superficial circumscribed inflammation; to soothe and heal burns, bruises, and irritable moist ulcers; to cool and relieve strained, inflamed tendons and joints, to abate the itching of nettle rash; in conjunction with a dose of physic, to remove the vesicles and irritation and heal the excoriations of herpes circinnatus; to limit the surrounding inflammation and pimples of acne; to arrest irritation and discharge in the moist stages of eczema, in such cases being advantageously alternated with sulphur or citrine ointments, alkalies, or yellow wash. For eye cases it is unsuitable, as the lead albuminate is apt to form a film over the cornea.

Doses, etc.—Of the lead acetates, horses and cattle take ʒ i.; calves and sheep, grs. xv. to grs. xx.; pigs, grs. vi. to grs. xij.; dogs, grs. ij. to grs. vj., given in bolus or solution, repeated once or twice a day. Cumulative and constitutional effects must be guarded against, and the medicine withdrawn whenever the appetite becomes impaired, the gums discoloured, or the bowels constipated or cramped. For external application, sugar of lead is used in powder, as an ointment, or more commonly dissolved in forty or fifty parts of water, with a little vinegar, to increase its solubility. The Pharmacopœia Goulard's Extract, diluted with four parts of linseed or olive oil, is recommended as a cooling application for blistered or contused surfaces (Morton). An equally serviceable astringent and anodyne is made with one part of extract to four or five of vaseline. Equal parts of extract and spirit, diluted with eight or ten parts of water, make a useful refrigerant astringent. Equal quantities of lead acetate and zinc sulphate, dissolved in thirty or forty parts of water, constitute the familiar white lotion of veterinary practice, and, although the preparation is not chemically a correct one, every-day experience proves it to be a valuable astringent, sedative, and antiseptic.

LINSEED.

Linseed Oil. Oleum Lini. The oil expressed from linseed without heat.

Linseed Meal. Farina Lini. The cake of linseed, from which the oil has been pressed, reduced to powder. (*Brit. Phar.*)

Nat. Ord.—Linaceæ. *Sex. Syst.*—Pentandria Pentagynia.

The Linum usitatissimum, or common flax, cultivated in Britain and other European countries, yields several important articles of the Materia Medica. 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.

To utilise the fibrous stem, the plant is steeped in water, which is 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 gauzey down, constitutes the familiar surgeon's lint. Both lint and tow, as well as jute, the prepared fibre of hemp, are employed for protecting wounds; and, when saturated with hot or cold water, prove cleanly substitutes for poultices, and, being little liable to be used a second time, are greatly preferable for cleansing of wounds to sponges, which are apt to retain and distribute septic germs. These fibrous materials are now sold in an antiseptic form, saturated with carbolic and boracic acids. Oakum, consisting of detached fibres of old ropes, when treated with Stockholm tar, is used as a cheap antiseptic dressing.

Flax or 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 15 per cent. of althea mucilage or bassorin (C_{12} H_{20} O_{10}), wholly present in the envelope of the seed; and hence only properly extracted by prolonged steeping or slow boiling; 25 of albumen and legumin; a little sugar, 30 of oil contained in the albumen and embryo; 3 of mineral matters, chiefly

phosphates, mostly stored in the husk, and about 9 of water. The seeds ground and pressed without the aid of heat produce about 20 per cent. of oil of the best quality; steam heat of 200° extracts 23 to 27 per cent. of oil of somewhat lower quality; 10 to 13 per cent. of oil remains in the residual linseed-cake or oil-cake.

Linseed oil, carefully prepared from tolerably sound seed, has a pale yellow colour, a mild but nauseous taste, and a specific gravity of about ·902. It remains liquid at 0°. Exposed to the air it speedily becomes rancid; but a thin stratum quickly dries up, forming a hard transparent varnish, hence its extensive use in the arts as a drying oil. This oxidation and drying property is greatly increased when the oil is boiled either alone or with lead oxide. It is insoluble in water, soluble in five times its weight of boiling alcohol, in forty parts of cold alcohol, and one and a half of ether. Boiled with alkaline solutions, it forms soaps; and is resolved into glycerine and linoleic acid (C_{16} H_{26} O_2: Mülder) associated with small amounts of oleic, palmitic, stearic, and myristic acids. Exposed in the air linoleic acid is converted into a colourless resinoid substance. Mixed with an equal quantity of lime water, it forms carron oil, once much used 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 printer's ink. It is sometimes adulterated with rapeseed oil; but is more commonly of inferior quality from rancidity, from preparation at high temperatures, or from presence of impurities.

Actions and Uses.—Linseed and linseed cakes are valuable feeding stuffs; they are palatable, digestible, and nutritive. As producers of fat, such oleaginous substances are generally regarded as two and a half times more effective than starch or sugar. Their digestion is aided by the pancreatic and biliary fluids; they constitute the molecular basis of chyle; they are absorbed mainly by the lacteals; are essential to the repair and growth of every tissue; and their combustion develops heat and force. In moderate amount they favour assimilation alike of the starchy and nitrogenous food with which they are given. Well-boiled linseed gruel, or bruised linseed cake

digested in hot water, is a most valuable nutrient for horses, cattle, and sheep, not only during health, but also during the progress of acute disease, in tuberculosis, rheumatism, chronic skin complaints, and during convalescence from reducing disorders. In all such cases it proves both food and medicine. Horses that are bad grubbers, have harsh scurfy skins, or are affected with roaring or thick wind, are usually much benefited, especially if 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. A daily 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, anæmia, and even black-quarter. In the state of gruel or decoction, linseed is in everyday use as a mucilaginous demulcent 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 flour, made into a paste with water, forms a good luting for distilling apparatus.

Linseed oil has been highly lauded 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. As a nutrient and restorative, 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; it is scarcely so actively cathartic as castor oil. Bland and unirritating, it is a valuable laxative in influenza in horses, in other debilitating disorders, in diarrhœa, hernia, and irritable states of the intestine, in overloaded torpid bowels, where reiterated purgative doses have to be used and where aloes repeated would prove too irritating. In these troublesome cases, two or three doses at intervals of a day are supplemented by two ounce doses of Epsom salt repeated two or three times daily. The salt contributes its special outpouring of fluid, thus softening dry impactions and moving them onwards. This conjoined use of oil and Epsom salt with frequent large clysters safely overcomes these attacks of overloaded bowels, without the nausea and superpurgation which are apt to follow more active treatment. In warding off attacks of weed, azoturia, or fulness and itching of the limbs, a dose of oil is often serviceable when hard-worked horses are to have more than one day's rest. It produces full evacuations without the nausea or griping which attend the action of many other cathartics, while large and repeated doses are given with small risk of dangerous superpurgation. In colic it is usually combined with stimulants and anodynes. One of the colic draughts of the Edinburgh Veterinary College consists of one pint of linseed oil with one or two ounces each of laudanum and oil of turpentine.

In cattle and canine practice linseed oil is much used as a purgative, especially for young and delicate 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 when exhausting disease has reduced strength, linseed oil is a very suitable laxative, and is more effectual when given with an equal amount of castor oil. On account of its lubricant and emollient properties, 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. As a permanent soothing dressing for hard, dry, irritable surfaces, its drying and liability to rancidity render it, however, less suitable than vaseline or than benzoated almond or cocoa nut oils. These shortcomings are, however, partially obviated by admixture with about one-fourth of lead acetate solution, which, moreover, increases emollient and soothing effects. The drying properties of linseed oil, possessed in common with poppy, walnut, and cod-liver oils, render it less suitable than olive, almond, rape, or colza oils, or than lard, for making ointments or liniments. The "black oil" so extensively used empirically throughout England for bruises, strains, and wounds, is usually 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, etc.—As a cathartic, horses take Oss. to Oj.; cattle, Oi. to Oij.; sheep and pigs, f℥vj. to f℥viij.; dogs, f℥i. to f℥ij.; cats, f℥i.; 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 large well-made bran mash.

LIQUORICE ROOT.

Glycyrrhizæ Radix. The root, or underground stem, fresh and dried, of Glycyrrhiza glabra, cultivated in England. (*Brit. Phar.*)

Nat. Ord.—Leguminosæ. *Sex. Syst.*—Diadelphia Decandria.

Liquorice grows in most countries of continental Europe, thriving on dry, light, sandy soils. The best qualities are grown in England, or imported from Spain and Italy. The perennial herbaceous plants vary from two to four feet in height, and have large, irregular, yellow-green leaves; papilionaceous, pale-blue flowers; and long, creeping, fibro-fleshy, branched, perennial roots, or underground stems, which are smooth, brown, cylindrical, and about the thickness of the thumb, arrive at perfection about the third year, have a peculiar

sweet and somewhat sickly taste, and constitute the officinal part of the plant. To preserve them from moisture, they are generally kept in sand. The powder has a yellow colour, a sweet taste, and is soluble in water, and to a less extent in alcohol. Besides ordinary vegetable constituents, it contains asparagin and mallic acid, a resinous oil, to which it owes its sub-acrid taste, and about 6 per cent. of a sweet, yellow, uncrystallisable sugar, termed glycyrrhizin (C_{16} H_{24} O_6). The natural juice or watery infusion, concentrated until it becomes solid, forms the well-known extract of liquorice or black sugar.

Actions and Uses.—Liquorice resembles sugar in its dietetic and medicinal uses. It is serviceable as a demulcent and emollient, in irritation of the pulmonary mucous membrane in man. It is largely used in the manufacture of tobacco, for making up boluses, and covering the disagreeable taste and odour of various drugs; but in veterinary practice is generally superseded by treacle.

MAGNESIUM AND ITS MEDICINAL COMPOUNDS.

Magnesium Oxide. Magnesia. Calcined Magnesia. Mg O.

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. Its density varies according to the temperature at which it is prepared; the light or magnesia levis of the Pharmacopœia is produced at the lower temperatures, and from the light carbonate, and is three and a half times the bulk of the heavy. It is sometimes impure from presence of lime, silica, or magnesium carbonate. Magnesian salts give negative results with hydrogen sulphide and ammonium hydro-sulphide. Like other salts of the alkaline earths, they produce with potassium carbonate a white precipitate of carbonates, which, unlike the carbonate of calcium or of barium, is soluble in ammonium chloride solution. This

depends upon the tendency of magnesium to form double salts with the alkalies. It is, however, precipitated by phosphate of soda even in presence of ammonia salt.

Actions and Uses.—Magnesia is antacid, a topical sedative, and a laxative. Both oxide and carbonate are absorbed only in small amount, chiefly as chlorides; the large proportion of ordinary doses is excreted unchanged by the intestines. As an antacid, magnesia is distinguished by its saturating a large amount of acid, by its laxative effects, and by its insolubility and consequent harmlessness even when given in excess. It resembles potash, soda, and their carbonates, but lacks their diffusive, solvent, and diuretic properties. Its laxative effect and absence of causticity distinguish it from lime. It is not sufficiently active to purge either horses or cattle; it is a gentle laxative for dogs and cats; and is occasionally prescribed with calomel, jalap, or buckthorn. Its laxative effects are increased when the bowels contain acid secretions. For foals and calves troubled with 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 concrete 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, etc.—Foals and calves, three or four months old, take, as an antacid, ℥ii. to ℥i.; dogs and cats, ℥ss. to ℥i. It is given suspended in milk or gruel, and conjoined with carminatives.

Magnesium Carbonate. Magnesia alba.

$3\,MgCO_3, MgO, H_2O, 3\,H_2O.$

When sodium carbonate is mixed with bittern or with a solution of magnesium sulphate, double decomposition ensues, and the precipitated magnesium carbonate, with a little magnesium hydrate, is collected, washed, and dried. The solutions tolerably concentrated and mixed without heat yield a heavy, when diluted and boiled they produce a light, carbonate. The

former is dense, loose, and granular; the latter lighter and 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 13 grains of carbonate dissolved in water charged with carbonic acid gas.

The action, uses, and doses of the carbonates are similar to those of the oxides. In contact with the acid gastric juice, carbonic anhydride is evolved. If not in undue amount, it exerts a topical sedative effect, while the resulting salt in part undergoes absorption, and the absorbed and unabsorbed portions alike provoke intestinal secretion.

Magnesium Sulphate. Magnesiæ Sulphas. Epsom Salt.

$Mg\,SO_4,\,7\,H_2O$.

This important magnesium salt is found in various rocks and soils, in sea-water in the proportion of 15 to 20 grains in the pint, and in some mineral springs. From its presence in the mineral streams of Epsom, it derives its vernacular name.

Preparation.—It is generally prepared from magnesite, the native carbonate, by saturating it with sulphuric acid, and crystallising; from magnesian limestone, or dolomite, or from bittern, the oily-looking liquid left when sea-water is concentrated for the separation of common salt. Magnesian limestone, a double carbonate of calcium and magnesium, is calcined to expel water and carbonic acid; the caustic lime and magnesia, so formed, are slaked with water; hydrochloric acid is added in sufficient quantity to convert the lime into calcium chloride, which is separated in solution, leaving the insoluble magnesia, which is treated with sulphuric acid, and the magnesium sulphate thus produced is crystallised out. Bittern, when concentrated, yields an abundant crop of crystals of magnesium sulphate, and still larger quantities are obtainable by first adding sulphuric acid to convert the chloride and other salts into sulphate. These two processes are sometimes conjoined, the calcined dolomite being added to the bittern, the

mixture heated with diluted sulphuric acid, and the solution concentrated until crystals separate on cooling.

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. In solution it gives with barium chloride a copious white precipitate of barium sulphate; and with a mixed solution of ammonia, ammonium chloride, and sodium phosphate throws down the white magnesium ammonium phosphate. Its aqueous solution at ordinary temperatures is not precipitated by ammonium oxalate (showing absence of lime), nor should it give a brown precipitate with chlorinated lime or soda (testifying absence of iron and manganese). (*Brit Phar.*) It is isomorphous with zinc sulphate, from which it is readily 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 effloresing 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 easily 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. It closely resembles common and Glauber salts, and is a more active cathartic than potassium bitartrate or sodium phosphate.

General Actions.—It has a low diffusion power; passes slowly through animal membranes; in the bowels it retards absorption, not only of the fluid with which it is administered, but of that which it encounters in its progress, and, moreover, stimulates the intestinal glandular apparatus, causing further outpouring of fluid, and accounting for the characteristic fluid dejections. It has less effect than aloes or croton in increasing peristalsis. Only a fractional portion, even of full doses,

appear to be absorbed from the stomach and duodenum. In the blood it is stated to diminish the cohesive tendency of the red corpuscles, to remove fibrin, and retard coagulation (Dr. Harley, Royle's *Mat. Med.*, sixth edition). Along with serum and fibrin the salt absorbed is shortly excreted into the large bowels, adding to the stimulation exerted by the unabsorbed portions. The operation of Epsom salt has been admirably illustrated by Dr. Lauder Brunton (*The Practitioner*, May and June 1874), who 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 was 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 copious secretion, but none so abundant as Epsom salt, which yielded 42 to 56 minims per square inch of intestine acted on by the purgative. This free secretion and osmosis from the intestinal walls is the chief specialty of Epsom salt, adapts it for softening dry hard fæces, a result often safely effected by small, freely diluted, repeated doses, secures the free washing out of the alimentary canal, whilst the removal of so much fluid and dissolved fibrin further develops marked febrifuge effects.

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. Like other

salines, large doses are uncertain and sometimes violent cathartics for horses, often act unexpectedly on the kidneys, but repeated doses of two or three ounces are alterative and febrifuge. On dogs the purgative effect is irregular, and often accompanied by vomiting. For cattle and sheep it is a convenient and effectual cathartic, equalled only by common salt in rapidity and fulness of action. On cattle, full doses generally take effect in twelve or fifteen hours, and induce copious fluid evacuations. Besides causing purgation, it diminishes blood-pressure and abates fever; whilst moderate, frequently repeated doses, in all animals, augment the secretions of the skin and kidneys.

Medicinal Uses.—To ruminating animals it is given for all the ordinary purposes of a purgative. In indigestion, constipation, and the earlier stages of diarrhœa, it clears the bowels of undigested fermenting food, of irritant matters, the result of retrograde tissue metamorphosis, and occasionally of worms. In overloading of the bowels, which occurs in horses fed especially on cut dry food, in conjunction with one or two doses of linseed oil and copious clysters, two ounces Epsom salt are repeated twice daily, and greatly help safely to soften and expel the dry impacted intestinal contents. Emptying the bowels and removing excrementitious products from the blood, it lowers temperature and relieves febrile and inflammatory affections. Although not so irritant as some other cathartics, it exerts on the intestinal surfaces a certain amount of counter-irritation which proves beneficial in inflammation of the brain, eye, and most organs, except the intestines. 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, lower blood-pressure and excessive temperature, 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 in convalescence from acute disorders, with powdered gentian and other carminatives. Epsom salt is one of the best antidotes for poisoning by salts of lead or 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, etc.—As a cathartic, adult cattle take lbj. to lbij.; calves of two to three months, ℥iij. or ℥iv.; sheep and pigs, ℥iv. to ℥vi.; dogs, ℥ii. to ℥iv. One-fourth or one-sixth 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 nauseously 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. Where prompt and full purgation is desired in cattle or sheep, equal weight of Epsom and common salt is preferable to either given alone; a like quantity of treacle and a full dose of ginger are added, and solution 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. *Sex. Syst.*—Monadelphia Polyandria.

The plants of the natural family Malvaceæ are rich in mucilage, and most of them yield tenacious fibres, from which cordage is obtained. The seeds of the several species Gossypium are surrounded by delicate, flattened, twisted hairs, which constitute raw cotton. The marsh mallow grows both in this country and on the Continent, generally in the neighbourhood of rivers and salt marshes. The flowers, stem, and leaves yield mucilage, but in lesser proportion than the biennial root of the cultivated plant, which is sold in light-coloured, fibrous, cylindrical pieces, six to eight inches long, and about an inch in circumference. Its sweet taste depends on the presence of uncrystallisable sugar; it further contains pectin, twenty-five to thirty per cent. of starch, about twenty-five of bassorin (C_{12} H_{20} O_{10}) identical with that of linseed, one to two of asparagin, and traces of a fatty oil.

Actions and Uses.—The common and marsh mallow roots are employed both internally and externally for the several purposes of demulcents and emollients; nearly resemble linseed; a decoction is used for drenches and poultices, and the mucilage is an excipient for boluses and emulsions.

MERCURY AND ITS MEDICINAL COMPOUNDS.

Mercury. Hydrargyrum. Quicksilver. Hg.

From its mobility and volatility, this metal is aptly named after the messenger of the gods; to its silvery appearance it owes its synonyme 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, chiefly obtained from Idria in Carniola, and Almaden in Spain, from Peru, California, and latterly from China and Japan. When the ore is roasted or heated with iron or lime, sulphur is got

rid of, and mercury distils over, and is exported in cylindrical wrought-iron bottles, holding from 60 to 112 lbs.

Mercury is easily distinguished by its mobility, liquidity, and silver-white lustre. It is tasteless and odourless; freezes at -40°, forming octahedral crystals; slowly volatilises at all temperatures; and boils at 662°, 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 readily over a sheet of white paper without losing their spherical shape, or leaving a stain. It readily 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 compounds are distinguishable by the following tests:—(*a*) Slightly heated in a quarter-inch test-tube with dry sodium carbonate, they undergo decomposition, their metallic portion volatilising, and condensing in the cool part of the tube in minute metallic globules. (*b*) 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. (*c*) When a drop of a solution of a mercury salt is placed upon a sovereign, and a key or other piece of iron applied so as to touch at the same time the gold and the solution, a current of electricity is evolved, which decomposes the salt and precipitates its mercury on the gold as a dark-grey stain, easily removable by heat. (*d*) In solution, a mercurous salt produces with hydrochloric acid a white precipitate. Silver and lead have similar white insoluble chlorides; and the three are distinguished by their behaviour with solution of ammonia, which blackens the mercurous chloride, dissolves the silver chloride, but leaves the lead chloride unaltered. (*e*) Hydrogen sulphide and ammonia hydro-sulphide give a black sulphide, insoluble in nitric acid.

There are numerous confirmatory tests. (*f*) Alkalies and lime-water with mercurous salts yield grey or black precipitates of the lower oxide; with mercuric salts, the yellow, red, or higher oxide. (*g*) Potassium iodide, added to mercurous solutions, gives the green unstable mercurous iodide; added to mercuric solutions, it gives the red or scarlet mercuric iodide, which is soluble in excess either of the mercury or potassium salt.

Actions and Uses.—Mercury, so long as it remains uncombined, like other metals, is devoid of physiological action. Several pounds, given to human patients for the purpose of removing obstruction of the bowels, exerted only mechanical effects. In a state of fine division it is, however, readily oxidised and dissolved, and thus acquires activity. In this way mercurial vapours speedily become poisonous, and exert their effects on water-gilders, barometer, thermometer, and looking-glass makers, who work with the metal. The volatility and poisonous action of mercury were seriously illustrated in the case of the "Triumph" man-of-war and "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 the whole of the crews became more or less affected. In the space of 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). Out of 516 workmen variously 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 pervades the atmosphere, that cows feeding in the neighbourhood of the furnaces suffer from excessive secretion of saliva, become unthrifty, and abort; the calves are also often ailing; while trout in adjacent reservoirs, contaminated by the waste products of the furnaces, lose their red spots and become sickly.

With the exception of the sulphides, which, according to Orfila, are inert, all mercurials are absorbed from the mucous or skin surfaces or from areolar textures; they enter the blood; remain there probably as albuminates; are determined to the liver, kidneys, and lymphatic glands, in which, after small

repeated doses, analysis discovers them in largest amount. Riedour has recovered four-fifths of ten grains of calomel given daily to dogs, the large proportion from the fæces. The effects of mercurials greatly vary with dosage and susceptibility of the patient. Small doses increase the number of the red globules, check inordinate secretion, are alterative and stimulant, aid in constructive metamorphosis and add to the body weight. Single large or repeated full doses diminish both red and white globules, increase secretion, cause destructive metamorphosis, and diminish body weight. Repeated doses, or occasionally even one full dose, produce the specific condition of mercurialism. Mercurials are excreted by the mucous and glandular surfaces, notably by the bowels and kidneys, increasing their activity. The nitrates, red iodide, and higher chloride, better known as corrosive sublimate, are powerfully irritant and corrosive. The higher per, or mercuric salts, are more active and corrosive than the corresponding lower, or mercurous. The most convenient alteratives and cathartics are calomel, grey powder, and blue pill. Mercury salts in repeated full doses resemble arsenic, antimonials, and iodine in increasing waste, but their effects are more slowly produced and rather more permanent, and they act on lymphatic glands rather than on the skin and mucous membranes.

Mercurials produce a specific condition called mercurialism, of which the symptoms are tolerably uniform in all animals. Secretion and excretion are increased. The abundant flow of saliva, so notable in man, is not observed to the same extent amongst the lower animals; large quantities of fæces are passed, containing much mucus; the functions of the kidneys and skin are exalted. Mr. Percivall and Professor Williams describe a form of eczema resembling red mange, and occurring especially in cattle and dogs (*Principles of Veterinary Surgery*); the mouth becomes tender, the gums red, soft, and swollen, the breath fœtid; the pulse usually somewhat accelerated. There is impaired appetite, with nausea, gradual loss of condition, and general weakness. In man, there results a peculiar tremor passing into paralysis, depending upon irritation and subsequent paresis of motor centres (Dr. Harley). The blood forms a soft friable clot, loses in man one-third of its fibrin,

one-seventh of its albumen, one-sixth of its globules, and is loaded with a fœtid oil. Such altered conditions of the blood tend to various serious disorders. Professor Williams, in his *Principles and Practice of Veterinary Surgery*, gives woodcuts of cancerous deposits found in the shafts of the long bones of a dog which had been in the habit of lapping vermilion paint. Although single moderate doses are generally got rid of within twenty-four hours, full repeated doses are much longer retained. In rabbits which received a single dose of corrosive sublimate, the poison was detected in half an hour in all the tissues, and continued to be excreted during four days. Mercury is stated to have been detected in the urine of man four weeks after its administration ceased (Schneider). Years after its use, globules have been found in the cancellous structure of the bones. It gets into the milk of nursing females, and Gasparin has seen lambs die from mercurialism when the ewes have been freely dressed with ointment.

Mercurialism is producible in any of the lower animals, but with most difficulty in horses, different individuals manifesting, however, various degrees of susceptibility. Thus 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 "cudded" his hay; whilst 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, and by blood-letting, nauseating medicines, or other means which diminish vascular tension and favour absorption. For curative purposes, production of mercurialism is, however, undesirable in veterinary patients. Control of gastro-intestinal irritation, cutting short inflammation, checking exudation, repression of scaly skin complaints, absorption of glandular enlargements—the chief benefits which were wont to be ascribed to the full action of mercurials—are more safely and effectually attained by small doses inadequate

to induce mercurialism, often indeed by the use of salines and other remedies. Whilst mercurialism continues, the patient must be carefully protected from cold and wet. When it is to be arrested, administration of the mercurial must be suspended, a saline purge exhibited, the mouth, if sore, repeatedly washed with solution of chlorinated lime or alum, and removal of chronic effects hastened by sulphurous fumigation or baths, potassium iodide, and small doses of opium. In poisoning by active irritant mercurials, the antidotes are salts of gold, zinc, or iron, liberal repeated doses of albumen, and administration of sulphur, especially in the form of hydrogen sulphide.

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 prepares it in the following manner:—The materials, consisting of equal weights of mercury and hog's lard, to which the Pharmacopœia directs the addition of one-sixteenth part of suet, "are kept in the fluid state by a temperature of about 100°, and are driven round with rapidity in a circular trough by two spherical iron balls, which are propelled by means of a steam-engine; and in this way extinction is accomplished in the course of twelve hours" (Christison's *Dispensatory*). The process is facilitated by adding to the materials one-sixteenth part of old ointment, or a small quantity of potassium nitrate or sulphate. Quality and purity are estimated by the bluish-grey colour; by the specific gravity, which should be 1·78; by observing, with a magnifying lens of four powers whether the metallic globules are extinguished; or by removing the fatty matters by ether, and weighing the residue. This strong ointment is usually diluted with two or three parts of hog's lard or soft soap. Good mercurial ointment contains about one per cent. of its mercury in the state of oxide, and infriction and exposure during application increase this more active oxidised portion, which is dissolved by the salts and fatty acids of the perspiration.

Actions and Uses.—Mercurial ointment, when merely laid

on the surface of the skin, exerts slight topical effect, and gradually becomes absorbed. When applied with smart friction, it irritates and vesicates, is promptly absorbed, and, in considerable amount, induces marked constitutional results. It is used in the several domesticated animals as a stimulant for indolent sores, ulcers, and chronic swellings. Stimulating the deeper skin textures, it frequently encourages healthier action in psoriasis and other persistent scaly disorders. For the successful treatment of psoriasis and other allied complaints, Professor Williams (*Principles and Practice of Veterinary Surgery*) recommends the internal as well as external use of liquor hydriodatis arsenici et hydragryri, already described, p. 386. For destroying tinea tonsurans and favus, and killing lice and other skin parasites, it is not superior to many milder and safer remedies. For such cases, it is generally applied in conjunction with tar, sulphur, or iodine. Mercurial ointments are apt to be used too freely and indiscriminately. Professor John Gamgee states that a druggist in Boston, Lincolnshire, sold in one year 25 tons of mercurial ointment, mostly to farmers. Besides undue irritant effects, if incautiously used, it is apt to become absorbed. I have repeatedly known both cattle and sheep dressed for skin complaints waste and die from mercurial poisoning. 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 the heads drooping to the ground (Taylor on *Poisons*). The ready absorption of the ointment is, however, occasionally usefully exerted in aiding the effects of mercury given internally. Two ounces of the stronger ointment, rubbed daily into the skin of a horse, salivates in four or five days.

Mercurial Liniment. Linimentum Hydrargyri. Mercurial Oleate.

An ounce of ointment, with a fluid ounce each of ammonia solution and camphor liniment, shaken together, constitutes the liniment of the Brit. Phar. Its effects are similar to those of the ointment. Two compound 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.	Creasote,	1 drachm.
Oil of tar,	4 ounces.	Liquor ammoniæ,	2 ounces.
Linseed oil,	4 ounces.	Linseed oil,	6 ounces.

Mr. John Marshall, the eminent surgeon, uses an oleate of mercury, made by heating oleic acid to about 300° with five to twenty per cent. of mercury red oxide. Where irritation and pain are to be combated, a grain of morphine is added during cooling to each drachm of oleate. The morphia, Mr. Marshall urges, "immediately begins to remove pain, allays nervous irritation and consequent vascular turgescence, and thus arrests the progress or persistence of the inflammatory process; whilst the mercury probably promotes the death and degeneration of the morbid products, and so facilitates their subsequent removal by absorption. Unless used in excessive quantity the oleate of mercury does not salivate or produce any marked constitutional disorder." These oleates are useful in synovitis, in articular inflammation, in painful exostosis, garget, and indurations of the udder, and glandular and indolent swellings. Mr. Marshall urges their use in relieving pain and checking morbid action in pleurisy, pneumonia, and pericarditis. They exert not only the superficial effects of a counter-irritant, but, actively diffusible, they penetrate, carrying deeply their stimulant, soothing, or deobstruent actions. An eight to ten per cent. solution of the mercury oleate destroys the fungus of favus, and spores of tinea, and kills lice and their ova, as well as the several parasites causing mange and scab. According to the purpose intended to be served, an occasional considerable dressing is rubbed in, while for its deeper effects the surface is moistened once or twice a day with a limited amount laid on with the finger or with a brush.

Mercurial Plaster. Emplastrum Hydrargyri.

The Brit. Phar. orders its preparation as follows :—"Heat one fluid drachm of olive oil with eight grains of sulphur, gradually added until they unite. With this triturate three

ounces of mercury until globules are no longer visible; then add six ounces of lead-plaster, previously liquefied, and mix thoroughly." This plaster is occasionally used as a stimulant for glandular and chronic enlargements, windgalls, and other bursal swellings.

MERCURY WITH CHALK OR MAGNESIA. Hydrargyrum cum Creta vel Magnesia. Grey Powder.

These mixtures are made by triturating together an ounce by weight of mercury with two ounces of chalk or magnesia until globules disappear, and a uniform grey colour is acquired. The mercury with chalk or grey powder should be free from grittiness, insoluble in water, its chalk soluble in hydrochloric acid, leaving the mercury in a finely-divided state. Both preparations are laxative, alterative, and antacid. I frequently give grey powder with good effect to young calves and foals suffering from persistent indigestion and diarrhœa, in doses of five to fifteen grains, repeated several times a day, conveniently placed on the patient's tongue, or administered with a drachm of ginger, either in spirits and water, milk, or a little gruel. Eight or ten doses may usually be given, but the medicine must be withheld before any constitutional effects are produced. To allay gastric irritation, and as an alterative for dogs, one to three grains are prescribed three or four 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.

MERCURIAL OR BLUE PILLS. Pilula Hydrargyri.

These pills, so much used in human medicine, are seldom employed in veterinary practice. They contain two parts by weight of mercury, one of liquorice root, and three of confection of roses. The addition to this of about one part of ferric oxide produces a pill mass prescribed by Mr. Morton as an alterative for horses, in doses of half a drachm to a drachm. Mr. Mayhew recommends, as a purge for a medium-sized dog, five grains blue pill, six grains powdered colchicum, and ten grains colocynth extract. Five grains blue pill and ten grains com-

pound extract of colocynth, flavoured with a few drops of oil of peppermint or of cloves, make a convenient laxative and alterative pill for a large dog, or two or three doses for a smaller. The activity of mercurial pills depends mainly upon their containing a small proportion of oxide which is dissolved by the hydrochloric acid of the gastric juice.

MERCURY BLACK OXIDE. Hydrargyri Suboxidum. Mercurous Oxide. $Hg_2 O$.

The black, grey, or lower oxide is prepared by decomposing calomel (Hg Cl) with a solution of an alkali or an alkaline earth. 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 readily decomposes on exposure to light. It is less active than the higher or red oxide; and is chiefly used as a stimulant for unhealthy sores and ulcers, in the form of the black wash—the *lotio hydrargyri nigra* of the Pharmacopœia—made by mixing thirty grains calomel with ten fluid ounces lime-water.

MERCURY RED OXIDE. Hydrargyri Oxidum Rubrum. Mercuric Oxide. Red Precipitate. Hg O.

The red, yellow, or higher oxide is prepared by decomposing corrosive sublimate with lime-water, or by heating mercuric nitrate until acid fumes cease to be evolved. Prepared by the precipitation process, it occurs in a finely divided state, has a yellow or brown colour, and constitutes the yellow wash of surgery. This *lotio hydrargyri flava* of the Pharmacopœia is made by mixing eighteen grains corrosive sublimate with ten fluid ounces lime-water. Prepared by heating the nitrate, it 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. It is devoid of odour, but has a metallic, acrid taste. It is greatly more active than the black oxide, a few grains causing fatal gastro-enteritis when given to dogs. Eight to fifteen grains caused colic in horses, and one or two drachms enteritis and death

(Hertwig). It closely resembles corrosive sublimate, and is applied externally as a stimulant and escharotic for indolent ulcers, over-luxuriant granulations, chronic scaly eruptions, and glandular enlargements, being used in the several forms of powder, lotion, or ointment.

MERCURY SULPHIDE. Hydrargyri Sulphuretum. Hg S.

Cinnabar, a red-brown native sulphide, found in Carniola and Spain, is the most abundant ore of mercury; a black amorphous sulphide is thrown down when hydrogen sulphide is added to any mercury salt; the beautiful bright-scarlet vermilion is a mercuric sulphide, prepared by sublimation; while Ethiops mineral is a heavy black subsulphide, with excess of sulphur. These sulphides are insoluble and nearly inert. Ethiops mineral used to be given to horses as an anthelmintic and specific for glanders, in doses of ʒi. to ʒiij. It has now, however, deservedly fallen into discredit.

MERCURY SULPHATE. Hydrargyri Sulphas. Turbith or Turpeth Mineral.

The four sulphates possess little veterinary interest. The insoluble yellow turpeth mineral ($Hg\ SO_4$, $2Hg\ O$) is prepared by triturating and washing the higher sulphate with boiling water. Half a drachm to a drachm poisons dogs; smaller doses are emetic. It is an active irritant, and errhine, was formerly prescribed for glanders and farcy, but is now superseded by safer and more certain remedies.

MERCURY CHLORIDE. Mercury Sub or Lower Chloride. Hydrargyri Subchloridum. Mercurous Chloride. Calomel. Hg Cl.

Calomel is found native in Carniola and Spain, but in too small amount to be of commercial value. It is obtained either by decomposing a solution of the nitrate with a hot solution of common salt, or by subliming a mixture of the lower sulphate and common salt. The latter process is now usually preferred, and is thus carried out by the instructions of the Brit. Phar.:—

"Moisten ten ounces of sulphate of mercury with boiling distilled water, and rub it with seven ounces of mercury until globules are no longer visible; add five ounces dried chloride of sodium, and thoroughly mix the whole by continued trituration. Sublime, by a suitable apparatus, into a chamber of such size that the calomel, instead of adhering to its sides as a crystalline crust, shall fall as fine powder on its floor. Wash this powder with boiling distilled water, until the washings cease to be darkened by a drop of sulphide of ammonium. Finally dry at a heat not exceeding 212°, and preserve in a jar or bottle impervious to light." In this process the triturating of metallic mercury with the sulphate produces a subsulphate; when this is heated with sodium chloride, mutual decomposition occurs, calomel is sublimed sodium sulphate remains. Traces of corrosive sublimate are removed by repeated washing. Thus :—

Mercurous Sulphate. Sodium Chloride. Mercurous Chloride. Sodium Sulphate.

$$Hg_2SO_4 + 2NaCl = 2HgCl + Na_2SO_4$$

Properties.—Sublimed and condensed in receivers, calomel has a fibrous, horny, crystalline structure, a sparkling lustre, and a yellow-white colour, both in powder and mass. Sublimed and condensed in large chambers, it is finely divided, and of a dull white colour. Obtained by precipitation, it is snow-white, but usually contains a trace of metal. It is inodorous, nearly tasteless, insoluble in cold water, alcohol, and ether; but partially decomposed into metallic mercury and corrosive sublimate by boiling water, especially when rich in salts, and by solutions of potash, soda, and lime. At a red heat it volatilises, but at lower temperatures it becomes yellow, regaining, however, its original appearance when cooled. Its specific gravity is 7·2.

Impurities.—Admixture of corrosive sublimate, although occasionally dreaded, rarely occurs. The minutest trace is discovered by testing with hydrogen-sulphide, caustic potash, or lime-water; and is readily dissolved out by agitation with cold water. Sal ammoniac, occasionally present, imparts a saline taste; whilst sublimation leaves as residue any inorganic impurities.

Actions and Uses.—Calomel is irritant, stimulant, alterative, and febrifuge. Large or repeated doses cause mercurialism. It is an emetic for dogs and pigs. It is a stimulant particularly of glands and secreting surfaces. It stimulates the several organs by which it is excreted, and accordingly proves cathartic, diuretic, diaphoretic, sialogogue, and, on account of its stimulating the duodenum, it is an expellant of bile. Applied externally, it is stimulant and desiccant.

General Actions.—Preceding the production either of poisonous or curative actions, calomel is dissolved and absorbed. Professor Tuson, of the Royal Veterinary College, has shown 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, remains unaltered, even after twenty-four hours; but when both pepsin and hydrochloric acid are used, solution speedily occurs, and a black precipitate of mercury sulphide is formed (*Veterinarian*, January 1872). The mucus and fats of the canal, and also the bile, further aid solution of calomel. It is chiefly absorbed as an albuminate. The opinion that it undergoes partial conversion into the higher chloride appears to be disproved by the facts that the chlorides in the canal are insufficient to effect such a change, and the two mercury chlorides are widely different in their actions (*Monthly Journal of Medical Science*, 1851, p. 88).

Toxic Effects.—Irritant effects, usually followed by constitutional effects, although less marked than those of corrosive sublimate or the nitrates, 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 black in dogs. Such doses, especially if repeated daily for three or four days, further induce thin and stinking evacuations, fœtid breath, soreness of the mouth, rapid impairment of the 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 the 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. Three or four grains, given night and morning, salivated large dogs in a week, and killed them in nine days; the only 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 medicine 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 has provoked much controversy and experimental inquiry. The late Professor John Hughes Bennett, and the Committee of the British Medical Association, appointed to investigate the subject, experimenting chiefly on dogs with fistulous openings into the duodenum, 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 18 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 20-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 10, 5, or 2 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 negative results occurred even when calomel was introduced into the intestine, mixed with bile or with hydrochloric acid. These carefully repeated experiments of skilled observers 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 probably also of pancreatic fluid. By reflex action the intestines irritated by the mercurial, propagate stimulant effects to the liver, much in the same way as resinous purgatives, croton, and acid chyme in the duodenum stimulate the liver and contract the gall bladder and hepatic ducts. The increased intestinal action sweeps out bile lodged in the duodenum, as well as in the hepatic ducts, and prevents its reabsorption, while, moreover, it 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 calomel as much used as formerly. Amongst the domestic animals it is still occasionally prescribed to control acute inflammation, especially when affecting membranous and parenchymatous textures, as in pleurisy, common and puerperal peritonitis, laminitis, and iritis. These curative effects appear to result from its stimulating glands and secreting surfaces, promoting excretion of waste or morbid products, and perhaps also to small doses increasing blood globules when these are deficient. In acute febrile and inflammatory cases it is sometimes prescribed after blood-letting or aconite. A few doses are given, at intervals of one or two hours, and usually combined with opium or some other agent which retards its excretion. In enteritis, whether in horses or cattle, the late Mr. Barlow sometimes used half a drachm of calomel, with an ounce of laudanum, in a pint of gruel, repeated every hour until three

or four doses were taken, or until relief, nausea, or collapse occurred. Two or three such doses are sometimes given at the outset of gastric fever in horses, but in such cases the laudanum is probably of more benefit than the calomel. In cases of metritis and peritonitis affecting cows three or four days after calving, a good laxative alterative and sedative consists of half a drachm calomel, two ounces laudanum, one pound castor oil, mixed with hot water and treacle; four doses are given at intervals of two or three hours. As an anthelmintic combined sometimes with santonine, it is useful in removing lumbricoid worms in all patients. Rheumatism, alike in horses and cattle, is occasionally relieved by daily doses of twenty grains each of calomel and quinine sulphate. Dysentery and protracted diarrhœa amongst horses and cattle are frequently benefited, the fever abated, the bowels rendered more regular, by ten grains of calomel, a drachm of opium, and an ounce each of gentian and chalk, made either into bolus or drench, and repeated daily, or as required. A more hazardous practice is sometimes pursued in these cases: large doses of calomel are given, conjoined with opium. Small doses, such as twenty grains for horses or cattle, three to five grains for foals, calves, or sheep, one or three grains for dogs, given either alone or united with chalk or with laxatives, often prove useful in persistent gastric irritation and catarrh, acidity, and bilious diarrhœa, accompanied by pale, noisome, clayey fæces, as well as in surfeit, nettle-rash, and old-standing skin disorders. Half-drachm doses, with two or three drachms of aloes, followed by salines, are prescribed in congested liver in horses. Its presumed cholagogue action has led to calomel being given in jaundice and chronic liver disease, sometimes conjoined with the rubbing of mercurial ointment into the right side, the mercurials being persisted with until constitutional symptoms present themselves. But more precise knowledge of the action of calomel discountenances such treatment, and confirms the teaching of clinical experience, which indicates that jaundice and torpid liver are usually best treated by laxatives and small repeated doses of salines, which sweep away unabsorbed bile, and by nitro-muriatic acid, which acts as a liver stimulant and tonic. Two or three grains of calomel given to dogs or pigs

usually produce both emesis and catharsis; but, unless in combination with tartar emetic, ipecacuan, or mustard, emetic action is neither prompt nor certain.

Calomel has an extended choice of channels of excretion, and, like other irritants, increases the action of the excreting organ. Its cathartic action is best developed by combining it with other purgatives—as in horses, with aloes; in cattle and sheep, with salts or oils; in dogs and pigs, with jalap or oils. In obstinate constipation and torpidity of the bowels, particularly in cattle, calomel is a useful adjunct. Along with catharsis are often induced febrifuge and anthelmintic actions. Diuretic and diaphoretic effects are determined when it is used in combination. Doses sufficient to induce purgation or mercurialism are to be avoided in malignant diseases, erysipelas, typhoid, and asthenic cases, and where the patient is weak.

Applied externally, in solution or ointment, 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. Although of no 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 horse's frog, and for relieving piles in dogs.

Doses, etc.—As an alterative and febrifuge, horses and cattle take grs. x. to ℥i.; sheep and pigs, grs. v. to grs. xxx.; dogs, grs. i. to grs. iij.; given three or four times a day, along with an equal weight of opium, to prevent their passing off too rapidly by the bowels. As a cathartic, calomel is not used alone; the dose is consequently regulated by the amount of other purgatives with which it is combined. A drachm of calomel, with five drachms of aloes, is a full purgative for the horse; one to two drachms, with a pound of Epsom or common salt, a pint of oil, or twenty croton beans, for cattle; three or four grains, with twenty to forty grains of jalap, for the dog. 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, in tepid water. To allay cutaneous irritation, and kill lice and other parasites, an *ointment* is used made with a drachm of calomel to an ounce of lard.

MERCURY PERCHLORIDE. Hydrargyri Perchloridum. Hydrargyrum Corrosivum Sublimatum. Mercuric Chloride. Corrosive Sublimate. $HgCl_2$.

Corrosive sublimate and calomel must be carefully distinguished from each other. Both are chlorides of mercury, but corrosive sublimate contains twice as much chlorine as calomel, is the higher per or mercuric chloride ($HgCl_2$), and is a very soluble and actively corrosive poison; whilst calomel, the lower or mercurous chloride (HgCl), is an insoluble, comparatively mild medicine. By using, whether in speaking or writing, the vernacular names of these two chlorides, risk of mistake is greatly diminished.

Preparation.—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 20 parts of mercury persulphate, and 16 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.

Properties.—It occurs either as a dense white powder of broken crystals, or in white, semi-transparent, brittle, four-sided prisms. It has no odour, but an acrid, disagreeable, metallic taste, and a spec. grav. of 5·4. When heated, it fuses, and rises unchanged as an exceedingly acrid poisonous gas. It is soluble in two parts of alcohol, still less of ether, three of boiling water, and sixteen of cold water. It has an acid reaction on colouring matter, and forms, with albumen and fibrin, flaky precipitates, soluble in solutions 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 (see p. 435). It is not

subject to intentional adulteration. When pure, it is free from colour and moisture, leaves no residue when heated, and is entirely soluble in water.

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 a stimulant, astringent, caustic, and as an antiseptic and parasiticide.

Toxic Effects.—Full doses induce in carnivora vomiting, and in all animals uneasiness, colicky pains, tenderness of the abdomen, evacuation of bloody fæces, a small, wiry, and accelerated pulse, short and difficult breathing, nausea, and prostration of strength, with occasional convulsions;—in short, all the symptoms of acute gastro-enteritis, with nervous depression. Seven or eight grains destroyed dogs in from 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, are tolerated when the poison is given at first 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. Compared with poisoning with arsenic, 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 the chemical action of the poison; where death is postponed for a day, patches of inflammation and sloughing are found; the kidneys and other urinary organs are congested; the lungs spotted with effused blood. The hearts of frogs and other animals destroyed by corrosive sublimate cease to contract very soon after death; and the hearts of frogs suspended in corrosive sublimate solution do not beat so long as when in water (Dr. Harley). Placed underneath the skin, or injected into the veins, the poison, in similar quantities, produces the same symptoms and appearances as when swallowed. Shepherds

and others using strong solutions frequently suffer from its irritant and occasionally from its constitutional effects. Dogs dressed with it for mange occasionally die from gastro-enteritis.

The best antidote is albumen, which forms an insoluble and inert mercury albuminate, and is, besides, useful as a demulcent. It is conveniently given in the form of white of egg. One egg suffices to counteract the effects of four grains of sublimate. When eggs cannot be had, wheat or barley flour, milk, or other albuminoids must be given, followed by astringent solutions. The stomach must be emptied either by emetics or the stomach-pump.

Medicinal Uses.—For internal use, milder mercurials are generally preferred. When swallowed it is formed into an albuminate, but appears to be absorbed chiefly as a double salt of mercury and sodium. It has been prescribed for horses in glanders, farcy, chronic furfuraceous skin eruptions, and thick œdematous legs resulting from repeated attacks of weed. Like other mercurials, it appears to control inflammation and promote absorption of exudate. Half, or even a quarter, of a grain, repeated every two hours, is sometimes useful in arresting the slimy, bloody, reducing discharges of persistent diarrhœa and dysentery in cattle. Professors Rutherford and Vignal found that doses of $\frac{1}{8}$ to $\frac{1}{16}$ grain, although not stimulating the duodenal glands, powerfully excite secretion of bile Conjoined with opium, hemlock, and salines, it has been advised in rheumatism.

As a stimulant, antiseptic, astringent, and caustic, it is applied to wounds of low reparative power, to indolent ulcers, to check purulent discharges or exuberant granulations, to heal fistulæ and foot-rot in sheep. Its notable power of coagulating albumen has led to its use in open joints ; but synovia-coagulants, and other devices for mechanically or chemically plugging such openings, are seldom of permanent effect ; and the rational treatment consists in keeping the limb fixed, and reducing irritation by cold water and antiseptic dressings. For destroying lice and acari, no remedy is more effectual ; besides poisoning the parasites, it also dissolves the albuminous envelope of the nits or eggs, and thus arrests their development. It destroys the cryptogamic growths both of favus and

tinea. In conjunction with fomentations it allays irritation of acne, and hastens removal and healing of sitfasts. Four or five grains, rolled in tissue paper, and introduced deeply into the sinuses of quittor and other fistulæ, in six or eight days sloughs out the fibrous secreting walls.

As an antiseptic, corrosive sublimate stands high. One-thirtieth of a grain wholly arrests the fermentation of twenty-five grains of sugar and one drachm of yeast—a result which it requires two grains of carbolic acid to effect. Some valuable experiments recently made by MM. Arloing Cornevin and Thomas at Lyons on the influence of various disinfectants on the virus of symptomatic anthrax, were reported in the *Lancet* for July 1, 1882. Dry virus was found to be more difficult to destroy than fresh virus. The bacilli or their spores suffer no diminution in activity when slowly dried at a temperature of 95° Fahr.; they retain their powers unimpaired for at least two years. Corrosive sublimate proved their most effectual destroyer. One part in 5000 robs the virus of its specific effects, as evidenced by the negative results of its hypodermic injection. Next in order of efficacy came nitrate of silver (1 part to 1000), salicylic acid of the same strength, and 2 per cent. watery solutions of carbolic acid. But these carbolic solutions, it is stated, require eight hours to destroy fresh virus, and twenty hours to destroy the dry. Sulphate of copper and boracic acid to be effectual required to be used in the proportion of one to five. Of the several antiseptic gases, bromine alone rendered dry virus inert. Vapour of chlorine, sulphide of carbon, saturated solution of oxalic acid, a one in twenty of permanganate of potash, a one in four of soda, although without effect on dry, destroyed fresh virus. Ammonia and its compounds, sulphate of iron and quinine, although stated to kill some bacilli, appeared powerless to destroy those of symptomatic anthrax. Even turpentine, recommended by Pasteur for destroying the bacillus of true anthrax, is not lethal to that of symptomatic anthrax. No effect was produced even on fresh virus by alcohol, although saturated with camphor and carbolic acid; nor by glycerine, chloroform, benzine, tannic acid, common salt, quicklime, or lime-water. These experiments establish the pre-eminent power of corrosive

sublimate in destroying the bacilli of symptomatic anthrax, and demonstrate that sublimate solutions may be effectually used for cleansing and disinfecting infected premises, and for saturating the carcases of anthrax subjects which cannot be burned.

Doses, etc.—Horses and cattle safely take grs. v. to grs. viij.; sheep and pigs, gr. j.; dogs, gr. $\frac{1}{16}$ to gr. $\frac{1}{8}$. It is more safe and certain given freely dissolved in water or other simple fluid. For most external purposes, a *solution* of sufficient strength is made with three to six grains to the ounce of water. An *ointment* of similar strength is used in skin complaints, and for destroying skin parasites. *Ammoniated mercury*, sometimes employed for such cases, is an opaque, white, insoluble powder, made by mixing solutions of corrosive sublimate and ammonia, and washing and drying the precipitate (H_2 N, Hg Cl). Sixty-two grains are made into an ointment with one ounce of simple ointment. To relieve itching, especially amongst dogs, two grains of corrosive sublimate and two minims prussic acid are dissolved in an ounce of water. Such poisonous remedies must, of course, be prescribed and used with great caution.

MERCURY GREEN or LOWER IODIDE. Hydrargyri Iodidum Viride. Mercurous Iodide. Hg I.

MERCURY RED or HIGHER IODIDE. Hydrargyri Iodidum Rubrum. Mercuric Iodide. Hg I_2.

The lower or green iodide, an unstable salt and an unnecessary encumbrance to the Pharmacopœia, is prepared by rubbing together the requisite proportions of iodine and mercury, or by adding solution of potassium iodide to calomel or any mercurous salt. It is not so active as the higher iodide; but a scruple destroyed a rabbit within twenty-four hours, and a drachm a pointer dog in five days (Cogswell).

The per higher or red iodide is usually met with as a bright scarlet, heavy, inodorous, 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. By direction of the British Pharmacopœia, it is prepared by mixing corrosive sublimate and potassium iodide, both in solution, when mutual decomposition ensues; the clear supernatant fluid is decanted away, and the red precipitate washed with distilled water and dried.

Actions and Uses.—The red iodide is as irritant as corrosive sublimate or mercuric nitrate; a scruple, given to a rabbit induced gastro-enteritis and death in twenty-four hours. It is not used internally, but, in the form of ointment is applied as a stimulant, counter-irritant, and caustic. This red ointment is most effectual for condensing and reducing splints, spavins, ring-bones, and other bony deposits. It penetrates deeply, arrests chronic inflammation, and develops healthy action in chronic enlargements and indurations of strained tendons, bursæ, and joints, and is occasionally used as a counter-irritant in sore throat, chronic cough, and roaring, relieving cases that have resisted the more usual blisters. In pleuro-pneumonia, and even pneumonia, in horses, when effusion has occurred, and other irritants are quite ineffectual, an ounce of iodide rubbed (if need be) into each side, sometimes appears to save the sinking patient. A strong ointment is frequently applied to the rheumatic joints of cattle. Repeated dressings are very serviceable in arresting induration of the absorbent glands and vessels in the earlier stages of farcy. It is more reliable than mercurial or citrine ointments, sometimes substituted for it; indeed, few simple farcy cases resist its timeous employment, conjoined with the administration, night and morning, of two drachms iron sulphate and ten grains arsenic, made into bolus with Canada balsam and meal, or an ounce each of iron chloride tincture and of oil of turpentine in a pint of cold gruel or ale. The Brit. Phar. orders the *ointment* to be made by thoroughly mixing sixteen grains red iodide with an ounce of lard; but for most veterinary purposes this ointment is not sufficiently strong, and a more effective preparation is made by mixing one part of red iodide with eight of lard. Mr. William Dollar, of New Bond Street, assures me that one part of red iodide dissolved in a water bath in ten of vaseline, makes an equally efficacious ointment, which has the further advantage, even when long kept, of neither

changing colour nor becoming rancid. These strong penetrating iodide ointments require to be used with care, otherwise they destroy the hair roots, and cause sloughing and blemishing.

MERCURY NITRATE. Mercuric Nitrate. $Hg\ 2\ NO_3$.
MERCURY NITRATE OINTMENT. Unguentum Hydrargyri Nitratis Citrine Ointment.

When mercury is dissolved in excess of diluted nitric acid, and the solution boiled for fifteen minutes, there is produced the liquor hydrargyri nitratis acidus of the Pharmacopœia,—a colourless, strongly acid solution, sometimes used abroad as a powerful caustic, and with twelve or fifteen parts of water and a little nitric acid forming a good remedy for foot-rot in sheep. Mercury nitrate is the active ingredient of citrine ointment, the pharmaceutical imitation of the empirical Golden Eye Ointment, and directed to be thus prepared :—"Dissolve four ounces of mercury in twelve ounces nitric acid, density 1·380 to 1·390, with the aid of gentle heat; melt fifteen ounces of prepared lard in thirty-two fluid ounces of olive oil, by a steam or water bath, in a porcelain vessel capable of holding six times the quantity, and while the mixture is hot (about 180°), add the solution of mercury, also hot, mixing them thoroughly. If the mixture do not froth up, increase the heat until this occurs. Keep it stirred until it is cold." (*Brit. Phar.*) When a less active preparation is required, the amount of mercury may be reduced to a half or a fourth, still using, however, the same quantity of nitric acid. Mild ointments, made by diluting the strong citrine ointment with lard, are only fit for immediate use, as they rapidly oxidise and spoil.

Properties.—Well-prepared citrine ointment has a golden-yellow colour, an unctuous consistence, a nitrous acid odour, and retains these characters for a long time if kept in earthenware or glass vessels, secluded from light. When badly prepared, exposed to light, or in contact with iron, it speedily, however, becomes of a greyish-green colour, hard, brittle, and easily pulverised, owing to portions of the nitrate being reduced to the metallic state. Samples injured by long keeping regain their original characters if heated with nitric acid.

Actions and Uses.—Citrine ointment and nitrate of mercury solutions are serviceable stimulants for scaly skin complaints, especially when used in combination or alternated with tar preparations. They are amongst the best remedies for eczema, especially after heat and pain have been subdued and desquamation has set in. Along with good feeding and alkaline washes, they are useful in those cases of pityriasis not uncommon amongst cattle in poor condition. They destroy lice and other skin parasites, and the cryptogamic growths of contagious ringworm. Being easily absorbed, they induce, if too freely applied, the usual specific effects of mercury. Diluted with olive oil or lard, citrine ointment greatly benefits irritable swollen discharging conditions of the eyelids. In eczema, ointments, whether of mercury or other remedies, are usually preferable in advanced furfuraceous stages, while lotions are more suitable in earlier irritable and weeping stages; ointments often answer best in cold weather, lotions in hot weather; in persistent cases, changes of dressings should be tried every four or five days.

METHYLIC ALCOHOL.

Methylic Spirit. Pyroxylic Spirit. Wood Spirit. Wood Naphtha. $C H_4 O$.

Wood spirit is the hydrate or alcohol of the radical methyl ($C H_3$), and its properties are the same as those of spirit of wine, the hydrate or alcohol of the ethyl series (p. 147). It must be distinguished from the mineral naphthas, which are pure hydrocarbons, now largely imported from America, under the name of rock oil, and the analogous bodies obtained from the distillation of coal tar (p. 512). The crude acid liquor resulting from the destructive distillation of wood when twice rectified is sold as wood naphtha, or pyroligneous ether, and is used as a solvent for resins, and burnt in lamps as a source of heat. It still contains acetone and volatile oily impurities, which render it milky when mixed with water. To get rid of these, it is saturated with calcium chloride, with which it forms a definite crystallisable compound which, when heated in a steam bath, gives off its volatile impurities, is dissolved in

water, digested with quicklime, and redistilled. Thus rectified, it is neutral, limpid, colourless, but gradually gets yellow by keeping, has a peculiar smoky, spirituous odour, and a warm, aromatic, disagreeable taste. Its specific gravity is is ·817 ; it is volatile and inflammable, boils about 145°, mixes with water in all proportions, and forms a cheap solvent for many organic compounds. The caustic alkalies immediately colour it brown, a character which readily distinguishes it from spirits of wine.

Actions and Uses.—It is stimulant, restorative, diaphoretic, and antiseptic; in large doses an inebriating narcotic. Its actions are identical with those of ethylic alcohol (p. 150), over which it has the advantage of cheapness, but the disadvantage of a disagreeable odour and taste. It is used as a readily assimilable restorative and stimulant in catarrh, sore throat, and influenza in hard-worked horses; is fancied to have some special virtue in chronic cough, allays irritability of the stomach and vomiting in dogs, serves the various purposes of an antiseptic, dissolves the active principles of many plants, and on account of its inflammability is used to singe the hair of horses.

Doses, etc.—Horses and cattle take f℥ ss. to f℥ j.; sheep and pigs, f℥ j. to f℥ ij.; dogs, ♏ v. to ♏ xx. Half an ounce, united with an equal quantity of diluted ammonia solution and given in cold gruel, or in a pint of ale, proves a good stimulant and anodyne for horses. Its unpleasant penetrating flavour lessens the chances of its being misapplied, as ordinary spirit draughts are apt to be. It is extensively used for making *methylated spirit*, which consists of one part of methylated alcohol, and nine of rectified spirit, and is sold for pharmaceutic and technical purposes free of duty. Without an excise permit methylated spirits cannot be sold in quantities exceeding one gallon, nor can a purchaser, without excise supervision of his premises, receive more than a gallon per day. In the preparation of most tinctures and ethers for veterinary purposes, it answers quite as well as the more expensive pure ethylic alcohol. The methylated ether, costing about half the price of the ethylic ether, is stated to produce more rapid and safe anæsthesia with less laryngeal spasm and nausea (*Lancet*, July 1, 1882).

MUSTARD,

Sinapis. The seeds of the Sinapis nigra and Sinapis alba, also the mixed seeds reduced to powder. (*Brit. Phar.*)

Nat. Ord.—Cruciferæ. *Sex. Syst.*—Tetradynamia Siliquosa.

The Sinapis 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 seeds of the black mustard are dark brown, about the size of millet, are reduced to a greenish yellow powder, which has a pungent oily taste, smells slightly nauseous when dry, and when macerated with water and distilled produces the pungent irritant volatile oil of mustard. The seeds of the white mustard are larger in size, lighter in colour, and when triturated produce no volatile oil, but an inodorous pungent-tasted yellow emulsion. The mustard-flour of the shops, according to information given to Sir Robert Christison by an English manufacturer, is made as follows :—"Two bushels of black and three of white seed yield, when ground, 145 pounds of flour; which, to diminish the pungency and improve the colour, is mixed with fifty-six pounds of wheat flour and two pounds of turmeric: and the acrimony is restored, without the pungency, by the the addition of a pound of chili pods and half a pound of ginger. Black seed alone, it is added, would be much too pungent for use at table. Wild mustard seed is sometimes substituted for the black species if the latter be scarce. Some manufacturers remove the fixed oil from both the white and black seed by means of expression, before making them into mustard-flour with the other ingredients, and the acrimony of the product is thus increased" (Christison's *Dispensatory*). This admixture of starch discovered by the iodine test, and of aromatics, diminishes the potency of commercial mustard-flour as a counter-irritant. Inorganic impurities occasionally present are detected by their remaining after burning.

Both black and white mustard seeds contain about 23 per

cent. of a yellow, tasteless, non-drying fixed oil, similar to that of rape; 20 per cent. of mucilage, chiefly found in the epidermis; 4 of inorganic matters; and probably 10 to 15 of myrosin, an albuminous ferment similar to diastase or the emulsine 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 contains about $2\frac{1}{3}$ per cent. of the crystalline potassium myronate or sinigrin; white mustard contains an allied principle, sinalbin. When these bodies are dissolved in water, as in the ordinary mixing of the mustard-flour into paste, they are decomposed by the fermentescible myrosin, and there are produced two pungent, acrid, irritant substances—volatile oil of mustard (C_4 H_5 NS) from the black mustard, and the oily vesicating acrinyl sulphocyanate (C_8 H_7 NSO) from the white mustard (Flückiger and Hanbury). The formation of oil of mustard, regarded as allyl isosulphocyanide, from potassic myronate may be represented thus:—

Potassium Myronate.		Sugar.		Potassium Bisulphate.		Mustard Oil.
C_{10} H_{18} KNO_{10} S_2	=	C_6 H_{12} O_6	+	KH, SO_4	+	C_4 H_5 NS.

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 special pungent acrid oily bodies 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 an emetic, when a dessert-spoonful of mustard flour, dissolved in several ounces of water, is given to the dog or cat. It is slightly laxative and diuretic, and allied to horse-radish and peppers. As an external irritant, mustard is much used as a rubefacient, vesicant, or suppurant. Mustard paste made with water, and rubbed into the skin of the horse, within fifteen minutes causes redness, heat, and tenderness. By reflex action, the activity of adjacent parts is roused (p. 45). Applied in larger quantity, or with smarter friction, the epidermis, after three or four hours, is separated from the true skin by effusion of serum, the small vesicles run into considerable blebs, which subsequently break and suppurate; surrounding

parts are swollen. The skin generally heals in a week. Occasionally, however, from repeated, prolonged, or injudicious use, as in irritable states of the skin, there ensue active inflammation, sloughing, and destruction of the hair-roots. Such severe effects are unjustifiable. It is unwise to apply it too freely, or in the acute stages of inflammation, in which it is apt to aggravate instead of abating irritation. In the treatment of pneumonia and other internal inflammation, Professor Williams declares that the good results generally ascribed to mustard are more effectually and safely secured by the use of hot fomentations. In the horse, he says, "the application of either mustard or turpentine causes very great distress, a high state of excitement, increase of the febrile disturbance, and often tends to hasten a fatal termination" (*Principles and Practice of Veterinary Surgery*). Such injurious effects do not, however, result where mustard is carefully and discriminately used. The occasional abuse of a useful medicine should not necessitate its disuse.

Compared with cantharides, mustard is more prompt, but less permanent; it is used to control functional disturbance rather than to repair structural damage; it causes less exudation of serum, but more swelling of surrounding parts; 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 mustard 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. For sheep and dogs it is also useful, especially when applied, as it ever should be, in moderate amount, and for a short period.

Medicinal Uses.—For all veterinary patients suffering from catarrh, sore throat, laryngitis, bronchitis, pneumonia, and pleurisy, mustard is applied in the early congestive stage to lessen pain and relieve difficult breathing. It is more serviceable in chronic than acute bronchitis. In pleurisy, weak

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 contributes to 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 most effectual when rubbed in 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 re-applied. In acute indigestion, in colic, enteritis, and typhoid fever, especially amongst horses, repeated dressings help to control irregular, violent nervous action. 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 and typhoid fever, in parturient apoplexy of cattle, and in poisoning by narcotics. Conjoined with administration of stimulants, it is rubbed over the region of the heart to counteract syncope. Applied over the kidneys, it promotes diuresis. It is occasionally used for determining secretion of pus, 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 is to be speedily induced and stimulation of the kidneys avoided. It is superseded by more permanent vesicants, such as cantharides or mercury biniodide ointment 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 increasing dangerous destructive metamorphosis and causing sloughing.

Doses, etc.—If used as a stomachic, carminative, or mild stimulant, horses take ℥iv. to ℥vj.; cattle, ʒss. to ʒj.; 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 and pigs. As an external irritant, it is used occasionally as a plaster or poultice, generally as a paste made as for table purposes, with water, which should be tepid, but not hot. Extra activity is secured by using ground mustard-seeds unmixed with bland ingredients, or by adding to the paste made from the mustard of the shops a little oil of turpentine or ammonia. Spirits and vinegar, sometimes advised as solvents, retard formation of the active vesicating oils. 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. For veterinary patients, little use is made of *plasters* prepared by spreading mustard upon calico or paper; of *leaves* introduced into human practice, and consisting of powdered mustard seeds and gutta-percha solution spread upon cartridge paper and dried; or of *poultices* ordered by the Brit. Phar. to be made with equal parts of mustard and linseed-meal, well stirred with four parts of boiling water. In the lower animals, the freshly-made paste is usually applied directly to the skin, with smart continued friction; after fifteen or twenty minutes it is washed off with tepid water, and may be again applied, if required, three or four times. Such repeated moderate external warming is usually more serviceable than one violent irritant dressing, whether for diminution of congestion, relief of pain, or even for removal of exudate. Unwarrantable, topical, as well as general irritation, as already indicated, is occasionally produced, especially in nervous horses, by the free and continued use of mustard. Wasteful, painful draining away of albuminoids from severely-blistered surfaces seldom serves any good purpose, but, on the contrary, often hinders repair or cure.

The volatile oil, prepared by distilling with water black mustard seeds from which the fixed oil has usually been previously expressed, is a prompt and powerful vesicant. Two drachms, rubbed into the skin of a dog, caused immediate irritation, with speedy formation of large vesicles, surrounded by inflammatory swelling.

MYRRH.

Myrrha. Gum-resinous exudation from the stem of Balsamodendron myrrha, collected in Arabia Felix and Abyssinia. (*Brit. Phar.*)

Nat. Ord.—Burseraceæ or Amyridaceæ. *Sex. Syst.*—Octandria Monogynia.

Myrrh is imported from the coasts of the Red Sea, chiefly by way of Bombay. From the earliest times it has been used with olibanum or frankincense in making incense, perfumes, holy oils, and unguents for embalming. It occurs chiefly in the cortical layer of the trunk or branches of at least two species of shrubby thorn-like Balsamodendrons, exuding spontaneously from perforations or cracks. At first of an oily consistence and a yellow-white colour, it gradually becomes solid, like gum, and of a brown-red hue. The best sorts, generally termed Turkey myrrh, are met with in irregular-shaped, semi-translucent, red-brown tears, which deepen in colour when breathed on. They are of variable size, 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 readily dissolves in rectified spirit. It consists of 40 to 65 per cent. of soluble gum, probably arabin; 25 of resin, with which is associated a bitter glucoside; and rather less than 1 per cent. of a faintly green volatile oil (Flückiger and Hanbury).

Impurities.—Inferior varieties, often mixed with the better qualities, are coarse, opaque, hard, resinous, dark-coloured, and devoid, or nearly so, of the characteristic aromatic odour and peculiar balsamic taste. Bdellium, or false myrrh, imported from Africa, and common in second-rate specimens, is deficient in lustre, aroma, and brittleness, and softens when held in the warm hand. Straw, sand, and other mechanical impurities are sometimes present.

Actions and Uses.—Myrrh, given internally, is a bitter stomachic, feeble tonic, and stimulant; externally, it is stimu-

lant and astringent. It gently stimulates the digestive mucous membrane, improves appetite, and arrests excessive secretion, bearing in this respect some resemblance to copaiva. It is similar to the fragrant gum resin olibanum, and to the concrete resin of the Elemi tree imported from Manilla. It differs from the turpentines and balsams in possessing tonic properties; it is less stimulant and antispasmodic than the fœtid gum resins. It is occasionally prescribed in indigestion, in chronic catarrh, and other mucous discharges; but its principal veterinary use is as a stimulant and antiseptic for wounds, applied in the form of tincture and compound tincture.

Doses, etc.—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, often used with other tonics, or with aloes, as 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 fourteen fluid ounces of methylated spirit and six ounces of water, previously mixed, for fourteen days in a closed vessel; shake frequently, filter, and add proof spirit to make one pint.

NITRIC ACID.

Acidum Nitricum. Aquafortis.

The strongest acid of commerce contains 85 per cent. of real nitric acid (N_2O_5), has the specific gravity 1·52, but is inconveniently unstable, and gives off nitrous fumes. The strongest acid of the Pharmacopœia contains 60 per cent. of anhydrous acid, has the specific gravity 1·42 ($2HNO_3$, $3H_2O$), and is ordered to be prepared by distilling together in a glass retort equal weights of potassium or sodium nitrate and sulphuric acid. On the large scale, the commercial acid is prepared in iron retorts, from seven parts of sodium nitrate and four of sulphuric acid. The strength and causticity of these acids are inconvenient, and the Pharmacopœia recognises a diluted acid with the specific gravity 1·101, and containing nearly 15 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 soon increases in quantity and diminishes in strength; diluted with water it evolves much heat. Its characteristic tests are the production of an orange-red colour with a solution or crystal of morphine or brucine; copper, mercury, and some other metals deoxidise strong solutions, with evolution of ruddy nitrous acid fumes ($N_2 O_3$); it gives a yellow stain of xanthoproteic acid to wool and to the skin—a decoloration deepened by alkalies, and removed from the skin only by its desquamation; it bleaches a warm solution of indigo sulphate; and with a solution of ferrous sulphate 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 added. Heated with strong potash, zinc dust, and iron filings, the nitrates give off ammonia.

Impurities.—The tests of purity are the specific gravity, which indicates the proportion of water; freedom from colour, proving absence of ruddy nitrous acid; 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.—According to quantity and degree of concentration, nitric acid is irritant and corrosive. It is prescribed as a tonic, anti-alkaline, and refrigerant. It is employed externally as a caustic stimulant and antiseptic. The mineral acids closely resemble each other, but Dr. Bence Jones states that hydrochloric chiefly promotes digestion, nitric secretion, sulphuric astringency; nitro-hydrochloric specially stimulates the skin and liver, whilst phosphoric is believed to dissolve phosphate of lime, but lacks marked tonic and astringent properties.

Readily absorbing water, and parting with oxygen, combining with bases and albuminoids, and possessed of great diffusive and penetrating power, strong solutions of nitric acid

corrode the living textures with which they come in contact. Both nitric and nitrous acids, whether in fumes or concentrated solution, are dangerously corrosive, although they do not always prove immediately fatal. They cause gastro-enteritis; leave yellow or brown marks about the mouth and fauces; but in the stomach and intestines, this discoloration is usually obscured by inflammation and extravasation of blood. In men and dogs, chronic inflammation of the alimentary mucous membrane is sometimes set up, with arrested assimilation, and death after several weeks. As with other irritants, nitric acid is less active and fatal in cattle than in horses and dogs, owing to the stomachs of ruminants being so constantly filled with food, and the lining membrane being thicker and less vascular. Injected into the veins, it coagulates the blood, and causes death in a few minutes. Like other acids, large or repeated doses, sometimes without irritant or corrosive effects, fatally neutralise alkalinity of the blood (p. 378). In all animals its appropriate antidotes are diluted alkalies, or alkaline carbonates, soap, chalk, and magnesia, given with diluents and demulcents, irritation allayed by opium, and nutrition aided by good, easily digested food.

Medicinal Uses.—Medicinal doses favour flow of saliva and other alkaline secretions, and thus abate thirst; they exert stimulant and antiseptic effects on relaxed and ulcerated conditions of the mouth and fauces, and are often beneficial in aphtha and stomatitis. They relieve atonic dyspepsia and check gastric fermentation; but in such cases hydrochloric acid is usually preferred. Given before eating, like other acids, nitric acid checks gastric secretion. It is very diffusible; in the blood it combines with bases and perhaps with albumen; it exerts tonic, alterative, and astringent effects, specially notable in atonic diarrhœa particularly of cattle and sheep, in enlargement and fatty degeneration of the liver, in typhoid fever in horses, and, alternated with arsenic, in chronic eczema and farcy. It is excreted by the intestinal glandular apparatus and by the kidneys.

As a caustic, nitric acid is used for extirpating warts, fungous and malignant growths which cannot be removed by the knife, and for dissolving the hardened scurf and pro-

moting a healthier condition of skin in mallenders, chronic eczema, and neglected cases of scab and mange. It destroys virus lodged in poisoned wounds, excites a healthier action, and removes noisome odours from caries, foul, and foot-rot, and arrests spreading sloughing sores. As an escharotic it is generally applied on a splinter of soft wood, surrounding tissues are protected by wetting with oil, and undue action arrested by subsequent washing with an alkaline solution. Freely diluted in hot water, it is serviceable in abating the itching of nettle-rash. Excessive sweating in horses during exertion or sickness is checked by sponging the skin several times daily with a very diluted acid solution. Dissolved in eighty or a hundred parts of water, it greatly relieves the tenderness and tension of piles in dogs. Diluted solutions are injected into the bladder of man, to dissolve phosphatic calculi, and neutralise and preserve from decomposition unduly alkaline urine; but although such conditions are not uncommon in male pigs and sheep, the injection of solvents cannot be effected without opening the urethra. 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 or corroding organic and metallic substances, and producing irritant effects if its fumes are incautiously breathed.

Doses, etc.—Of the diluted medicinal acid, horses or cattle take f℥ i. to f℥ 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 part of nitric acid and three of hydrochloric are mixed and gently heated, red acid fumes are evolved, and there remains 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. The diluted medicinal nitro-hydrochloric acid of the Pharmacopœia is prepared by mixing, in a glass bottle, three fluid ounces of nitric acid and four of hydrochloric, allowing the mixture to stand for twenty-four hours, and adding twenty-five fluid ounces of distilled water in successive portions, shaking after each addition, and preserving in a stoppered bottle. This diluted acid consists of undecomposed nitric and hydrochloric acids, holding in solution free chlorine and peroxide of nitrogen (Royle). It is colourless, smells of chlorine, and has the specific gravity 1·074.

Actions, Uses, and Doses.—Large or concentrated doses are corrosive and irritant. It is prescribed medicinally as an alterative and tonic; stimulates the skin, liver, and intestinal glands; is used specially in hepatic torpidity and rickets, and is believed by Dr. Lauder Brunton to act beneficially by multiplying the ferments of the liver and intestines (*The Practitioner*, Sept. 1876). The doses of the medicinal acid are the same as those of nitric acid; it must be used with the same precautions as to dilution, and avoidance of too frequent or prolonged use. It is applied for the same escharotic purposes as the other mineral acids.

NUX VOMICA.

The seeds of Strychnos Nux vomica. Imported from the East Indies. (*Brit. Phar.*)

Nat Ord.—Loganiaceæ or Spigeliaceæ. *Sex. Syst.*—Pentandria Monogynia.

The Strychnos nux vomica abounds 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 false Angustura bark of the shops; oval-shaped, shining leaves, of variable size; round fruit, about the size of apples, containing, amid a soft gelatinous pulp, which birds are said to eat with impunity, several round, flat, grey-drab seeds, about an inch in diameter, and covered with short satiny hairs. These seeds, the nuces vomicæ, have a little umbilicus on their concave ventral surface, and, amidst the horny grey albumen towards the margin, lies the white embryo, with two heart-shaped, thin cotyledons. So tough and horny are the seeds, that in order to powder them, they require to be steamed, sliced, and ground in a coffee-mill. The powder, partially soluble in water and spirit, has a dirty green-grey colour, an intensely pure bitter taste, and produces an orange-red colour when moistened with nitric acid. Besides eleven per cent. of protein compounds, six of sugar, four of fat and mucilage, nux vomica contains the soluble yellow-brown amorphous strychnic or igasuric acid, in combination with which occurs about one per cent. of three poisonous alkaloids—strychnine, brucine, and igasurine—present in all parts of the tree, but especially in the seeds and bark. Their properties and uses are noticed below.

Actions and Uses.—Nux vomica stimulates the motor tract of the spinal cord. Large doses produce fatal tetanic convulsions and death by asphyxia. Medicinal doses are bitter stomachics, nerve tonics, and antipareses. It is a slight topical irritant.

Toxic Effects.—A full dose in a soluble form almost immediately stimulates and disorders the motor centres of the cord, causes rigidity and spasm of the whole voluntary contractile tissues, alternated with periods of quiet, during which the patient is much prostrated; the vaso-motor centre is excited, hence blood-pressure is heightened, and capillary circulation quickened, reflex irritability is exalted, and by and by exhausted by over-stimulation; the recurring convulsions involve the voluntary muscles of the limbs, of the body, and of respiration, causing rigidity of the diaphragm and thoracic muscles, and death by asphyxia. There is no direct effect on the brain

proper, the muscles, the heart, or the sensory nerve trunks. It poisons all animals, and by whatever channel it enters the system. Half a drachm of powdered nux killed a moderate-sized dog in forty-five minutes. Eight grains proved fatal to dogs, five grains to cats (Christison), and one or two ounces to horses (Moiroud). Hertwig observed that ten drachms, in the solid state, were inadequate to destroy a horse, but proved fatal in ten hours when given in solution. Professor Coleman gave a mare two ounces in a drench; in an hour, and after the animal had drunk some water, she had violent tetanic symptoms, and died half an hour later. Ounce doses given to a glandered horse caused tetanic spasms, but were not fatal. Sheep are destroyed by half an ounce in about thirty minutes; but goats, curiously enough, are much less susceptible. Hertwig gave a goat 440 grains in eleven days, without any obvious effect; and Tabourin considers that eight ounces would be requisite to poison. The same authority has seen violent tetanic convulsions caused in pigs by fifty grains.

Poisonous doses produce in all animals trembling, twitching of the voluntary muscles, and violent tetanic spasms, usually lasting one or two minutes, gradually becoming more frèquent and severe, and from their involving the glottis, diaphragm, and muscles of respiration, causing death usually by asphyxia. The symptoms, as well as the mode of death, are much the same as in tetanus, but are more suddenly developed, more intermittent, and much more rapidly fatal. They resemble still more closely those of meningeal spinal apoplexy or spinal hæmorrhage. The post-mortem appearances vary somewhat with the severity and duration of the case; the blood is dark-coloured and unusually fluid; there is generally venous engorgement; congestion of the lungs, 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 the 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.

There are no reliable chemical antidotes for poisoning either by nux vomica or strychnine. Charcoal and tannin solutions have very slight neutralising effects. Any unabsorbed poison should at once be removed by emetics or the stomach-pump. The physiological effects are partially antagonised by such motor paralysers as curara, conium, tobacco, opium, and Calabar bean, and more fully and effectually by chloral and inhalation of ether and chloroform. Alcohol and potassium bromide have been successfully used in several cases in which human patients have taken poisonous doses. Perseverance with artificial respiration has sometimes saved life. Professors Crum Brown and T. D. Fraser have discovered that the ethyl and methyl compounds of strychnine, although resembling strychnine in most chemical characters, are physiologically antagonistic to it, and, instead of convulsants, stimulating the centres of motion and reflex action, they are, like curara, paralysers of the end organs of motor nerves. In frogs poisoned with small doses of strychnine, the tetanic symptoms are arrested by removing the animals to a warmer medium, or bringing them within the circle of a current of electricity itself capable of causing tetanus (T. Kunde, in *Virchow's Arch.* vol. xviii., 1860).

Medicinal Uses.—Like other bitters, small doses stimulate the gastro-intestinal secretions, antagonise atony of the membrane whether evidenced by diarrhœa or constipation, by want of appetite or dyspepsia. But its special curative function is rousing the motor tract of the cord when paralysed either by accident or disease. Even where paraplegia depends upon softening or wasting of nervous textures, Dr. Brown-Séquard believes that degeneration may be arrested by the fuller current of blood which these nerve stimulants, dilating the capillaries, determine to the part. I have given nux vomica with striking advantage to horses partially paralysed, during, or as a sequel of influenza or strangles. British veterinarians prescribe nux vomica or strychnine in cerebro-spinal meningitis when the more acute symptoms have abated, but American practitioners who have large experience of this disease amongst horses, both in its sporadic and epizootic forms, inform me that, after trying many modes of treatment, they find nothing so successful as half a dose of aloes or of oil,

immediately followed by frequently repeated small doses of nux vomica or strychnine.

Mr. David Aitkin, Loughborough, has prescribed nux in cattle practice since 1853, and generally with success. He gives me particulars 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 fifty-five, and rather weak; his hind extremities and tail had lost their power of movement, and were devoid of sensation; the sphincter ani was relaxed; urine dribbled away involuntarily. Purgative medicine was given, and operated next day, without, however, any abatement of the paralysis. Two drachms nux were prescribed night and morning for ten days; but as little improvement was then visible, the dose was increased to three drachms thrice a day. Three days later, Mr. Aitkin, whilst examining the animal, accidentally trod on his tail, when he jumped on his legs and endeavoured to stand; in another day he could turn himself from side to side; in about ten days he was able to walk round the house in which he was confined, and rapidly recovered. The other bullock exhibited very 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 allowing laxative nutritive diet, with tonic medicine, and turning the patient several times daily. After parturition, most cases gradually regain the use of their limbs; but when they continue to exhibit want of nervous power, nux vomica or strychnine is decidedly indicated, and has been used with success. Mr. Aitkin also employs nux in puerperal apoplexy. He describes the case of a cow, taken ill at eight o'clock at night, and found next day at noon prostrate, motionless, scarcely able to swallow, comatose, almost devoid of sensation, and given over as hopeless by the village blacksmith, who had bled her, when first affected, the evening before. Along with a powerful stimulant and purgative, two drachms of nux vomica were given, mustard embrocation well rubbed over the loins, and injections of tepid water with a little turpentine thrown into the rectum. Next

day the bowels were acted on; but as the animal could not move, two drachms nux were given in gruel twice a day: recovery was rapid.

French veterinarians give nux in amaurosis and stringhalt in horses, and chorea amongst dogs, especially when accompanied by muscular flaccidity and debility. In all animals, in torpidity of the bowels resulting from want of muscular tone, nux is usefully conjoined with aloes or other purgatives. Continued during some weeks, it is believed to stimulate the sexual functions. To insure active curative results, it should be persevered with until it produces muscular twitching, usually first apparent during the night, noticed earliest in the paralysed part, and when the patient is suddenly disturbed. If therapeutic results do not shortly succeed these physiological effects, the medicine will seldom be of service, no matter how long it be continued. Given in the solid form, violent and even fatal effects have occasionally resulted from several doses, having remained unchanged, becoming unexpectedly dissolved and absorbed. Unlike lead or mercury, it has, however, no cumulative properties. Nor, on the other hand, does the system, by use, become less susceptible to its action, as is observed with alcohol, opium, and tobacco. Nux vomica must be avoided in the acute stages of spasmodic and other nervous diseases, and so long as irritation, inflammation, or muscular rigidity continues.

Doses, etc,—Of powdered nux, horses take ℥ ss. to ℥ i.; cattle, ℥ j. to ℥ ij.; sheep, grs. x. to grs. xl.; pigs, grs. x. to grs. xx.; dogs, grs. ss. to grs. ij. These doses are repeated twice daily, and slightly and gradually increased for a week or ten days, or until some of their physiological or therapeutical effects are produced. The powder is given in bolus. The *extract*, eight or ten times as active as the simple powder, is got by boiling the powder with successive portions of rectified spirit, recovering most of the spirit by distillation, and evaporating the residue in a vapour bath. The *tincture*, prepared by maceration and subsequent percolation of two ounces of powder and one pint of rectified spirit, is used both internally and externally, for the latter purposes being sometimes conjoined with ammonia.

Strychnine or Strychnia (C_{21} H_{22} N_2 O_2) is found in the

Strychnos nux vomica, in the bean of St. Ignatius, and in other plants of the same natural family. Sir Robert Christison considered that it might be cheaply and easily procured from false Angustura bark. It is generally got from nux vomica, which contains about one part in 200. The following are the chief steps in the somewhat tedious Pharmacopœia process:—The nuts, steamed and reduced to powder, are exhausted by spirit, which is recovered by distillation; to the watery extract is added lead acetate, which precipitates acid and colouring matters; the filtered solution is treated with ammonia, which precipitates the alkaloids. The precipitate is washed, dried, and re-dissolved in spirit, and the solution, reduced by evaporation, set aside, when the less soluble strychnine crystallises out, leaving brucine in solution. Commercial strychnine usually contains some brucine and igasurine; but repeated washing with diluted spirit, boiling with rectified spirit, and crystallising, secure the pure alkaloid.

Strychnine occurs in right-square octahedra or prisms, is colourless and inodorous; soluble in 6700 parts of cold water, in 2500 parts of hot water, and communicates its intensely bitter taste even when diluted with 600,000 parts of water. It is soluble in boiling rectified spirit, and in chloroform, but not in absolute alcohol or in ether. It is not coloured by nitric acid, and leaves no ash when burned with free access of air. It forms crystalline, colourless, intensely bitter salts. Strychnine is readily recognised. A particle is placed on a white plate, and near it a fragment of potassium bichromate; each is moistened with pure sulphuric acid; a minute or two is allowed, to insure solution; the dissolved chromate is drawn with a glass rod over the dissolved strychnine, when a beautiful deep purple colour is struck, rapidly passing through red to yellow. Lead dioxide, manganese black oxide, potassium permanganate, oxidise and colour strychnine in the same manner. The extreme bitterness and tetanic spasms produced in frogs and other small animals by solutions containing the $\frac{1}{5000}$th part of a grain, prove valuable corroborative tests.

Actions and Uses.—Strychnine concentrates the active properties of nux vomica. Poisonous doses violently stimulate the motor tract of the spinal cord, producing muscular rigidity

and tetanic convulsions. Carefully regulated medicinal doses are bitter stomachics, and stimulants and tonics of motor centres, including the vaso-motor centre. Brucine, igasurine, and akazga, have the same effects. Thebaine, one of the opium alkaloids, and picrotoxin, the bitter active principle of Cocculus Indicus, are also motor excitants.

Toxic Effects.—One-sixth of a grain of strychnine, in solution, destroys a dog in two minutes, and sometimes even more rapidly; one-eighth of a grain in twelve minutes (Christison). Half a grain poisoned an English terrier in twenty-four minutes; three grains poisoned a greyhound in an hour and a half; whilst one grain poisoned another greyhound in thirty-three minutes (Dr. S. Macadam). Half a grain, introduced into a wound, would suffice, it is believed, to kill a man within fifteen minutes. Dogs poisoned 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 temperature is raised 4° to 6°. The tetanic convulsions continue one to two minutes, cease for several minutes, but recur, with increased force, until death is produced, from the exhaustion of over-stimulation, and from asphyxia, caused by spasm of the respiratory muscles. Doses both absolutely and relatively larger than those fatal to dogs, are required to poison horses and cattle. A horse had twitching of the muscles after swallowing six grains, but was poisoned by twelve grains in 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 rose to 120. Bloodletting 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). Half a grain, given hypodermically, induced in half an hour general muscular rigidity. All animals are tolerably uniformly affected by strychnine; but chickens appear less susceptible than other birds; and guinea-pigs and some monkeys seem in a remarkable manner to resist its effects (Dr. H. C. Wood, *Treatise on Therapeutics*).

Mr. MacGillivray, Banff, gave an old cow thirty grains, 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). Four grains placed in the areolar textures of a cow destroyed it in twenty minutes (Tabourin). On 18th October 1852, at twelve o'clock, I gave a small red cow, affected with pleuro-pneumonia, and in a state of great weakness, grs. xv. of strychnine, suspended in two ounces of oil. At 12.30 the pulse had risen from 70 to 78, regurgitation was observable in the jugular veins, and quivering and twitching of the facial muscles, particularly during inspiration. At 12.45 the pulse numbered 84, and the symptoms were aggravated. Two grains of strychnine 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. Thirty grains strychnine 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 showed much sensitiveness, especially about the hind extremities. It reeled and fell. At 2.30 the pulse had risen to 160, the limbs were very rigid, the eyes protruding, the involuntary spasms more general, frequent, and severe. Two minutes later she died quietly. The post-mortem appearances were similar to those detailed as occurring in poisoning by nux vomica. $\frac{1}{100}$th of a grain killed rabbits weighing three lbs. in fifteen to twenty minutes. In dogs destroyed at the Edinburgh Veterinary College with one-eighth of a grain of strychnine, the buccal mucous membrane was blanched; the left auricle, as also the intestines, continued to contract for nearly an hour after death, and the cerebral and intestinal vessels were congested with dark venous blood.

After poisonous, and even after full medicinal doses, strychnine is readily detected in the stomach and other viscera, as well as in the blood and urine, and is detectable many months after the animal has been destroyed (Dr. S. Macadam, *Pharmaceutical*

Journal, August and September 1856). The antidotes are the same as for nux vomica (p. 473). An animal having received a poisonous dose of strychnine, if brought immediately under the influence of chloral hydrate, the convulsions abate in force and frequency, and life may be saved. Injection subcutaneously, or into a vein, insures most certain and rapid effect. But rabbits receiving $\frac{1}{96}$th of a grain, hypodermically injected, are not saved unless the chloral hydrate is injected within ten minutes. Strychnine does not so perfectly antagonise chloral hydrate, for it does not combat the brain symptoms (*Antagonism of Medicines*).

Medicinal Uses.—Strychnine, like nux vomica and other bitters, increases secretion of saliva, and acts as a stomachic. But its special value is in cases of deficient or deranged motor power. In horses, after falls or serious injuries, after attacks of stomach staggers,[1] strangles, influenza, or rheumatism, when the eccentric cause of reflex paraplegia has been removed or when irritation and inflammation have passed away, there sometimes remains impaired action of the limbs, imperfect power of urination, or occasionally of defecation. Weakened

[1] The following case, illustrative both of the poisonous and medicinal action of strychnine, came under my observation in November 1853:—A four-year-old gelding, suffering from a severe attack of staggers, lost the power of moving his hind extremities. He could not be moved, turned, or put backwards, without imminent risk of falling. Mineral tonics were given for a fortnight without obvious amendment. Four grains strychnine, made into bolus, were administered morning and evening, and gradual improvement ensued. The doses were slowly augmented until they amounted to ten grains, which were given daily in two separate doses. No physiological action was observable; no twitching or unusual sensitiveness of the muscles; no acceleration or alteration of the pulse. But the appetite improved; the muscles became firmer; and in about three weeks from the first use of the strychnine, the patient was able to walk without reeling, and could also turn and back without difficulty. The strychnine was withheld for four days, and the patient became decidedly worse, and walked very unsteadily. The medicine was again prescribed, but, from an unfortunate mistake, was given in doses of five grains, repeated twice a day. After three such doses, violent spasms supervened, affecting especially the head and neck, and becoming particularly severe when the animal was touched or disturbed. Clysters and stimulants were employed, and after two days the poisoning symptoms disappeared; but the paralysis remained, and was accompanied by hanging of the head and dulness. Blisters were applied along the spine, and the use of the strychnine renewed in doses of two and a half grains twice a day. Under this treatment, the paralytic symptoms again diminished; in fifteen days the patient was able to walk and turn with comparative ease, and appeared in the fair way of recovering, when unfortunately the owner, tired of waiting, had the animal destroyed.

or deranged motor power also occurs in cattle, especially after puerperal apoplexy, in dogs after distemper, in all animals after lead poisoning. Strychnine in such cases is given with fair prospect of success. Dr. Brown-Séquard teaches that strychnine stimulates the vaso-motor centre, dilates blocked or contracted arterioles, increases flow of blood, more especially to the cord, and thus often arrests its degeneration. In paralysis of those muscles of the larynx of the horse constituting roaring, Mr. F. Mavor of Park Street, London, has successfully used strychnine, injecting it subcutaneously in doses of half a grain to a grain. In the earlier stages of such cases, before there is extensive muscular atrophy, it is worthy of more extended trial, used both by the mouth and hypodermically. In torpidity of the bowels, whether following acute indigestion, inflammation, or febrile attacks, strychnine is sometimes advantageously conjoined with aloes or salines. Chorea, and even some epileptic cases are benefited by it. In atony of the bladder and rectum, with involuntary discharge of their contents, injections sometimes answer better than internal administration; but such injections require to be used warily, for doses which may be safely enough swallowed occasionally act with unexpected violence when injected either into the hollow viscera or into the areolar textures. In local paralysis, where practicable, the injection should be made deeply into the affected muscle.

Probably from climatic peculiarities cerebro-spinal meningitis is greatly more common amongst horses in America than in Great Britain. Often it occurs as an epizootic. Mr. Alexander Lockhart, of New York, informs me that he has seen two hundred horses affected at the same period 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 preferable 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.

For the destruction of rats, mice, and other vermin,

strychnine is much used. It constitutes the active ingredient of Hunter's Infallible Vermin and Insect Destroyer, of Butler's and Battle's Vermin Killers, which contain starch, sugar, and about ten per cent. of strychnine, and are coloured by soot or Prussian blue. Battle's shilling packets have sixty grains, and the sixpenny, twenty-five grains, of strychnine (Dr. S. Macadam).

Doses, etc.—Strychnine is about ten times as active as nux vomica extract, more than thirty times as active as the powdered nux. Of the alkaloid, or hydrochlorate, which, on account of its solubility, is greatly preferable, the dose for the horse is grs. j. to grs. ij.; for cattle, grs. ij. to grs. v.; for sheep, gr. $\frac{1}{5}$ to gr. j.; for dogs, gr. $\frac{1}{50}$ to gr. $\frac{1}{20}$. It is generally given twice a day, and continued in gradually increasing doses until it produces some physiological or curative effects. From its subtlety as a poison, and its irregularity of strength, it must be used with much caution. On account of its intensely bitter taste, it is frequently preferred in the form of bolus. The Pharmacopœia *solution*, which really contains the hydrochlorate, is made by gently heating strychnine grs. iv., water, f ℥ vj., and diluted hydrochloric acid, ♏ vj. to insure solubility, then adding rectified spirit, f℥ij. and water sufficient to form an ounce. This solution is readily absorbed, and eminently suitable for hypodermic injection. Strychnine arsenite, in three to five grain doses, has been used at the veterinary school of Turin with some success, in the treatment of malignant nasal discharges supposed to be glanderous.

Brucine or Brucia (C_{23} H_{26} N_2 O_4, $4H_2$ O) is associated with strychnine in the seeds, and still more largely in the bark, of Strychnos nux vomica, and in St. Ignatius' bean. It crystallises from the mother liquor from which strychnine or its nitrate has been separated; occurs in oblique four-sided prisms; is almost as bitter, but is more soluble in water than strychnine. It is reddened by nitric acid and chlorine. The bright red coloration caused by nitric acid is changed to violet or green by sodium hyposulphite and other reducing agents, which decolorise the analogous red coloration produced by the action of nitric acid on morphine. Strong sulphuric acid colours brucine a rich rose tint, but on adding manganese black oxide, the blue, violet, and purple colours observed with strychnine

are not produced. Physiologically, brucine resembles strychnine, but has only one-twelfth (or, according to other authorities, one-sixth) of its activity.

Igasurine or igasuria, said to occur in nine different varieties, is probably identical with brucine.

Akazga, the ordeal plant of the West Coast of Africa, is obtained from the seeds of a tree of the Strychnos family, and yields an alkaloid analogous to strychnine in its reactions and physiological effects (Professor T. R. Fraser).

OAK BARK.

Quercus Cortex. Dried bark of the small branches and young stems of Quercus Robur, sub-species pedunculata. Collected in early spring from trees growing in Britain. (*Brit. Phar.*)

Nat. Ord.—Cupuliferæ. *Sex. Syst.*—Monœcia Polyandria.

Bark from smaller branches or young trees is more astringent than thicker pieces of older growth; the interior finer fibrous portions, than the external rougher cortical. Astringency depends upon the presence of 10 to 15 per cent. of querci-tannic acid, which differs somewhat from gallo-tannic acid, and does not, by oxidation, yield gallic acid. The infusion, like that of galls, has a powerful astringent taste, reddens litmus, gives a blue-black precipitate with ferric salts; and with gelatine solution a white flocculent precipitate, which resists putrefaction better than that of gallo-tannic acid. Acorns—the fruit of the oak—are readily eaten by many animals, are collected in many parts of England for feeding sheep and pigs, are considered to be nearly as valuable as beans, but on account of their astringency require to be used in moderation.

Actions and Uses.—Oak bark is astringent. It is prescribed for all animals to arrest chronic diarrhœa, dysentery, and other excessive mucous discharges. For weakly scouring calves, I find no astringent more serviceable; the decoction is given once or twice daily as required, either alone or with gentian, spirit, ether, or chloroform, or, where there is griping, with

laudanum. It lacks the tonic properties of cinchona and gentian, and when given too frequently, or in too large amount, causes intestinal derangement. A decoction is applied for stimulating unhealthy wounds, bracing relaxed mucous membranes, relieving piles in dogs, arresting bleeding, and reducing herniæ and protrusions of the anus and uterus.

Doses, etc.—Horses take ℥ij. to ℥i.; 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 oak bark to the pint of water. It is given with aromatics and bitters; in dysentery, with opium and starch gruel; in typhoid cases, with camphor and mineral acids.

OLIVE OIL.

Oleum Olivæ. The oil expressed in the south of Europe from the ripe fruit of Olea europæa.—*Brit. Phar.*

Nat. Ord.—Oleaceæ. *Sex. Syst.*—Diandria Monogynia.

Olives are obtained from several varieties of an evergreen tree, which grows abundantly in southern Europe, and yields a resinous juice once used medicinally, bitter, tonic, astringent leaves, and the succulent fruit, an oval purple drupe about the size of a damson, and containing a single seed. The pulp of ripe olives yields about 70 per cent. of oil, of which the finest quality, imported from Provence and Florence, is obtained by moderate pressure of the freshly-gathered fruit placed in coarse bags. Medium qualities are prepared by strong pressure from long-gathered and fermented fruit, and a good deal of oil of this description is brought from Naples. Inferior varieties, got from stale or rotting olives, or by moistening with boiling water and pressing the residue left during the manufacture of superior qualities, come from Sicily and Spain. The crushed kernels of ripe olives yield a fixed oil in the proportion of about one-fortieth of that obtained from the pulp (Flückiger).

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 compounds of an acidulous radical, oleic, palmitic, or stearic acid, and the basylous

glycerine. Olive oil contains about 72 per cent of fluid olein ($C_3 H_5$, 3 $C_{18} H_{33} O_2$), 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°, is ·910. At 36° its solid fats begin to crystallise; at 32° it is completely solidified. It is not miscible with water, is scarcely soluble in alcohol, but dissolves in one and a half 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 oleaginous bodies, small quantities are easily digested and assimilated, aid cell development, produce force, 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 one of the safest and best laxatives for the dog. When injected into the veins, like other fluid fats, it fatally obstructs capillary circulation. Half-an-ounce injected into the jugular speedily destroys a dog. In poisoning by irritants and corrosives, it exerts demulcent and emollient effects, further combats the action of alkalies by forming soaps, and also retards solution and absorption of arsenic. Not drying or readily becoming rancid, it is a soothing protective for irritable or abraded surfaces, but for such veterinary purposes is usually superseded by the cheaper rape, lard, or linseed oils, or by vaseline.

OPIUM.

The juice inspissated by spontaneous evaporation, obtained by incision from the unripe capsules of the poppy, Papaver somniferum, grown in Asia Minor.—*Brit. Phar.*

Nat. Ord.—Papaveraceæ. *Sex. Syst.*—Polyandria Monogynia.

Opium, one of the most ancient articles of the Materia Medica, derives its name from the Greek word ὀπός (*opos*), signifying juice. It is obtainable from any of the poppy

species, several of which abound as annual weeds. The stem, unripe capsules, and other succulent parts of any of the poppy species contain a milk-white narcotic juice. The fresh red petals of the Papaver rhœas, or corn rose, used as colouring agents, when eaten by animals are stated to have caused staggering gait, pain, diarrhœa, delirium, and sometimes stupor (*Veterinarian's Vade Mecum*); but this is scarcely possible, as they do not contain morphine or any other active principle (Attfield). The roots of many species contain a cathartic principle. The nearly ripened poppy heads or capsules, gathered about twelve days after the petals fall, when dried, contain less narcotic matters than in the green state; traces both of morphine and codeine are, however, still present, with a feebly alkaline crystalline inert substance rhœadine, and a large amount of mucilage. Digested in hot water, these capsules are used for making soothing infusions. They contain numerous white or brown reniform seeds, devoid of narcotism, but yielding a bland, drying oil, similar to that of lint or rape-seed. The cake or residue left after expression of the oil is used as cattle food.

The Papaver somniferum—the common white or garden poppy—is the true opium poppy. It is a native of the warmer parts of Asia, is largely cultivated in Asia Minor, but also thrives in this country. According to climate and elevation 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. All the opium of commerce is derived from the several varieties of this poppy. The white-flowered sorts 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 from the incisions a thick milk-white juice, which concretes and deepens in colour until it forms semi-solid, red-brown, adhesive tears. This is opium. Twelve or fifteen hours after the incisions have been made, the tears, weighing a few grains, are collected from each capsule, 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.

Varieties.—The several sorts of opium—of which the most notable are Turkey, Egyptian, East Indian, Persian, and European—owe their characteristics to differences in soil, climate, 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 brought down in bags or baskets, is covered with poppy leaves and with the chaffy seeds of the rumex, and exported from Smyrna and Constantinople; 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 pale-coloured solution, and to alcohol of all strengths, forming dark-coloured tinctures. Good samples in a fresh state contain on an average 10 or 12 per cent. of morphine, and are also rich in meconic acid.

Egyptian Opium, being generally grown on moist soils, and collected before the capsules are ripe, is inferior to the best Turkey opium. It is in round flattened cakes, about four inches in diameter, of a red colour, hard, dry, and brittle; is covered with the remains of the leaf of the oriental plane (Professor Bentley); and contains on an average about 6 per cent. of morphine.

East Indian Opium, chiefly prepared in the central tract

of the Ganges, in the districts of Benares and Patna, and in the province of Malwa, is mostly disposed of to the Chinese, who prefer it to Turkey opium, and purchase annually about twelve million pounds at the rate of about 20s. per lb. The juice is extracted in the usual way, the fluid part poured off, the solid residue carefully dried in the shade, and in most districts disposed of by the native cultivator to the government factories, where it is purified, raised to the desired consistence, and encased in poppy, and sometimes in tobacco, leaves. This outer case gradually becomes black, hard, unyielding, of the appearance of a large bullet, and usually contains about 3½ lbs. standard opium, which remains for a long time soft and ductile, and of a dark pitch-like appearance. The best Bengal opium, not intended for exportation, is dried in the sun, until it contains only 10 per cent. of water, is moulded into square pieces of two pounds weight, enveloped in oiled Nepaul paper, and packed in wooden boxes. It is firm, dry, of a yellow-brown colour, and nearly equal to Smyrna opium in quality and percentage of morphine. The Malwa opium, which does not pass through the Government factories, is neither so uniform nor so good as that of Benares (Report of Dr. Eatwell, Opium Examiner at the Government Factory at Ghazipur, in *Pharmaceutical Journal*, vol. xi., 1852).

Persian Opium, cultivated in the central provinces, much of it forwarded overland to China, a small amount brought to Europe usually by way of Trebizond and Constantinople, is of irregular quality, and occurs in rounded cones or flat circular cakes, weighing six to ten ounces; the best samples yield 8 to 10 per cent. of morphine.

European Opium.—Opium is obtainable in all temperate and sub-tropical countries where the rainfall is not excessive, 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 57½ lbs. 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 lbs. per acre of very fine 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 lucrative. Unless, however, returns could be realised like those got in India, where the acreable yield is 30 lbs., the production of opium could not pay in this country. But under favourable circumstances, poppies might be cultivated, and morphine at once extracted.

Properties.—The several kinds of opium, although possessed of various distinctive properties, are all obtained from the nearly ripened capsules of the same species of poppy; occur in irregular red-brown or brown-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. Recently imported, they contain 10 to 15 per cent. of water, and are moist and plastic; long kept, or artificially dried, they are hard, and easily reduced to a brown powder, which is apt, unless carefully preserved, to absorb moisture. Under the microscope they exhibit various crystalline forms. When heated they soften, and at high temperatures burn 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 ingredients. Rectified spirit dissolves about 80 per cent., and forms a dark-brown tincture, which includes all the active principles. Acids, when strong, disorganise opium; when diluted, are excellent solvents for it. The watery solution reddens litmus, owing to the presence of meconic acid 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 18s. per pound, there is great temptation to substitute inferior qualities, or add foreign matters. Inferior specimens are distinguished by narrowly examining their consistence, texture, colour, odour, and taste. They are often dry, hard, and resinous, or oleaginous and waxy; their fresh fracture devoid of the characteristic red tint and agreeable aromatic odour; 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, inferior tobacco, and, most subtle and difficult of detection, opium from which the morphine has been already extracted. Such inorganic matters as sand, clay, and mud, may be detected by inspection, especially if the specimen is 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 15 per cent. But the most certain test of quality or purity is the proportion of morphine. 100 grains of good opium, subjected to the rather complicated test process of the British Pharmacopœia, yields at least eight grains of morphine.

Composition.—Opium is a complex substance. It contains mucilage, with somewhat different characters from those of gum arabic, pectin, wax, albumen, and colouring matters, chiefly derived from scrapings of the capsules, and constituting about 10 per cent.; 10 to 15 of water; traces of an aromatic volatile oil; caoutchouc sometimes reaching 11 per cent.; traces of uncrystallisable sugar which, owing to unwarrantable addition, in some French specimens, reaches 6 or 8 per cent.; about 7 of ash; and, combined chiefly with meconic and sulphuric acids, several crystalline alkaloids and neutral principles, of which the most important are morphine, meconine, narceine, papaverine, narcotine, codeine, and thebaine. A number of derivative constituents have also been separated. A detailed notice of these bodies, to which opium owes its poisonous and medicinal actions, is subjoined:—

Morphine or Morphia (C_{17} H_{19} N O_3, H_2 O), the most important of the crystalline principles of opium, is prepared by decomposing with ammonia a solution of morphine hydrochlorate (p. 503), washing the precipitate, and drying at a gentle heat. The yield from different specimens of opium previously dried ranges from 6 to 20 per cent. The highest recorded yield is 22·88 per cent., obtained from opium grown near Amiens, and nearly the same results have been got from selected specimens of Turkey opium. From good opium, in its fresh state, as found in English warehouses, the yield varies from 10 to 15 per cent. Morphine crystallises in minute, transparent, right rhombic prisms, usually arranged in tufts; has an intensely bitter taste, and an alkaline reaction. It is insoluble in ether, benzole, and chloroform, dissolves in 1000 times its weight of cold water, in 400 of boiling water, in 30 of boiling rectified spirit, in amyl, alcohol, oils, caustic alkalies, and weak acids, with which it forms crystallisable and usually soluble salts. Carbonate of soda precipitates morphia from its salts, the precipitate is not re-dissolved by excess of the reagent. 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. Concentrated sulphuric acid and a little molybdic acid give a violet colour, gradually turning brown and finally blue. Its actions and uses are identical with those of its salts. (See p. 504.)

Apomorphine (C_{17} H_{17} N O_2), a crystalline derivative from morphine, is prepared by heating morphine hydrochlorate for several hours in a hermetically-closed tube, when an atom of water is abstracted. It is amorphous, slightly bitter, moderately soluble in water, more so in alcohol ; exposed to the air it gradually becomes green. It is the most certain and active emetic known ; $\frac{1}{4}$ grain in solution in water when swallowed, $\frac{1}{10}$ grain injected hypodermically, cause in men and dogs emesis within five or ten minutes, usually recurring several times at intervals of ten or fifteen minutes, causing sleep, but occasionally also inducing syncope (Dr. Harley).

Meconine or Opianyl (C_{10} H_{10} O_4) is neutral, fusible, volatile, mildly bitter, in silky prisms, resembling quinine sulphate. It constitutes ·01 to ·02 per cent. of opium ; is soluble in hot water and chloroform ; in sulphuric acid it forms a bright amber-coloured solution, which, on heating, passes through green, indigo-blue, and eventually becomes a permanent purple. Dr. Harley, experimenting upon horses, injected subcutaneously grs. xiv., and gave grs. xx. by the mouth, without observing any effect ; but on dogs and mice more decided tranquillising effects were produced than by the less soluble narceine.

Narceine (C_{23} H_{29} N O_9) 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°, soluble in 100 parts of boiling water, 400 of cold, 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 slight hypnotic effects, similar to what are induced by a grain of morphine. Poisonous doses arrest respiratory movements, but do not cause convulsions (Dr. Harley).

Papaverine (C_{21} H_{21} N O_4) (Flückiger) is present to the extent of about 1 per cent., is separable in shining prisms, which melt at 297°, is tasteless, sparingly soluble in water, soluble in dilute acetic and hydrochloric acids, forms with cold nitric acid an orange colour, and is a decided but feeble hypnotic.

Cryptopine or Cryptopia (C_{21} H_{23} N O_5), an alkaloid discovered by Messrs. T. and 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 resembles that of meconine and narceine, and is about one-fourth that of morphine. Poisonous doses destroy life by arresting respiratory movements (Dr. Harley).

Narcotine (C_{22} H_{23} N O_7) 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 the impure narcotine with hot alcohol and animal charcoal. Its colourless rhombic prisms melt at 350°, have an insipid taste, and are soluble in ether, alcohol, and weak acids, but not in cold water. By heating with water narcotine is split up into meconine and cotarnine (C_{12} H_{13} N O_3). 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; it is tonic and antiperiodic; 20-grain doses have been used in India as a substitute for quinine in the treatment of intermittent and remittent fevers; large doses are convulsant.

CODEINE or CODEIA (C_{18} H_{21} N O_3), present in the proportion of $\frac{1}{4}$ to 1 per cent., is a colourless bitter alkaloid, crystallising in rhombic octahedra, soluble in 50 parts water at 60°, in 25 parts at 212°, and in less than two parts of alcohol and chloroform. It melts at 300°. Unlike morphine, it is insoluble in cold, weak, caustic potash, and unaffected by ferric-chloride. It exhibits, like the other alkaloids, the twofold soporific and excitant action, but the excitant action is stronger; although closely resembling morphine it requires four times the dose to produce its effects; it causes convulsions, nausea, embarrassed breathing, and cardiac excitement (Dr. Harley).

THEBAINE or PARAMORPHIA (C_{19} H_{21} N O_3) is present to the extent of $\frac{1}{2}$ per cent., is obtained in minute, colourless, rectangular prisms, melting at 380°, 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. Harley).

MECONIC ACID (H_3, C_7 H O_7, $3H_2$ O), found only in opium, in quantities varying from 3 to 6 per cent., forms, along with sulphuric acid, the solvent for the alkaloids. It is obtained as a by-product in the preparation of morphine muriate by mixing the crude calcium meconate (see p. 503) with ten parts of boiling water and an excess of strong hydrochloric acid. Separated from calcium sulphate and colouring matter, it is in transparent, snow-white, scaly crystals, which are soluble in water and alcohol; heated above 150°, they are decomposed. It is tribasic; forms, with neutral solution of ferric-chloride, a blood-red solution; and with copper ammonia-sulphate, a green precipitate. No effect is produced by eight grains given to dogs, cows, and frogs, or by four and five grains administered to men (Pereira).

Physical and Chemical Tests.—Solid opium is easily identified by its red-brown colour, peculiar odour, and bitter taste; simple solutions by the last two of these tests, and by the reaction of nitric acid on the morphine, or of neutral solution of ferric-chloride on the meconic acid. Such tests are, however, inapplicable in the contents of the stomach or other complex solutions, until they are freed of colouring matters and impurities. This may be effected as follows:—Reduce the solid parts of the mixture to a state of fine division, add water if necessary, acidulate with acetic acid, filter, and evaporate to the consistence of syrup. Redissolve the concentrated fluid in alcohol, boil, and filter when cool. Then evaporate the solution, dissolve the semi-solid residue in water, and filter again. The fluid, now tolerably clear, if opium has been present, will contain morphine meconate, and is treated with excess of lead acetate and filtered. The clear solution so got contains morphine acetate; the solid residue left on the filter is lead meconate; and both solution and residue afford valuable indications of the presence of opium.

The clear solution, treated with hydrogen-sulphide to remove any traces of lead, is filtered and treated with ammonia to precipitate the morphine, which is washed, purified if necessary by solution in alcohol, and crystallises in colourless rhombic prisms. Nitric acid dissolves these crystals with effervescence, instantly producing an orange-red colour, which becomes

yellow when excess of acid is used. This very delicate test is not, alone, certain evidence of the presence of morphine, as nitric acid produces the same effect on brucine and commercial strychnine. A strong neutral solution of ferric-chloride strikes a dirty-blue colour. A fragment of iodic acid, dropped into a test-tube containing a strong solution of a morphine salt, is decomposed, and the free iodine may be detected by mucilage of starch. This, however, is only a confirmatory test, as iodic acid is similarly decomposed by various albuminoids.

The solid residue left on the filter, containing, as above stated, lead meconate, should also be examined, as the tests for meconic acid are very delicate, and afford indication of opium even when it is in such minute quantity as to be undetectable by the morphine tests. The meconic acid may be separated from the lead either by hydrogen sulphide or sulphuric acid; the insoluble salts, thus formed, are got rid of by filtration, leaving the meconic acid in solution. (*a.*) In considerable quantity it may be purified, when it appears in colourless tabular crystals, which, when aggregated, have an appearance like spermaceti. (*b.*) Heated in a test-tube, it is partly decomposed, partly sublimed, forming radiated tufts of needle-like crystals of pyromeconic acid. (*c.*) In aqueous solution, it produces, with copper sulphate, a pale green precipitate, which is dissolved by boiling, but reappears on cooling. (*d.*) But its most delicate and characteristic test is the neutral solution of ferric-chloride, which produces an intense blood-red solution of iron meconate. For all practical purposes, this test, along with the reaction of nitric acid upon morphine, is conclusive evidence of the presence of opium. Ferric-chloride produces, however, a blood-red solution with acetates, but only in strong solutions, and when the acetic acid can be easily detected by other tests; and with sulpho-cyanates existing in the saliva, especially of sheep. Two simple tests remove this source of fallacy, and readily distinguish iron sulpho-cyanate from iron meconate. Corrosive sublimate bleaches the sulpho-cyanate, but does not affect the colour of the meconate; whilst, conversely, hydrochloric acid decolorises the meconate, but does not affect the sulpho-cyanate.

Actions and Uses.—Opium containing so many diverse constituents exhibits many and diversified actions. It acts both on the cerebro-spinal and sympathetic systems. Full doses cause primary stimulation and secondary depression. Dr. John Harley describes opium and its alkaloids as soporifics which include anæsthesia, and excitants which include cramp and convulsions (Royle's *Mat. Med.*, 6th edition.) The prominence of one or other of these dissimilar actions varies with the species of patient, his state of health, and the dose administered. In most horses, receiving full doses, the excitant action predominates; in most dogs the two antagonising actions are more evenly balanced—there is usually delirium with stupor; in frogs tetanus without narcosis occurs; in most men the soporific action speedily obscures the excitant action. Poisonous doses usually prove fatal by arrest of respiratory movements. Small, frequently-repeated doses are stimulants,

restoratives, diaphoretics, and cardiac tonics. They reduce sensibility of sensory nerves, hence diminish supplies of blood determined to irritated or inflamed parts, and thus are effectual anodynes. They lower excitability of the respiratory centre, and hence abate cough and bronchial irritability. Fuller doses are narcotic, sedative, antispasmodic, and, in virtue of their paralysing nerve centres and end organs, are anodyne. Digestion and absorption, secretion and excretion, are not retarded by stimulant or feebly soporific doses, but are checked or arrested by full soporific or anæsthetic doses. Applied topically, opium acts as it often does when given internally—it first stimulates, and then soothes and paralyses both sensory and motor nerves. Used, whether externally or internally, it is thus one of the most effectual antidotes for pain, nervous irritability, and spasm.

The following are the primary constituents of opium, and its chief secondary or derivative constituents, arranged in the order of their activity as soporifics and sedatives :—

Morphine.	Narcotine.
Meconine.	Apomorphine.
Narceine.	Codeine.
Papaverine.	Thebaine.
Cryptopine.	

Morphine stands first in this series as the most active soporific and sedative, but the least excitant. Next follow in order alkaloids each less soporific but more excitant, until thebaine is reached, which is the least soporific, but most excitant and convellent of the series.

Toxic Effects.—Opium is readily taken up from any of the mucous or serous surfaces, from the skin, or from wounds. Entrance into the blood is essential to the production of its constitutional effects. It is excreted chiefly by the kidneys and skin. From his admirable experiments on various animals, detailed in *The Old Vegetable Neurotics*, Dr. John Harley concludes that opium and morphia "act both upon the cerebro-spinal and the sympathetic nervous systems—the soporific effects resulting from its action on the cerebral hemispheres; the excitant from excessive stimulation of the corpora striata

and spinal cord; and the acceleration of the heart's action partly to direct stimulation of the sympathetic nerves and partly to an indirect stimulation of the same centres, resulting from the excitement of muscular movement. How far the muscular movements are due to excitation of the motor centres in the brain is not very evident. That the spinal cord is implicated appears to be indicated by the rhythmical character of the movements; the horse scrapes the ground with the same hoof for hours together, begins and ends with a regular tread from side to side, or goes round and round continuously in the same direction. There is an evident tendency to forward movement, together with inaction of the hind legs. Vascular excitement, if intense and prolonged, ends in dilatation of the capillaries, general congestion, imperfect oxidation of the blood, and weakness of the heart" (p. 105). Dr. Harley further states, that opium diminishes the conductivity of the vaso-motor nerves, deranges and depresses the functions of the vagus, and thus develops the characteristic nausea, retching, cramp of respiratory muscles, and distention of the right heart (p. 121). Dr. Fothergill ascribes the soporific effects of opium to cerebral anæmia and diminished activity of the cerebral cells.

Horses, like men, exhibit considerable differences in their susceptibility to the action of opium; excitable, well-bred subjects are more readily brought under the excitant effects; quiet, phlegmatic individuals under the soporific actions. This difference in temperament accounts for many of the diverse reports concerning the action of opium on horses. Hertwig mentions that two to four drachms have scarcely any other effect than that of a slight stimulant; 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. Harley found that four drachms powdered opium caused little effect for seven hours, and then only acceleration of the pulse. Four ounces laudanum had no noticeable effect. Some of Dr. Harley's interesting

experiments with morphine on horses are detailed below. 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. From disease of the eyes the condition of the pupil could not be noted. After half an hour, four drachms, also dissolved in water, were given, and increased the dulness and weakness of the pulse, which now numbered 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 induced, after six doses, acceleration of the pulse to eighty-eight, restlessness, vertigo, nausea, champing of the teeth, and death on the third day.

Ruminants are not very susceptible either of the excitant or soporific effects of opium. Cows take an ounce, and sheep four drachms, without suffering any further effects than dryness of the mouth, occasional nausea and restlessness, acceleration, and subsequently slight depression of the pulse. Swine, after receiving one or two drachms, become first lively, and then dull and sleepy, their bowels constipated, and their skins hot. Dogs are acted on much in the same way as men. With moderate doses most become stupid and drowsy; but other individuals are rendered delirious, especially by large doses. The pupil is not dilated as in the horse or cat, nor continuously contracted, as in man, but is contracted whilst the dog is asleep or narcotised. One to three drachms usually cause in dogs, 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, and, as death approaches, stupor—never, however, so deep or lasting as in human patients, and from which the animal may always be easily roused. The symptoms continue from three to fifteen hours; and most animals which survive the latter period eventually recover. Dr. Harley injected

twenty minims laudanum under the skin of a bitch about twenty-five 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. Dr. Weir Mitchell's experiments show that ducks, chickens, pigeons, and other birds cannot be poisoned by crude opium or any of its preparations given internally; that morphine salts are fatal only when given in enormous doses, and produce convulsions, but neither sleep nor stupor.

In animals poisoned by large doses of opium the blood is fluid and dark-coloured from imperfect decarbonisation, but does not yield on analysis any indications of the poison. There is general venous engorgement, and the right cavities of the heart are distended with soft coagula. The subarachnoid spaces and ventricles contain more serum than usual.

Opium and its preparations annually destroy in Great Britain upwards of one hundred human lives, three-fourths being children under five years. In the lower animals accidental poisoning with opium occurs occasionally, intentional poisoning very rarely. Any unabsorbed poison is to be promptly got rid of either by the stomach-pump or by emetics, but both in men and dogs, so long as the patient can swallow, the latter are most effectual. Mustard and warm applications to the chest counteract cramp of the respiratory muscles, and sustain the action of the heart. Artificial respiration, dashing cold water over the head and neck, and faradizing the muscles of the chest, antagonise paralysis of respiration. Blood drawn from the jugular vein helps to relieve lung congestion. Strong tea and coffee, stimulant clysters, and keeping the patient moving about counteract tendency to stupor. Tincture of galls and other chemical antidotes are of little avail. Strychnine has a decided antagonising effect, and when used hypodermically, in a few minutes rouses dogs from hopeless stupor. Belladonna, or atropine, given before, along with, or

immediately after, a poisonous dose of opium, exerts partial antagonism, prevents in dogs nausea and vomiting, relieves bronchial spasm, and stimulates the over-taxed heart. But although antagonising some of the actions of opium, neither strychnine nor atropine is, however, available as a safe antidote (Dr. Harley).

Medicinal Uses.—No article of the Materia Medica is more frequently and generally prescribed. As a stimulant and restorative it sometimes acts almost like food or alcohol. Cutchie horsemen share their opium with their jaded steeds, and increased activity and capability of endurance with retardation of waste are observed alike in man and beast. In the treatment of inflammation opium is an important remedy; it dulls excessive sensibility and irritability, raises the tonicity of congested or inflamed vessels, thus diminishes the amount of blood determined to irritable or inflamed parts, and hence acts as a true antiphlogistic. In various diseases of the bowels it maintains their quietude; in many cases it counteracts exhausting pain. It is more generally serviceable in inflammation of serous and fibrous tissues than in inflammation of mucous membranes or parenchymatous organs.

In gastritis, or gastro-enteritis, whether produced from disease or from swallowing acrid poisons, opium is of value in allaying 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. Whether occurring from congestion of the alimentary mucous membrane, or as a symptom of other ailments, diarrhœa is often removed by a laxative which carries away offending matters. Occasionally, however, the intestines get into an irritable relaxed condition; opium in such cases abates irritability, diminishes excessive secretion, and is often advantageously united 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, and half an ounce of chalk. These ingredients are either 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 a good astringent anodyne drench for diarrhœa in the cow, and may be given in gruel, ale, or spirits and water. Another useful prescription for such cases of relaxed bowels consists of an ounce each of laudanum, decoction of oak bark, ginger, and sodium carbonate, given several times daily in gruel or ale. One-third of this dose suffices for six-months calves. For dogs, Stonehenge mixes three to eight drachms laudanum, two to three drachms chalk, one drachm aromatic confection, and two drachms gum arabic, dissolved together in seven ounces of water; and of this mixture orders one or two table-spoonfuls every time the bowels are relaxed. In dysentery, whether in horses, cattle, or dogs, opium is of great service in allaying pain and straining, and may usually be freely given both by the mouth and rectum. A drachm each of powdered opium, galls, and copper sulphate, is a good formula, and may be repeated twice a day either for horses or cattle. Whilst febrile symptoms continue, this mixture, or indeed opium itself, 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.

Antagonising muscular spasm, opium is valuable in intestinal colic, so common amongst improperly and irregularly fed horses, and is usually conjoined with such stimulants as sulphuric ether, sweet spirit of nitre, chloroform, spirit of ammonia, or oil of turpentine, and such laxatives as aloes in solution and linseed or castor oil. For general service, few colic draughts are more effectual than four or five drachms of aloes rubbed down in a quart of tepid water, with an ounce each of laudanum and ether added when the solution is nearly

cold. As an antispasmodic for the dog, Stonehenge advises half a drachm to a drachm each of laudanum and sulphuric ether, given in an ounce of camphor mixture. In the rapidly fatal muco-enteritis, amongst the heavier descriptions of hard-worked horses, a dose of opium and calomel was 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 the most successful treatment consists in repeated hypodermic injection of morphine, atropine, and ergotine. In peritonitis, whether common or puerperal, the chief hope of cure lies in the early frequent administration of large doses of opium, which control inflammation, exudation, and passive hæmorrhage, and lessen irritability and pain. Where acute pain is to be blunted or violent spasm counteracted, large and repeated doses are conjoined with belladonna extract, and given in solution. In such circumstances there is little fear of bad consequences, for the system attains great toleration both of narcotics and stimulants. Obstruction of the bowels from dust ball, strangulation of the intestine, and intussusception, are usually hopeless, but the only treatment which affords much promise of success is the administration of large doses of opium, which combat spasm, irritation, and pain, and may allow time and opportunity for restoration of the parts to a more normal condition.

Diseases of the respiratory organs, with shallow embarrassed breathing, are unsuitable cases for full doses of opium, which are apt still further to depress respiratory function, and favour death by apnœa. Pleurisy may be treated by larger and more frequently repeated doses than bronchitis or pneumonia. Opium, however, diminishes excitability of the respiratory centre, and hence relieves cough irritability 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—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, and besides improves appetite and strengthens the pulse. A similar prescription answers in cases of 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. In typhoid fever in horses, especially where the bowels are irritable and relaxed, opium is given in frequent small doses, conjoined with nutrients, salines, mineral acids, or stimulants.

Rheumatism is sometimes advantageously treated with opium, used in the earlier and more acute stages with calomel and salines ; and in more chronic cases with turpentine and other stimulants, smart friction, and warm clothing. Neuralgic pains occurring in horses, and causing puzzling, sometimes frequently-shifting lameness, are checked and occasionally cured by opium, or more conveniently by morphine used hypodermically. American practitioners find it effectual in 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 ; whilst 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. Combined with chloroform, it is of service alike in mares, cows, and bitches, in allaying the irritability and straining which occasionally follow parturition. Many practitioners recommend it in rabies and chorea, but it is of little use in either. It was once largely used in polyuria amongst horses ; but is less to be depended on than iodine. Although without power to arrest phthisis pulmonalis, it is often serviceable in relieving the accompanying cough and diarrhœa.

Opium is contra-indicated in acute fever, with a hot and dry skin and a full and strong pulse, in congestive and inflammatory diseases of the brain, and in obstinate constipation. 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, 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. When the skin is tender or abraded, especially in small and young animals, opium must be applied cautiously, as it is apt to become absorbed and produce constitutional effects. Boils and carbuncles may sometimes be aborted by freely saturating them with a strong solution or ointment, covering with a piece of oiled silk, and applying a large poultice. For hæmorrhoids, opium is conjoined with gall ointment. As a soothing astringent injection, it is used in enteritis, typhoid fever, and dysentery, and to allay pain and spasm in irritation and inflammation of the uterus, kidneys, bladder, and rectum. Such injections have not only beneficial topical effects, but by reflex action also soothe the organs connected with their respective external passages. As a clyster, opium is used in about the same quantities as are given by the mouth.

Doses, etc.—The average dose of solid opium for horses is ℥i. to ℥ij.; for cattle, ℥ij. to ℥iv.; for sheep, gr. x. to grs. lx.; for pigs, grs. v. to grs. xx.; for dogs, gr. i. to grs. vj.; and for cats, gr. ss. to grs. ij. Besides being given alone, it is combined with other medicines, which alter, increase, or repress some of its actions. In suitable cases, sufficient or repeated doses may usually be given until there appear such physiological symptoms as drowsiness, contraction of the pupil, or arrest of pain. Tolerance alike of opium and morphine is increased by acute pain and continued use. Effects are intensified by prescribing both together, and by introducing them simultaneously by several channels. The cardiac sedative actions of opium are intensified by combination with calomel, aconite, or tartar emetic; its stimulant and antispasmodic effects by admixture with sulphuric, chloric, or nitrous ether; its antispasmodic and anodyne effects by giving it with belladonna, Indian hemp, chloral hydrate, or conium; its anodyne and soporific effects by union with chloral hydrate, hemlock, or henbane, and by administering it about the times when

rest and sleep are usually taken; its diaphoretic effects by conjunction with warm clothing, hand-rubbing, exercise, and diluents, ammonia acetate, sweet spirit of nitre, and ipecacuan.

The opium preparations of veterinary practice are less numerous than these of human medicine. Crude opium is given to horses and dogs made into bolus, 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, is not a commendable preparation; for the high temperature at which it is generally made causes the resinous matters to unite with the alkaloids, forming compounds which are insoluble and of diminished activity. *Dover's Powder*, or rather the pharmaceutical imitation of that patent nostrum, consists of one part each of powdered opium and ipecacuan, and eight parts potassium sulphate, added to facilitate the trituration and intermixture of the vegetable matters. It is given to dogs as a febrifuge, in doses of grs. iij. to grs. x. A *watery solution*, made by rubbing down opium in hot water, and giving both dissolved matters and residue, is excellent for veterinary practice, being cheaper than the tincture, and more prompt and effectual than the solid drug. *Tincture of opium*, popularly known as laudanum, is thus prepared by the Brit. Phar. process:—"Take of opium in coarse powder an ounce and a half; proof spirit, one pint; macerate for seven days, 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 of laudanum contains the solid matters of 33 grains of opium, or 13¼ minims represent one grain of dry opium. The evaporation of a known quantity, and the weighing of 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 preferable to solid opium. The dose for horses and cattle is f℥i. to f℥iij.; for sheep and pigs, f℥ii. to f℥vi.; for dogs, ♏ xv. to ♏ xl. The vinegar and wine of opium are

seldom used in veterinary practice. An *ammoniated tincture* is prepared by digesting for seven days an ounce of opium with four fluid ounces of strong ammonia solution and 16 ounces of rectified spirit. An *ethereal tincture* is made with one or two ounces of opium to a pint of sweet spirit of nitre. Laudanum and soap liniment, mixed, make an excellent anodyne, much used externally, and occasionally added to clysters; but for this latter purpose the watery solution or tincture is generally preferred. In diarrhœa and dysentery, accompanied by pain and straining, few remedies are more effectual than injections of opium tincture, mixed with warm, well-boiled starch gruel.

Morphine Hydrochlorate or Muriate.—Hydrochlorate of morphine, or morphiæ hydrochloras ($C_{17}H_{19}NO_3HCl, 3H_2O$), is got by macerating opium in successive portions of water, when the morphine meconate is dissolved. Calcium chloride is added to the solution, mutual decomposition ensues, calcium meconate is precipitated, and morphine muriate remains in solution. The solution is concentrated, the morphine salt is crystallised out, purified by strong pressure in flannel or stout calico, which removes narcotine and colouring matter, and then redissolved in hot water and again crystallised. Several crystallisations, with the use of animal charcoal, are necessary to remove the last traces of colour; whilst, to free it from codeine, it is dissolved in water, and ammonia added, when pure morphine is precipitated, collected, redissolved in hydrochloric acid, and again crystallised. (*Brit. Phar.*) When the process is carefully managed, good Turkey opium yields 10 to 12 per cent. of morphine hydrochlorate.

Properties.—A snow-white powder, consisting of broken-down crystals, which, when entire are white, lustrous, flexible, needle-like prisms, clustering in radiated groups, it has no odour, but the intensely bitter taste which characterises morphine and all its salts. It is soluble in its own weight of water at 212°; in sixteen parts at 60°; and still more so in spirit. A good keeping solution is made with three parts water, one part rectified spirit, and a few minims hydrochloric acid. With salts of morphine, as with the alkaloid itself, nitric acid produces an orange-yellow coloration; strong neutral

solution of ferric-chloride, a greenish-blue coloration; iodic acid, the evolution of iodine, discoverable by the immediate production of the blue compound with mucilage of starch. A trace of colouring matter, narcotine, codeine, or other alkaloids, does not interfere with ordinary medicinal actions. White sugar is sometimes used for adulteration. The Brit. Phar. gives the following purity tests:—Entirely destructible by heat, leaving no residue. Twenty grains of the salt dissolved in half-an-ounce of warm water, with ammonia added in the slightest possible excess, gives on cooling a crystalline precipitate, which, when washed with a little cold water, and dried by exposure to the air, weighs 15·18 grains, the proper proportion of morphine.

Morphine Acetate.—Acetate of morphine, or morphiæ acetas (C_{17} H_{19} N O_3, C_2 H_4 O_2), is prepared by decomposing a solution of morphine hydrochlorate by ammonia solution, adding diluted acetic acid to the precipitated morphine, and drying at a gentle heat. It closely resembles the alkaloid, is snow-white and obscurely crystalline, with an intensely bitter taste; is decomposed and dissipated by heat; is almost completely soluble in water, and entirely so in acidulated water and alcohol. It is distinguished from morphine and its other salts by the acetous odour it evolves on addition of sulphuric acid. Whilst the hydrochlorate is generally used throughout Scotland, the acetate is often prescribed in England.

Actions and Uses.—Morphine, its hydrochlorate, acetate, and meconate, possess, in concentrated form, the several actions of opium. They have the same twofold characters as excitants and soporifics. According to the dose or species of patient, they destroy life by hypnotism, convulsions, or paralysis of respiration. They derange and paralyse the nervous centres, but the nerve-cords retain sensibility and conductivity. They are used to antagonise irritability, spasm, and pain. Compared with opium, morphine and its salts are less stimulant, less convulsant, more anodyne, less diaphoretic, less constipating, but more apt to affect the contractility of the bladder.

Dr. Harley and Messrs. Mavor (*Old Vegetable Neurotics*) found that four grains morphine acetate, subcutaneously injected, accelerated the pulse of horses by 20 to 28 beats, and

increased alike its force and volume, produced restlessness, pawing, increased moisture of the mouth and skin, elevation of temperature, and slight dilatation of the pupils. 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°; two hours later the pulse was 56, the temperature remained the same, the pupils dilated, the patient restless, the tongue moist; the effects gradually abated, and disappeared in twenty-four hours (*Veterinarian*, January 1874). Twelve grains, dissolved in three drachms of water, injected by three punctures, produced in one horse light drowsiness, giving way, after three hours, to excitement, restlessness, and slight delirium, continuing about six hours. Thirty-six grains, dissolved in seven drachms of water, introduced in three punctures, caused, in a seven-year-old hunter, in good condition, drowsiness and stupor, coming on in fifteen minutes, 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, respiration, at first slow and sighing, gradually becoming 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. Twelve grains 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 killed a horse with convulsions in three hours (Dr. H. C. Wood's *Treatise on Therapeutics*).

A brown bitch, weighing 25 lbs., had half a grain acetate subcutaneously injected by Dr. Harley, and in a few minutes was vomiting and urinating, 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 kill dogs of 12 lbs. to 16 lbs. weight 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; there are vomiting, nausea, restlessness, and delirium. In rabbits the action is also more spinal than cerebral, death often occurring in convulsions. In mice Dr. Harley records cramp of the spine and restlessness, hypnosis altogether an after affect, narcotism only occurring after a dangerous dose. The antidotes are those of opium.

Morphine and atropine are analogous in some of their actions, antagonistic in others. Morphine acts more notably on the cerebro-spinal system, atropine on the sympathetic. Morphine in full doses causes more or less stupor, cardiac depression, dilatation of arterioles and veins, pallor of the surface, reduction of temperature, diminished intestinal movements and renal action, usually with contraction of the pupil. Atropine in full doses causes delirium, cardiac and respiratory stimulation, contraction of arterioles, redness of the surface, elevation of temperature, increased intestinal movements and renal action, with dilatation of the pupil. Its effects are more persistent than those of morphine. The Edinburgh Committee of the British Association, appointed to investigate the antagonism of medicines, demonstrate that within a limited degree atropine and morphine are antagonistic. In dogs receiving poisonous doses of morphine meconate, subcutaneously injected, and at once followed by atropine sulphate, the symptoms are diminished; the respiro-cardiac functions, depressed by large doses of morphine, are stimulated by atropine, and life is saved. But the two narcotics are mutually helpful in controlling irritability, pain, and spasm. Dr. Harley found that four grains morphine acetate, with two grains atropine sulphate, swallowed by a horse, increase restlessness and delirium, rapidity and force of the pulse, diaphoresis and diuresis, and further induce sleep, which neither drug alone readily produces. When morphine and atropine are given simultaneously to dogs, the nausea and vomiting caused by full

opiates are checked; antispasmodic and anodyne effects are increased; while narcotism, so rarely produced by either drug alone, is sometimes developed (*Old Vegetable Neurotics*).

Medicinal Uses.—Morphine hydrochlorate and acetate are serviceable in the various cases in which opium, as above indicated, is prescribed. They are specially suitable where the medicine is required in concentrated form, and particularly for endermic or hypodermic use. Irritability and pain, unaffected or only slightly amended by opium, or even by morphine when administered by the mouth, are often abated or entirely removed by hypodermic injection of the alkaloid. The medicine, brought nearer to the abnormal condition, acts more speedily and certainly; a smaller dose suffices. Morphine hypodermic injections have been successfully used by various veterinarians, especially in neuralgia, acute rheumatism, spasmodic cough, hæmorrhage and muco-enteritis in horses; and in combating neuralgic and spasmodic pains, notably good effects result from conjoining with the morphine about one-twentieth to one-tenth of atropine. Mr. A. E. Macgillivray of Banff, has for several years used morphine muriate hypodermically, especially in colic, superpurgation, acute indigestion, inflammation of the bowels, post-partum hæmorrhage pains and straining, as well as in tetanus and hysteria. In tetanus he conjoins morphine with atropine, in hysteria he also prescribes full doses of bromide of potassium. He has sometimes advantageously kept up the action of the opiate by repeated injections for several days, insuring desirable quiet in cases of obstruction and twisting of the bowels. Mr. Macgillivray uses grs. iij. to grs. iv., and prefers a watery solution containing 32 grains to the ounce. Full doses in susceptible patients are occasionally found to induce staring eyes, restlessness, prancing round the box, increased rapidity and threadiness of the pulse,—symptoms which sometimes continue three to five hours (*The Veterinarian*, March 1881).

Doses, etc.—The hydrochlorate and acetate have fully six times the activity of solid opium. Horses and cattle take grs. iij. to grs. x.; sheep and pigs, gr. ss. to grs. ij.; dogs, gr. $\frac{1}{8}$ to gr. $\frac{1}{2}$, given in bolus, or dissolved in diluted spirit, slightly acidulated either with hydrochloric or acetic acid. For hypo-

dermic injection, not more than the minimum doses mentioned should in the first instance be used. For such purposes, the salt, freshly prepared, is dissolved as required in 10 to 20 parts of water.

PEPPERMINT.

Mentha piperita. Oleum Menthæ piperitæ. The oil distilled in Britain from fresh-flowering peppermint tops.

Nat. Ord.—Labiatæ. *Sex. Syst.*—Didynamia Gymnospermia.

The natural family Labiatæ furnishes mint, lavender, rosemary, marjoram, and thyme, the leaves of which contain aromatic volatile oils. Similar essential oils are extracted by distillation, chiefly from the leaves of various myrtaceæ, from the petals of rosaceæ, from the flowers and fruit of aurantiaceæ, and from the seeds of umbelliferæ. The presence of such volatile oils confer on these several plants aromatic antiseptic stimulant properties.

Peppermint is the most frequently used of the Labiatæ aromatics. It is herbaceous, grows wild in damp situations in many parts of Britain, is cultivated largely both in this country and abroad, has a smooth annual stem three to four feet high, and stalked ovate lanceolate smooth leaves. The herb, and especially the leaves, have an agreeable aromatic odour, and a warm aromatic taste, followed by a sensation of coldness, the result of the evaporation of the volatile oil of which the fresh leaves yield 1 to 1·25 per cent. It is levigose, and remarkable for the varied and beautiful colorations and fluorescence produced when it is acted upon by nitric acid and other reagents. At 24° Fahr. the oil deposits crystals of menthol or peppermint camphor (C_{10} H_{18}, H_2 O) which, if distilled with phosphoric acid, produces menthene (C_{10} H_{18}).

Actions and Uses.—Oleum menthæ piperitæ like oil of turpentine and other volatile oils, is antiseptic, stimulant, and a paralyser of the ends of the sensory nerves with which it is brought in contact. It is hence stomachic and carminative; after local stimulation it exerts reflex actions and sedative effects, often beneficial in gastric discomfort and flatulence. The changes it undergoes when it quickly reaches the blood

are unknown. It checks the fungous growth of favus, destroys most bacteria, and kills skin parasites. For such antiseptic purposes, both menthol and menthene have also been used. The oil is besides much used for flavouring and preventing the nausea of unpalatable drugs.

Doses, etc.—For horses and cattle, ℥ xx. to ℥ xxx; for dogs, ℥ iij. to ℥ v., given on a piece of sugar or in spirit and water. *Peppermint water* is prepared by distilling the fresh-flowering herb with water and a little rectified spirit, or, according to the Brit. Phar., by distilling 1½ fluid drachm volatile oil with 1½ gallon water, and collecting a gallon. A strong *spirit* or *essence*, very suitable either for medicinal or pharmaceutical purposes, is prepared by dissolving one part of the volatile oil in four parts of rectified spirit. The M. viridis, or spearmint, and the M. Pulegium, or penny-royal, are scarcely so powerful as peppermint.

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 20 to 30 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 P. officinarum and P. longum, is brought from Singapore and Batavia, and consists of small, closely-attached berries, arranged on cylindrical grey spadices one or two inches long. Cubebs, or Cubeba, are the dried partially ripened fruit of the Cubeba officinalis, 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, wrinkled,

with a strong odour, and pungent, aromatic, bitter taste. 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 piperin, which is isomeric with morphine (C_{17} H_{19} N O_3), and is resolved by nitric acid into piperic acid (C_{12} H_{10} O_4), and an active oily alkaloid piperidine (C_5 H_{11} N).

P. angustifolium, a shrub found in moist regions throughout Brazil and Peru, yields the matico leaves, much used in America as a styptic, and also prescribed for the arrest of internal hæmorrhage.

Jamaica pepper, pimento, or allspice, closely resembles the true peppers; is the dried unripe berry of Eugenia pimenta, an evergreen West Indian tree of the natural family Myrtaceæ. The berries, $\frac{1}{5}$th of an inch in diameter, 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, besides fixed oil and starch, 3 to 4 per cent. of volatile oil, nearly resembling oil of cloves, tannic acid, and traces of an alkaloid with the odour of coneine (Flückiger).

Capsicum—the dried ripe fruit of Capsicum fastigiatum and annuum—is also known as Chili pepper, chilies, Guinea or pod pepper, and, although originally from America, British supplies are now chiefly brought from Zanzibar. The several varieties differ in shape and size, are of a red colour, and filled with numerous red-brown, pungent seeds. The fruit is seldom used whole, but, when dried and ground, constitutes the familiar Cayenne pepper, which has a reddish-yellow colour, a faint disagreeable odour, and an acrid pungent taste. From its alcoholic extract is got capsicine, a yellow-red irritating liquid, slightly soluble in water, and consisting of resin and fatty matters. An extract of Cayenne pepper, made with petroleum, yields well-defined, volatile, intensely acrid crystals of capsaicin (C_9 H_{14} O_2), of which half a grain, volatilised in a large room, renders the air very irritating.

Actions and Uses.—The peppers are irritant, stomachic, and rubefacient. Large doses, especially in carnivora and omni-

vora, are irritant poisons, causing inflammation of the alimentary canal, and sometimes also of the urino-genital organs, with general vascular excitement. That they are especially poisonous to pigs is a popular error. Properly regulated doses as they are swallowed excite the nerves of common sensation and of taste; are stomachic and carminative; act as general nerve stimulants; are excreted by the kidneys, increasing their secretions, and sometimes beneficially stimulating 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. Cubebs is less irritant and stimulant, but has special power of arresting excessive mucous discharges. Pimento is less active than the common peppers, is occasionally used as a carminative and a flavouring aromatic; while capsicum and Cayenne are more irritant than black pepper.

Black pepper, the variety chiefly used in veterinary practice, is administered in simple indigestion, and for obviating the disagreeable taste and nausea of various drugs. It is not now given as a sialogogue, nor for the irritational 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, etc.—Of black pepper, as a stomachic and carminative, 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. An ointment made with one or two drachms of ground pepper to the ounce of lard was formerly used externally.

PETROLEUM—BARBADOES TAR—NAPHTHAS.

Petroleum is a somewhat vague term, applied to a class of bitumens usually found in the tertiary strata; produced during the formation of vegetable matters into coal, and varying in density and solidity from the hard brittle asphalt and mineral pitch to the viscid mineral tar and fluid naphthas. They closely resemble the artificially produced coal-tar, obtained from distillation of coal in the manufacture of gas. Coal-tar, the refuse of the gas-works, when distilled in an iron retort, gives off first ammonia, then about 10 per cent. of light oils, which, when purified by agitation with sulphuric acid, yield rectified coal naphtha, which, according to the mode of preparation, has the formula—C_{12} H_{20}, C_{14} H_{24}, or C_{16} H_{28}. The remaining heavier, or dead coal-tar, contains denser, less inflammable oils with higher boiling points, and is the source of carbolic acid.

The natural petroleum, brought from Rangoon, is obtained in unlimited quantity by digging wells about sixty feet deep, is of the consistence of paste, of a greenish-brown colour, and an agreeable bituminous odour. 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, is of the consistence of treacle, of a dull, green-brown colour, with a strong, disagreeable, persistent pitchy odour, and a bitter taste. Like other allied substances, it is not miscible with water, becomes hard and pitch-like when exposed to the air; when heated it liquefies, evolves volatile naphthas, and burns with a dense sooty flame. During the last thirty years enormous quantities of petroleum or rock oil have been brought from the oil springs or wells of Canada and the North American States, and used for illuminating and lubricating purposes. The petroleums and rock oils consist of a solid residue of bitumen or pitch, which, in Rangoon tar, reaches four per cent.; a crystalline spermaceti-like paraffine, the same as is obtained from cannel coal, and used instead of wax in candle-making; and a series of more volatile hydrocarbons or naphthas, chiefly belonging to the marsh gas series,

easily separated by distillation, varying in volatility and boiling point, excellent solvents for indiarubber, resins, fats, and sulphur, burning readily like alcohol; the source of aniline and other dyes; and under the several names of paraffine oils, petroleum spirits, benzole (C_6 H_6), or naphthas, used for burning, for singeing horses, and as antiseptics and stimulants.

Actions and Uses.—The petroleums are irritant, stimulant, diuretic, anthelmintic, and antiseptic. The more fluid and active naphthas in large doses are inebriant narcotics, and feeble anæsthetics, allied in physiological effect to the members of the alcohol series. Professor Williams records (*Principles and Practice of Medicine*) the chronic poisoning of cattle from their drinking water contaminated by the oils from paraffine works. The animals had diarrhœa, wasted, became anæmic; the oil was found to have saturated and darkened the intestinal glands, preventing their absorbing. Benzole and naphthas, in virtue of their penetrating solvent powers, are useful in getting rid of thickened skin scales, dissolve and remove condensed sebaceous matter, stimulate the dermis, penetrate to the hair roots, especially when rubbed in, promote their growth, are effectual in destroying the cryptogamic growths of ringworm, and are fatal to the several skin parasites. In the cure of mange and scab, they are advantageously added to or alternated with the ordinary sulphur, iodine, tobacco, or stavesacre dressings. Rangoon tar and the more solid petroleums were once prescribed as specifics in chest diseases, and as anti-emetics; but as internal remedies they are now little used. Barbadoes tar is still, however, applied externally for the same purposes as wood tar, particularly for the cure of skin complaints, thrush, canker, and other diseases of the feet. Coal-tar differs from Barbadoes tar chiefly in having a stronger, more offensive smell, and well deserves its popular credit as an antiseptic and stimulant adhesive particularly useful in diseases of the feet.

PODOPHYLLUM—PODOPHYLLIN.

Dried rhizome and rootlets of Podophyllum peltatum, from which the resin Podophyllin is extracted by rectified spirit.

Nat. Ord.—Berberideæ. *Sex. Syst.*—Polyandria Polygynia.

The Podophyllum, or May apple, a perennial herbaceous plant, grows abundantly in the Northern States of America, where its subacid fruit is eaten under the name of wild lemons. The root is imported in pieces of variable length, about two lines thick; mostly wrinkled longitudinally; dark reddish brown externally, whitish within; breaking with a short fracture; accompanied by pale brown rootlets. The powder has a yellowish grey colour, a narcotic disagreeable odour, a bitter, sub-acrid, nauseous taste. (*Brit. Phar.*)

The dried, coarsely-powdered root, by re-percolation with rectified spirit, yields three to five per cent. of the active resin or podophyllin, a pale, greenish-brown, amorphous powder; almost entirely soluble in pure ether, and quite soluble in rectified spirit and ammonia; precipitated from the former solution by water, from the latter by acids. The amorphous alkaloid berberine, devoid of irritant properties, also present in various plants of the Berbery tribe and in calumba root, an odoriferous principle and saponin formerly reported to be associated with the resin, have not been found in recent investigations (Flückiger).

Actions and Uses.—Podophyllum has long been used by the American Indians as an anthelmintic and emetic, and from its supposed resemblance to calomel has been styled vegetable mercury. Both the root and extracted resin are irritants. When swallowed they stimulate the mucous membrane and glands, particularly of the duodenum and small intestines; they stimulate the hepatic cells, are hence cathartics and cholagogues; while full or repeated doses are nauseants and sedatives. Full doses cause emesis in carnivora.

General Actions.—The late Dr. F. G. Anstie made, in 1863, a series of experiments with an alcoholic solution of podo-

phyllin, which he injected into the peritoneum of dogs, cats, and rats. With dogs about eighteen inches high, the solution, containing one to two grains of podophyllin, caused no uneasiness or movement of the bowels until ten or fifteen hours after injection, when vomiting and purging were set up, the frequently-passed dejections became very fluid, freely mixed with mucus, usually tinged with blood, and passed with much pain; breathing became shallow and hurried; the pulse feeble, at first rapid, but after a few hours very slow; insensibility, disturbed by occasional convulsions, continued for several hours before death, which occurred in twenty-two hours after the injection. There was no inflammation of the peritoneum, the stomach was perfectly healthy; but the small intestines, and especially the duodenum, were intensely reddened and inflamed; and where two grains had been injected, ulcers, of somewhat smaller size than a threepenny piece, were also found in the duodenum. The large intestines were healthy; there was no unusual amount of bile in the bowels, and no congestion or inflammation of the liver; the kidneys and mucous membrane of the urinary passages were slightly congested. Similar results were noticeable in cats, which, for the development of these poisonous effects, are stated to require doses fully larger than those which destroyed dogs. (*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 prompt and certain, but there was no griping, 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 anything like such marked results. I find that one grain podophyllin, bolted in a piece of meat by an English terrier weighing twenty pounds, produced no notable effect upon the bowels; and that two grains acted as a gentle laxative, but only eight hours after exhibition. My friend, Mr. Thomas A. Dollar, of New Bond

Street, London, has used the drug frequently, both in dogs and horses, and has kindly placed at my disposal his notes of the following cases :—

To a Scotch terrier, eight months old, Mr. Dollar administered half a grain of 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, of thirty-six lbs. live weight, received four grains in a pill, without showing any notable symptoms; and on the following day got 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 a scruple of 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; the fæces were little altered in colour; there were no indications of any special action upon the liver.

Podophyllin has less effect on cattle and horses than on men and dogs. To three healthy shorthorn cows I gave three drachms each, and to another cow half an ounce, without observing any laxative effect. I have repeatedly given healthy horses, prepared by mash diet, 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 only slight softening of the dung, such as might be expected from the aloes alone. I am again indebted to Mr. Dollar for the following interesting experiments :—

A thorough-bred horse, well prepared by mashes, had two drachms podophyllin without its producing the slightest purga-

tive 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 last case, of nearly ten beats per minute in 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 thorough-bred mare, 14½ hands high, 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 without showing 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.

Medicinal Uses.—The cholagogue actions of podophyllin have been thoroughly investigated by Professor Rutherford of Edinburgh. He finds that moderate doses of the resin, introduced into the duodenum, whether of fasting or of 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 is shared by aloes, rhubarb, colchicum, and croton oil. Like other purgatives, acting upon the small intestines, it moreover sweeps out food, which when absorbed stimulates the liver; while, in virtue of the catharsis produced, it carries away bile poured into the canal, and thus prevents its reabsorption. 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. Mr. Dollar's experiments demonstrate that amongst veterinary patients it is a tardy and uncertain purgative, especially when used alone. In combination however with aloes, jalap, or calomel, it certainly relieves torpidity or congestion of the liver; while its nauseant and sedative effects may sometimes be available in lowering inordinate action of the heart in acute diseases of the respiratory organs, rheumatism, laminitis, and other inflammatory disorders.

Doses, etc.—For cholagogue or sedative purposes, horses and cattle take ℥j. to ℥ij. of podophyllin, united with aloes or calomel, with nitre or Epsom salt. For dogs, gr. j. to grs. ij. may be conjoined with calomel gr. j., grey powder grs. v. to grs. x., or the same quantity of ipecacuan.

POTASSIUM AND ITS MEDICINAL COMPOUNDS.

Potassium salts are obtained chiefly from the mineral carnallite found in Saxony, and containing 50 per cent. potassium chloride, from sea water, or from the crude potashes got by dissolving the ashes of plants in water, evaporating the solution, and fusing the residue. They are identified in solution by their negative reaction with the several group tests for the metals, and their concentrated solution gives with platinum chloride a yellow crystalline precipitate of platinum and potassium chloride ($2\ KCl, Pt\ Cl_4$); and with excess of tartaric acid a white granular precipitate of cream of tartar ($KH, C_4\ H_4\ O_6$), soluble in excess of alkali. Evaporated to dryness, and ignited with alcohol, they produce a faint, violet-coloured flame—the spectrum of which is distinguished by two bright lines, one in the red, the other in the violet.

General Actions.—Potassium salts are two or three times more powerful than the corresponding sodium salts. Dr. Paul Guttmann states that poisonous doses paralyse the spinal cord and heart, depress or destroy first the functions of afferent nerves, lower blood pressure and temperature, and cause muscular weakness, affecting first the hind extremities. There are dyspnœa and convulsions, diminished frequency and force of the heart-beats, sometimes causing irregularity and in poisonous doses arrest of the action of the heart, which ceases to act in diastole—an effect which, as it follows even when the vagi are divided and the medulla removed, indicates a direct depressant action either on the heart itself or on its ganglia. They do not appear to act upon the muscles or peripheries of nerves. (Ringer's *Handbook of Therapeutics.*)

Potassium salts are constituents of the blood and all animal textures; abound especially in the juice of flesh and in milk; their excess or deficiency appears curiously to produce the same scorbutic effects. They are as essential for plant as for animal growth; are present in most land plants; various salts, notably the chloride, occur in the Australian salt bush countries, and are stated to be the source of the health and size of the stock grown and their freedom from

parasites. Potassium salts are very soluble. Like other alkalies, the hydrate and carbonates aid digestion of fatty matters. Given after eating, they neutralise undue acidity; but seldom permanently remove the cause of acid dyspepsia, which is usually best treated by acids given before meals. Small doses increase the gastric and other acid secretions; but diminish the alkaline secretions of the salivary glands, liver, and pancreas. They have a high diffusion power, rapidly enter the blood, increase its alkalinity, promote oxidation and tissue metamorphosis, are solvents of albuminoids, and thus in inflammation counteract deposition of exudate. Too long persisted with, or in large doses, they deteriorate the blood, and reduce bodily weight. They are excreted from the body 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 larger amount than soda salts, which are excreted more largely during convalescence.

It simplifies the understanding of the potassium salts to divide them into three groups :—1*st*, Those which are corrosive, antacid, and antilithic—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. 2*d*, Those which are irritant, cathartic, diuretic, alterative, febrifuge, and refrigerant —such as the sulphate, acetate, tartrate, nitrate, chlorate, and permanganate. 3*d*, Salts which show prominently the actions of their acid, or salt radical constituent—such as potassium sulphuretum, iodide, bromide, and cyanide.

POTASSIUM HYDRATE. Potassa caustica. Potassa fusa. Potassic hydrate. Hydrate of potash. Caustic potash. K HO.

POTASSIUM HYDRATE SOLUTION. Liquor Potassæ. Solution of potash, containing 5·84 per cent. by weight of hydrate.

Crude potashes, obtained by dissolving the ashes of land plants, calcined until white, yield pearl ashes or potassium carbonate, which, when boiled with freshly slaked lime, produce by double decomposition liquor potassæ, of which one

fluid ounce contains 27 grains of potassium hydrate (K HO or K_2 O, H_2 O). It is a dense, oily-like fluid, of specific gravity 1·058, colourless and odourless, 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. The concentrated oily liquid, when boiled until a drop removed on a stirrer becomes hard on cooling, and poured into pencil-like moulds, forms the grey or white deliquescent, hard, crystalline sticks of caustic potash.

Actions and Uses.—Large doses of potassic hydrate, whether solid or in concentrated solution, are irritant, corrosive, and cardiac sedatives. Medicinal doses are antacid, febrifuge, and diuretic. Externally they are used as active penetrating caustics.

Excessive doses, when swallowed, soften, corrode, and inflame the œsophagus and stomach, sometimes so severely as to cause perforation; while, accompanying the local lesions, are great depression, with paralysis of the extremities and heart. Hertwig records that two drachms of caustic potash, dissolved in six ounces 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 examination 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, although dark-coloured, owing to the solvent action of the alkali, is generally fluid. Smaller or more diluted doses gradually impair digestion and assimilation, and destroy life by inanition. The fitting 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, with milk gruel or other demulcents. Dr. John Shortt, of Madras, finds the solution an effectual antidote for the poison of snakes and vipers. Half a drachm, repeated twice daily, has been prescribed for feeding sheep affected

with vesical and urethal calculi; but the carbonate is milder and equally effectual. Caustic potash is used for eradicating warts and fungous growths, and making issues. Being very deliquescent and apt to spread, and penetrating, it must be applied cautiously, and any excess of alkali neutralised by subsequent washing with a weak acid. Mixed with lime, constituting Vienna paste, it is less deliquescent, and hence more safe and manageable.

POTASSIUM CARBONATE. Potassæ Carbonas. Potassic Carbonate. Carbonate of Potash. ($K_2 CO_3$).

POTASSIUM BICARBONATE. Potassæ Bicarbonas. Bicarbonate of Potash. ($KH CO_3$).

The American pot or wood ashes, in their partially purified condition of pearl ashes, contain about 80 per cent. of potassium carbonate, with 20 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. A pure carbonate is got by burning together equal parts of potassium bitartrate and nitre, adding water, filtering and evaporating the solution. The carbonate occurs in crystals as a crystalline powder, but more generally in grains; 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°, 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 16 per cent.

Potassium bicarbonate, or acid carbonate of potash, is prepared by passing a current of carbonic acid through a strong solution of the neutral or mono-carbonate. It occurs in transparent, colourless, right rhombic prisms; has a mild, saline, and slightly alkaline taste; dissolves in about four times its own weight of water at 60°; when heated to redness, it gives off carbonic acid, and becomes converted into the neutral carbonate, from which it is distinguished by its milder non-acrid

taste, by its more abundant effervescence with hydrochloric acid, by its not deliquescing when exposed to the air, and by its giving, in diluted solution, no precipitate with Epsom salt or corrosive sublimate. The hypothetical hydric carbonate ($H_2 CO_3$) being dibasic, is capable of exchanging either one or both of its atoms of hydrogen for the same number of atoms of the monovalent potassium, forming in the first case the bicarbonate ($KH CO_3$), and in the second the carbonate ($K_2 CO_3$).

Actions and Uses.—The two carbonates differ only in the degree of their action. Both resemble the hydrate, but have their activity tempered and diminished by combination with carbonic acid. The bicarbonate has no irritant or corrosive action, is preferred as an antacid, and in virtue of its liberating carbonic acid exerts soothing effects on the irritable gastric membrane. 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). Its antidotes are the same as those of caustic potash. Both carbonates are antacid, antidotes for overdoses of acids, alteratives, and diuretics.

Medicinal Uses.—Potassium bicarbonate is occasionally substituted for sodium bicarbonate to aid the emulsionising of fats, and, on account of the evolution of carbonic anhydride, to exert gently sedative effects on 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 acid fermentation of starch, sugar, or fats—cases common amongst carelessly fed calves. The precise pathology of rheumatism is not yet clearly made out; but small repeated doses of alkaline bicarbonates often prove beneficial, apparently by promoting metamorphosis of albuminoids, neutralising excess of lactic acid, and encouraging the action of the kidneys. In such cases it is often conjoined with oil of turpentine, quinine, or potassium iodide. Similar antacid treatment is also successful in nettle rash, lichen, and occasionally in eczema; the bicarbonate being also applied externally to raw, weeping, painful, or itching surfaces. In antagonising lithic

acid deposits, potassium bicarbonate is specially suitable; for the potassium lithate is much more soluble than the sodium lithate. For calculi of the bladder and urethra, common in highly-fed rams and wethers, and largely made up of ammonio-magnesian-phosphate, Mr. Litt of Shrewsbury, with exercise and laxative diet, recommends castor oil, f ℥ij. to f ℥viij., with belladonna extract, grs. viij. to grs. xvj., followed by potassium bicarbonate, ℥ ss. to ℥ j., 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. Pearl ashes are sometimes applied externally as a stimulant and detergent. In the Cape Colony, a ley made from wood ashes is used successfully as a remedy for scab, either alone or mixed with sulphur. Diluted with 80 to 100 parts of water, the bicarbonate forms a soothing dressing for the earlier weeping stages of eczema, especially in dogs, and also proves a serviceable injection in leucorrhœa in all patients.

Doses, etc.—Of either carbonate, horses and cattle take ℥ ss. to ℥ j.; sheep and pigs, ℥ ss. to ℥ j.; dogs, grs. x. to grs. xl., repeated several times a day, liberally diluted with water. For stimulating gastric secretion, they should be given half an hour before eating; but in most dyspeptic cases acids are more permanently effectual.

Potassium Sulphuretum. Potassa Sulphurata. Sulphurated Potash.

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, soluble, alkaline substance, which is odourless when dry, but when moistened smells of hydrogen sulphide. Recently prepared, it is a mixture of potassium polysulphides and hyposulphite; but as it oxidises and becomes lighter coloured, it contains besides potassium sulphite and sulphate.

Actions and Uses.—Large doses are narcotic and irritant; medicinal doses are stimulant and alterative. Externally,

it is occasionally applied as a stimulant in chronic skin diseases. 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). No very obvious morbid appearances remain after death, and the compound has hence been supposed to act chemically on the blood in the same manner as hydrogen sulphide. Its antidote is chlorinated lime. It has been used in chronic cough, rheumatism, and skin diseases, in doses of one to three drachms for horses and cattle, and two to ten grains 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. Potassæ Sulphas. Sulphate of Potash. ($K_2 SO_4$.)

Potassium Bisulphate. Hydropotassic Sulphate. Bisulphate of Potash. ($KH SO_4$.)

The residue left in the preparation of nitric acid from equal parts of sulphuric acid and nitre consists of potassium sulphate, with some excess of sulphuric acid, which may be got rid of by adding to the solution potassium or calcium carbonate, filtering and evaporating the mixture, when potassium sulphate crystallises in transparent, colourless, six-sided prisms, terminated by six-sided pyramids, which have a sharp, saline, bitter taste, are hard and difficult to powder, and dissolve in four parts of water at 212°, and in sixteen parts at 60°.

The bisulphate is prepared by adding to the neutral sulphate its own weight of sulphuric acid, dissolving and crystallising. It is colourless, crystalline, and soluble, with an acid taste, and an acid reaction on colouring matter. It is distin-

guished from the neutral sulphate by its small flat prisms, its greater solubility, 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.—In human patients large doses of sulphate (in one case two ounces, in another ten drachms) are said to have proved fatal. Both sulphates are cathartic, cholagogue, and diuretic. Neither, however, passes readily through animal membranes; they cling to the fluid which they meet in the bowels; like Epsom salt they cause osmosis and secretion from the surface, especially of the small intestine; and by their irritation also provoke increased peristalsis. But, as cathartics, they are less prompt and certain than the sodium and magnesium sulphates; and as diuretics, are less to be depended on than the potassium nitrate or acetate. Professor Rutherford found that it 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, the sulphate 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 conveniently prepared by decomposing a solution of iron iodide with potassium carbonate. The Brit. Phar. recommends the following process:—"Place a gallon of solution of potash in a glass or porcelain vessel, and add twenty-nine ounces, or a sufficiency of iodine, in small quantities at a time, with constant stirring, until the solution acquires a permanent brown tint. Evaporate the whole to dryness in a porcelain dish, pulverise the residue, and mix this intimately with three ounces wood charcoal in fine powder. Throw the mixture, in small quantities at a time, into a red-hot iron crucible; and when the whole has been brought into a state of fusion, remove the crucible from the fire, and pour out its contents. When the fused mass has cooled, dissolve it

in two pints of boiling distilled water, filter, wash the filter with a little boiling distilled water, unite the liquids, and evaporate until a film forms on the surface; then set the liquid aside to cool and crystallise. Drain the crystals, and dry them quickly with a gentle heat. Evaporate the mother liquor, and get another crop of crystals. Preserve the salt in a stoppered bottle." In this detailed process, potassium iodide and iodate are first produced. Fusion with charcoal deoxidises the iodate, converting it into iodide. The subjoined equations indicate the two stages in the process :—

Potassium Hydrate.		Iodine.		Potass. Iodide.		Potass. Iodate.		Water.
$6\ KHO,$	+	$6\ I$	=	$5\ KI,$	+	$KIO_3,$	+	$3\ H_2O.$

Potassium Iodate.		Charcoal.		Potassium Iodide.		Carbonic Oxide.
$KIO_3,$	+	C_3	=	$KI,$	+	$3\ CO.$

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°, and in half its weight of boiling spirit. Both aqueous and alcoholic solutions dissolve iodine freely, and are hence useful vehicles for its exhibition. The following tests of the Brit. Phar. guard against the common impurities :—"The addition of tartaric acid and mucilage of starch to its watery solution does not develop a blue colour. Solution of nitrate of silver, added in excess, forms a yellowish-white precipitate, which, when agitated with ammonia, yields by subsidence a clear liquid, in which excess of nitric acid causes no turbidity. Its aqueous solution is only faintly precipitated by the addition of saccharated solution of lime."

Actions and Uses.—Potassium iodide closely resembles iodine, but is less powerful, and devoid of local irritant action. Medicinal doses are alterative, antiseptic, deobstruent, and diuretic. A solvent of mercury and lead salts, it helps their removal from the body. It is rapidly absorbed, permeates the textures, and is excreted through the mucous surfaces, and still more notably through the kidneys. In the blood it is converted into iodides and iodates of ammonium and sodium; during its elimination ozone is liberated (Bucheim), lymphatics

are stimulated, tissue metamorphosis is increased, and waste products got rid of.

Two or three drachms dissolved in water, and given to dogs, caused vomiting, great depression, and death in a few days; oue drachm had a similar effect on rabbits; three drachms injected beneath the skin of the back of a dog caused extensive subcutaneous inflammation, and death in three days. Iodine was 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). Maillet (quoted by Tabourin) states that two or three drachms given to horses act as an irritant poison, and that three or four drachms cause fatal intestinal hæmorrhage. But this must be a mistake. I have many times given horses and cattle half an ounce to an ounce without any other effect than slight diuresis and occasional catharsis. Such doses continued twice daily for a week do not produce in horses any irritation or symptoms of iodism such as occasionally follow its use in human patients.

Medicinal Uses.—For arresting discharge of chronic bronchial catarrh, hastening absorption of exudate remaining from lymphangitis in horses, and dispersing other exudates and effusions, it is conjoined with tonics or stimulants, and is used both internally and externally. In such cases horses and cattle frequently receive a drachm each of potassium iodide and ammonium carbonate, and half an ounce of gentian, given twice daily, either in ball or solution. It is also prescribed in scrofulous glandular enlargements, and in chronic rheumatism; aids removal of lead mercury and other metals from the body, apparently causing their re-solution and expulsion in the urine. It is applied externally for the reduction of tumors, and is constantly employed for increasing the solubility of iodine, both in water and alcohol.

Doses, etc.—Horses and cattle take ℥ij. to ℥vj.; sheep and pigs, grs. xx. to grs. lx.; dogs, grs. v. to grs. xv.; repeated 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 (*The Practitioner*, September 1876).

Potassium Bromide. Bromide of Potassium. K Br.

The Bromide is prepared from the mother liquors of the salt-works at Stassfurth, and from salt-springs in the United States (Bloxam). When purified, it occurs in colourless cubical crystals, soluble in water, but insoluble in spirit, odourless, but with a pungent saline taste. When chlorine is added to the aqueous solution, bromine is liberated, identified by its distinctive yellow-brown colour, and, when in considerable amount, by its suffocating odour.

Actions and Uses.—It is a direct sedative of the cerebro-spinal system, both central and peripheral, and a paralyser of vaso-motor centres. Full doses produce anæmia of the brain and cord, impair reflex action, and subsequently cerebral function, and partially paralyse the hind limbs. Pulse respiration and arterial tension are lowered. It is rapidly excreted unchanged in the urine. In human patients it is prescribed to control reflex and cerebral excitability. In all animals it abates convulsions whether depending upon centric or eccentric causes. In dogs it is useful in convulsive epilepsy, especially when recent. With apparent benefit it has been given to horses suffering from tetanus in ounce doses twice daily. In horses in an irritable excited state from weakness, shock, or fright, it is advantageously conjoined with alcohol, chloral, or opium. Like the corresponding iodine salt it has been reputed to be deobstruent. Brown-Séquard conjoins the ammonium and potassium bromide, both of which are more active than the sodium salt, and advises their being intermitted after a week, but resumed again in a few days.

Doses, etc.—Horses and cattle, ℥ss. to ℥j.; dogs, grs. v. to grs. xx., either of the potassium or mixed bromides, given in pill or solution, prescribed with anodynes or sedatives.

Potassium Nitrate. Potassæ Nitras. Nitrate of Potash. Nitre. Salpetre. (KNO_3 or K_2O, N_2O_5).

In the East Indies, Persia, Egypt, Spain, and other warm climates, a brown incrustation of nitre covers considerable tracts of country. Nitric acid is formed by oxidation of the ammonia

alike of the soil and atmosphere, and also by direct union of the nitrogen and oxygen of the air under influence of electricity. Potassium is liberated from disintegration of felspar and mica rocks and from plant remains. The resulting saline efflorescence, consisting of sodium chloride and sulphate, and potassium and calcium nitrates, is gathered towards the end of summer; in India, about November. It is dissolved in water, and mixed with impure potassium carbonate; the insoluble calcium carbonate is allowed to settle, and the potassium nitrate poured off in solution, and purified by repeated solution and crystallisation. In France and other continental countries, nitre for gunpowder and other purposes is prepared artificially by collecting into large heaps animal and vegetable refuse, with old plaster and other calcareous matter. The heaps are sheltered from rain, but freely exposed to the air, frequently watered with urine, and occasionally turned. After about two years the whole is lixiviated, and purified by a process similar to that followed with the natural nitre.

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 3½ 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 are irritant and feebly cathartic. Medicinal doses are alterative, antiseptic, febrifuge, and refrigerant. It is excreted from the bronchial glands, the skin and kidneys increasing the secretions of these organs. Used externally, nitre is stimulant and refrigerant.

An ounce has proved fatal in human patients, but very large doses are required to cause serious effects either in horses or cattle. Mr. Morton gave a healthy horse two pounds, dissolved in six pounds of 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. Several ounces usually purge horses and cattle, and cause vomiting in dogs, accompanied by irritation of the kidneys and bladder. Dr. Paul Guttmann states that poisonous doses paralyse the spinal cord, cause dyspnœa and occasionally convulsions, and muscular weakness, first overtaking the hind extremities; they lessen the frequency and force of the heart's action, which in fatal doses ceases to act in the diastole.

Medicinal Uses.—Unless in very large doses, nitre does not, like other less soluble salts, remain long enough in the bowels to cause purgation. It has a high diffusion power, and rapidly enters the blood; it appears to counteract adhesion of the red globules, and diminish their power of carrying oxygen; it is not administered in quantity sufficient to exert any solvent action on fibrine. It appears to promote osmosis, and favours secretion of the bronchial, cutaneous, and notably of the urinary organs. Waste products are thus removed, pulse and temperature lowered, febrile and inflammatory conditions relieved. In the earlier and acute stages of disease nitre is conjoined with other salines, antiseptics, and sedatives; in the second stages, with alteratives, stimulants, and tonics. Mr. Alexander Lockhart, of New York, and other American practitioners, give two ounces dissolved in a pint of water, repeated thrice daily, and assure me that they find nothing so effectual in abating acute fever and pain, and controlling exudation in laminitis, which, owing to careless feeding and long fasts, is still common in America. These large doses probably impair the oxygen carrying power of the hæmato-globulin, and thus check destructive tissue metamorphosis. Small frequently repeated doses are sometimes given in purpura, and occasionally are serviceable in cases in which iron and turpentine have proved ineffectual. Repeated doses, especially when conjoined with ammonium acetate solution, are excreted by the bronchial membrane increasing its secretions, and affording relief in laryngitis and bronchitis. Many agriculturists give their horses, whilst on hard food, an ounce of nitre with a mash

every Saturday night; bowels, kidneys, and skin are thus kept in good order; and attacks of swelled legs and weed, so common when hard-worked horses stand idle, are warded off. Nitre, dissolving in water, abstracts heat, and is hence sometimes used as an external refrigerant; its cooling effects are increased by admixture of sal-ammoniac. Five ounces each of nitre and sal-ammoniac, dissolved in sixteen of water, reduce the temperature from 50° to 10°, or through 40° (Pereira). For such refrigerant purposes, however, ice is cheaper, and more convenient.

Doses, etc.—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 common diuretic mass of the Edinburgh Veterinary College is thus made:—Take soap and nitre, of each lbs. ij.; resin, lbs. iij.; Venice turpentine, lbs. ij.; oil of turpentine, f ℥ viij. 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 every two or three hours, and is generally conjoined with other medicines. A sedative febrifuge and laxative ball for the horse is made with an ounce nitre, a drachm aloes, and twenty grains calomel, made with simple syrup, or linseed meal and water. Where the horse has cold, fever, and impaired appetite, a useful draught is made with Epsom salt two ounces, and nitre, powdered gentian, and ammonia acetate solution, of each an ounce, dissolved in gruel or ale. Catarrhal symptoms and sore-throat are often relieved by four drachms nitre and one drachm each of ipecacuan, camphor, and belladonna extract, made into bolus, and repeated every two hours. An ounce each of potassium carbonate and nitrate, with two drachms iodide, are useful in rheumatism. Similar combinations are serviceable amongst cattle. For them a convenient alterative is made with two ounces each of nitre, sulphur, and ginger, given in treacle and water or in ale. A good febrifuge for the dog 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 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. Potassæ Chloras. Chlorate of Potash. ($K Cl O_3$.)

Chlorine gas, evolved from manganese black oxide and hydrochloric acid, is conducted into a large carboy containing a mixture of potassium carbonate and calcium hydrate. 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. Potassium chlorate occurs in colourless rhomboidal plates, has a cool saline taste, is soluble in sixteen parts of cold water, and in two parts at 212°. It readily parts with its large amount of 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, febrifuge, alterative, refrigerant, sialogogue, and diuretic; used externally, it is stimulant and refrigerant. It is less soluble than nitre or than sodium chlorate, both of which it closely resembles. Poisonous doses like those of the nitrate decompose hæmato-globulin, the blood becomes dark coloured, and broken down corpuscles accumulate in the spleen.

Medicinal Uses.—Antiseptic actions probably determine most of its curative effects. The coagulability and keeping properties of recently drawn blood are greatly increased by addition of a small amount of the salt. The large amount of contained oxygen does not explain its therapeutic value, for it

is excreted unchanged, small doses mostly by the kidneys, larger by the bowels. During its topical application, as well as during its excretion by the salivary and buccal glands, it acts as a ciliary excitant, and exerts besides, some unexplained alterative effects. It is serviceable in aphthous ulceration of the mouth, in soothing and healing the eruptions of foot and mouth complaint, and as a gargle in catarrh and sore throat. While usually diminishing excessive secretion, it increases defective secretion—a twofold action observed not only when the salt is used as a wash or gargle, but also repeated more generally when it has been swallowed. Like some other salines, in febrile and inflammatory cases, whether in horses or cattle, it lowers pulse and temperature, cleans the tongue, improves appetite, gently stimulates the bowels, and renders their evacuations more natural and less coated with mucus. It is usually prescribed with Epsom salt, gentian, or ether. In hard-worked horses, overdone or suffering from cold, half an ounce night and morning, with gentian and ether, usually acts admirably. Mr. Thomas A. Dollar, of New Bond Street, who uses it largely, considers that in such cases its regular use during a week or two sometimes wards off attacks of farcy. In the catarrhal epizootics of horses, Principal Robertson orders it with sweet spirit of nitre and camphor. Where turpentine and iron salts, usually the most effectual treatment for purpura, do not succeed, Professor Williams recommends potassium chlorate, believes that it increases, as it does outside the body, the coagulability of the blood liable to extravasation, and orders, first, several doses of half an ounce to an ounce, but finds that two to three drachms repeated thrice daily then suffice. Given twice a week, in quarter or half ounce doses, to calves and young cattle, it seems to prevent attacks of quarter-evil, and other congestive disorders. Solutions of six to twenty grains to the ounce of water are used as antiseptic gentle stimulants for unhealthy wounds.

Doses, etc.—Horses take ℥j. to ℥iv., cattle, ℥ij. to ℥vj.; sheep and pigs, grs. xx. to grs. lx.; dogs, grs. v. to grs. xv. given either in bolus or solution, alone or conjoined with bitters, tonics, or stimulants. Most horses will take an ounce daily, dissolved in their water or gruel. Conjoined with

camphor, belladonna extract, and treacle, a soothing electuary is made for sore throat.

POTASSIUM PERMANGANATE. Potassæ Permanganas. Condy's Fluid. (K Mn O_4, or K_2 O, Mn_2 O_7.)

When manganese black oxide is fused with potassium hydrate and chlorate, a green mass, or, with addition of water, a green solution, is formed of potassium manganate. When this oxidises slowly by exposure to the air, or more rapidly by addition of a little sulphuric acid, the permanganate is formed. It may be crystallised in dark-purple slender prisms, but is more generally used in the deep crimson or purple solution known as "Condy's Fluid,"—a mixture of manganates and permanganates of potassium and sodium. The Pharmacopœia Liquor potassæ permanganas is about double the strength of Condy's Fluid, and contains four grains permanganate to the ounce.

Actions and Uses.—The manganates and permanganates are deodorisers and mild stimulants, adapted for external use. They are of no value as internal remedies, for when swallowed they are rapidly decomposed, manganese black oxide being evolved. They are used to cleanse the water supplies both of men and animals. Four ounces Condy's Fluid, stirred amongst a hundred gallons of stale-smelling, unsightly rain water, left too long in a foul cistern, usually precipitates all impurities, and after a few hours renders the clarified water 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 indication of the amount of organic contamination in the water, other fluids, or even in the air, experimented with. In virtue of this oxidising power, permanganates attack and break up those gases and organic particles on which bad smells depend. Portions of sacking wetted with solutions of one part of Condy's Fluid to fifty or sixty of water, are suspended about the premises to be deodorised, or shallow vessels containing such solutions are placed about the building. But, although removing smells, they cannot, like the tar or sulphurous acids, arrest the causes on which

such smells depend; they have little antiseptic power; half a grain potassium permanganate is less effectual in preventing fermentation of saccharine solutions than one-thirtieth of a grain of corrosive sublimate, or one-tenth of a grain of sulphuric acid; whilst Dr. C. Calvert found that meat soaked in permanganate solution, and placed in closed bottles, became tainted in two days, and putrefied in four, although, when similarly treated with carbolic acid, it dried up and was effectually preserved. Thus deficient in antiseptic power, and, moreover, not being volatile, permanganates are not to be depended upon as disinfectants.

Potassium permanganate has been given to horses as an alterative and febrifuge in drachm doses; but observation does not justify its preference to the nitrate or chlorate. Dissolved in fifty to a hundred parts of water, Condy's Fluid proves serviceable for cleansing and deodorising the mouth in febrile cases, in aphtha, ozœna, and ulceration of the fauces, as a refreshing wash in typhoid fever, and as a mildly stimulating deodorising lotion for offensive wounds.

Potassium Acetate. Potassæ Acetas. Acetate of Potash. ($K C_2 H_3 O_2$.)

When potassium carbonate is neutralised by acetic acid, the white, asbestos-like, soluble, deliquescent acetate is produced. It closely resembles the nitrate in its actions and uses, is prized in human medicine as a diuretic, and is given to animals in the same or somewhat larger doses. Like other alkaline salts containing a vegetable acid, it is mainly converted in the system into a bicarbonate, and as such is excreted in the urine.

Potassium Acid Tartrate. Potassæ Tartras Acida. Potassæ Bitartras. Acid Tartrate of Potash. Cream of Tartar. ($K H, C_4 H_4 O_6$.)

The crude tartar or argol, obtained in an impure state from the interior of wine casks, when purified by solution and crystallisation, occurs in white, hard, crystalline masses, with a

sharp acid taste. Large quantities cause in all animals inflammation of the alimentary canal. Several ounces operate on horses and cattle as a mild laxative; lesser doses act, like nitre, as alteratives and febrifuges, are converted in the body into the carbonate, and excreted mostly in the urine, causing diuresis.

PRUSSIC OR HYDROCYANIC ACID.

Acidum Hydrocyanicum. (H CN or H Cy.)

Prussic acid is so called from having been first obtained from Prussian blue. Its title of hydrocyanic acid is derived from its being composed of hydrogen and the compound radical cyanogen (CN or Cy). It may be extracted from the leaves and seeds of various plants of the apple and almond tribes, by crushing and moistening them with water, when their albuminoid emulsin excites in the amygdalin a species of fermentation, from which are evolved hydrocyanic acid, benzoic aldehyde, and sugar.

Amygdalin. Water. Prussic Acid. Benzaldehyde. Sugar.

$$C_{20}H_{27}NO_{11} + 2H_2O = HCN + C_7H_6O + 2C_6H_{12}O_6.$$

The diluted medicinal solutions usually contain 1 to 5 per cent. of anhydrous acid.

Anhydrous Prussic Acid, one of the most active of poisons, is prepared by decomposing any metallic cyanide with a strong acid, or by treating dry mercuric cyanide with hydrogen sulphide, and collecting the vapour evolved in a receiver kept cold by a mixture of ice and salt. It is a colourless, very volatile liquid, with a specific gravity of ·7, is devoid of acidity, has a strong pungent bitter taste, and produces a peculiar sensation in the back of the throat. Its odour, generally likened to that of bitter almonds, or cherry-laurel water, is perceptibly different from either, and entirely devoid of ratafia aroma. It unites both with alcohol and water, with the latter produces cold, accompanied, curiously enough, by diminution of volume. It is inflammable, boils at 80°, and when dropped on the skin produces a sensation of coldness and numbness.

Medicinal or Diluted Acid may be obtained by decomposing the cyanides of potassium, mercury, or silver; but the

most convenient and economical method is by the action of sulphuric acid on potassium ferrocyanide, which is thus prepared :—Azotised animal refuse, such as scrapings of hides, cuttings of hoofs and horns, are fused in an iron retort with potassium carbonate and iron filings. The carbon and nitrogen of the organic matters at the high temperature, and in presence of the potassium salt, unite to form the volatile radical cyanogen (CN or Cy), which is fixed by the potassium forming potassium cyanide (K Cy). But iron being also present, a double cyanide of iron and potassium is formed. The ferrocyanide of potassium, or yellow prussiate of potash, which crystallises in four-sided tabular yellow prisms, gives with iron protosalts a grey precipitate, speedily becoming blue from absorption of oxygen, and with iron persalts a deep Prussian blue at once. It is tetrabasic, with the formula K_4 Fe Cy_6, $3H_2$ O. When chlorine is passed through a solution of this ferrocyanide an equivalent of potassium is removed, and there is produced the ferricyanide of potassium or red prussiate of potash, which crystallises in bold red right rhombic prisms, is distinguished from the yellow prussiate by giving no precipitate, but only an olive green coloration, with iron persalts, but a brilliant deep blue at once with protosalts. It is tribasic, and has the formula K_3 Fe Cy_6, or K_3 Fdcy.

For the making of medicinal prussic acid the Brit. Phar. gives the following directions :—"Dissolve 2½ ounces of ferrocyanide of potassium in 10 ounces of water. Dilute 1 ounce of sulphuric acid with 4 ounces of water, and when the mixture is cold, add it to the solution of prussiate of potash in a flask arranged with a suitable condenser and a receiver for distillation. Put 8 ounces of water into the receiver, apply heat to the flask, until by slow distillation the liquid in the receiver is increased to 17 fluid ounces. Add to this 3 ounces of water, or as much as may be sufficient to bring the acid to the required strength, viz. that 100 grains (or 110 minims) of it, precipitated with a solution of nitrate of silver, shall yield 10 grains of dry cyanide of silver."

In this process the sulphuric acid and the potassium ferrocyanide undergo mutual decomposition, cyanogen is evolved, combines with hydrogen, and comes over as hydrocyanic acid.

There remains an insoluble double cyanide of iron and potassium with hydro-potassic sulphate. The changes, probably somewhat complex, are formulised as follows :—

Potassium ferrocyanide.	Sulphuric acid.	Potassium acid sulphate.	Iron and Potass. cyanide.	Hydrocyanic acid.

$$2\,K_4Fe\,Cy_6 + 6\,H_2SO_4 = 2\,K\,HSO_4 + 3\,K_2Fe_2\,Cy_6 + 6\,H\,Cy.$$

Prussic acid, even when carefully made by the same process, is liable to variation of strength, and is, moreover, apt to volatilise and diminish in activity. Determination of the strength is, however, easy. Silver nitrate throws down a white precipitate of silver cyanide, every five grains of which represent one grain of anhydrous acid. Thus 100 grains of Pharmacopœia acid should yield ten grains of silver cyanide, or contain, in other words, two per cent. of anhydrous acid. Scheele's acid is usually uncertain in strength, containing one to four per cent. of anhydrous acid.

Properties.—The medicinal acid has most of the properties of the anhydrous, exhibits the same distinctive penetrating diffusible odour, causes similar numbness of the parts on which it is dropped, is volatile, and rapidly diminishes in strength, unless kept in well-stoppered bottles protected from light. It has the specific gravity ·997 ; reddens litmus only very slightly and transiently ; evaporated on a platinum capsule, it leaves no residue. It is generally very pure ; its price, of about a halfpenny per ounce, affords no temptation for intentional adulteration. A trace of sulphuric, or of other mineral acid, is said to improve its keeping properties.

Tests.—Prussic acid is easily identified, even in small quantity and diluted solution. (*a*) Its odour is strong, diffusible, and penetrating ; and, as above stated, readily distinguished from that of cherry-laurel water and bitter almonds by the absence of ratafia aroma. (*b*) Scheele's test, or the production of Prussian blue, is very delicate and characteristic. The acid solution, rendered alkaline by potash solution, is treated with iron sulphate solution ; a greyish green-precipitate is thrown down ; the solution is then boiled, and, on addition of a little hydrochloric acid to re-dissolve the ferrous oxide, assumes, after a few minutes' exposure, a deep Prussian blue

colour. (*c*) Silver nitrate produces a white precipitate of silver cyanide, resembling the white chloride by being soluble in ammonia and in hot dilute nitric acid, but insoluble in cold concentrated nitric acid, but differing from the chloride by 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. (*d*) Boiled with ammonium hydro-sulphide, previously boiled with sulphur, and with ammonia solution, sulpho-cyanic acid (H Cy S) is produced, and the liquid, when acidified with hydrochloric acid, gives a blood-red solution with ferric-chloride solution. (*e*) Schönbein's test is thus given by Professor Attfield:—"Filtering-paper is soaked in a solution of three parts of guaiacum resin in 100 of alcohol. A strip of this paper is dipped in a solution of one part of sulphate of copper in 50 of water, a little of the suspected solution is placed on this paper and exposed to the air, when it immediately turns blue."

Complex liquids, such as the contents of the stomach, are filtered, neutralised with sulphuric acid, cautiously distilled, and the clear liquid which first comes over tested in the usual way. A still simpler and more direct plan is to place a portion of the suspected fluid in a porcelain crucible, a wide-mouthed bottle or beaker, add a few drops of strong sulphuric acid, gently stir with a glass rod; if needful, the vessel may be placed in a basin of warm water, but the acid added usually evolves heat sufficient to volatilise any prussic acid, which condenses on a watch-glass inverted over the crucible or bottle, and moistened with silver nitrate, produces silver cyanide. If the watch-glass is moistened with potash solution, and any prussic acid is given off, potassium cyanide is formed, detectable by adding to it a drop of iron sulphate and perchloride, or any other mixed ferrous and ferric salt, and then a drop of hydrochloric acid, when Prussian blue is developed. As hydrocyanic acid is readily volatilised and decomposed by many organic substances, it can seldom be detected in the bodies of animals poisoned by it, unless examination is made within four or five days after death. It sometimes disappears even in less time, especially if the body has been exposed to the weather.

Actions and Uses.—Prussic acid is equally fatal to vegetable

and animal life. Poisonous doses paralyse the cerebro-spinal axis, act most notably on the medulla and respiratory centre, and destroy life chiefly by paralysis of respiration, in very large doses also by cardiac paralysis. Medicinal doses are sedative, anodyne, and antispasmodic. Topically applied, it paralyses the ends of sensory nerves, and hence allays irritability and itching in urticaria, eczema, and other skin complaints.

Toxic Effects.—No poison is more active than anhydrous prussic acid (Christison on *Poisons.*) Injected into the jugular vein of the dog, it causes death within a minute. One to four drops, placed on the tongue or within the eyelids, of dogs, cats, rabbits, or such small animals, begin to operate in ten to thirty seconds; three or four rapid laboured inspirations, a hurried convulsive expiration, and a general tetanic seizure precede death. Guinea-pigs inhaling it for one second die in fifteen seconds; strong rabbits inhaling it for three seconds, die in thirty seconds; but frogs are less sensitive. Air saturated with it killed one dog in ten seconds, another in five, a cat in two seconds. Ten to twenty drops produce similar effects in horses. The two per cent. medicinal acid, given to dogs and cats in doses of forty to sixty minims, sometimes acts with a rapidity scarcely inferior to the anhydrous acid; more commonly, however, life is prolonged for several minutes, and death is preceded by giddiness, profuse salivation, dilatation of the pupil, impaired voluntary movement, slowing of the pulse, a slight rise and subsequent fall of blood pressure, rapid failure of respiration, and tetanic convulsions. The heart continues to pulsate for several minutes after respiration has ceased. Asphyxia probably results from spasm of the pulmonary arterioles and paresis of the muscles of respiration. Recent observations disprove any special action on the vagus (Dr. Bochin, *Practitioner*, September, 1874). Convulsions depend upon paralysis of the spinal cord, and not, as with strychnine, on stimulation. When life is prolonged beyond a few minutes, the general sedative effect of the drug is demonstrated; there is paralysis of motility, sensibility, and reflex irritability, muscular tremblings and convulsions. This general paralysis affords the key to the medicinal uses of prussic acid. It is excreted partially by the kidneys, chiefly by the lungs;

non-poisonous doses are got rid of in an hour, and if an animal poisoned lives for half an hour, recovery may be expected.

Professor Coleman gave an aged horse repeatedly, at intervals of several days, one to three drachms of Scheele's acid, containing about 4 per cent. of anhydrous acid, and noted much excitement, the pulse raised to 100, and in one experiment to 160, laboured breathing and tetanic contractions 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. 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 internally administered, caused a long deep expiration, collapse of the lungs, and fatal tetanic contraction of the respiratory muscles (Jones and Bartholow). Poisonous effects are observed in all animals, and by whatever channel prussic acid enters the body. It is absorbed and diffused with great rapidity in whatever condition it is administered, but, as above remarked, is especially active in the state of vapour. In combination with bases, it manifests the same tremendous energy, the cyanides being very poisonous; but the ferrocyanides are harmless. As with many other medicines, the precise mode in which it establishes its effects is unknown. It may act directly on the nerve cells, arresting generation of force, interfering with conductivity, or less directly by checking oxygenation.

The post-mortem appearances vary with the dose and concentration of the poison. When death occurs within two or three minutes the heart contains black blood, its right cavities are gorged. In less acute cases there is, besides, congestion of the cerebral membranes and nervous centres, and engorgement of the large venous trunks; the blood everywhere is fluid, of a blue appearance, and evolves the peculiar odour of the acid, which is sometimes also perceptible in the contents of the stomach, in the serous cavities, and in most of the secretions. Owing to the volatility of the poison, its

odour can seldom, however, be detected where life has been prolonged for an hour, or the body has lain exposed for two or three days. The voluntary muscles and those of the intestines lose their contractility, and become flaccid; the villous coat of the intestines is sometimes red, shrivelled, and easily removed.

Prussic acid is so rapidly fatal that the animal is often dead before any remedial measures can be adopted. Ammonia counteracts the mortally sedative effects, is given internally, and also inhaled; care being taken that it be not so strong as to irritate the fauces and other parts with which it comes in contact. Inhalation of chlorine gas also acts beneficially. Cold affusion is sometimes effectual; should be applied only to the head and neck, and continued at short intervals. Artificial respiration greatly prolongs life, and saves animals that have had lethal doses; it directly antagonises the notable want of oxygen and excess of carbonic anhydride in the blood. Bleeding from the jugular relieves congestion of the lungs, and right side of the heart, which are the immediate causes of death. Atropine stimulates the cardiac and respiratory centres, and its hypodermic injection has therefore been advised (Preyer); but more recent observations throw douhts on the antagonism of atropine and prussic acid (*The Practitioner*, September 1874). The only reliable chemical antidote is solution of potassium carbonate, followed immediately by a mixture in solution of a ferric and ferrous salt, which converts the acid into the insoluble and inert Prussian blue. Messrs. T. and H. Smith, of Edinburgh, who proposed this antidote, advise potassium carbonate grs. xx. dissolved in an ounce of water; and immediately after this is swallowed, ferrous sulphate grs. x., and ferric chloride tincture f℥j., dissolved in an ounce of water. These quantities should neutralise nearly two grains of prussic acid. Unless swallowed before the poison is absorbed, such a slowly acting antidote cannot, however, arrest the effects of such a quickly acting poison.

Medicinal Uses.—As a calmative and antispasmodic, prussic acid is occasionally prescribed in paroxysmal cough, where there is no organic disease. For such cases in horses, twenty minims of acid, with a drachm each of camphor and opium,

are made into bolus with liquorice powder or linseed meal, and repeated twice or thrice a day. In gastrodynia and obstinate vomiting in dogs it is sometimes also given. Mild cases of tetanus, especially in young animals, are sometimes benefited; but it is of little use in aggravated cases, or in aged animals. Paralysing the end organs of sensory nerves, it allays the irritation of urticaria, eczema, and prurigo, and, for such purposes, two drachms of medicinal acid and a drachm corrosive sublimate are dissolved in a pint of water or vaseline.

Doses, etc.—Of the Pharmacopœia acid horses and cattle take ℥ xx. to f ℥ j.; sheep and pigs, ℥ x. to ℥ xx,; dogs, ℥ ij. to ℥ v., given in water sweetened with simple syrup. As the soothing effects are transient, doses should be repeated three or four times a day; until perfectly regulated, their effects must be carefully watched. It does not appear to be cumulative, so that well-regulated doses may be given with perfect safety for many weeks. With a fresh sample of the medicine, to guard against variation in strength, the dose should at first be considerably reduced. To prevent the mistakes apt to arise with a colourless liquid, it is often made up with compound tincture of cardamoms. Used externally, it should be largely diluted with water, and as it undergoes absorption it must be applied with caution, especially when the skin is abraded.

Cyanide of potassium nearly resembles prussic acid, but is less powerful. For human patients a solution containing one grain to the drachm of water is used externally to relieve headache, depending upon reflex irritability, and to abate the itching of eczema and other skin complaints.

QUASSIA WOOD.

Quassiæ Lignum. The wood of Picræna excelsa—the Jamaica quassia or bitter wood tree—imported from Jamaica.

Nat. Ord.—Simarubaceæ. *Sex. Syst.*—Decandria Monogynia.

The dense, tough, white quassia wood, the produce of a handsome tree, is imported from Jamaica and other West India 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 a yellow resin and, according to Wiggers, on $\frac{1}{10}$th per cent. of a neutral crystalline principle, termed quassiin, which recent investigators have, however, failed to find.

Actions and Uses.—Quassia is a bitter stomachic, tonic, and anthelmintic. It nearly resembles gentian, calumba, and cinchona. It is prescribed for the several domestic animals in dyspepsia, loss of appetite, convalescence from debilitating disorders, and for the destruction of lumbrici and ascarides. For removing ascarides the infusion is used both by the mouth and rectum. It acts as a narcotic poison for flies and other insects, and is said also to kill fish. (Royle's *Mat. Med.*) For the destruction of flies the infusion is placed in shallow vessels about the premises.

Doses, etc.—The infusion prepared by macerating the chips for an hour with cold water is the most convenient preparation, is administered alone or conjoined 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 f ℥ ij. to f ℥ iv.; sheep and pigs, f ℥ iv.; dogs, f ℥ j. Neither the extract nor tincture is used by veterinarians.

RHUBARB ROOT.

Rhei Radix. The dried root deprived of the bark from one or more undetermined species of Rheum. From China, Chinese Tartary, and Thibet. Imported from Shanghai and Canton, and brought overland by way of Moscow.—*Brit. Phar.*

Nat. Ord.—Polygonaceæ. *Sex. Syst.*—Enneandria Monogynia.

Central Asia is the habitat of the perennial herbaceous plants yielding medicinal rhubarb, of which the finest, coming from Siberia, is stated to be produced by Rheum palmatum, var. tanguticum (Royle's *Mat. Med.*), or by R. officinale (Flückiger). The root, collected in summer from the mountain

ranges of the interior of China, Chinese Tartary, and Thibet, from plants six years old, is cleaned, peeled, cut into trapezoidal, round, cylindrical, or flat reddish-yellow pieces, and bored with a hole, through which a cord is run to hang it in the sun. Internally it is marbled with greyish-white lines. The powder is bright, has a strong peculiar aromatic odour, with a bitter astringent taste, and is gritty when chewed, owing to the presence of crystals of calcium oxalate. The East Indian rhubarb is coarser and less aromatic. English rhubarb, so generally cultivated for its familiar leaf-stalks, of which the pleasant acid taste is due to the presence of malic and oxalic acids, is from R. raponticum, is grown extensively for its roots near Banbury, Oxfordshire, and is mixed with or substituted for the Chinese, but 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. The several varieties are readily dissolved by ether, rectified, and proof spirit; and less readily by cold and hot water, with the latter of which it forms an orange-coloured solution. Rhubarb consists of a bitter extract, probably its chief active constituent, starch, cellulose and sugar, three aromatic resins, the golden yellow, odourless, tasteless, feeble crystalline, chrysophanic acid, or methyldioxyanthraquinone, rheotannic, cathartic, and arabic acids, calcium oxalate, with 13 to 20 per cent. of ash. Good qualities are free from decay, not worm-eaten; boracic acid does not turn the yellow exterior brown—a test showing the absence of turmeric, which, with wheat flour, is often mixed with rhubarb powder.

Actions and Uses.—Rhubarb is stomachic, tonic, astringent, mildly cathartic and cholagogue. Small and repeated doses improve the appetite; correct slight gastric derangements; in virtue of their tannin, diminish secretion and peristalsis; by their colouring matter impart to the fæces a yellow-brown hue, and may be detected in the blood, urine, and occasionally in the milk. Larger doses, in human patients, dogs, and cats, 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; whilst half a pound to a pound caused in the horse only slight laxative effects after thirty-six hours (Moiroud). On skin or mucous surfaces it acts as a mild astringent.

Doses, etc.—As a stomachic and tonic, repeated several times a day, horses have ʒ j.; cattle, ʒ ij.; sheep, ℥ j.; dogs and cats, grs. x. to grs. xxx. 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 the form of simple powder, occasionally as an infusion or tincture. The compound powder, or Gregory's mixture, prepared by mixing thoroughly a pound of magnesia, two ounces of ginger, and four ounces of rhubarb—all in fine powder—is an excellent stomachic and antacid, given in doses twice as large as those of the simple rhubarb. In chronic diarrhœa and dysentery in calves and foals it has the advantage of clearing the canal of indigestible matters, and subsequently exerting wholesome astringency. For such corrective purposes two drachms each of rhubarb and magnesia, with half a drachm of opium, are also given several times a day in well-boiled wheat or flour gruel, with a table-spoonful or two of spirits or sweet spirit of nitre. One-third or one-half this quantity answers for diarrhœa amongst lambs.

SALICYLIC ACID.

Oxybenzoic Acid (H C_6H_4 OH CO_2, or H C_7 H_5 O_3).

This valuable antiseptic can be procured by fusing potassium hydrate with salicine—the crystalline bitter principle extracted from willow bark. In needle-like crystals a very pure acid is prepared from oil of spirea or of winter green. The acid of commerce, much of it made in Germany, is commonly obtained by passing dry carbonic anhydride through dry sodium phenol at a temperature over 212°. The resulting di-sodium salicylate is dissolved in water, decomposed by hydrochloric acid, and purified by subsequent

washing and recrystallisation. It occurs as a soft, light, white powder of minute acicular crystals, odourless, with a sweet, dry, somewhat acrid taste, soluble in 400 parts of water at 60°; very soluble in hot water, alcohol, and ether; its solubility being increased by admixture with borax or sodium phosphate. The acid prepared from phenol frequently retains traces of it. With iron perchloride solution salicylic acid and salicylates strike a deep indigo blue.

Actions and Uses.—Salicylic acid is an antiseptic, and is used in surgery in the same class of cases as boracic, benzoic, and carbolic acids. Poisonous doses cause cardiac paralysis. Full and repeated doses are cardiac and vaso-motor sedatives; they are febrifuge and antipyretic; promote excretion of urea; have been vaunted as specifics in acute rheumatism, and are quickly excreted, chiefly by the kidneys.

Like its analogues, benzoic and phenic acids, it arrests fermentation and putrefaction. A watery solution containing one per cent. of acid, dissolved with the aid of a little borax, preserved effectually blood, pus, and urine. Such solutions, freely or frequently applied, dry or shrivel mucous surfaces, but are devoid of irritant effect. Freedom from odour and almost from taste as well as from irritant property, recommend salicylic acid as an internal antiseptic. Sodium salicylate, which has exactly the same effect as the acid, persistently administered to dogs, asses, and horses, in doses of one gramme daily to each kilogramme of body weight, induces rapid emaciation and death from cardiac paralysis. Moderate doses of the acid are soluble in the stomach, and enter the blood as sodium salicylate. Although producing slight effects on healthy subjects, fifteen to twenty grains administered to human patients; one to two drachms to horses; in febrile attacks, repeated at intervals of one or two hours, after slight stimulation, depress the cardiac and vaso-motor ganglia, lower the force and frequency of the pulse, reduce blood-pressure and temperature, and promote perspiration; these effects are usually maintained both in men and animals for several hours (Bartholow).

Medicinal Uses.—These physiological actions are beneficially exerted in rheumatic fever especially of an articular

character. In human patients it has been shown to abate pain, lower temperature three or four degrees, and shorten attacks. In febrile cases it further exerts an antiseptic action on the alimentary mucous membrane and deodorises foul excretions. It is surmised that in the rheumatic textures the lactic acid liberates the antiseptic salicylic acid, which directly antagonises excessive tissue metamorphoses. In veterinary practice it deserves further trial in rheumatic and typhoid fevers, in strangles and purpura in horses, and in metro-peritonitis in cows and ewes. Mr. Dollar of New Bond Street, and Mr. I. Print of Clapham, without any curative results, have, however, given drachm doses twice a day to horses affected by farcy and nasal gleet. The antipyretic actions of salicylic acid ally it to quinine, which, however, exerts its notable effects in half the doses, and is more widely applicable to typhoid and zymotic cases. As a febrifuge, the acid is more active and certain than salicine, and rather more active than sodium salicylate.

In all animals it preserves wounds in an aseptic state; in those which have been neglected and peopled with bacteria, it destroys these parasites; it counteracts fœtor and suppuration, abates pain, and hastens healing. It is especially applicable in serious wounds that through their sloughing stages have been treated with carbolic or other more irritant dressings, and in which both granulation and epithelium growth require to be encouraged simultaneously. This important two-fold service is usually better done by sanitas, boracic, or salicylic acids than by carbolic acid. Being non-irritant it is suitable as an injection into open joints and serous cavities, and Mr. C. Gresswell of Nottingham reports his thus using it successfully in open hock joint (*Veterinarian*, January 1882). It abates the itching, discharge, and smell of eczema in horses' heels.

Doses, etc.—Horses and cattle take ℥ j. to ℥ ij., sheep and dogs grs. x. to grs. xv. every hour or two hours, mixed with a little borax to insure solubility, and administered in mucilage, or glycerine. Sodium salicylate may be used in somewhat larger doses than the acid. For surgical purposes a convenient *solution* of medium strength is made with eight grains each of

salicylic acid and borax to the ounce of water. An *ointment* is prepared with one part of acid mixed in a heated mortar with six or eight of vaseline or lard. This may be got as a handy paste by addition of one part of paraffine. Lint, cotton-wool, or jute, soaked in a strong, hot, watery solution, made as above with borax to insure solubility, absorbs the acid, and may be used as an antiseptic covering for wounds and burns in the same manner as carbolic, boracic, or sanitas lint. Being unirritating, it may be applied directly to abraded surfaces without the intervention of any protective. Iron salicylate is both antiseptic and astringent, and has been used as a styptic.

SANITAS.

Oily and watery fluids prepared by oxidation of oil of turpentine, and containing camphoraceous bodies and hydrogen peroxide.

"Sanitas" has recently come into use as an antiseptic, disinfectant, deodoriser, and air purifier. It is prepared by peroxidation of oil of turpentine. A current of air is driven by an engine for about 120 hours through a series of Doulton stoneware receivers, surrounded by vats of water maintained by steam at a temperature of 140° Fahr. In each receiver are placed 30 gallons of Russian or Swedish oil of turpentine, and about twice that amount of water. The oil gradually becomes darker in colour, increased in specific gravity, raised in its boiling-point, and 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_{14} O_4), which the careful investigations of Mr. C. T. Kingzett, F.C.S. (Managing Director of the Sanitas Company) demonstrates to be gradually converted into camphoric acid (C_{10} H_{16} O_4), another antiseptic camphoric substance (C_{10} H_{18} O_3), and the soluble hydrogen peroxide which remains chiefly in the water. Mr. Kingzett has shown that all essential oils containing true terpenes (C_{10} H_{16}), cymene (C_{10} H_{14}), and menthene (C_{10} H_{18}) undergo similar peroxidation, and evolve

camphoraceous and allied acids and hydrogen peroxide as natural disinfectants. 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 chronic bronchitis. The Eucalyptus globulus in like manner pours forth antiseptic and highly oxygenated volatile products, which are antidotes for malaria, and even, it is said, for consumption; while on a smaller scale every plant or flower producing an essential oil exerts the same purifying and oxygenating effects.—(*Nature's Hygiene*, by C. T. Kingzett, F.C.S., London and Berlin.)

Sanitas is the active constituent of various useful bodies. When the manufacture is finished there floats on the surface of the aqueous solution a yellow brown dense oxidized oil of turpentine, containing thymol, an organic peroxide, and other camphoraceous principles. Mixed with lime this sanitas oil is used as a disinfecting and deodorant powder. United with ordinary fatty matters it is made into antiseptic soaps, and with vaseline and paraffine wax produces ointments. Heated with Dammar resin and paraffine wax a mixture is obtained which is used to impregnate muslin, converting it into antiseptic gauze. Soothing emulsions are formed with gum-arabic, and antiseptic and deodorant emulsions with iodoform. Antiseptic desiccants result from admixture with chalk or starch. The watery solution rendered clear by filtration contains thymol and, in lesser amount, the camphoraceous constituents which characterise the oil, and is specially rich in the oxidising hydrogen peroxide or hydroxyl, which contains 94 per cent. by weight of oxygen, and gives off 475 times its volume of that element (Pelouze). Hydroxyl effectually prevents the fermentation of grape sugar, and preserves for long periods meat infusions, milk, and wine from putrefaction. It has been favourably reported on by Dr. Day of Geelong, and others, as destroying the poisons of small-pox, scarlet fever, and typhoid fever.

Actions and Uses.—Sanitas oil and fluids are effectual volatile, non-poisonous, antiseptics, disinfectants, and deodorants. They contain several active volatile constituents capable of operating on ferments, and probably also on con-

tagium from several different points of attack. The fluids give off oxygen freely. The various preparations have an agreeable aromatic odour, are not corrosive, and do not stain or injure organised substances. Their volatility and peroxidising powers entitle them to the highest position as deodorants. They can attack smells which the non-volatile permanganates cannot get at; while their freedom from irritation, their not attacking clothing, and their agreeable balsamic odour, in certain cases justify their being preferred to carbolic or sulphurous acids or chlorine preparations.

Experiments show that a small percentage of sanitas fluid arrests fermentation of grape juice, prevents putrefaction of solution of white of egg, preserves milk for a length of time, and wine for still longer periods, and also arrests putrefaction in fish and meat, destroying their putrescent odours, and preventing the recommencement of decay. To calves receiving milk and suffering from dyspepsia, I have given ounce doses of sanitas fluid after each meal, with the result of checking undue fermentation and consequent diarrhœa. It deserves more extended trial as an antiseptic stomachic. Experiments are also wanting to determine what antiseptic and antipyretic powers it possesses when administered internally. Recent envenomed wounds, or those which have been neglected and become offensive, are usually washed with zinc chloride solution, but the undiluted sanitas oil also appears in many cases to answer. Diluted according to circumstances with one to ten parts of water, the sanitas fluids are useful antiseptic lotions for wounds, ulcers, and bruises. Where serious wounds for a week or longer have been treated with carbolic or other more irritating dressings, granulation and skin growth often proceed more satisfactorily with the substitution of the milder sanitas. Sore throat, nasal gleet, aphthæ, and foot and mouth complaint, in all animals, are beneficially treated with sanitas solution or spray. Being devoid of irritant effects it answers well for antiseptic injections into the rectum, uterus, or bladder. Sanitas gently stimulates the skin textures; and hence the solutions and soaps rubbed in are useful in prurigo, chronic eczema, and other scaly cutaneous complaints. Along with vinegar or other acid, sanitas fluid diluted with twenty to fifty

parts of tepid water is serviceable for sponging febrile patients, promoting comfortable perspiration, and also destroying any contagious matters. Sanitas, even in the form of oil, does not appear to have the potent poisoning effect of carbolic acid on germ parasites, but it effectually destroys the skin parasites of scab and mange, as well as lice, fleas, and maggots. The cryptogamic parasite of tinea tonsurans is killed by soaking several times with the oil. Even in concentrated form there is no risk of exciting undue irritation, or inducing from its absorption constitutional results, such as follow the free use of strong carbolic preparations. Sanitas powder, made by admixture of the oil with lime, is used with good effect as a disinfectant and deodoriser in stables, kennels, cow-houses, and piggeries; it purifies the air in exhibitions of animals, in manufactories where fermentescible materials are employed, and on shipboard destroys unpleasant odours and substitutes its own camphoraceous aroma.

SAVIN.

Sabina. Fresh and dried tops of Juniperus Sabina, collected in spring from plants cultivated in Britain. (*Brit. Phar.*)

Nat. Ord.—Coniferæ. *Sex. Syst.*—Diœcia Monadelphia.

Juniperus Sabina is a shrubby evergreen plant, 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, stated to be isomeric with oil of turpentine (C_{10} H_{16}), although recent researches of Tilden (1877) give the formula (C_{10} H_{16} O). The brown empyreumatic oil of cade, imported from the Continent, and in growing repute as an insecticide, is obtained from the dry distillation of the brown-berried juniper—the Juniperus Oxycedrus—a native of countries bordering the Mediterranean, and from

other coniferæ. It resembles Swedish tar, often substituted for it, but is thinner, transparent, and devoid of crystals.

Actions and Uses.—Savin applied externally is rubefacient and vesicant; moderate doses are stimulant, anthelmintic, and diuretic; they stimulate especially the urino-genital organs, are allied to the turpentines, and in large doses produce gastro-enteritis. In its stimulation of the uterus it resembles rue and ergot. Excretion occurs by the skin, pulmonary membrane, and kidneys.

Hertwig has given horses half a pound twice daily for six or eight days, without effect; Professor Sick continued it with little effect for half a year; 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). In carnivora it is still more irritant. Four drachms, according to Orfila, destroyed a dog 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. The stomach is found reddened, and the rectum inflamed. Large doses likewise irritate the kidneys and bladder, often causing copious discharge of bloody urine. The irritation extends to the uterus, and savin on this account is occasionally ignorantly used to produce abortion or hasten parturition. Two cases of abortion in mares heavy in foal are recorded by Mr. Mellet 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. No judicious practitioner will, however, use savin to produce abortion; for this result is only attained when poisonous doses are given sufficient to produce violent intestinal irritation. It is occasionally used chopped with fodder for the destruction of intestinal worms, but is neither so safe nor so certain as oil of turpentine. If used at all, the best form is the essential oil. Decoction of the tops in an alkaline ley and the essential oil are occasionally applied as antiseptics and stimulants for indolent wounds and warts.

Doses, etc.—As an anthelmintic, the chief purpose for which savin is administered, f℥iij. to f℥iv. of the volatile oil is given to horses or cattle; ℥ iij. to ℥ v. to dogs, dissolved in any fixed oil or in mucilage. For external application, a decoction is usually made with one part of fresh tops to six or eight of water and two of spirit. The ointment, light green and smelling of savin, is thus prepared:—Melt sixteen ounces prepared lard (or vaseline) and three ounces yellow wax together on a water bath, add eight ounces fresh savin tops, and digest for twenty minutes; then remove the mixture, and strain through calico. (*Brit. Phar.*) A mixture of equal parts of savin and of verdigris ointments is occasionally used as a stimulant dressing for foot-root, and other indolent sores.

SILVER AND ITS MEDICINAL COMPOUNDS.

SILVER NITRATE. Argenti Nitras. Lunar Caustic. Lapis Infernalis. ($Ag\ NO_3$.)

When metallic silver is heated with diluted nitric acid, nitric oxide gas is evolved, and when the solution is evaporated, silver nitrate crystallises in colourless right rhombic prisms. To form the familiar sticks or pencils, the salt is fused and run into moulds. It is devoid of odour, has a disagreeable, caustic, metallic taste, remains permanent in the 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, and corrodes soft animal tissues. Like other silver salts, it is distinguished by giving, with hydrochloric acid, a white precipitate of chloride (Ag Cl), insoluble in nitric acid, but soluble in ammonia. Hydrogen sulphide and ammonium hydro-sulphide yield black precipitates of sulphide (Ag_2 S), insoluble in alkalies. Potash and soda solutions throw down the brown oxide (Ag_2 O).

Actions and Uses.—Large doses, besides topical irritation and corrosion, stimulate the spinal cord producing convulsions and paralysis with death from respiratory arrest. Chronic poisoning, as with arsenic and antimony, is accompanied by

fatty degeneration. Medicinal doses are tonic, stimulant, and astringent, and are excreted chiefly by the intestines and liver. Applied externally it is caustic, stimulant, and astringent. Salts of silver closely resemble those of copper and zinc.

Toxic Effects.—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 to produce a given effect a solution five times as strong; ferric-chloride acted only feebly; alum caused dilatation (*The Practitioner*, September 1876). Silver nitrate, given to dogs in doses of thirty to sixty grains, acts as a topical irritant, causing fatal gastro-enteritis. It is most powerful when in concentrated solution. Rouget found that small doses given to various mammalia caused excitement almost like that produced by strychnine, while toxic doses induced convulsions and asphyxia. With hypodermic injections of silver hypo-sulphite, Curci induced in various animals primary stimulation of the sensory columns of the cord, while later and less notably the motor column became affected (Phillips's *Materia Medica*, 1882). Frequent full doses are stated to alter the outlines and pale the colour of the blood globules and convert hæmoto-globulin into hæmatin. The metal is discovered in the liver and spleen, and in the structure of the skin, where it produces a black stain; it induces fatty degeneration, especially of the kidneys, liver, and heart; elimination occurs slowly chiefly, by the intestines and liver.

Medicinal Uses.—Moderate doses are absorbed as double chloride of sodium and silver, as albuminates and peptonates. As a tonic, it is prescribed in chorea, and epilepsy, especially amongst dogs. Like arsenic it is sometimes used to check chronic gastric irritation. Along with opium half a grain is given several times daily in chronic diarrhœa, dysentery, and cholera in dogs; whilst enemeta of five to ten grains to the ounce of distilled water, or of starch gruel, are occasionally also used.

Its external applications are numerous and important. Applied to irritable, relaxed, abraded skin or mucous surfaces, it constringes dilated vessels, coagulates mucus and albumen, produces a white film of chloride, which gradually deepens in colour, owing to the salt being reduced to the sulphide and

metallic states. 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 used to remove fungus growths, warts, and angleberries; to alter the condition of indolent wounds; to heal callous ulcers; to circumscribe patches of lichen, and promote a healthier action in the scaly stages of eczema. A crystal rolled in a piece of tissue paper is sometimes substituted for corrosive sublimate in fistulæ, and a few days after its introduction causes sloughing of the hard walls of the canal, and leaves a healthy granulating surface. It is an excellent dressing for obstinately sore teats in cows. Mr. Robert Littler of Long Clawson regards it as one of the most effectual remedies for the interdigital inflammation and discharge which constitute one of the familiar forms of foot-rot in sheep. A solution, containing two to five 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 of recent origin and produced by acidents, but is of little avail in cloudiness in the cornea resulting in horses from repeated attacks of periodic ophthalmia. A strong solution of 20 grains to the ounce of water, or of ether, is sometimes applied in the same manner as collodion, to arrest inflammation in the early papular stages of boils, or in circumscribed erysipelas, and synovitis. A weak solution relieves pain and hastens healing of scalds and burns, and is applied either immediately after the accident, or so long as pain and undue discharge continue. A solution of three to five grains to the ounce of water, conveniently blown from a spray-producer, is sometimes used to control congestion, suppuration, and sloughing of the fauces and throat; but for relaxed sore throat and ulcers, glycerine of tannin, ice, and potassium chlorate are safer and equally effectual. Solutions of ten to twenty grains to the ounce destroy the parasites of mange, scab, and ringworm; and weaker solutions are sometimes used as clysters to bring away ascarides from the rectum of horses and dogs; but for

this latter purpose many other remedies are preferable. It is occasionally employed as a hair-dye, uniting with the sulphur of the hair to form the black sulphide. Where too freely used, whether internally or externally, injurious consequences are best controlled by solution of common salt, which forms the insoluble and inert chloride.

Doses, etc.—Horses and cattle, grs. v. to grs. x.; sheep, grs. ij. to grs. iv.; pigs, gr. ss. to gr. j.; dogs, gr. $\frac{1}{8}$ to gr. ss. It is repeated two or three times a day, and on account of disagreeable taste, is given in bolus, made with meal, bread crumb, or other convenient excipient. For external purposes the little *sticks* are sometimes coated with wax to preserve them from decomposing action of air and light, and held in quills or forceps to prevent their blackening the fingers. An *ointment* is occasionally made with grs. v. to grs. viij. to the ounce of vaseline or lard. Solutions, protected from light and kept in bottles with glass stoppers, vary in strength with the uses to which they are applied.

SOAPS.

Potassium or Soft Soap. Sapo mollis.
Sodium or Hard Soap. Sapo durus.

Oils and fats consist of fatty acids—the oleic ($HC_{18} N_{33} O_2$), palmitic ($HC_{16} H_{31} O_2$), and stearic ($HC_{18} H_{35} O_2$), united with glycerine ($C_3 H_8 O_3$) (p. 363). These fats when boiled with solutions of potash, soda, or ammonia, are decomposed. The alkali displacing the glycerine unites with the fatty acids forming soaps, which chemically are oleates, palmitates, and stearates, of the alkalies. The process is similar to that occurring in the making of lead plaster (p. 418), in which lead oxide takes the place of the alkali. Soft soap is usually made by boiling crude potashes with seal or whale oil, excess of water being got rid of by evaporation. Hard soap is prepared by boiling carbonate or caustic soda with tallow, palm oil, cocoa-nut oil, or other fatty matters. The commoner sorts are run at once into moulds. To get the better qualities, the boiling gelatinous solution is treated with common salt, when the soap, in flakes, separates from the alkaline impurities, and glycerine

floats to the top, is ladled off, and transferred to moulds. Hard soap is a mixture of sodium stearate with about one-third of oleate, and 20 to thirty per cent. of water. Yellow soap, whilst 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. Castile soap is made from olive oil. Glycerine soap is got by heating the soap ley with water for two or three hours at 400°; the mass run into moulds contains a mixture of soap and glycerine. The Pharmacopœia soaps are directed to be made with olive oil, which is, however, much too expensive for ordinary soap-making. Soaps have an alkaline acrid taste, dissolve readily in water and spirit, but ought not to impart an oily stain to paper. When heated they fuse, swell up, and leave charcoal and carbonate of their alkalies. Lime and magnesia in solution, as in hard water, displace the alkali and combine with the fatty acids, forming insoluble flakes. This property has led to the use of soap as a test for the hardness of water.

Actions and Uses.—Soaps are mildly laxative, diuretic, emetic, and antacid; are used externally as stimulants, detergents, and lubricants; and in pharmacy as excipients. They form convenient adjuncts to more active laxatives or diuretics, and an excellent addition to laxative clysters. With warm water they are in every-day use for cleansing the skin, removing acrid fatty matters, keeping open the orifices of sebaceous glands, and aiding the action of blisters and other medicinal applications. They abate erythema and intertrigo from friction of badly fitting harness or other causes, the irritable parts being subsequently dressed with vaseline, with vaseline and sugar of lead lotion, or dusted with sanitas or other soothing antiseptic powder. Gently rubbed over slight burns or scalds, soap prevents access of air and relieves irritation. A thorough washing night and morning is often useful in eczema, removes the scales of psoriasis, and with smart friction breaks up the burrows of mange or scab acari, and prepares for the effectual use of special insecticides. 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, to

warm horses' chilled legs, and produce counter-irritation in cold and 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. To this are sometimes added two or three ounces of camphor. 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 they are less effectual than the 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 for making boluses, liniments, and occasionally ointments.

SODIUM AND ITS MEDICINAL COMPOUNDS.

Sodium salts abound in the ashes of marine and maritime plants, but sea-water is the source of the chloride from which most of the other salts are obtained. 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, as albuminates, chlorides, and phosphates, are constituents of the blood, bile, and serous fluids, indeed of all animal secretions and textures. They are soluble and readily diffusible, furnish the soda which is drained away rapidly, especially during convalescence from acute disease; promote osmosis and oxidation; many are antacids, are solvents of albuminoids, hasten tissue metamorphosis, increase both the solids and water of the urine, with which the more soluble salts in small doses are chiefly excreted, while the less soluble in larger doses 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 readily convertible into carbonates, are antacid, alterative, and diuretic. The alkali and monocarbonate are caustics.

2. The chloride, sulphate, nitrate, and permanganate are stimulants, most of them antiseptics, refrigerants, febrifuges, in small doses diuretic, in large doses cathartic.

3. The borate, hyposulphite, and chlorate resemble their acid or salt radical portion rather than their base.

Sodium salts are less diffusible and irritant than the corresponding potash salts; they have no sedative effect on the heart, muscle, or arterioles; doses two or three times greater than those of the corresponding and more deadly potash salt produce only passing weakness.

SODIUM CARBONATE. Sodæ Carbonas. Carbonate of Soda. $Na_2\ CO_3\ 10H_2\ O$.

SODIUM BICARBONATE. Sodæ Bicarbonas. Bicarbonate of Soda. $NaH\ CO_3$.

Sodium hydrate or caustic soda (Na HO) and solution of 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. To the extent of about 200,000 tons annually, it is now obtained from common salt by heating it in furnaces with sulphuric acid; the sulphate thus obtained 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 rhombic crystals of hydrated carbonate used for washing purposes. The water may be driven off by heat, when the dried Pharmacopœia sodium carbonate remains. The carbonate in any of its forms is alkaline, efflorescent, and soluble in water.

The bicarbonate, produced when the carbonate is exposed to carbonic acid, is a white crystalline powder, or aggregation of irregular opaque scales, has a saline, slightly alkaline 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 30 grains of bicarbonate, and is saturated with carbonic acid gas, dissolved under pressure of seven atmospheres.

Actions and Uses.—Sodium carbonate and bicarbonate are antacids and alteratives. They differ only in the degree of their action, closely resemble the corresponding potassium salts, but are less penetrating and irritant, and, containing a higher percentage of alkali, have a greater neutralising power.

Medicinal Uses.—Small doses given half-an-hour before meals increase secretion of gastric juice. Given with meals or after feeding they aid emulsionising and digestion of fats and neutralise the acid of the gastric juice, and any acid produced by excessive fermentation of food. They are hence serviceable in relieving occasional cases of indigestion and flatulence, their efficacy being increased by administration with an aromatic or stimulant. Young calves too freely fed on stale skim milk, and suffering from atonic dyspepsia are often relieved by solution of three or four drachms of bicarbonate in each meal of milk. Soda carbonates 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 preferable for promoting oxidation, tissue metamorphosis, and alkalinity of the urine. They are dissolved and readily absorbed chiefly as chloride. They stimulate vibratile movements of ciliated epithelium. They restore any deficiency of soda salts which are apt to be passed out of the body in abnormal amount during convalescence from acute disease. They increase oxidation and tissue metamorphosis, hence reduce excessive obesity of pampered show animals, aid removal of waste and excrementitious substances, and are thus febrifuge. They maintain and increase the alkalinity of the blood, and are hence believed to antagonise the rheumatic diathesis. Their effect on the blood is not, however, very considerable or permanent, for they are speedily eliminated chiefly by the kidneys, rendering the urine alkaline, and increasing solubility of uric acid. As anti-

lithics they are, however, less active than the potassium carbonates.

Carbonate solutions lessen the irritation of urticaria of lichen and other eruptions, but potassium cyanide is still more effective. The alkaline secretion and itching of the weeping stages of eczema are abated by carbonate solutions; half a drachm to the pint is most generally suitable; weak are preferable to strong solutions; lint well soaked is applied to the irritable surface, and evaporation checked by a piece of oil-skin laid over. To prevent brittleness and tenderness of skin it should subsequently be moistened with vaseline or glycerine and water, and in more chronic cases the alkaline dressing should be alternated with tar or oil of cade. The simple white non-puriform leucorrhœa is usually arrested by two or three injections. A strong solution of bicarbonate greatly checks the pain of burns.

Doses, etc.—Of the carbonate horses and cattle take ℥ ij. to ℥vj.; sheep and pigs, grs. xx. to grs. lx.; dogs, grs. x. to grs. xx. The bicarbonate, although about half the activity of the carbonate, is more convenient for general use, and is given in double these doses. Both salts are used in bolus and solution.

Sodium Borate. Sodæ Biborate. Borax.

$Na_2O, 2B_2O_3, 10H_2O.$

Borate of soda occurs native in certain Austrian mineral waters, and as an incrustation on the edges of various lakes in Thibet and Persia. As crude borax or tincal, it is imported from Calcutta in greenish pieces covered with a greasy deposit, to prevent efflorescence. It is purified by calcining and recrystallising. Borax is also readily got by boiling, or calcining together boracic acid and sodium carbonate. Its colourless, oblique, six-sided prisms speedily 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 ($N_2O, 2B_2O_3$), much used as a flux. A hot

saturated solution, treated with a mineral acid, deposits the crystalline scales of boracic acid.

Actions and Uses.—Borax resembles the carbonate and bicarbonate, is feebly irritant, antacid, and detergent; is an effectual antiseptic destroying yeast diastase and other particulate ferments; and is excreted by the kidneys unchanged. The powder or strong solution is a useful dressing for the small, round, superficial ulcers of aphtha, occurring especially in calves and lambs, removes the curdy exudation of thrush, checks diphtheritic sore throat, abates irritation of skin abrasions, and allays itching of eczematous eruptions, especially in dogs, when it is best alternated with zinc oxide. It is occasionally prescribed, in the same doses as the bicarbonate, to combat gastric irritation, fermentation, and fulsome discharges. Its soothing effects are increased by conjoining it with glycerine. In America it is prized for the destruction of cockroaches.

Sodium Sulphate. Sodæ Sulphas. Sulphate of Soda. Glauber's Salt. $Na_2 SO_4, 10H_2 O$.

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. It is a by-product in the preparation of chlorinated lime and of sodium carbonate, but is usually got when hydrochloric acid is made from sulphuric acid and common salt, by adding sodium carbonate to the acid sodium carbonate ($Na\ H\ SO_4$) left in the retorts. It occurs in large rhombic or in needle-like crystals, is colourless, transparent, efflorescent, of a saline, bitter taste, and soluble in three parts of water at 60°.

Actions and Uses.—It is cathartic, diuretic, alterative, and febrifuge. It has a low diffusion power; like magnesium sulphate it retains the water with which it is usually administered, attracts fluids present in the intestines, is slowly and only very partially absorbed, but moderate doses provoke both osmosis and secretion, slightly increase peristalsis, and augment the quantity and fluidity of the dejections. Not only does it carry away bile lodged in the duodenum, and thus prevent its

reabsorption, but unlike the magnesian sulphate, Professor Rutherford's experiments on fasting dogs demonstrate that acting upon the secreting cells it augments secretion of bile. The phosphate has a similar moderate cholagogue action. As with other salines, although large doses are removed by the bowels, small doses freely diluted are given 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. In dogs it acts both as an emetic and purgative.

Doses, etc.—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.
$Na_2\ SO_3, 10\ H_2O.$

SODIUM THIOSULPHITE. Hyposulphite of Soda.
$Na_2\ S_2\ O_3\ 5\ H_2O.$

The sulphite is manufactured chiefly for the dyer. By passing sulphurous acid gas through a concentrated solution of sodium carbonate, four-sided crystals of sulphite are deposited, acid in taste and reaction, and with an odour of sulphurous acid. When this acid salt is saturated with sodium carbonate, the normal or neutral sulphite is obtained. This salt, gently heated with sulphur, yields sodium hyposulphite, which is largely used in photography and in paper-making as an antichlore. Exposed to the air, the sulphites absorb oxygen, and are converted into sulphates ; the hyposulphites are more permanent ; but all are decomposed by mineral acids, yielding the active sulphurous acid.

Actions and Uses.—The sodium sulphites and hyposulphite are antiseptics, deodorisers, alteratives, and insecticides. In the presence of acids, and in the stomach, they give off sulphurous acid, which they therefore resemble. They kill bacteria, destroy septic germs, arrest fermentations, and remove offensive smells—properties greatly increased when they are used along with carbolic or cresylic acids. When standing

long in contact with water, the sulphite has the disadvantage of decomposing, and gives off hydrogen sulphide.

The sulphites and hyposulphites, when swallowed, are absorbed, retard molecular change, remove noisome smell and acridity from unhealthy secretions, and are excreted mostly as sulphates. Being less irritant than carbolic acid, they may be administered more freely without risk of poisoning. Professor Polli, of Milan, made upwards of three hundred experiments with acid sulphite, mostly upon dogs, and found that it neutralised, or at any rate 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 30 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. Into the thighs of two dogs Professor Polli injected 15 grains of fœtid pus from an unhealthy abscess, 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 30 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. Another experiment, still more striking, was made with the muco-purulent discharge from a glandered horse. Forty-five grains 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. Both were drowsy and panted, but the one protected by previous administration of the sulphite, although at first seeming to suffer most, was in a few hours able to eat, and was next day in tolerable health. The other, however, became more drowsy, and stood with difficulty; by the third day, the limb was tender and œdematous; by the fourth, gangrene set in, and a purulent discharge ran from the nose and eyes; while, during the sixth day, the beast died, worn out by pain, diarrhœa, and fœtid suppuration.

These experiments held out great hopes that septic disorders might be antagonised by sulphites. But the high expectations which were formed of them unfortunately have not been corroborated by repeated careful clinical observation, and their internal use does not appear to arrest or materially alter the course of febrile, contagious, or zymotic diseases. Amongst horses they are sometimes given in febrile attacks, inveterate skin disorders, tedious cases of strangles, rheumatism, and farcy. In indigestion they sometimes counteract flatulence. They relieve acidity and flatulence occurring in young calves hurriedly and carelessly fed. Ounce doses of acid sulphite, given thrice daily, I have found lower temperature, and ease breathing in contagious pleuro-pneumonia in cattle. In cattle plague it has been given both by the mouth and injected into the veins, and although it did not act as a specific, or save life, it abated fever, lowered excessive temperature, and postponed the unfavourable issue (*Report on Cattte Plague*). Mixed with treacle and placed within the lips, it diminishes irritation, smell, and acrid discharge in foot-and-mouth disease. Alone, and occasionally with potassium chlorate, it has been given to young cattle to prevent attacks of the anthracoid 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. Twenty grains given twice daily help to keep the bowels regular, diminish offensiveness of the secretions, and abate the low fever occurring in distemper in dogs.

Doses, etc.—Horses and cattle have ℥ j. to ℥ ij.; sheep and pigs, ʒ ss. to ʒ j.; dogs, grs. x. to grs. xxx., given in powder or solution, and repeated several times daily. Having little taste, it may usually be taken mixed with the food. It is sometimes conjoined with ginger, gentian, camphor, or ammonium carbonate.

Sodium Chloride. Chloride of Sodium. Common Salt. Muriate of Soda. Na Cl.

Salt is found in immense strata 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 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 cubic crystals free from moisture, and has a purely saline taste" (*Brit. Phar.*). From the presence of magnesium and calcium chlorides, many samples are deliquescent. It is soluble in about 2½ 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, alterative, and antiseptic; larger doses are irritant, cathartic, and emetic; it is used externally as a stimulant, antiseptic, and refrigerant.

So essential is the regular or frequent use of salt for the maintenance of health, that animals in a state of nature instinctively travel many miles to saline springs, the sea-shore, or incrustations or beds of salt. M. Boussingault, experimenting regarding the dietetic value of common salt (*Annales de Chemie et de Physique*, 1847, tom. 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, consumed it in a shorter time, and also drank larger quantities of water. Salt is especially necessary for animals receiving cooked grains, or roots; for the salt naturally present is apt to be diminished by such preparation. 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 instinctively then take salt freely, and its restoration is essential for robust health. Besides being itself restorative, it probably favours absorption 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. Animals should have access to salt at all times; a piece of rock salt should constantly lie in the horse's manger, the ox's crib, and the sheep's trough. The condiment not only gratifies the palate but also, as indicated, serves important nutritive purposes. Besides otherwise aiding digestion, it furnishes hydrochloric acid for the gastric juice, and soda salts for the bile; it assists nutrition, abounding where active reparative or formative changes are taking place. It is excreted by the mucous membranes and kidneys.

Toxic Effects.—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 as an emetico-cathartic, being used to clear out the stomach and intestines, and to induce those febrifuge effects which accompany the operation of most emetics. Doses insufficient to act on the stomach or bowels are determined to the kidneys, increasing secretion of urine and proportion of urea. On pigs it acts as a purgative, but is scarcely so safe or certain as oil, jalap and calomel, or aloes. In the *Veterinarian*

for 1839 and 1862, cases are recorded of pigs suffering from flatulence, diarrhœa, vertigo, convulsions, and paralysis, and dying in eight to twenty-four hours, from eating about four and a half ounces, repeated during several days. 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, reports 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 carcases 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 large recently applied doses. (See "Nitre," p. 530; and *Veterinarian*, September 1876.)

Medicinal Uses.—For vigorous adult cattle and sheep common salt is a very useful purgative, resembling in its effects Epsom and Glauber salts. It is, however, more soluble and highly diffusible; moderate doses are more quickly absorbed from the stomach and small intestines; are shortly returned to the larger bowels, into which they enter both by osmosis and secretion. Small doses are mainly removed by the kidneys. Professor Rutherford's experiments on fasting dogs demonstrate that common salt slightly increases secretion of bile. It purges not only the bowels, which is the main func-

tion of the more slowly diffusible Epsom and Glauber salts, but it also purges the blood. Thus establishing their cathartic effects in somewhat different manner, increased results are attained by conjoining common and Epsom salts. Full doses of these salines, causing thirst, induce the animal to drink largely of water or other bland fluids, which soften and carry onwards the hard, dry, impacted matters, so 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, and cautiously used in 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 is the best antidote for controlling excessive action of silver salts. Small and repeated doses are stomachic, and are prescribed with gentian, ginger, or spirits and water, for all animals suffering from indigestion and irregular appetite. 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 obviates in great measure the evil effects of damp and badly kept fodder, and with nutritive dry food, prevents or retards the progress of liver-rot in sheep. It is a common addition to laxative clysters. Dissolved in six or eight parts of water, it proves a valuable antiseptic and stimulant in ulcerated and relaxed sore-throat of horses and other patients, and increases the activity of the cilia of the bronchial mucous membrane. From its action as a stimulant, as well as from the cold it produces during solution, it is of benefit in various diseases of the joints and feet, particularly amongst cattle and sheep. Where a cooling mixture is required, one part each of salt nitre and sal ammoniac is dissolved in 30 to 40 parts of water; or one 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, and stands high on the list of antiseptics.

Dr. Angus Smith found that one hundredweight of night soil was preserved for thirty-four days, with scarcely any putrefaction, by two ounces of salt (*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 now recommended to preserve for manure the meat seized at the Metropolitan markets as unfit for human food.

Doses, etc.—As a purgative the adult ox or cow takes lb.$\frac{3}{4}$ to lb. j.; sheep, $\frac{z}{3}$ j. to $\frac{z}{3}$ iij. Instead of using common salt by itself, I prefer as more prompt and effectual for cattle half-doses of common and Epsom salts, dissolving the mixture in about two quarts of tepid water, adding two ounces of powdered ginger, anise, or other aromatics, and a pound of treacle. When the mixture is thus sweetened, some cattle readily drink it, and the trouble of putting it over may be saved. In treating gastric derangements and other cattle cases, accompanied with torpidity of the bowels, it is often necessary to hasten and increase the effects of salines by addition of other purgatives; and an effectual combination is made with half a pound each of common and Epsom salts, two or three drachms of calomel (or twenty powdered croton beans), a pound of treacle, and two ounces of oil of turpentine—all dissolved together in three quarts of water. Where such a dose fails to act in twelve or fifteen 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, since they induce nausea and depression, which prevent purgation. When a patient has got two, or at most three, full doses of physic 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 an alterative and stomachic for horses or cattle, one or two 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 popular emetic for a medium-sized dog consists

of a table-spoonful of salt, and half a tea-spoonful of mustard flour, dissolved in three or four ounces of water. More prompt results are obtained by adding a grain of zinc or copper sulphate; while a grain of tartar emetic confers sedative effects.

SODIUM CHLORATA. Chlorinated Soda. Liquor Sodæ Chloratæ. Hypochlorite of Soda.

When chlorine is passed into a solution of sodium carbonate, a colourless alkaline bleaching liquid is produced, recognised by the Pharmacopœia as liquor sodæ chloratæ, known also as Labarraque's disinfecting fluid, and containing sodium chloride, hypochlorite, and bicarbonate. Like the analogous chlorinated lime, the liquor may be evaporated, and chlorinated soda obtained as a soft white powder, with a chlorine odour and alkaline astringent taste.

Actions and Uses.—It is antiseptic, stimulant, and antacid, is also used as a disinfectant and deodorant, and resembles chlorine and chlorinated lime. Like other hypochlorites, it is decomposed, even by the feeblest acids, with liberation of the unstable hypochlorous acid, which readily parts with its oxygen, and as a bleaching agent is twice as active as chlorine. Sodium chlorate is absorbed into the blood either unchanged or as hypochlorous acid; it probably oxidises, as it does out of the body, urea, hippuric acid, and other secondary organic compounds, and converts the colloids which are unable to permeate the capillaries walls into the readily absorbed crystalloids (Dr. John Harley; Royle's *Mat. Med.*, 6th edition). Hence in febrile cases it favours excretion of imperfectly oxidised matters. It has been prescribed in typhoid cases, and purpura in horses. Coster found that the solution neutralised the poison of rabies and of syphilis; but its power of destroying the germs of smallpox, scarlet fever, or typhus is not established. It is an antidote for poisoning by hydrogen sulphide, the hydro-sulphides, and prussic acid. It is a valuable antiseptic, is not much inferior to carbolic acid as a destroyer of bacteria; it deodorises foul sloughing wounds and ulcers, checks excessive noisome discharges from the skin or mucous surfaces, controls the moist earlier stages of eczema and

prurigo, and is employed for douching from an atomiser relaxed and irritable sore throats, especially in horses. As an antiseptic, although more expensive, it is for some purposes preferable to chlorinated lime, for by exposure it becomes converted into common salt—itself a valuable antiseptic, and more permanent and convenient than the deliquescent, moist calcium chloride, left from the bleaching powder.

Doses, etc.—Of the Pharmacopœia solution, containing one part of the chlorinated soda, dissolved in one of water, horses and cattle take f℥j. to f℥ij.; sheep and pigs, f℥j. to f℥ij.; dogs, ♏xv. to ♏xxx. dissolved in water.

SPERMACETI.

Spermaceti or cetaceum is nearly allied to the fats and solid oils, and 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, which do not, however, yield it so abundantly as the head. Purified by melting, straining, and solution in weak potash ley, it is a translucent, pearly white, crystalline fat, with the density ·940, tasteless, odourless, tough, and difficult to powder, unless previously moistened with a few drops of rectified spirit. It is insoluble in water, sparingly soluble in cold alcohol, readily soluble in hot alcohol and oils, and does not melt under 100°. Along with a little sperm oil, it consists of cetin (C_{32} H_{64} O_2), which, unlike ordinary fats when saponified, does not yield glycerine, but taking up an atom of water separates into palmitic acid (HC_{16} H_{31} O_2) and the solid crystalline ethal or cetyl alcohol (C_{16} H_{34} O).

Actions and Uses.—It is emollient and demulcent, resembles wax, is rarely given internally, but is used for making ointments and plasters.

STARCH.

The farina or flour of seeds and soft cellular roots and stems (Royle).

Starch is largely present in the cereal grains, in the stems of many plants, and in most roots. Wheat flour contains 70 per cent. of starch, which receives the special title of amylum, 10 of glutin, with sugar, gum, bran, water, and ash; oatmeal contains 66 of starch and about 16 of glutin; barley, 68 starch, 14 glutin; rice, 70 starch, 8 glutin; potatoes, 20 starch, 2·8 glutin. From any of these sources starch is got by finely dividing the grain or root; sometimes facilitating the separation of the 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 also 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 glutin by a weak solution of soda.

Starch consists of flattened ovate granules, varying in size and appearance with the source from which they are obtained; the large granules of tous-les-mois being $\frac{1}{200}$th of an inch long, the small ones of rice being $\frac{1}{3000}$th of an inch. It is insoluble in cold water; has a specific gravity of 1·5, and hence is deposited when mixed with water. With water above 140° its granules swell and burst, forming the viscid gelatinous mucilage used by the laundress. It is converted first into dextrin or British gum, and thence into grape sugar, by diluted sulphuric acid, by a temperature of 400°, or by diastase and various fermentescible animal matters. Its distinctive test is the blue compound which boiled solutions, allowed to cool, give

with iodine. Starch is isomeric with cellulin, and has the formula $C_6 H_{10} O_5$.

Actions and Uses.—Starch is easily digested and nutritive, especially when given with albuminoids. Like other such proximate principles, pure starch alone is inadequate to support life for any lengthened period. As a demulcent and emollient, starch mucilage protects and softens irritable surfaces. In diarrhœa and dysentery it is used about the consistence of cream, at the temperature of 100°, 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 is occasionally dusted over wounds and open joints to absorb discharges. Mixed with equal parts of zinc oxide it relieves the irritation, the weeping earlier stages of eczema. Mixed with carbolic acid or sanitas oil, convenient, desiccant, antiseptic powders are formed. Heated with about eight parts of glycerine until it forms a translucent jelly, it is applied with three or four parts of water as a soothing demulcent. Starch is used for mixing and subdividing medicines, and as a vehicle for their administration.

STAVESACRE SEEDS.

Staphisagriæ Semina. The ripe seeds of Delphinium Staphisagria, imported from Germany and the south of France (Royle).

Nat. Ord.—Ranunculaceæ. *Sex. Syst.*—Polyandria Trigynia.

Stavesacre or larkspur is a stout biennial herb, two to four feet high, growing throughout the south of Europe. Its officinal seeds are brown, wrinkled, irregularly triangular, about ¼ inch long and scarcely so broad; contain a white oily kernel; are bitter, acrid, and nauseous, and have a disagreeable smell. The kernel contains one-fourth of its weight of a fixed oil. The seeds, especially in their shelly covering, contain about one per cent. of several alkaloids soluble in ether and acetic acid: delphinine ($C_{22} H_{35} N O_6$), yielding large crystals of the rhombic system; staphisagrine ($C_{22} H_{35} N O_5$), amorphous, soluble in one part of ether and 200 of water; delphinoidine, amorphous,

the most abundant of the active principles; and traces of delphisine separable in crystalline tufts (Flückiger).

Actions and Uses.—Stavesacre seeds and their alkaloids are irritant poisons and insecticides. The seeds were formerly prescribed as a vermifuge. Their only veterinary use is for the destruction of lice, whence they have been called louse seeds. They are effectually applied in infusion made by boiling an ounce of seeds in a quart of water. The seeds boiled in vinegar yield a solution which not only kills pediculi, but when rubbed into the skin also destroys their eggs. Strong solutions, too freely applied, sometimes nauseate and prostrate delicate subjects. Occasionally they are conjoined with sulphur and tar.

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, a jointed annual stem six to twelve feet high, and long grassy leaves, which send out a flowering stem terminating in a panicle of beautiful silver-grey flowers. The lower parts of those canes which have not previously borne flowers are richest in saccharine matter. The canes are crushed between heavy rollers; the pale-green expressed juice, which contains nearly 20 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 exceeding 140°; the coagulating albumen, 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 brought to this country often contains 40 per cent. of water and impurities, and 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°, quickly dried in small crystals, or poured into conical moulds and crystallised as loaf sugar. A cwt. of raw sugar yields about 80 lbs. refined sugar and 16 lbs. treacle.

Cane sugar, sucrose, the saccharum purificatum of the Pharmacopœia (C_{12} H_{22} O_{11}), is colourless, odourless, porous, friable, and sweet. Like sulphur and arsenious acid it has an amorphous and a crystalline form; its hard crystals are of the oblique rhombic system; its specific gravity is 1·606. It is soluble in one third of its weight of water at 60°, phosphoresces in the dark, is decomposed by mineral acids, and readily fermented by yeast. When slowly crystallised at 170°, 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°, fuses, and the vitreous mass can be moulded into barley-sugar. Above 356° sugar 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.

Grape sugar, or glucose (C_6 H_{14} O_7), as a commercial article, is prepared from white beet; it is produced by prolonged boiling of cane sugar; it results when starch is boiled with water acidulated with sulphuric acid; it is the variety occurring in the blood, in the animal textures, and in the urine, and formed from starch, whether in or out of the body; and is yielded by a number of proximate vegetable principles termed glucosides, including salicine, amygdalin, and digitalin, when these are boiled with diluted acid. Fruits, new honey, and germinating seeds, contain an uncrystallisable variety styled fruit sugar or fructose (C_6 H_{12} O_6), apparently an intermediate stage in the transition of starch, cellulose, and cane sugar into grape sugar. The transition from fructose to glucose takes place in dried fruits. Fructose is also called inverted sugar or lævulose, on account of its rotating rays of light to the left instead of, like other sugars, to the right. Between glucose and sucrose there are several marked distinctions. Glucose is neither so sweet

nor so soluble as sucrose, crystallises in cakes or square plates, and is not charred by sulphuric acid, but forms with it sulphosaccharic acid. It produces a readily crystallisable compound with common salt; but its most 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 fructose or glucose is present, but no reddening or precipitation occurs with pure sucrose unless the solution is boiled.

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. Liquorice contains the uncrystallisable, unfermentable sugar glycyrrhizin (p. 427).

Honey or mel, the saccharine secretion deposited in the honeycomb by the hive bee, when first collected, is yellow, translucent, and viscid, contains cane sugar and inverted sugar, but the cane sugar becomes slowly inverted, and glucose thus accumulating, crystallises out. Forty ounces honey, liquefied by heat, and mixed with five ounces each of acetic acid and water, constitute the detergent expectorant *oxymel*.

Milk sugar or lactose (C_{12} H_{24} O_{12}) is prepared by evaporating whey, filtering, and crystallising. It is obtained from the homœopathic chemists, who use it for subdividing their medicines. 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; is not directly fermentable; is insoluble in alcohol and ether, and requires for solution six times its weight of cold water or two of boiling water.

Actions and Uses.—The sugars are readily absorbed, are employed as respiratory fuel, or converted into and stored away as fat, are decomposed and got rid of as water and carbonic anhydride, or in excessive doses and in certain disordered states are formed into lactic and oxalic acids. They are stated to destroy frogs, leeches, and earthworms; to stupefy fish, and poison pigeons, with swelling of the head and convulsions.

But Hertwig gave pigeons three to five drachms without any bad consequences. One or two pounds given to horses, eight to twelve ounces to dogs, increase the amount and fluidity of the fæces, and usually augment secretion of urine. As a demulcent, sugar is used in human practice in the dry stages of catarrh; in poisoning with salts of mercury and copper; and as a domestic remedy for wounds, and for removing specks on 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 lime salts (p. 242), and retards oxidation of ferrous compounds (p. 396). Simple syrup, the *syrupus simplex* of the Pharmacopœia, 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 7½ lbs. The specific gravity is 1·330. (*Brit. Phar.*)

Molasses and treacle, in veterinary practice, are often substituted for sugar. They are palatable, digestible, laxative, articles of diet, well adapted for sick animals and convalescents. They are convenient auxiliary purgatives, especially 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 gargle for horses with sore throat, three or four ounces of treacle and an ounce of borax or of potassium nitrate or chlorate, are dissolved in a pint of water; a few ounces of the sweet solution are slowly administered every hour or two, or when cough is troublesome; an ounce of belladonna extract is sometimes added. Treacle, like sugar, is antiseptic, and one of the best excipients for making ball masses, giving them 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, etc.—Of sugar and treacle, as laxatives, horses and cattle take lb j.; sheep, ℥ iij. or ℥ iv.; pigs, ℥ ij. or ℥ iij.; dogs,

℥ i.; administered with aromatics and salines, usually dissolved in water or beer, or mixed with gruel.

SULPHUR.

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 garlic, the Brassicaceæ, Umbelliferæ, and other strong-smelling plants, in some mineral waters as hydrogen sulphide, and in the various pyrites or metallic sulphides, from which it is got by roasting. It is, however, mostly obtained from the native uncombined sulphur, occurring as a product of volcanic action in beds of blue clay in Italy and Sicily. This crude sulphur is purified by distillation, and when run into wooden moulds, forms the stick or roll sulphur. The finely divided, impalpable, minutely crystalline sublimed sulphur, or flowers of sulphur, is prepared by subliming sulphur, and introducing its vapour into large chambers, where it condenses. When five parts sublimed sulphur are boiled with three parts slaked lime and twenty parts water, filtered and acidulated with hydrochloric acid, there is thrown down a greyish-yellow soft powder of milk of sulphur or precipitated sulphur, the molecules being more finely divided than those of sublimed sulphur. Sulphur vivum, caballinum, or horse sulphur, the residue left in the subliming pots, if obtained from iron pyrites, must be used with caution, as, besides other impurities, it occasionally contains arsenic. Sulphur unites with many other elements; with metals to form sulphides; with hydrogen producing hydrogen sulphide; with oxygen forming eight acids; and also with chlorine, iodine, bromine, and carbon.

Properties.—Sulphur has a yellow colour, a specific gravity of about 2, but varying in its different conditions, has a peculiar faint odour and taste, is insoluble in water and cold alcohol, feebly soluble in chloroform and ether, and more soluble in benzole, carbon bisulphide, and fixed and volatile oils. It is entirely volatilised by heat, inflames at 500°, burning with a pale blue flame, and giving off suffocating fumes of sulphurous anhydride. It boils at 836°, producing heavy brown-red

vapours. Sulphur, when heated, undergoes remarkable changes. At 240° it melts, becoming clear, limpid, and amber-coloured; about 300° it gradually gets darker and opaque, and so viscid that it adheres to the vessel even when inverted; above 350° heat becomes latent, the sulphur recovers its liquidity, and when about 500°, if poured into cold water, it is so viscid and vitreous that it may be drawn into threads, but in a few hours this ductility disappears, latent heat is lost, and the mass returns to the normal brittle crystalline form. When melted sulphur is allowed to cool at the ordinary temperature of the air it forms thin transparent monoclinic prisms, but in the course of a few hours these become opaque, splitting up into a mass of small octahedra; when, however, melted sulphur is allowed to cool at a temperature of 200° transparent rhombic octahedra are formed; this is the form assumed by native crystals of sulphur. Sulphur thus occurs in four allotropic states: it is crystalline, the crystals assume either the rhombic or monoclinic form; amorphous, as in the precipitated variety; and vitreous, as in the temporary condition just described, as occurring when sulphur is raised to 500° and slowly cooled.

Roll sulphur occurs in opaque, crystalline, brittle rolls or masses. When grasped in the warm hand, being a bad conductor of heat, it crackles and sometimes splits into fragments. Sublimed sulphur is a yellow, crystalline, granular powder, which represents two distinct forms of the element—the amorphous portion insoluble in bisulphide of carbon, the crystalline soluble. For medicinal and pharmaceutical purposes, sulphur is usually of sufficient purity; but traces of arsenic are sometimes present in that made from pyrites.

Actions and Uses.—Large doses are irritant; medicinal doses, laxative, alterative, and stimulants of mucous and cutaneous surfaces. Applied externally, sulphur is a stimulant of the skin, and an effectual antiparasitic. Full doses when swallowed pass through the canal almost unchanged; small portions converted into sulphides, exert on the intestines mild irritation, increase both secretion and peristalsis, and according to Neligan soothe hæmorrhoids. In contact with the alkaline bile small quantities are dissolved, are absorbed into the circulation, and are shortly excreted by the mucous and

cutaneous surface in the offensive form of hydrogen sulphide, stimulating epithelial cells, and increasing movements of the cilia of the pulmonary membrane. Small portions pass off in the urine as sulphates. The tissues generally are rapidly impregnated; small doses given to sheep are stated by Waldinger to impart a disagreeable flavour to the mutton.

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 additions 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 smelt of sulphur, 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). The sulphides in small doses gently relax the bowels, while, in some manner not yet explained, they counteract and control suppuration, and are usefully prescribed in wounds, boils, strangles, and inflammation of the udder. Horses and cattle take grs. v. to grs. x. of sulphide of calcium, repeated every hour or second hour; dogs take about one-tenth of such doses.

Medicinal Uses.—Sulphur is given to the several domestic animals gently to open the bowels in piles or pregnancy, where more powerful purgatives might irritate; in chronic pulmonary disorders, in convalescence from acute diseases, and occasionally in rheumatism, chronic eczema and acne. Its efficacy as a vermifuge has been over-estimated. A piece of roll sulphur in the water which the animal drinks is a popular preventive

of distemper and other canine disorders; but, being quite insoluble in water, its effects when thus used are *nil.* Applied with friction to the skin, it stimulates the cells of the rete Malpighii, and thus hastens desquamation; while it also increases contractility of the muscular texture of the skin, and hence overcomes passive hyperæmia (Dr. W. Allan Jamieson, *Practitioner*, for September 1881). Rubbed daily into the affected part, it is said to abate the pain of rheumatism. Although sulphur dusted on the skin has very slight effect, when mixed with an alkali and with vaseline or other fatty matter, and smartly rubbed in, it stimulates the dermis and promotes a more healthy action in chronic eczema and psoriasis. In such cases benefit results, especially when the simpler sulphur dressings are conjoined or alternated with iodine or carbolic acid, and aided by the administration of sulphur and arsenic.

For all veterinary patients it is much used for the destruction of acari and lice. To effect a prompt and effectual cure of mange and scab, it is essential to reach the burrows in which the female acari have deposited their ova, by diligently scrubbing the patient with soft soap and water. The thickened skin being thus softened, and scales removed, the sulphur dressing comes into immediate and fatal contact, not only with fully developed, but with embryo acari. In cases of long standing a second or even a third application at an interval of a few days may be requisite to destroy any acari which have been hatched since the former dressing. The hydrogen sulphide, eliminated when sulphur comes in contact with organic matter, appears to destroy the parasites. Lethal effects are intensified by presence of alkali. Kückenmeister demonstrated that although acari lived for several days in sulphur ointment, they perished in fifteen minutes in mixtures of sulphur and potash. In intractable mange, complicated as it often is with hypertrophied and scaly skin, besides scrupulous attention to cleanliness and the internal use of arsenic and alkalies, it is desirable to vary the external application, using in turn sulphur, tar oils, and diluted mercurial ointments, which, penetrating deeply, reach the burrowing parasite.

Doses, etc.—As a laxative, horses take ℥ iij. to ℥ iv.; cattle,

℥ iv. to ℥ vi.; sheep and pigs, ℥ j. to ℥ ij.; dogs, ℥ vj. to ℥ vj. 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, antimonials, or mercurials. For horses or cattle, a laxative mixture is made with two or three 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.

For external use almost every practitioner has his own formula. The simple *ointment* consists of one part of sulphur and four of vaseline or lard; one-fourth part mercurial ointment is sometimes added. The common *liniment* is made with one part of sulphur and six or eight of linseed or other common oil; one part of tar oil or of Barbadoes tar is often added. A useful mange dressing is made with two parts of sulphur, one each of tar oil and potassium carbonate, and ten or twelve of lard or of oil. For mange, ringworm, and other itching skin complaints, few remedies are equal to sulphur iodide (p. 389). Inveterate cases of grease Professor Williams treats with eight parts of sulphur, four potassium carbonate, one carbolic acid, with thirty-two each of lard and olive oil freely rubbed in, allowed to remain on for two or three days, and then washed off with soap and warm water. For itch and cases of papules and vesicles, Dr. Tilbury Fox recommends in human patients a drachm of sulphur, eight grains each of mercury ammonia chloride and creasote, twenty minims chamomile oil, and two ounces lard: this prescription answers very well for dogs.

SULPHURIC ACID.

Acidum Sulphuricum. Hydrogen Sulphate. Oil of Vitriol. An acid produced by the combustion of sulphur and the oxidation of the resulting sulphurous acid by means of nitrous vapours. $H_2 SO_4$. (*Brit. Phar.*)

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. Jets of steam convert it into liquid sulphurous acid ($H_2 SO_3$). Nitric peroxide (NO_2), obtained from potassium or sodium nitrate, treated with sulphuric acid, is discharged into the chambers, and supplies the oxygen which converts the sulphurous into sulphuric acid ($H_2 SO_4$). The nitric peroxide, after oxidising the sulphurous acid, is reduced to the condition of nitric oxide (NO), absorbs oxygen from the air, again becomes nitric peroxide (NO_2), is again deoxidised by the sulphurous acid, and without itself undergoing much diminution thus becomes 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 1·72, when it constitutes the brown acid of commerce. For pharmaceutical or chemical purposes, it is further concentrated in platina or glass vessels to the specific gravity of 1·843.

Properties.—The strong acid of commerce contains 96·8 per cent. of real acid ($H_2 SO_4$), and corresponds to 79 per cent. of anhydrous acid (SO_3), has the specific gravity 1·843, is oily-looking, colourless, odourless, with an intensely acid, acrid taste. It freezes about —30°, boils at 640°, 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, and in combining with it evolves much heat. This affinity for water causes it to decompose and char organic substances and soft animal tissues; whilst its readily giving off oxygen causes its conversion into sulphurous acid when it is heated with charcoal, sulphur, or metals. The acidum sulphuricum dilutum, or medicinal acid, contains about 13½ per

cent. of strong acid. The acidum sulphuricum aromaticum, flavoured with cinnamon and ginger, is of similar strength. Sulphuric anhydride or sulphur trioxide (SO_3) occurs in silky needles, resembling asbestos, has no acid reaction, forms four definite compounds with water, the most important being the fuming or Nordhausen acid used for the solution of indigo, and generally represented as H_2 O 2 SO_3 or H_2 S_2 O_7, and the monohydrate H_2 O SO_3 or H_2 SO_4. The test for sulphuric acid is its forming, in diluted solution, with soluble barium salts, an abundant white precipitate (Ba SO_4), insoluble in other acids, and which, when heated with charcoal, forms sulphide of barium, recognised by the black stain it produces on silver.

Impurities.—The specific gravity and neutralising power of the volumetric solution of soda indicate the proportion of water. 50·6 grains by weight of the strong acid, mixed with an ounce of distilled water, require for neutralisation 1000 grain measures of the volumetric solution of soda. (*Brit. Phar.*) Any trace of organic matter causes discoloration. Lead or arsenic is discovered by diluting the acid, and adding hydrogen sulphide. Iron ferrous sulphate solution poured over the specimen in a test-tube produces a purple colour where the two liquids meet, if nitrous compounds are present.

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.—Concentrated doses in all animals corrode and inflame the surfaces of the mouth and fauces, blacken the teeth, excite colic, with vomiting in dogs and pigs; the bowels are usually relaxed, the breathing difficult, the pulse frequent and feeble. The contents of the stomach are found after death acid; the alimentary canal stripped in patches of its mucous covering and studded with black spots; the blood in surrounding vessels coagulated. When the acid has been strong, the walls of the stomach are sometimes eroded; when the animal lives for some days, the mucous membrane becomes thickened and inflamed. Injection into the veins proves fatal by coagulation of blood and thrombosis. Frequently repeated

full doses attack the red globules, render them smaller, darker, and granular; oxygenation and nutrition are impaired. They reduce the normal alkalinity of the blood, causing first stimulation, and subsequently paresis of the respiratory centre. (See Hydrochloric Acid, p. 378.) The appropriate antidotes are alkaline bicarbonates, chalk, and magnesia, with such diluents and demulcents as oil, milk, and linseed gruel, followed by opium and fluid nutrients.

Medicinal doses help to form peptones, and improve relaxed conditions of the alimentary mucous membrane. Osmosis is encouraged by acidulating the fluids in the alimentary canal, while the inner aspect of the membrane is bathed with the alkaline blood. Ordinary doses are absorbed in part in combination with albumen and bases, but a certain proportion appears to be absorbed unchanged into the blood, as is evident from the fact that acids and their salts are not identical in action, which should be the case were acids altogether converted into salts previous to absorption. The small quantity of alkali present in the intestinal canal is moreover insufficient to neutralise the doses of acid usually given. Absorbed into the blood, they liberate weaker acids and lessen alkalinity. Salivary and other alkaline secretions are increased; thirst is diminished; pulse rate and temperature are reduced; refrigerant properties are brought out by combination with salines; administered with gentian, quassia, and other bitters, astringent and tonic effects are developed. It is got rid of chiefly through the bowels, kidneys, and skin, exerting on these excreting channels its astringency. For arresting excessive sweat sulphuric or phosphoric acid is often conjoined with zinc sulphate, and the patient sponged over with a tepid acid solution. Comparing the three mineral acids, Dr. Bence Jones states that hydrochloric acid specially promotes digestion, nitric acid secretion, sulphuric acid astringency.

Medicinal Uses.—Sulphuric acid is prescribed in feebleness and atony, during convalescence from acute disease, and in other cases where mineral tonics and astringents are indicated. In dyspepsia hydrochloric acid is generally preferred, but in these cases acids cannot be long freely used without injuriously diminishing gastric secretion. In diarrhœa, dysentery, and

cholera, the acid controls the profuse alkaline discharges and acts moreover as an astringent; a drachm is administered twice daily to horses and cattle, usually united with an ounce of laudanum, and given in starch gruel or mucilage. In influenza in horses, with a tendency to œdema or purpura, I have seen benefit from thirty drops sulphuric acid given in gruel or ale several times a day with an ounce each of ether and powdered cinchona bark. In relaxed and ulcerated sore throat amongst horses, 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, and usually reduced pulse and temperature, relieved breathing, and sustained the vital powers. Its success, however, was by no means invariable, nor was the percentage of recoveries greater than when iron sulphate or other tonics were given. Two and even three ounces have been used with impunity, but repeated large doses in pleuro-pneumonia, as in other cases, are apt to cause diarrhœa and colic. It sometimes stays purpura hæmorrhagica as well as bleeding from the lungs, stomach, or other internal organs, and, correcting gastric derangement, arrests itching of chronic nettle-rash and lichen. It is an effectual antidote for lead poisoning.

In a state of concentration the acid, applied to the skin, combines with its moisture, bases, and albuminoids, and disorganises the cuticle, exposing the nervous fibrillæ. Its fluidity adapts it for cauterising irregular, sinuous, and poisoned wounds, and for many of the uses of a styptic and astringent. Three parts strong acid, thoroughly mixed with one of asbestos, rubbed to fine powder, are used in France for removing cancerous and other swellings; 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 the late Professor Syme made sulphuric acid into a thin pulp with sawdust, protecting the neighbouring tissues by a wall of gutta percha. It is used in like manner to destroy warts, which, from their shape or situation, cannot readily be removed by knife or by ligature. It hastens disintegration of necrosed bone. It is added to blistering ointments, but, unless in small amount, is apt to cause blemishing. A few drops given along with Epsom salt

and other saline purgatives, diminish their disagreeable taste and rather increase their activity.

Doses, etc.—Of the medicinal acid horses take f℥j. to f℥ij.; cattle f℥ij. to f℥iv.; sheep, f℥ss. to f℥j.; pigs, ♏x. 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.

SULPHUROUS ACID.

Acidum Sulphurosum. A solution in water of 9·2 per cent. of Sulphurous anhydride.

When sulphur is burned in air or oxygen, or when sulphuric acid is heated with charcoal, iron, copper, or other bodies having affinity for water and oxygen, there is given off a heavy, colourless, liquefiable, suffocating gas—sulphurous anhydride, popularly styled sulphurous acid (SO_2). This gas, in the presence of moisture, or when it is passed into water, evolves heat, and becomes true sulphurous acid (H_2SO_3), which is crystallisable (H_2SO_3, 14 H_2O), unstable, and forms a series of soluble sulphites. The sulphurous acid of the Pharmacopœia contains, dissolved in water, 9·2 per cent. by weight of sulphurous anhydride. It is a colourless liquid, has a pungent sulphurous odour, reddens litmus, bleaches colouring matter, leaves no residue when heated, has the specific gravity 1·04. It is distinguished by its pungent odour; when in combination it is liberated by hydrochloric acid. Chlorine water converts it into sulphuric acid, recognised by the barium test; nascent hydrogen, on the other hand, reduces it to sulphuretted hydrogen, recognised by its blackening paper moistened with lead acetate solution. 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.—Both the gaseous and liquid acids are irritants. The gas, insufficiently diluted, irritates the upper

air-passages and causes suffocation. Both gas and solution are administered as stimulants and antiseptics. Externally they are applied as stimulants, antiseptics, and insecticides. They are employed as antiseptics, disinfectants, and deodorisers.

Sulphurous acid possesses in concentrated form the same antiseptic properties as the sulphites and hyposulphites (p. 565). It decomposes hydrogen-sulphide, the products being sulphur and water, and hence removes bad smells. It destroys the yeast plant, and thus arrests fermentation. A little sulphur burned in the casks before they are filled prevents the souring of beer or cider. It kills bacteria, micrococci, and other organisms which excite and maintain fermentation and putrefaction. Sir Robert Christison found that one-fifth of a cubic inch, diluted with ten thousand volumes of air, destroyed the leaves of various plants in forty-eight hours. It prevents putrefaction of the gelatine used in paper-works; is the only agent that effectually checks the noisome effluvia of the cochineal dye-works; meat suspended in bottles containing gaseous acid remained perfectly preserved for years. Professor Graham stated that "animal odours and emanations are immediately and most effectually destroyed by it." Dr. Baxter, reporting to the Privy Council, states that sulphurous acid has greater activity than chlorine or carbolic acid in destroying vaccine virus.

Medicinal Uses.—Dr. Dewar, of Kirkcaldy, first showed its extended application in medicine and surgery. He uses it in solution, in fumigation, and in spray. He treats with it wounds and bruises, and arrests the pain and progress of erysipelas. In colds in the head, sore throat, bronchitis, phthisis, and typhoid fever, he causes its inhalation and administers it in solution. In rheumatism, he further directs the bed-clothes to be exposed to the vapours from burning sulphur, and then laid over the patient, when refreshing perspiration is evoked. In analogous cases amongst the lower animals, sulphurous acid is equally serviceable. Professor Robertson uses it at Camden town in influenza cases where there is muco-purulent discharge from the upper air-passages. Professor Williams recommends its inhalation in nasal gleet. Dr. Dewar and others, with con-

siderable advantage, have used both the solution and the gas in the treatment, as well as in the prevention, of contagious pleuro-pneumonia of cattle. In this, as in other typhoid cases, it probably neutralises the specific poison, soothes the irritable bowels, and counter-acts acridity and smell of the discharges. In such cases it is often prescribed with salines, tonics, and stimulants. In hoven in cattle, and tympanitis in horses, I have tried the medicinal solution in two-ounce doses without the prompt and certain relief which usually follows ammonia or ethereal solutions. In young calves, tympanitic from hasty or careless feeding, ounce doses act, however, more certainly than in older animals. The gas mixed with air, as when sulphur is burned on red-hot charcoal, in a loose-box, destroys bronchial filariæ in calves and lambs. Two fumigations at intervals of a few days usually effect a cure, which is hastened by a dose of turpentine.

Sulphurous acid is one of the cheapest and best antiseptics for irritable weakly noisome wounds. The spray of the undiluted acid, applied for six or eight minutes, or until the part gets chilled, often arrests pain and inflammation of bruises, strains, or enlarged joints. For irritable and relaxed sore throat in horses a spray of one part of acid and ten of water proves useful. Unlike carbolic acid, its liberal use does not irritate, interfere with granulation, or get absorbed and produce dangerous constitutional effects. It is sometimes substituted for sulphur in the treatment of mange; it destroys the cryptogamic growth of ringworm; and relieves the itching of eczema, herpes, and psoriasis.

Burning sulphur, used since the time of Homer, is still one of the most effectual disinfectants. By its help smallpox was stamped out in Iceland in 1871; by its free use at Marlborough College in 1875 scarlet fever was arrested (*The Practitioner*, May 1877); its employment has frequently stayed the progress of foot-and-mouth disease. The gas is readily evolved in the stable or premises to be purified, by scattering flowers of sulphur over a few embers on a shovel or in a chauffer; and it burns best when previously mixed with about $\frac{1}{40}$th part of finely divided charcoal. Where men or animals remain in the premises, care must be taken that the gas evolved is not in

such quantity as to cause coughing, irritation, or discomfort. For each 100 feet of cubic space 1½ ounces of sulphur suffice. In tenantless buildings, the doors and windows should be closed, and a large amount of gas evolved and allowed to permeate every corner; a fresh evolution may be made after a day's interval. During the prevalence of any epizootic of plague, pleuro, or mouth-and-foot disease in cattle, or of influenza, typhoid fever, or glanders in horses, or of distemper amongst dogs, to protect healthy animals in the same or adjacent premises, they should breathe daily for half an hour the diluted acid, and should also be daily sponged over with a weak solution, which will be rendered still more destructive to disease germs if mixed with a little carbolic acid. Besides antiseptic and disinfectant actions, sulphurous acid also destroys offensive smells; it attacks and oxidises hydrogen sulphide; it converts ammonia into ammonium sulphite, itself a valuable antiseptic. The lime about the walls of infected buildings is converted by the sulphurous acid into calcium sulphite, a valuable disinfectant, and one of the constituents of M'Dougall's Powder. If used constantly or repeatedly, articles of clothing should be kept out of its way, otherwise they get bleached, and eventually rotted, from the sulphuric acid condensed upon them.

Doses, etc.—Of the medicinal solution horses and cattle take f℥i. to f℥ij.; sheep and pigs, f℥ss. to f℥j.; dogs, ♏ xx. to ♏ lx.; given every two hours, freely diluted in water or other cold bland fluid, and continued until the system is saturated and the skin gives off its odour. It is often conjoined with aromatics, alcohol, ether, or opium. Dr. Dewar believes this solution is a more effectual antiseptic than either the sulphites or hyposulphites. To insure its antiseptic properties it must, however, be freshly prepared or kept in well-stoppered bottles; exposed, it oxidises and becomes irritant from formation of sulphuric acid. For surgical purposes, the medicinal solution is diluted usually with three or four parts of water; with this the lint or other dressings are kept saturated; for irritable or painful wounds a little laudanum is added; in skin irritation admixture of glycerine proves soothing. Baths are readily made by conducting the vapour of burning sulphur

into water. In curing mange and other skin complaints in veterinary patients, baths or strong solutions are more effectual than fumigation. As a disinfectant, it is fittingly used with carbolic acid, but not with chlorine or bleaching powder, which neutralise it.

SWEET SPIRIT OF NITRE.

Spiritus Ætheris Nitrosi. A spirituous solution containing nitrous ether ($C_2 H_5, NO_2$).

When rectified spirit, sulphuric and nitric acids are heated with copper wire, the nitric acid is deoxidised by the copper; the resulting nitrous acid (HNO_2) seizes the ethyl of the alcohol ($C_2 H_5 HO$), and there is formed nitrous ether ($C_2 H_5 NO_2$) which distils over with a portion of the alcohol, and, when diluted with three times its bulk of rectified spirit, constitutes sweet spirit of nitre. In this process complicated reactions doubtless occur, but the ultimate results are represented by the formula—

Alcohol	+	Nitric Acid	+ Copper +	Sulphuric Acid.		Copper Sulph.	+ Water +	Nitrous Ether.
C_2H_5HO	+	HNO_3	+ Cu +	H_2SO_4	=	$CuSO_4$	+ $2H_2O$ +	$C_2H_5NO_2$

In preparing nitrous ether, to prevent tumultuous ebullition, violent succussions, and liability to explosion, sand is placed within the retort or matrass, a powerful refrigerator and safety-tube employed, the acid added slowly and gradually, proximity to a naked flame avoided, and the temperature not allowed to exceed 180°. The Brit. Phar. furnishes the following explicit details:—To one pint of rectified spirit add gradually two fluid ounces of sulphuric acid, stirring them together; then add gradually two and a half fluid ounces of nitric acid. Put the mixture into a retort, with two ounces of fine copper wire (No. 25). Insert a thermometer, and attach an efficient condenser, and, applying gentle heat, let the spirit distil, commencing at 170°, and raised to 175°, but not exceeding 180° until twelve ounces have passed over into a receiver, cooled, if necessary, with iced water; then allow the contents of the retort to cool, introduce half an ounce more of nitric acid, and

resume the distillation as before, until the distillate measures fifteen fluid ounces. Mix this with sufficient (about two pints) rectified spirit to make the product correspond to the tests given below. Preserve in well-closed vessels.

Properties and Tests.—Transparent and nearly colourless, with a very slight tinge of yellow, specific gravity 0·845, mobile, inflammable, of a peculiar penetrating, apple-like odour, and sweetish, cooling, sharp taste. It effervesces feebly or not at all when shaken with a little sodium bicarbonate, indicating absence of acid. Agitated with solution of iron sulphate and a few drops of sulphuric acid, it becomes deep olive-brown or black, owing to the formation and solution of nitric oxide. When agitated with twice its volume of saturated solution of calcium chloride in a closed tube, two per cent. of its original volume will separate in the form of nitrous ether, and rise to the surface of the mixture, showing the presence of ten per cent. by volume of nitrous ether in the spirituous solution. (*Brit. Phar.*)

Actions and Uses.—Large doses are narcotic, producing delirium and coma, with a variable amount of preliminary excitement. Medicinal doses are stimulant, antispasmodic, antiseptic, febrifuge, diuretic, and diaphoretic. Applied externally, it is refrigerant. It closely resembles alcohol and ether.

For all animals it is a valuable carminative and antispasmodic in indigestion, tympanitis, and colic; a ready rouser of the heart's action; a serviceable stimulant in typhoid cases and convalescence from debilitating disorders; an effectual excitant of the skin and kidneys in cold and rheumatism. Like alcohol and ether, properly regulated doses are febrifuge, and lower excessive animal temperature. It is excreted by the lungs, skin, and kidneys, increasing their secretions.

Doses, etc.—As a stimulant and antispasmodic, horses take f℥j. to f℥ij.; cattle, f℥j. to f℥iv.; sheep, f℥ij. to f℥iv.; pigs, f℥j. to f℥ij.; dogs, ♏xv. to f℥j. As it is readily decomposed, even by water, it should not be diluted or mixed with other medicines until immediately before it is administered. It is usually given in cold water, beer, or linseed tea. As an antispasmodic, it is united with opium, chloral hydrate, belladonna, or hyoscyamus. For colic in horses, two ounces are given,

with two or three drachms of aloes, dissolved in a pint of cold gruel, ale, or water, often advantageously conjoined with one or two ounces of laudanum. Two ounces, with the same quantity of laudanum, repeated every hour, counteract the spasms which occasionally follow parturition in cows. Catarrhal fever and typhoid ailments in horses are successfully treated by two ounces each of sweet spirit of nitre and ammonium acetate solution, conjoined with a drachm of belladonna extract. More continuous and permanent effects are produced by addition of a couple of ounces of spirit, and by repeating the draught at intervals of two or three hours. To combat serous exudation, one or two ounces of sweet spirit of nitre are usefully conjoined with half a drachm each of iodine and potassium iodide. Diuretic effects are 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 or sore-throat, a soothing febrifuge draught is made with two ounces sweet spirit of nitre, an ounce of 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 one to four drachms.

TOBACCO.

Tabaci Folia. Leaf Tobacco. The dried leaves of Virginian Tobacco—Nicotiana Tabacum. Cultivated in America. (*Brit. Phar.*)

Nat. Ord.—Atropaceæ. *Sex. Syst.*—Pentandria Monogynia.

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 subtropical countries of both hemispheres. It was unknown in the Old World, at all events in Europe, until after the dis-

coveries of Columbus; and was first introduced into England by Sir Francis Drake in 1586. About fifty million pounds are now 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, 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 the leaf is fermented, so as to destroy resinous and albuminous matters, which, when smoked, give rise to oils and unpleasant products. Sugar and liquorice are added to give mellowness and pliability. The several tobaccos of the shops owe their peculiarities chiefly to the manner in which they are prepared for sale; the unmanufactured Virginian, being strongest, is generally preferred for medicinal purposes. Snuff is prepared by cutting tobacco into small pieces, piling it in heaps, and freely wetting it to encourage fermentation. The heaps heat, and evolve ammonia; the process continues during one to three months, according to the sort of snuff required; the fermented product is ground and sifted.

Commercial tobacco contains about 12 per cent. of moisture, 20 to 25 of lignin, and nearly the same amount of inorganic matters, chiefly salts of potash and lime. The active principle is nicotine (C_{10} H_{14} O_2)—a colourless, volatile, inflammable, oily alkaloid, with an acrid odour and taste. It is present in all parts of the plant, occurs in combination with malic, phosphoric, and citric acids; constitutes five to seven per cent, of the dried leaf, and is soluble in water, alcohol, ether, the fixed and volatile oils. It is an energetic tetanising poison. Distilled with water, tobacco yields a tasteless, crystalline, concrete, volatile oil—nicotianin or tobacco camphor. Tobacco smoke contains little or no nicotine, but its intoxicating effects

are due to pyridine ($C_5 H_5 N$) and allied bases. It also contains prussic acid, formic, acetic and butyric acids, phenol, and some hydrocarbons.

Actions and Uses.—Tobacco tetanises and paralyses. It acts first on the end organs of motor nerves, then on their trunks, ultimately on the spinal cord, but does not exhaust muscular irritability ; it kills by respiratory arrest. Medicinal doses cause motor depression and muscular relaxation, and hence are antispasmodics. It induces emesis, diaphoresis, and catharsis. Its active principles are excreted chiefly by the kidneys. It is used as an anthelmintic, and to poison acari, lice, and other skin parasites.

Toxic Effects.—Hertwig carefully investigated the action of tobacco on the lower animals. He gave horses half an ounce to an ounce of the powdered leaves, and found the pulse was lowered three to ten beats per minute, and became irregular and intermittent ; whilst a repetition of such doses, increased evacuation both of fæces and urine. Large doses, especially when injected into the veins, accelerated the pulse, increased activity of the bowels and kidneys, and made the animal generally irritable and restless. Two ounces powdered tobacco, in a pound and a half of water, given in divided doses, but within two and a half hours, to a healthy middle-aged cow, heightened the skin temperature, raised the pulse from 65 to 70, caused quickened but somewhat oppressed breathing, coldness of the horns, ears, and extremities, dilatation of the pupil, and copious perspiration continuing all night. 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 restless, ground his teeth and groaned, lay with outstretched limbs and distended rumen, passed quantities of thin, fœtid 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 introduced five drachms and a half of powdered tobacco (rappee) into the stomach of a dog, and retained it there by ligature of the

œsophagus. There ensued violent efforts to vomit, nausea, purging, tremors of the extremities, giddiness, accelerated respiration, quicker and stronger action of the heart, convulsions, stupor frequently interrupted by spasms, and in nine hours death. Convulsions and stupor are dependent on imperfect oxygenation of the blood, and not on direct action on the brain. 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. The usual appearances after death are fluidity and dark colour of the blood, venous congestion, and redness of the alimentary mucous membrane.

As a motor depressant it is allied to pituri, a solanaceous plant, to hemlock, and to lobelia inflata, or Indian tobacco. Calabar bean and prussic acid are more immediate and direct depressors of the cord. From most allied solanaceous and atropaceous plants it differs in contracting the pupil and promoting secretion. Its appropriate antidotes are the stomach-pump and emetics; alcohol, ether, ammonia, or other diffusible stimulants; warmth and artificial respiration.

Medicinal Uses.—As a muscle-relaxer, tobacco acts beneficially in colic, contraction of the neck of the bladder, and occasionally in strangulated hernia, which is now, however, more generally relieved by chloroform or by operation. Impacted colon and obstinate torpidity of the bowels, whether from lead poisoning, or other conditions depending upon paresis of the muscular layer, are usually relieved by tobacco, generally given in the form of smoke clysters. One or two drops of nicotine—equivalent to about a drachm of Virginian tobacco—prescribed at intervals of two hours, usually allay the spasms of tetanus in man; a decoction applied directly to the affected muscles has also afforded relief, but, as with other remedies used in tetanus, the symptoms are only temporarily removed. Howsoever administered, it poisons intestinal worms, and diluted solutions thrown into the rectum readily bring away ascarides lodged there; but its poisonous properties necessitate its cautious employment.

Externally, it is used to kill the acari of mange in horses

and dogs, and of scab in sheep; whilst it also effectually destroys lice, fleas, and ticks. Strong solutions, liberally applied, are apt, however, to cause nausea, trembling, tetanic spasms, and sometimes death; but there is small danger in the careful use of decoctions diluted with thirty or forty parts of water. A useful wash or dip for sheep, effectual in destroying ticks, warding off for a considerable time attacks of flies, and not injurious to the colour or texture of the fleece, is made with one pound each of tobacco, sulphur, potashes, and soft soap, dissolved in thirty gallons of water, part of which, as in other dips, may be used hot. For such purposes the tobacco is previously boiled for ten or fifteen minutes in a couple of quarts of water, and the decoction mixed with the other ingredients. These quantities suffice to dip thirty lambs or a score of big sheep. For the destruction of scab acari, double the amount of tobacco may be cautiously used and the efficacy of the dressing increased by admixture of crude carbolic acid.

Doses, etc.—The larger quadrupeds take ʒj. to ʒij.; sheep, grs. x. to grs. xx.; dogs, grs. v. to grs. x.; dissolved in hot water. As an antispasmodic laxative clyster, the smoke is more effective and safer than the infusion, and is conveniently given by filling a common barrel syringe with smoke drawn from a clay pipe. Three or four syringefuls are repeated at intervals of an hour, or as required. For external application, or for enema, the infusion is made by boiling or digesting one or two drachms of tobacco with a pint of hot water, Stronger solutions require to be used with great caution, especially if swallowed, injected into the rectum, or placed in contact with an abraded absorbing surface. A single drop of nicotine destroys rabbits and small dogs in five minutes, producing tetanoid convulsions and general paralysis. Like strychnine and other nitrite bases, it is shown by Professor Fraser to lose its tetanising power when converted into an ethyl or methyl compound.

TURPENTINES.

Nat. Ord.—Coniferæ. *Sex. Syst.*—Monœcia Monadelphia.

Most of the Coniferæ contain an oleo-resinous juice, which exudes spontaneously or from incisions made into the stems and branches. In this way are obtained common and Venice turpentine, Canada balsam, and frankincense. These natural turpentines, when strongly heated, give off the volatile or essential oil of turpentine, and leave a residuum of resin. The roots and refuse timber, subjected to smothered combustion, yield tar, which, when distilled, evolves impure pyroligneous acid, acetone (p. 134), and, as the temperature is further raised, methylic alcohol (p. 458), with volatile oil of tar, and a series of less soluble hydrocarbons, leaving a residue of pitch. These coniferous products are conveniently grouped as follows :—

I. The several turpentines—the oleo-resinous juices of the Coniferæ.

II. The oil of turpentine—the volatile or essential oil procured from turpentines by distillation (C_{10} H_{16}).

III. The resins—the residue of the distillation of turpentine (C_{44} H_{62} O_4).

IV. Tar and pitch—got by subjecting the roots and wood to destructive distillation.

I. The Turpentines.

The terebinthinate juices recently exuded from the Coniferæ are fluid, or nearly so; but when exposed to the air their volatile oil is partly given off and partly oxidised, and they solidify. They have a peculiar pungent bitter taste and odour, are scarcely soluble in water, are partially soluble in rectified spirits, are soluble in oils, ether, and alkaline solutions; are inflammable, and leave, when burnt, a finely-divided residue of carbon or lamp-black. The most important varieties are common and Venice turpentines, Canada balsam, and frankincense.

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. Pine-forests freely absorbing oxygen give off various camphoraceous volatile oils and peroxide of hydrogen, and hence act as natural purifiers of the air. During winter or early spring one to four holes, pockets, or boxes, as they are termed, six or eight inches long and about the same width, and capable of holding about a quart of juice, are cut with a small axe in the bark of each tree. Selection is made of trees 12 to 18 inches in diameter. Between May and September the bark above each box is hacked so as to tap the oleo-resin cavities and ducts, which in this species lie chiefly between the wood and bark, and this hacking is repeated every eight or ten days. The turpentine is removed from the boxes by a spoon, and a large proportion is distilled in the locality of its collection. In the south-west of France, the Bordeaux turpentine, chiefly 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 annual yield of each tree ranges from 12 lbs. to 20 lbs. The trees continues productive for upwards of fifty years (Flückiger and Hanbury). Turpentine from different sources differs somewhat in appearance; 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 an emulsion convenient for administration. The crude American variety, when recent, yields 15 to 25 per cent. of essential oil (C_{10} H_{16}).

Venice Turpentine (Terebinthina Veneta), chiefly extracted in the Tyrol, Switzerland, and Piedmont, is got 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 concrete 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 five ounces of oil of turpentine melted with a pound of black resin. This artificial mixture is distinguished by its stronger odour, and its more quickly evaporating, and leaving a varnish on a sheet of paper, on which Venice turpentine remains viscid.

Canada Balsam, chiefly brought from Lower Canada, is obtained by making incisions into the bark or puncturing the special 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, with an agreeable balsamic terebinthinate odour, and a slightly bitter, feebly acrid taste; on exposure drying very slowly into a transparent adhesive varnish: solidifying when mixed with one-sixth of its weight of magnesia. (*Brit. Phar.*) 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 is, however, 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; 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 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 galipot or barras. Turpen-

tine from the Norway spruce fir, when melted in hot water and strained, constitutes Burgundy pitch, which occurs in semi-opaque yellow-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 turpentines are topical irritants. Given internally, they are speedily absorbed, act as general stimulants, and are discharged by the kidneys, bronchial membrane, and skin, stimulating whichever channels are employed in their excretion. Their uses resemble those of their active constituent, oil of turpentine. 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 by human patients in the treatment of bronchitis, phthisis, and rheumatism. The growing pine-forests, and the oleo-resins extracted from them in presence of oxygen, evolve antiseptic camphoraceous oils and peroxide of hydrogen, which purify the air and destroy disease germs.

Doses, etc.—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 linseed gruel, milk, oils, mucilage, eggs, treacle and water, or about 1-20th part of magnesia. For external purposes they are made into liniments and ointments.

II. Oil of Turpentine.

The crude turpentines contain 15 to 30 per cent. of oil of turpentine, oleum terebinthinæ, often improperly called spirits or essence of turpentine. It is usually got from the common white or American turpentine by melting, straining, and distilling. Leaving the resin, the volatile oil passes over, is recognised as common or unrectified oil of turpentine, or turps, is denser, more viscid and acrid than the rectified Pharmacopœia oil, obtained by redistilling the crude oil with water and potash solution. This purified oil varies according to its source, in odour, specific gravity, boiling-point and effect on polarised light. It is colourless, limpid, very volatile, neutral, with a penetrating odour, and pungent, bitter taste. Its specific gravity ranges from ·854 to ·870; its boiling point varies from 305° to 340° Fahr.; it is very inflammable, burning with a heavy yellow flame, and producing much smoke; is very sparingly soluble in water; more soluble in alcohol; and readily dissolved in ethers, fixed and volatile oils. It is itself a valuable solvent for resins, fats, many alkaloids, india-rubber, and gutta-percha, and has been economically substituted for alcohol in making some veterinary tinctures. Its composition is C_{10} H_{16}. It is isomeric with various essential oils, such as juniper, savin, citron, eucalyptus, coriander, and nutmeg; with water, it forms three distinct hydrates; with hydrochloric acid, two artificial camphors. Digested with a small quantity of oil of vitriol it yields the isomeric aromatic hydrocarbon, terebene, recently introduced as a stimulating antiseptic. It has a strong affinity for oxygen, which, when freely absorbed, leads to the formation of camphoric acid (C_{10} H_{16} O_4) and peroxide of hydrogen (H_2 O_2). This avidity for oxygen has been utilised by Dr. Kingzett in the manufacture of Sanitas (p. 550).

Actions and Uses.—Oil of turpentine is a topical and general stimulant acting specially on the heart, and vaso-motor centres and nerves. Poisonous doses are irritant and narcotic. Medicinal doses are stimulant, antispasmodic, hæmostatic, and anthelmintic; in their passage out of the body they excite the particular excretory channel by which they are got rid of, large doses being cathartic, smaller doses diuretic, diaphoretic, or

expectorant. It is used externally as a counter-irritant, antiseptic, hæmostatic, and antiparasitic. Its actions and uses resemble those of alcohol, and of other volatile oils.

General Actions and Toxic Effects.—Applied to the skin, it causes heat, redness, vesication, and even ulceration. Swallowed, it is rapidly absorbed and diffused, and may speedily be detected in the chyle, breath, and sweat, which have a strong terebinthinate flavour, and in the urine, to which it imparts the odour of violets. It stimulates vaso-motor centres, contracts arterioles, increases the strength and number of the pulse-beats, and raises blood-pressure. Large doses exhaust nervous irritability; the lungs are congested; carbonic acid poisoning ensues, with symptoms of inebriation, muscular weakness, dilated pupils, and delirium. Injected into the veins of the horse, it causes fatal pulmonary congestion. Two drachms produced in a dog staggering, cries, tetanic convulsions, failure of circulation and respiration, with death in three minutes (Christison on *Poisons*). Less rapidly fatal doses irritate and redden the alimentary mucous membrane, cause vascular excitement, ecchymosis of the air-passages, lung congestion, and hyperæmia of the kidneys. Dosage and other conditions influence its mode of exit from the body, and determine its action as a diaphoretic, diuretic, or adjuvant cathartic. It poisons lice, acari, and other entozoa, whether lodged in the bowels, bronchial tubes, or skin. Like the members of the alcohol series, the naphthas, and other volatile oils, it is antiseptic; it arrests fermentation and putrefaction, and destroys vibriones and bacteria.

Medicinal Uses.—For all veterinary patients it is serviceable in indigestion, flatulence, overloading of the alimentary canal, and even in some cases of diarrhœa, owing its good results to its checking fermentation, and stimulating and imparting tone to the mucous membrane. Although an uncertain cathartic when given alone, it is useful as an adjuvant cathartic, and is prescribed both by the mouth and rectum. As a prompt antispasmodic in colic, it is usually conjoined with aloes or oils and with laudanum. Like alcohol it sustains the action of the heart, relieves internal congestion, promotes skin and kidney secretion, and restores appetite in influenza, congestion and inflammation of the lungs, and in prostration from

overwork, cold, or disease. In scarlatina, purpura, typhoid fever, in passive hæmorrhage, especially from the lungs, stomach, and bowels, and in excessive or morbid mucous discharges, it is equal to alcohol, indeed sometimes superior to it, for besides stimulating the heart, it braces dilated, weakened vessels, and exerts more marked astringent and hæmostatic properties. In cases of purpura in horses, no prescription is so effectual as turpentine given in ounce doses with the same quantity of tincture of the chloride of iron, and repeated twice daily. The same combination, to which two drachms of potassium chlorate is sometimes added, proves effectual in combating farcy. Inhaled and also swallowed, as well as applied externally, it proves useful in allaying irritation and inordinate secretion of chronic bronchitis and phthisis. Conjoined usually with salines, oil of turpentine sometimes relieves suppression of urine and dropsy, especially when depending upon cardiac and vascular weakness, and unconnected with kidney irritation. Like most other diuretics, its continued or excessive use produces strangury, and sometimes even hæmaturia. Its diaphoretic action is brought out by administering it with ammonium acetate solution, or sweet spirit of nitre, and keeping the patient warm and well clothed. Combination of stimulant, diuretic, and diaphoretic properties renders it useful in all animals in rheumatism, in which it is employed both internally and externally. Turpentine, especially the French variety, forms with phosphorus a crystalline spermaceti-like mass of turpentine phosphoric acid, which is eliminated unchanged by the kidneys. Diffused in the atmosphere of rooms in which phosphorus is prepared for lucifer matches or other purposes, it is stated to prevent necrosis of the jaw and other serious disorders to which those working with the ordinary phosphorus are liable (Dr. Letheby). Animals receiving full doses of phosphorus, which would produce the characteristic fatty degeneration, showed neither this nor other evidences of phosphorus poisoning when the phosphorus 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 imme-

diately after deadly doses of phosphorus, only one died (Dr. Ringer's *Handbook of Therapeutics*).

In cattle practice full and reiterated doses are valuable in hoven. Chronic diarrhœa and dysentery, especially when accompanied by flatulence, are often benefited by small doses conjoined with lime-water, aromatics, or opium. In the second stages of contagious pleuro-pneumonia, one or two ounces, given every three or four hours, usually abate febrile symptoms, excessive temperature, cough, and difficulty of breathing, results produced with equal certainty by smaller doses of whisky. In puerperal apoplexy it is advantageously given with ammonia carbonate; in puerperal peritonitis with laudanum, and in such cases is also applied as an external stimulant. Frequently repeated doses, conjoined with iron salts, check that form of hæmaturia in cattle popularly known as red-water. As an antidote for the anthracoid disorder blackleg amongst young cattle or sheep, oil of turpentine was wont to be prescribed, dissolved usually in milk, conjoined with potassium chlorate, or sodium sulphite, and given every second morning for ten days, but where attacks of this fatal disorder are to be dreaded, susceptible subjects should be inoculated with benignant cultivated lymph (pp. 4 and 39). Used either alone or with iron chloride tincture, turpentine is often serviceable in chorea and epilepsy in dogs, in such cases sometimes doing good by destroying worms.

To kill and expel intestinal worms, turpentine should be given conjoined with a laxative, after the bowels have been emptied by a cathartic, and the patient has had a long fast. Large and sometimes reiterated doses are often required to destroy tapeworms. For horses, male shield fern may be used along with the turpentine. A few doses of copper sulphate, continued for several mornings, are a valuable help. For tapeworm in dogs areca nut and santonin are, however, safer and more effectual. To dislodge ascarides from the rectum, turpentine and quassia enemata are very effectual. For removing the strongylus filaria from the air passages of calves and young cattle, a teaspoonful of oil of turpentine is sometimes poured into the nostrils, often causing much irritation, and occasionally choking the patient. But the volatile oil is so rapidly absorbed

and diffused that it is equally destructive to the thread-worms, and much safer for the calf, when given in a state of dilution by the mouth; two or three doses, at intervals of two or three days, seldom failing to effect a cure. Filariæ similarly invade the air-passages of lambs, giving rise to paroxysms of cough and rapid wasting. Turpentine here also proves the most reliable remedy. Dr. Crisp, in his Bath and West of England Prize Essay on *The Lamb Disease*, advises "Epsom salt, six ounces; nitre, four ounces; boiling water, three pints; adding, when milk-warm, four ounces oil of turpentine and half an ounce bole armeniac; mix well, and give three to four tablespoonfuls every other day. Another formula consists of common salt, three pounds; powdered ginger and nitre, half a pound each; dissolved in three gallons warm water, with twenty-four ounces oil of turpentine added when nearly cold. The dose for lambs between four and six months old is two ounces. These quantities suffice for 160 lambs." A good mixture for coughing, purging, delicate lambs, is made with two ounces each of oil of turpentine, powdered gentian, and laudanum, dissolved in a quart of linseed tea or lime water. This will make twelve or sixteen doses. Messrs. Littler, the veterinarians of Long Clawson, Leicestershire, for years have prepared a convenient turpentine mixture for hoose, which stock-owners throughout the Midland Counties assert is a most effectual remedy both for calves and lambs. Where bronchial filariæ prevail, a few doses of such vermifuge mixtures, given at intervals of a week throughout July and August, ward off attacks both of thread and tape worm, and diminish the scouring and mortality so common amongst lambs when first put upon roots. A few drops of a solution of one of turpentine and eight of milk placed in the mouth kill sclerostoma syngamus—the filaria which causes gapes in poultry. A dressing of one part of turpentine and two of bland oil, applied round the outside of the throat of ailing chickens is in part absorbed, and helps the destruction of the parasites.

Externally, oil of turpentine is used as a stimulant, antiseptic, and counter-irritant. Applied to the skin of horses, it causes almost immediately topical irritation and restlessness, and if used largely and repeatedly, it is besides apt to blemish.

On the less sensitive hides of cattle it usefully hastens and increases the activity of other vesicants; and conjoined with oils, mustard, and ammonia, helps to control inflammation of the air-passages, bowels, and joints. A piece of flannel wrung out of hot water and sprinkled with turpentine oil is often used. As with other external irritants, a continuous moderate action is more serviceable than a single violent effect. In inveterate eczema and psoriasis the thickened scaly skin is sometimes stimulated to healthy action by moistening with turpentine undiluted, or sparingly diluted, while the drying effects of this dressing are obviated by subsequent in-rubbing of vaseline and other oily matters. As a stimulant turpentine is applied in rheumatic swellings, more particularly of cattle and sheep; in sprains and bruises after the first pain and tenderness have been subdued by fomentation; in overcoming congestion arising from frost-bite, which is not uncommon in the limbs of horses used for night-work; in promoting activity in old sores and sitfasts; in the troublesome chronic abscesses occurring about the heels of heavy draught horses; in dry gangrene of dogs' ears; and in tedious foot-rot in sheep. In such cases it is used mixed with two or three parts of vaseline bland oil or glycerine. A similar mixture destroys lice and other skin vermin. An occasional sprinkling over dogs' beds keeps them free of fleas. It is often added to stavesacre, tobacco, and other antiparasitic solutions. Held in antipathy by most entozoa, it enters into the composition of various mixtures used by shepherds to protect their flocks from fly and to kill maggots. For such purposes three ounces oil of turpentine, one ounce each of oil of amber and mucilage, and one drachm corrosive sublimate, are mixed in a pint of water. Turpentine is contra-indicated either for internal or external use where there are acute febrile symptoms, violent action of the heart, or irritation or inflammation of the bowels or urino-genital organs.

Doses, etc.—For horses and cattle as a stimulant and anti-spasmodic, the dose is f ʒ j. to f ʒ ij.; as a diuretic, f ʒ ss. to f ʒ j.; as an adjuvant cathartic or anthelmintic, about f ʒ ij. It is combined with aloes in solution, with castor or linseed oils, with iron salts, quassia, gentian, or other bitters. Big adult

cattle will take these doses increased to the extent of a third or even a half. I have repeatedly given cattle suffering from hoven four ounces of oil of turpentine with impunity. Sheep and pigs take f℥j. to f℥iv.; dogs, ℥xxx. to f℥j. It is administered dissolved in ether or bland oils; shaken up with linseed gruel or milk, or made into an emulsion with mucilage or eggs. Aromatics, bitters, or flavouring matters are sometimes added. For clysters, turpentine is usually diluted with fifteen or twenty parts of mild oil, or with a little oil or mucilage for solution, and then mixed with twenty to thirty parts of soap and water; in diarrhœa or dysentery it is conjoined with laudanum and starch gruel. For external purposes it is usually applied with linseed oil, soap, ammonia, or mustard. A convenient stimulating mixture is made with equal quantities of oil of turpentine, bland oil, and soft soap. Two or three ounces of oil of turpentine added to a pint of the ordinary soap liniment make a useful stimulating embrocation. A smart blister for cattle is prepared with half a pint each of oil of turpentine, medicinal ammonia, and linseed oil. As an embrocation 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 a prompt blister is prepared with an ounce each of oil of turpentine and medicinal ammonia, and six ounces of any bland oil.

Terebene is a cheap and useful stimulant, antiseptic, and deodoriser, serviceable for unhealthy indolent wounds; it has no injurious irritant action; as it evaporates it leaves on raw surfaces a protecting film; it is applied to most of the purposes for which carbolic and salicylic acids have been recommended.

III. Resin, Rosin, Resina.

The crude turpentines contain 70 to 90 per cent. of resin or colophony. The commercial article is mostly prepared from American turpentine. When the turpentine is distilled with a little water, which the resin retains, the residue is the yellow or white resin; when deprived of water it becomes transparent resin, and when rather more strongly heated, it is still clearer, and is known as black or fiddler's resin. Resins are yellow or

dark brown, of variable transparency, according to the proportion of water they contain; are inflammable, of a faint turpentine odour and taste, have the spec. grav. 1·07; are insoluble in water, partially soluble in alcohol, readily dissolved in ether, benzole, volatile oils, and caustic alkalies; soften at 154°, 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, $C_{44} H_{64} O_5$. The Bordeaux resin or gallipot contains, besides the isomeric, pimaric acid.

Actions and Uses.—Resin is a gentle stimulant, diuretic, and astringent. 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 stumulant, astringent, and styptic. In castration, a few grains applied to the severed end of the 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 dark brown, thick, viscid, aromatic, bituminous liquid, obtained from the wood of Pinus sylvestris and other pines by destructive distillation (*Brit. Phar.*). Mineral or Barbadoes tar has already been noticed under petroleum (p. 512). Coal tar, obtained from the destructive distillation of coal, is a by-product in the manufacture of gas. There are two sorts of wood tar, that got from such hard exogens as oak, birch, and ash, as the residue in the making of pyroligneous acid, or of charcoal for gunpowder; and that imported from Stockholm, Archangel, and America, got from the Coniferæ by roasting, or *distillatio per descensum*. Billets of the roots, branches, and

refuse timber are stacked in pits dug on a bank or inclined plane; the heaps are closely covered with turf; fire is applied; and whilst smothered combustion proceeds, as in the making of charcoal, tar, yielded to the amount of seven to ten per cent., runs into iron pots placed at the bottom of the pit, and thence by spouts into the barrels in which it is exported. This process is being superseded by distillation of the refuse wood in cast-iron stills, and nearly double the yield of tar is thus obtained; 14 per cent. is got from air-dried stems, 16 to 20 per cent. from roots.

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 is a complex substance. Its lighter portions consist of impure pyroligneous acid, and include acetic acid, wood naphtha (CH_4 O), acetone (C_3 H_6, O), other allied substances, and the pungent, irritating pyrocatechin (C_6 H_4, 2 HO). The heavier portions, constituting the proper wood tar, consist of hydrocarbons, sparingly soluble in water, and furnishing, when distilled, lune (C_7 H_8), Kylole (C_8 H_{10}), and other analogous bodies, with paraffine, which has a somewhat variable composition. Tar made from hard woods contains creasote.

When tar is distilled, and the first 15 or 20 per cent. of more volatile methylic alcohol and acetone are got rid of, there comes over a red-brown limpid oil of tar, oleum picis liquidæ, containing the substances above enumerated, and there remains 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 stimulant, antiseptic, diuretic, diaphoretic, expectorant, and antiparasitic. Although for many purposes superseded by carbolic acid, it is still occasionally prescribed for horses in bolus or draught, or its fumes inhaled, and probably, by increasing activity of the cilia of the pulmonary membrane, it amends some cases of cough, and relieves chronic bronchitis. As a cutaneous stimulant, it is used in all

animals both internally and externally in the squamous stages of grease and other forms of eczema, in mallenders or psoriasis, and in pityriasis, the scaly surfaces being covered with undiluted tar, after several doses, well washed with soft soap and water, and refractory spots dressed with mercurial ointment. It is a capital stimulant for thrush and canker of the horse's foot, being used either alone or with copper sulphate, sulphuric or nitric acid. Mixed with equal parts of fatty matters, soft soap, or cow-dung, so as to give proper consistence, it forms a capital 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. In 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 various empyreumatic substances confer marked 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, whilst large doses or strong solutions are apt to become absorbed and cause pulmonary congestion. It is used for both favus and tinea tonsurans, but is seldom so successful as iodine.

Pitch is used in veterinary practice as a mild stimulant in thrush, canker, and sandcrack in horses; in foot-rot in sheep; for giving adhesiveness to plasters; while as a domestic air-purifier its empyreumatic fumes are occasionally disengaged by inserting a red-hot poker into an iron pot containing the pitch.

VALERIAN.

Valerianæ Radix. The dried root of Valeriana officinalis. From plants indigenous to and also cultivated in Britain; collected in autumn, wild plants being preferred.—*Brit. Phar.*

Nat. Ord.—Valerianaceæ. *Sex. Syst.*—Triandria Monogynia.

The officinal valerian consists of a short yellow-white tuberous upright root stock, the thickness of the little finger, with attached radicles, which are about the size of goose quills, two or three inches in length, shrivelled, brittle, and of an earthy brown colour. It has a penetrating odour, which becomes stronger and even fœtid by keeping, and a bitter, acrid, camphoraceous taste. It contains resinous matters, a little sugar and malic acid, and 1 to 2 per cent. of a clear, volatile oil, which, when recent, has a faint odour, but becoming acrid from formation of valerianic acid, acquires a strong smell. One drop of the crude oil dissolved in 20 of carbon bisulphide, with addition of one drop of nitric acid, specific gravity 1·20, develops a superb violet or blue colour. Other colorations are obtainable, even with valerian tincture, by bromine and concentrated sulphuric acid. From the oil there have been separated a hydrocarbon isomeric, with oil of turpentine (C_{10} H_{16}), an oxidised camphoraceous substance (C_{10} H_{18} O), a crystalline compound of similar composition, probably identical with the camphor of Dryobalanops aromatica (p. 248), and a greenish oil which distils over when the temperature reaches 300°. The pungent, acrid, odorous valerianic acid (C_{10} H_{20} O_4, or HC_5 H_9 O_2), is present in small amount in the fresh roots, increases by oxidation of the oil, is also present in the berries of the Guelder rose, in whale oil and decaying cheese, and is obtained artificially by distilling fusel oil (amylic alcohol C_5 H_{12} O) with sulphuric acid and bichromate of potash, and treating the distillate with caustic alkali. (Bloxam.)

Actions and Uses.—Valerian is an excitant of the cerebro-spinal system, a diffusible stimulant, antispasmodic, nerve tonic, and anthelmintic. Dr. Whilla ascribes its effects to its diminishing irritability of the sensory nerves (*Pharmacy Materia*

Medica and Therapeutics, 1882). It resembles asafœtida, the other gum resins, camphor, and the Sambul 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. In dogs and cats it causes giddiness, reeling gait, and symptoms of intoxication. 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 their amatory propensities; but this results not from any special nervous influence, but rather from its suggestive odour. Repeated doses are stated to improve the appetite, and produce tonic effects. Its pungent volatile oil confers feeble vermifuge properties, and is chiefly excreted by the skin and kidneys.

Doses, etc.—Used for horses or cattle, it may be given in quantities of ʒ ij. to ʒ iv.; for dogs, ʒ j. to ʒ ij.; for cats, grs. xx. to grs. lx., given in powder or infusion several times a day; conjoined with ginger, gentian, or camphor, or dissolved in spirit of ammonia.

Sodium Valerianate, or Sodæ Valerianas ($Na\ C_5\ H_9\ O_2$), is obtained by the oxidisation of fusel oil, by distilling it with potassium bichromate and sulphuric acids, and saturating the distilled liquid with solution of soda. It is a white solid, with a greasy, soapy feel, a sweet, nauseous taste, and a strong odour of valerian, developed by moistening it with sulphuric acid. Dissolved and heated with zinc sulphate solution it yields zinc valerianate, which crystallizes in snow-white tabular plates, has a slight odour of the acid, and a taste resembling its metallic base. Sodium and zinc valerianates are nerve tonics. Four or five grains are given to dogs, and one or two grains to cats, without success, in chorea and epilepsy, but are believed to soothe in nervousness and hysteria. The tonic and antispasmodic virtues ascribed to the conjunction of valerian and the metals are probably more certainly obtainable by prescribing with the metallic salts the oil of valerian, which concentrates the properties of the drug. Valerianic acid itself resembles acetic acid (Royle).

Iron Valerianate is made by mixing, in the cold, solutions of sodium valerianate and iron sulphate. The precipitated

valerianate dries as a loose, light red powder, with a faint taste and odour of the acid. As a tonic for the smaller domesticated animals, and a remedy in chorea and epilepsy, it is used in similar doses, and is stated to be more certain than the zinc salt.

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, are decomposed by acids and by temperatures exceeding 120°, and are dissolved with difficulty in water, but readily in rectified spirit and ether. As a nerve tonic two or three grains are given to dogs and cats in chorea, and in those troublesome nervous disorders which accompany and follow distemper. On account of its bitterness, it is administered in pill, often with a few grains of camphor.

VASELINE.

A yellow jelly-like hydro-carbon, the purified residuum of American rock-oil after the lighter naphthas have been removed by distillation.

It is made at New York by the Chesebrough Manufacturing Company, the chief feature in the process being repeated melting and filtration. It has the consistence of summer butter, is yellow, tasteless, odourless, and neutral. It melts at 95° and boils at 302°. It is insoluble in water, partially soluble in alcohol, perfectly soluble in ether, mixes with fixed and volatile oils and with glycerine, but the glycerine mixture is broken up by addition of water. It is not affected by acids, nor does it saponify with alkalies. Unlike animal and vegetable oils, it does not oxidise or become rancid. A somewhat darker, less transparent article, but otherwise with exactly the same properties, is sold at 8d. or 9d. per lb. for veterinary purposes.

Actions and Uses.—It is an unirritating lubricant, demulcent, and emollient; incapable of rancidity, it proves a bland, soothing dressing for irritable skin, mucous and cutaneous

surfaces; like other oils, it is a good solvent for many medicines, and is a convenient well-keeping basis for ointments and liniments.

It is occasionally administered as an internal demulcent for the several purposes for which mucilage syrups or glycerine and water are used. It is conjoined as a gargle, with salines, carbolic, or other acids or astringents. One part of belladonna extract to eight of vaseline makes a soothing electuary for sore throat in horses. It moistens and soothes bruised, blistered, burned, or inflamed cutaneous surfaces, protecting them from irritating exposure. It is superior for such purposes to animal and vegetable oils on account of its freedom from disagreeable greasiness and irritating rancidity. In the earlier weeping stages of eczema used either alone, or with about one-sixth of Goulard's extract or zinc oxide, it allays heat and itching; while in the later squamous stages, and in psoriasis, it is conjoined with carbolic acid or tar. In the tinea form of ringworm, Mr. Startin recommends four grains mercury red oxide and five minims creasote, dissolved in an ounce of vaseline. Mixed with a little carbolic acid, it is occasionally substituted for oil or soap for lubricating the hands previous to examination of the rectum or uterus. It is a serviceable lubricant, more penetrating than lard, for the half hour's daily rubbing, which is often so beneficial in stimulating circulation, and removing exudate in bursal enlargements, swollen glands, and chronic strains. Being a capital solvent for sulphur, iodine, bromine, carbolic acid, volatile oils, alkaloids, and many other medicinal substances, it is extensively used for making ointments, liniments, and embrocations. It is about the same price as lard; is free from the salt which is often an undesirable ingredient in lard; citrine, mercury red iodide, and other ointments, made with vaseline, have the great advantage that they may be kept almost indefinitely without risk of becoming rancid and unsightly. It is a useful non-corrosive protective for surgical and other steel instruments, and for guns.

VERATRUM.

Veratri Albi Rhizoma. White Hellebore Rhizome. Dried Rhizome of Veratrum album.

Nat. Ord.—Colchicaceæ or Melanthaceæ. *Sex. Syst.*—Polygamia Monœcia.

White hellebore is a native of the Alps and other mountainous regions of middle and southern Europe. The rhizome, or underground stem, occurs in cylindrical pieces, two to four inches in length, an inch in diameter, usually with stout radicles attached to the lower surface, whilst on the upper remain the scales of the dried leaf-sheaths. Externally, the rhizome is grey or brown and rough; internally, greyish-white, and rather fibrous, is generally met with in slices or small fragments, which, when dried, have little odour, but a bitter acrid taste. Veratrum viride, the green or American hellebore, is collected in autumn in Canada and the States. In common with such allied species as cevadilla or sabadilla, and Colchicum autumnale, white and green hellebores are stated to contain the pale grey, acrid, crystallisable, alkaloid veratrine. According to Wright and Luff the seeds of Veratrum sabadilla contain three alkaloids: cevadine (C_{32} H_{49} N O_9), veratine (C_{37} H_{53} N O_{11}), and cevadilline (C_{34} H_{53} N O_8); while Tobien finds in the root of Veratrum album only two, viz., jervine (C_{27} H_4 N_2 O_8), and veratroidine (C_{24} H_{37} N O_7), in combination chiefly with the crystalline veratric acid ($C_{14}H_{10}$ O_{12} + 2 H_2O).

Actions and Uses.—White hellebore and veratrine, applied locally, produce slight irritation and numbness, the result of paralysis of sensory nerves. Full doses after slight stimulation cause depression and paralysis of motor centres and nerves, and, according to Bezold and Hirt, also act directly on the muscles. Disordered nervous function is evidenced in sneezing, vomiting, and muscular twitching. Full or repeated doses paralyse the heart, although not so notably as the voluntary muscles; there is marked muscular weakness and difficulty in movement; death results from asphyxia. Their legitimate medicinal use is limited to cases of neuralgia and rheumatism. The green or American hellebore is believed to be less irritant

than the white; both resemble colchicum, and are allied to aconite, tobacco, and other vasomotor depressants.

Toxic Effects.—The prominent symptoms of hellebore poisoning are vomiting, purging, depression and irregularity of the circulation, great prostration, muscular spasm, followed by muscular paralysis. Waldinger states that two ounces of white hellebore cause in horses slavering at the mouth, 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 animal 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 the filly 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 the notable post-mortem appearance (*Veterinarian*, February 1873). The antidotes are demulcents and mild laxatives, with diffusible stimulants to counteract cardiac depression, and morphine to antagonise nausea and gastric irritation. Such astringents as infusions of gall nuts or tannin may also be given, as they form insoluble compounds with any unabsorbed veratrine.

Medicinal Uses.—Some veterinary authorities consider that veratrum "powerfully rouses the absorbent system" (Morton); and recommend it for chronic œdema of the legs. As a sedative it is 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, unless in combination,

its actions are irregular and uncertain. For neuralgic and rheumatic cases it is generally superseded by aconite. It is occasionally employed for the destruction of lice, for smearing setons and as an addition to blisters; but more fitting agents can be found for any such objects, and active preparations have the disadvantage of sometimes being absorbed and producing untoward constitutional effects.

Doses, etc.—Of the powdered rhizome horses and cattle take ℥ss. to ℥j.; sheep and pigs, grs. xx. to grs. xxx.; dogs, grs. ij. to grs. vj.: given in bolus, or dissolved in dilute alcohol, and repeated at intervals of three or four hours. Externally, there are used the powder, a watery decoction improved by a little spirit, and an ointment made with one part of hellebore to eight of vaseline or lard, and occasionally applied with tar or sulphur dressings.

VERATRINE.—Applied to the skin it paralyses the filaments of sensory nerves; in contact with a mucous membrane it causes besides some amount of irritation; the smallest quantity introduced into the nostrils provokes violent sneezing, sometimes lasting for hours; swallowed, it stimulates and subsequently paralyses the terminations of the pneumogastric nerve and respiratory centre. 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, usually amid convulsions, from paralysis of the respiratory muscles. In human practice it is chiefly serviceable in neuralgia of the fifth nerve and in sciatica.

WATER.

Aqua. Hydrogen Oxide or Monoxide (H_2 O).

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; its specific gravity being represented as 1 or 1000. It solidifies, freezes, or crystallises at 32°, expanding and giving out latent heat; it reaches its greatest density at 39°·2; it slowly volatilises at all temperatures; at 212° it boils, rising in steam or gas, 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 1000° of heat. The melting ice or evaporating water, thus abstracting heat from bodies in contact with them, are valuable refrigerants.

Water readily dissolves a variety of salts, gases, and organic matters, and hence natural waters are scarcely ever perfectly pure. They hold in solution common salt and other chlorides; calcium carbonate and other lime salts; atmospheric air and carbonic anhydride, which render good drinking-waters sparkling, refreshing, and palatable, whilst the absence of carbonic anhydride accounts for the flatness and mawkishness of rain and recently-distilled waters. Gases are more soluble in cold than in hot water; salines the reverse. Organic matters are present, especially in river and marsh waters, cause them to spoil rapidly, and occasionally produce diarrhœa and dysentery. In suspension also occur such dangerous impurities as the germs of various catching diseases, and the ova of parasites. The solid constituents of drinking waters vary greatly. Glasgow has from Loch Katrine the purest water supply of any large city in the world, containing only $\frac{3}{4}$ grain of organic

matter and 1½ grain of inorganic matters to the gallon. The water of the Thames supplied to part of London contains about 3 grains of organic and 16 grains of inorganic matters to the gallon. When the saline ingredients exceed $\frac{1}{5000}$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 is not so well liked by animals, and is apt to cause diarrhœa and other digestive derangements, especially in subjects unaccustomed to it. When the salts do not amount to one-5000th part, the water is considered soft. 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, the solids amount to 3·5 per cent., an imperial pint contains about 240 grains of common salt with smaller amounts of other salts of sodium, potassium, magnesium, and calcium, traces of iodine and ammonia.

Various methods are adopted for purifying water. Subsidence and decantation get rid of grosser mechanical particles. Filtration through sand, charcoal, or gravel, removes organic and organised impurities. Oxidation gradually destroys disagreeable or dangerous defilements; hence a running stream contaminated even by sewage, a few hundred yards lower down may again become clear and wholesome. Alkaline permanganates, by similar oxidation, promptly destroy organic contamination. Boiling kills vegetable and animal matters, drives off carbonic anhydride, 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 anhydride and causes subsidence of lime 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 in this work "water" is ordered for pharmaceutic purposes.

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 also 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 also emetic. Water applied topically, as in the form of fomentation, or as the familiar water dressing, is emollient and anodyne, abates congestion of circumscribed inflammation and wounds, and also propagates its beneficial effects 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 effectual not only for comfort and cleanliness; but for regulating animal temperature, and promoting reconstruction.

Water is an unfailing constituent of all living tissues, and is essential for the support of animal life. It constitutes a large proportion of every kind of food, rendering it more easily digested and assimilated, replaces the loss of fluid constantly taking place by the skin, lungs, and kidneys. It increases the activity of these excreting organs, and adds to the solid matters in the urine. According to the manner in which it is used, it promotes construction or disintegration. 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 much overheated and prostrated, it is unnecessary to restrict the water supplied to horses. Indeed, in most well-managed modern stables a small amount of water is constantly at the horse's head, and less is actually drunk than when the animal is allowed to slake his thirst three or four times daily. A moderate amount of water is essential for digestion; an excessive quantity injuriously dilutes alimentary ferments and favours acid fermentation. Horses,

especially if tired and hungry, should have a few swallows of water, or better still, a bucket of gruel, before feeding. In many cab and carrying establishments each horse on his return from work is provided with a pail of oatmeal gruel, which is found not only to help condition, but profitably to diminish attacks of colic and other gastric 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 very apt to set up colic and inflammation.

In febrile and inflammatory diseases, water in moderation is a valuable diluent, febrifuge, and evacuant; and is perfectly safe and greatly more palatable and satisfying when given cold than in the usual tepid state. Small portions of ice, placed in the mouth, will be sucked by most animals, and not only abate thirst, but control irritation and inflammation of the throat, and lessen inordinate secretion. Water satisfies thirst in much smaller amount when it is cold, or when rendered feebly bitter with a little cascarilla or quassia infusion, additions which favour secretion of the alkaline saliva. Horses disposed to be greedy of water, and especially those with damaged wind or liability to acidity or diarrhœa, should be supplied with small quantities and often, whilst 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. Injection of cold water checks bleeding, produces general reaction, and occasionally expels ascarides. 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, hence facilitates access of the special dressings to the burrows of the female parasite.

Water is the important constituent of most emollients. Hot fomentations relieve tension, tenderness, and pain; moisten, soften, and relax dry and irritable surfaces. Applied early, and continued for several hours, they control or prevent congestion or inflammation of strains, and severely contused wounds. Their external application, by reflex action, often soothes irritated or inflamed internal parts. Thus, fomentations allay the pain of colic and inflammation of the bowels. Steaming of 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, by laudanum, belladonna, ether, vinegar, sulphurous acid, or alkaline hypochlorites, is readily evolved from a well-made bran mash, placed in a roomy nose-bag, or by holding the head over a bucket of water, from which steam is driven off by plunging a hot iron into it at short intervals. Several folds of lint or tow, saturated with hot water, and covered with oiled skin, macintosh or gutta-percha 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 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 or soft rug. 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 very hot water from time to time poured amongst the folds of the rug. The extensive counter-irritation thus rapidly developed, in careful hands does not blemish, and frequently proves of service in the first stages of pneumonia and pleurisy, colic, enteritis, peritonitis, and obstinate constipation both 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 scrupulously covered by folds of antiseptic lint constantly wetted. Such continuous irrigation is readily effected through a small vulcanised india-rubber pipe brought from a supply-tank on a higher level. Cold water similarly supplied keeps at low temperature the swabs round the coronets and feet of horses suffering from laminitis. Cold water dashed over the head and neck is a powerful stimulant, serviceable in megrims, sunstroke, phrenitis, convulsions, syncope, and the comatose stages of puerperal apoplexy in cattle, as well as in poisoning with alcohol, chloroform, opium, and prussic acid, and for encouraging respiration in young animals that breathe tardily at birth. The shock is increased when very cold water is used, and when it falls on the patient from a height of several feet.

Ice in small fragments in a bag or bladder exerts similar but more intense effects, and is serviceable in inflamed and prolapsed uterus and rectum, in piles, herniæ, and in those violent bleedings which occur at the time or shortly after parturition. But care must be taken that vascular parts are not kept too long at such a reduced temperature as to lessen injuriously their blood supplies and diminish cell growth. Two parts of ice mixed with one of salt form a powerful freezing mixture of the temperature -4°, and are applied to prevent too sudden rise of temperature and gangrene in frost-bite, to arrest circumscribed congestion and inflammation, to check bleeding and stop convulsions. Four or five minutes' contact with the skin removes sensation, so that opening of abscesses, neurotomy, and such operations, can be performed without pain; but for inducing local anæsthesia, ether spray is preferable. Dr. Chapman has taught that the ice-bag applied along the spine "not only exerts a sedative influence on the cord, but

also on those nervous centres which preside over the blood-vessels in all parts of the body; it partially paralyses them." It thus determines to the part acted on an increased afflux of blood, diminishes muscular tension, sensibility, and secretion, and hence has been used in tetanus, chorea, epilepsy, cramps, in neuralgic pains, and inordinate discharges from the bowels or kidneys. Conversely, a bag filled with water, which should not exceed 120°, applied to the spine, causes more energetic action of the spinal and sympathetic ganglia. The calibre of arterioles is accordingly diminished. The bag, placed along the cervical region, arrests hæmorrhage from the nose or lungs; placed along the dorsal and lumbar region, inordinate uterine discharge and bleeding are controlled.

Baths are important alike for the preservation of health and the cure of disease. As in human medicine, they are used of varying temperature. Cold baths range from 36° to 60°, temperate from 75° to 85°, tepid from 85° to 92°, warm from 92° to 98°, hot from 98° to 112°; the vapour bath, especially if the animal is to breathe the heated air, should not exceed 120°. Few complete veterinary baths are met with in this country, except in some training establishments, at the Royal Veterinary College at Camden Town, and at Mr. Thomas Dollar's Hospital at Manchester Street, Manchester Square, London, where the arrangements for hot, cold, and vapour baths are particularly good.

Tepid baths cleanse the skin, promote perspiration, allay thirst, and are grateful to tired and heated horses. They are useful, not only in promoting comfort, but in removing stiffness both of horses and dogs after a hard day's work. Tepid baths of 80° or 90°, gradually cooled whilst the patient is in them, or sponging with tepid water followed by cold water, care being taken to avoid undue exposure and secure thorough drying and reaction, prove of much value in reducing abnormal animal temperature. Excessive temperature long maintained perverts, depresses, and eventually arrests tissue metamorphosis. Baths and even sponging used as described, in the domestic animals, notably antagonise dangerous advances in temperature, and lower it one to four degrees. In acute febrile attacks the bath or sponging may be repeated two or three times daily; the

patient may be kept in the bath fifteen to twenty minutes; any approach to syncope is warded off by stimulants. With skin functions re-established and temperature lowered, congestion and other morbid processes are checked, and pain is often relieved. Such water treatment is contra-indicated when the patient is very weak, where it effects no reduction of temperature, or where in spite of quiet careful management it induces excitement.

Hot baths stimulate the skin, incite perspiration, raise temperature, and when long continued, quicken and enfeeble the pulse, retard oxidation, and impede electric currents through the nerves (Ringer). They soothe animals which have been subjected to severe muscular exertion, relieve colic and cramps, benefit chronic skin disorders, arrest colds and attacks of weed, promote excretion of noxious matters, and thus prevent or alleviate rheumatism and various forms of blood-poisoning.

Cold baths abstract heat or prevent its excessive formation, are tonic and stimulant, increase tissue metamorphosis, and are specially useful in convalescence from acute disease. Owing to its saline ingredients and the constant movement of the waves, a sea bath is more exhilarating than fresh water at rest. As curative agents, cold baths should rarely be continued for more than ten to fifteen minutes. Healthful reaction is encouraged by thorough drying, hand-rubbing, clothing, and, if need be, by subsequent administration of stimulants.

Vapour, Roman, or Turkish baths, when followed as they should be, by cold affusion, combine most of the advantages of hot and cold baths. They are less depressing than the hot, and produce less nervous shock than the cold bath. They should not exceed the temperature of 120°. They promptly cleanse the skin, evoke perspiration, stimulate circulation, and increase both the destruction and construction of tissue. They are specially useful in chronic cough, dyspepsia, want of appetite, rheumatism, laminitis, in the shivering cold stage of fever, and in disorders depending upon blood contamination. Professor Gamgee thus strongly sets forth their advantage:—"I unhesitatingly say that we have in the thermæ the most effectual diaphoretic, the most active depurant, and 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."—(*Our Domestic Animals in Health and Disease.*)

Where proper baths cannot be obtained, many of their curative advantages are secured by rapidly sponging the patient, according to his ailment or condition, with tepid, hot, or cold water. Noxious and irritable matters are thus removed from the skin, circulation is equalised, excessive heat reduced, spasm counteracted. In chorea, especially in tolerably vigorous and short-haired dogs, cold sponging is very serviceable. In febrile cases, whether in horses or cattle, the temperature of the water at first should not be less than 80° or 85°; a little acid may be advantageously added to the water; the sponging should not occupy more than three minutes; the animal should be wisped dry and immediately clothed. Within two or three hours the operation may be repeated, especially if the temperature reduced by the first sponging rises again to 103° or 104°; after the first or second sponging, temperate water at 60° or 65° may be used; the usual antiseptic salines and stimulants are prescribed. Such hydropathic treatment is especially suitable for that large class of cases above noted as being benefited by the vapour bath. Wet packing, either with tepid or cold water, is not adopted with veterinary patients, and is seldom so serviceable as sponging or the bath.

WAX.

Many plants produce wax resembling that furnished from the glands on the ventral scales of the bee; but bees' wax is an animal secretion, produced by bees feeding upon sugar. The comb, after removal of the honey, when pressed, fused in boiling water, strained, and poured into moulds, constitutes the yellow wax, or cera flava, which has a dull yellow colour, a granular fracture, a slightly sweet and pleasant taste, but no odour or greasiness; it is insoluble in cold rectified spirit, but entirely soluble in oil of turpentine. Yellow wax, purified by

melting with steam, straining, and decolorising by exposure in thin ribbons for one or two weeks to air and sunshine, or by boiling with nitrate of soda and sulphuric acid, loses colour and becomes white wax, or cera alba. 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°, and readily unites with fats and resins. It consists of one third of myricin or melissyl palmitate (C_{30} H_{61}, C_{16}, H_{31} O_2), a body analogous to spermaceti or Chinese wax, insoluble in alcohol, soluble in benzole and in ether, and saponified by alkalies; about 22 per cent. of the crystalline cerotic acid or cerin (HC_{27} H_{53} O_2) soluble in boiling alcohol or ether, but imperfectly saponified by alkalies; and about 5 per cent. of ceroline, a soft acid fat, communicating colour and odour, and soluble in cold alcohol. The ordinary impurities of wax do not interfere with its veterinary uses: starch may be detected by iodine; resin, by its separating on addition of cold rectified spirit; fatty matters by their greasiness and fusibility; inorganic substances by their remaining as a residue after the specimen is burnt or melted and strained.

Actions and Uses.—Wax is more difficult of digestion, and less nutritive, than fats. It is 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 as a simple ointment, for preserving abraded or irritable surfaces from air and disease-germs floating in it, protecting the sound skin from acrid discharges, and preventing corrosive or blistering applications extending their effects beyond the parts to which their action is to be limited. The required consistence of the ointment determines the proportion of wax to the fats or oils. One part of yellow wax to four of prepared lard, or two and a half of almond or other oil, are the proportions usually recommended.

ZINC AND ITS MEDICINAL COMPOUNDS.

Metallic zinc, obtained by roasting the sulphide or carbonate ores, when alloyed with nickel and copper, yields German silver; when alloyed with copper, it yields brass. A coating of zinc over iron prevents rusting, and constitutes galvanised iron. It is a bluish-white metal, brittle at low and high temperatures, but between 212° and 300° it is ductile and malleable. It is diatomic; its salts are colourless. They are not precipitated by hydrochloric acid. Ammonium hydrosulphide throws down the white sulphide (Zn S), which is insoluble in acetic acid, but soluble in the stronger acids. Ammonia solution precipitates the white hydrate ($ZnOH_2O$), which, unlike the aluminum hydrate, is soluble in excess. Cobalt chloride solution gives a green colour with zinc salts heated in the blowpipe flame.

Actions and Uses.—The chloride, nitrate, and iodide are the most soluble, most readily diffused, and hence the most active and corrosive zinc salts; the sulphate and acetate are more energetic than the less soluble oxide or carbonate. Their astringent effects depend upon their forming insoluble compounds with albumen, while affinity for water adds to their corrosive power. They enter the blood probably as chlorides, lactates, or albuminates; given for a long period they increase tissue change, and produce a series of symptoms resembling those caused by lead; they are, however, more rapidly excreted than mercury, lead, or copper, are removed in small quantity by the kidneys, but chiefly by the liver and intestinal glands (Bartholow). They resemble salts of aluminum, silver, copper, bismuth, and cadmium. According to dosage they are corrosive, irritant, astringent, tonic and antiseptic.

Zinc Oxide. Zinci Oxidum. Oxide of Zinc. Zn O.

When metallic zinc or the carbonate is exposed to a red heat, 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.

As an astringent tonic, the oxide has been prescribed for horses and cattle in doses of ℥ij. to ℥iv.; for dogs, grs. v. to grs. x. Either alone or mixed with chalk or other impalpable powder, the oxide is dusted, as a desiccant gentle stimulant and astringent, over chafed irritated excoriated surfaces. The heat, tenderness, and itching of erythema and eczema in all animals, are abated by zinc oxide, used according to circumstances, either in powder, solution, or ointment. With cleaning of the meatus, zinc oxide ointment is useful in canker of the ear of dogs and diseases that simulate it. The ointment is made usually with one part of vaseline or benzoated lard.

Zinc Carbonate. Zinci Carbonas. Carbonate of Zinc. $Zn\,CO_3$.

Calamine, the native carbonate, and an important ore of zinc, is greyish brown, usually earthy-looking, and effervesces with acids. The Pharmacopœia carbonate—white, tasteless, and insoluble in water—is made by boiling together nearly equal weights of zinc sulphate and sodium carbonate, and is a mixture of carbonate and oxide with water of crystallisation ($Zn\,CO_3$, $2Zn\,O$, $3H_2O$). Its uses are identical with those of the oxide. An ointment made with one part to four or five of lard is occasionally employed.

Zinc Sulphate. Zinci Sulphas. Sulphate of Zinc. White Vitriol. $Zn\,SO_4$, H_2O, $6H_2O$.

Zinc blende, the native sulphide (Zn S), when roasted, yields a crude sulphate. The Pharmacopœia salt is got by dissolving granulated zinc in diluted sulphuric acid, and getting rid of any iron or tin by chlorine solution and zinc carbonate. It occurs in colourless, transparent, long prisms, isomorphous with those of Epsom salt, with a styptic metallic taste, and is 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°. Heated, it melts in its water of crystallisation, six of the seven atoms 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, sedative, astringent, antiseptic, and nerve-tonic. It is used externally as a stimulant, desiccant, astringent, and antiseptic.

Toxic Effects.—As with some other metallic irritants, several ounces are given to horses and cattle without injury. Orfila found that seven and a half drachms were vomited by dogs in a few seconds, but produced no lasting bad effects. When, however, vomiting 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*). Emesis, although remarkably prompt and full, is seldom accompanied by the nausea and depression which follow tartar emetic. Repeated doses, absorbed as chloride lactate or albuminate, are detected in the spleen, liver, fæces, and urine. It does not, like lead or mercury, exhibit any cumulative action. Two horses had half an ounce each for a fortnight without effect; but an ounce repeated thrice a day impaired appetite and caused nausea with diuresis (*Veterinarian*, January 1844).

Medicinal Uses.—As a tonic it resembles, but is inferior to, iron and copper sulphates. As an astringent in diarrhœa or dysentery, it is given with opium, but is less effectual 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, 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, or poisons. It is an antidote in poisoning by salts of lead and barium. 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.

Doses, etc.—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, ℥j. to ℥iij.; for sheep, grs. x. to grs. xx.; for dogs, grs. ij. to grs. v. 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.

ZINC CHLORIDE. Zinci Chloridum. Butter of Zinc. $Zn Cl_2$.

When zinc or its 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, with an astringent metallic taste, and soluble in water, alcohol, and ether.

Actions and Uses.—It is an irritant and corrosive poison; medicinal doses are astringent, tonic, and antiseptic. Externally, it is applied as a caustic, stimulant, and astringent. It is also in use as a general antiseptic, disinfectant, and deodoriser. It is not administered internally.

Surgical Uses.—As an energetic caustic it resembles butter of antimony; 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 fistulæ, zinc chloride is introduced, usually mixed with one or two parts of flour made into a paste with water, or gently heated with two parts of gutta-percha. Not liable to get absorbed, it cannot, like arsenic or mercury salts, do constitutional mischief. The watery solution is a capital stimulant, astringent, and antiseptic; it readily destroys bacteria. It is an effective dressing in most varieties and stages of eczema, alike in horses and dogs, and a useful wash for destroying ticks and other skin vermin. For surgical purposes forty grains to an ounce of water are used for cleansing envenomed

wounds, for ragged, irregular surfaces not easily got at by solid caustics, where repeated dressings are inadmissible, and the volatile carbolic acid cannot be conveniently replaced. It is applied effectually to secure the aseptic state of wounds preparatory to their being covered in by carbolic or other antiseptic dressings.

As a general antiseptic, zinc chloride is effectual and cheap, is serviceable for keeping animal tissues for dissection; and in the presence of much water is superior to carbolic acid, as well as to corrosive sublimate, arsenic, and, indeed, all known antiseptics. Although prompt and effectual in preventing or arresting putrefaction, it is not so ready a deodoriser as chlorine, iodine, sulphurous acid, or sanitas. Concentrated solutions have the disadvantage of producing, with decomposing organic matters, disagreeable-smelling, fatty acids. Sir William Burnett's Disinfecting and Antiseptic Fluid contains 25 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.

$$Zn\ 2C_2\ H_3\ O_2,\ 2H_2\ O.$$

Zinc acetate is prepared by dissolving metallic zinc, its oxide or carbonate, in diluted acetic acid. When three-quarters of an ounce of zinc sulphate and an ounce of lead acetate are dissolved in a pint of water, mutual decomposition ensues, lead sulphate is precipitated, zinc acetate remains in solution, which, if decanted or filtered, constitutes the White Lotion so extensively and successfully used by the late Professor Dick. For most stimulant and astringent purposes, this strong lotion requires dilution with at least another pint of water. Zinc acetate 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.

Actions and Uses.—The acetate closely resembles the sulphate. It is emetic and nerve-tonic, but it is seldom used internally. Externally, as a stimulant and astringent, it pro-

motes healing of wounds, dries excessive serous and pustular discharges, relieves erythema, eczema, and impetigo, and combats conjunctivitis and other superficial inflammations. Professor Tuson (*Veterinary Pharmacopœia*) recommends 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.

I. INDEX OF DISEASES.

ABORTION: Slipping; Premature Birth.
Perfect quiet.
Sloppy laxative food.
Opium; belladonna.
Tonics.
Cleanliness.
Disinfectants.
Isolation from pregnant animals.

ABSCESS: Swelling, containing Serum or Pus.
Fomentations; Poultices.
Water dressing.
Counter-irritants; Mercury oleate or iodine around or adjacent.
Knife; Cautery.
Carbolic acid dressing.
Stimulating injections.
Sulphites, calcium and potassium sulphides, tonics, salines, and belladonna, internally.

ACARI.
Soft soap and alkalies.
Sulphur and sulphur iodide.
Carbolic acid; Tar oils.
Corrosive sublimate.
Arsenic.
Stavesacre.
Tobacco.
Linseed and other oils.

ACIDITY OF STOMACH.
Mineral acids given before eating.
Alkalies, their carbonates and bicarbonates, as antacid palliatives.
Lime water; Chalk; Magnesium carbonate; Antiseptics.
Bismuth.
Nux vomica, strychnine, or bitters.

ACNE: Pimples.
Fomentations; Poultices.
Zinc chloride solution.
Iodine or mercury iodide ointments.
Salines.
Sulphur; Arsenic; Potassium bromide; Alteratives internally.

AFTER PAINS: Heaving.
Remove clots from uterus.
Raise hind quarters.
Clysters of tepid linseed tea, with laudanum or belladonna.
Syringe out uterus with carbolic acid, sanitas, Condy's fluid, and anodynes.
Belladonna; Opium; Chloroform.
Laxatives.
Draw away milk.

AMAUROSIS: Gutta Serena; Glass Eye.
Cathartics.
Blisters; Setons.
Tonics.
Diuretics.
Nux vomica or strychnine.

ANÆMIA: Bloodlessness.
Iron and copper salts.
Gentian; Quinine; Bitters.
Salines.
Mineral acids.
Generous diet.
Alcohol.
Pure air; Exercise.

ANEURISM: Arterial tumour.
Pressure; Truss; Bandages.
Acupressure.
Electrolysis.
Catgut ligature.
Potassium iodide.
Rest and quiet.

ANGLEBERRIES; see also WARTS.
Remove with knife or torsion.
Remove with ligature or caustic.

ANTHRAX OF PIGS; Hog Cholera; Blue Disease; Carbuncular Fever.
Emetics.
Laxatives; Clysters.
Cooling sloppy diet.
Antiseptics; Sodium sulphite.
Sulphurous acid sponging.

ANTHRAX OF PIGS—*Continued.*
Comfortable airy quarters.
Prevent by inoculation with benignant cultivated lymph.
APHTHA: Vesicles in Mouth; Thrush.
Alum; Borax; Sulphurous solutions.
Potassium chlorate.
Oxymel; Glycerine and water.
Sodium sulphite; Condy's fluid.
Laxatives.
Cooling digestible food.
APOPLEXY, CEREBRAL.
Venesection.
Ice to head.
Active purgatives.
Laxative clysters.
Seton in back of neck.
APOPLEXY, PARTURIENT: Milk Fever in Cows and Ewes.
Bleed in very earliest stage.
Cathartics active.
Salts and croton.
Diluents; Avoid solid food.
Body and legs rubbed and clothed.
Use catheter.
Ice or refrigerants to head and neck.
Linseed gruel frequently by stomach-pump and clyster.
Ammonia; Ether; Alcohol.
Remove milk every hour.
Raise hind quarters, place on sternum, keep up head.
Rubefacients to spine.
APOPLEXY, SPLENIC: Charbon in Cattle and Sheep.
Bleed in earliest stage.
Cathartics.
Sodium sulphite; Other antiseptics.
Setons.
Prevent by inoculation with benignant cultivated lymph.
ARTERITIS: Inflammation of Arteries.
Rest.
Alteratives; Salines.
ARTHRITIS: Inflammation of joints; see OPEN JOINT and SYNOVITIS.
ASCARIDES; see also FILARIÆ and WORMS: Oxyuris curvula, inhabiting colon and rectum.
Clysters containing turpentine, lime water, quassia, or ether.
Salines and bitter tonics.
Aloes; turpentine and oil.
ASCARIS MEGALOCEPHALA of horse (lumbrici) in stomach and intestines.
Aloes and oils, with turpentine and other volatile oils.
ASCARIS—*Continued.*
Aconite.
Iron chloride solutions.
Copper sulphate.
Bitter tonics.
Salt in manger.
ASCITES: Abdominal Dropsy.
Diuretics.
Purgatives.
Oil of turpentine.
Jaborandi; Digitalis.
Rubefacients and friction.
Trocar and canula.
ASTHMA.
Ether and belladonna.
Chlorodyne.
Chloroform inhaled.
Amyl nitrite inhaled.
Morphine and atropine subcutaneously.
Arsenic.
Regular digestible diet.
ATHEROMA: Arterial degeneration.
Liberal oleaginous dietary.
Iron salts and tonics.
Avoid over-exertion.

BARRENNESS.
Change of diet and surroundings.
Alteratives; Potassium iodide.
Tonics.
BELLONES: Tumour in Throat of horses.
Excise tumour by knife or ligature.
BITES OF INSECTS.
Ammonia solution.
Potassium hydrate solution.
Carbolic acid.
Prussic acid; Chloroform.
BLADDER, IRRITABLE.
Diluents; Linseed.
Alkalies; Potassium citrates.
Laxatives.
Anodyne clysters.
Belladonna and opium.
Milk diet.
BLACK LEG; see QUARTER EVIL.
BLADDER, INFLAMMATION OF; see CYSTITIS.
BLEEDING; see HÆMORRHAGE.
BOG SPAVIN.
Rest; High-heeled shoe.
Fomentation.
Cold water.
Spring truss.
Counter-irritation.
Firing-iron; Seton.
BOILS; see also ABSCESS.
Foment; Poultice.
Belladonna.

Boils—*Continued.*
Carbolic dressing.
Counter-irritants around inflamed spot; Silver nitrate.
Laxatives.
Sulphites and chlorates.
Calcium sulphide; Arsenic.
Bone Spavin; see Spavin.
Bots.
Turpentine and oils.
Quassia and bitters.
Hydrochloric acid.
Copper sulphate and arsenic.
Bowels, Inflammation of; see Enteritis.
Brain, Inflammation of; see Phrenitis.
Braxy in Sheep: Gastro-Enteritis.
Oil, calomel, and laudanum.
Salines.
Antiseptics.
Counter-irritation to abdomen.
Broken Knees.
Cleanse thoroughly.
If flap of skin raised, stitches or suture sometimes useful.
Tie up head.
Cold-water dressings.
Carbolic dressings.
Perfect rest.
Splints.
Slings.
Blister.
Broken Wind in Horses.
Relieved by careful dieting.
Damped food.
Laxatives occasionally.
Salines.
Chalk; Whiting.
Professor Dick's cough ball.
Bronchial Filariæ; see Filariæ, Bronchial.
Bronchitis: Acute Inflammation of Air-Passages.
Water vapour inhaled.
Mustard to throat and sides.
Ether and belladonna.
Medicated inhalation with carbolic and sulphurous anhydride.
Soft but nutritious diet.
Salines.
Aconite.
Alcohol.
Ammonium salts.
Chloral hydrate.
Warm clothing, but cool air.
Bronchitis, Chronic.
Cantharides blisters.
Linseed and other oleaginous food.
Alcoholic stimulants.
Bronchitis, Chronic—*Continued.*
Oil of turpentine.
Tar, in bolus and inhaled.
Baths and sponging.
Bronchocele: Enlarged Thyroid.
Iodine.
Potassium iodide.
Bruises.
Foment; Poultice.
Cold-water dressings.
Refrigerants.
Carbolic dressings.
Lead acetate and astringent solutions.
Belladonna.
Brushing or Interfering.
Careful shoeing.
Well-fitting boot.
Improved condition.
Burns: Scalds.
Carbolic dressing.
Exclusion of air.
Cotton wool.
Carron oil.
Salicylic and boracic ointments.
Sodium carbonate saturated solution.
Silver nitrate.
Bustian Foul: Chronic Rheumatism in Cattle and Sheep.
Poultice; Foment.
Lead acetate and vinegar solution.
Aconite and belladonna lotion.
Purgatives; Salines.
Tonics; Oil of turpentine; Stimulants.

Calculi, Biliary.
Purgatives.
Morphine and atropine hypodermically.
Salines.
Calculi, Urinary: Lithiasis; Gravel.
Alkalies; Alkaline bicarbonates.
Diluents.
Soft laxative food.
Anodyne clysters.
Belladonna and opium.
Lithotomy; Lithotrity.
Cancer.
Knife.
Carbolic dressing; Bromine.
Caustics; Chronic acid.
Generous diet.
Canker of Horse's Foot.
Remove diseased surface.
Nitric acid.
Zinc chloride solution.
Silver nitrate.
Tar and tow.

Canker of Horse's Foot—*Continued.*
Firm pressure.
Carbolic acid.
Tonics and salines.
Liberal diet.
Canker of Ear ; see Otorrhœa.
Capped Hock in Horse.
Stimulate by cantharides liniment, or mercury iodide ointment.
Shoe raised at heel.
Apply pressure.
Evacuate serous abscess.
Inject cavity with iodine or astringents.
Infriction daily of soft soap.
Caries of Bone.
Excision of diseased tissue.
Free vent by producing slough.
Actual cautery.
Phosphate of lime.
Cataract.
Extraction.
Belladonna ; Atropine solution.
Alteratives and salines.
Catarrh : Cold in Head ; Coryza.
Steam head.
Extra clothing ; Hood.
Warm bath.
Cool air ; Laxative.
Salines ; Ammonium acetate.
Stimulate throat externally.
Choking.
Oil or linseed tea.
Remove any foreign body by hand.
Probang.
Cut into gullet and extract obstruction.
Colic : Gripes ; Spasm of bowels.
Purgative in solution.
Clysters of warm water.
Hand-rubbing.
Hot fomentations.
Gentle exercise.
Mustard to abdomen.
Ether and opium.
Oil of turpentine.
Ammonia solution or carbonate.
Belladonna.
Chloral hydrate.
Tobacco-smoke clysters.
Morphine and atropine, subcutaneously.
Cholera.
Laxatives; Castor oil and laudanum.
Chloral hydrate.
Lead acetate and opium.
Tannic and gallic acids.
Mineral acids.
Ice bag to spine.
Opium and camphor,
Cholera—*Continued.*
Morphine subcutaneously.
Chorea : St. Vitus's Dance.
Chloral hydrate.
Iron salts.
Laxatives.
Arsenic.
Cold sponging.
Spinal ice-bag.
Valerian.
Calabar bean.
Zinc and silver salts.
Liberal dietary.
Remove worms.
In bad cases, chloroform inhalation.
Coma : Stupor.
Cold affusion.
Ammonia, inhalation and subcutaneously.
Mustard to extremities.
Cautious bleeding.
Congestion.
Equable pressure.
Stimulant, local.
Stimulant, general.
Belladonna ; Ergot.
Congestion of Lungs.
Cool air.
Warm clothing for body and limbs.
Ammonia solution or carbonate.
Ether ; Alcohol ; Oil of turpentine.
Mustard to sides.
Careful abstraction of blood.
Congestive Fever of Cattle and Sheep ; Charbon : see Quarter Evil.
Conjunctivitis : Inflammation of Mucous Membrane of Eye.
Remove irritant.
Foment.
Silver nitrate or other astringent.
Belladonna or atropine.
Citrine ointment.
Laxatives.
Blister orbit ; Seton.
Constipation : Torpidity of Bowels.
Purgatives.
Frequent laxative clysters.
Aloes, oils, calomel, and small doses Epsom salt for horses.
Salts ; Croton and gamboge for cattle.
Calomel and jalap, castor, and linseed oils, and emetics for carnivora.
Oil of turpentine by mouth and rectum.
Tobacco enemata.
Laxative diet.

CONSTIPATION—*Continued.*
Nux vomica.
Electricity.
CONSUMPTION, PULMONARY; see PHTHISIS PULMONALIS.
CONVALESCENCE.
Easily digested nutritive food.
Eggs and milk.
Alcoholic stimulants.
Bitters; Tonics; Mineral acids.
Iron and phosphates.
Baths or cold sponging.
CONVULSIONS: Fits.
Chloral hydrate.
Chloroform, inhaled and swallowed.
Potassium bromide.
Ammonia.
Cold affusion; Ice to head.
Spinal ice-bag.
Morphine and atropine subcutaneously.
CORNS IN FOOT OF HORSE.
Pare.
Remove pressure.
Light shoe with wide web.
Poultice.
Nitric acid.
Shoe strong feet with tips.
CORYZA: Cold in Head; see CATARRH.
COUGH.
Ether.
Chloroform; Chlorodyne.
Belladonna; Opium.
Chloral hydrate.
Steaming head; Soothing or astringent gargles.
Counter-irritation: Mustard.
Pure air.
Careful feeding; oleaginous food.
Turkish bath.
Comfortable housing and clothing.
Laxatives.
Balsams; Ipecacuan; Demulcents.
COUGH, CHRONIC, OF HORSES.
Careful dieting.
Food damped.
Linseed.
Epsom salt occasionally.
Professor Dick's recipe.
Belladonna extract; Camphor and prussic acid.
Tar and creasote: Arsenic.
Nerve tonics.
Mustard; other counter-irritants.
Seton.
CRIB-BITING.
Iron stable-fittings.
Manger when unused turned into recess of wall.
Spiked collar-strap.
CRIB-BITING—*Continued.*
Chalk and antacids.
CROUP: Cynanche trachealis.
Tracheotomy.
Steam throat.
Spray with iodine iodoform or carbolic acid.
Silver nitrate.
Laxatives: Antiseptics.
Warm bath and emetics for dogs.
CURB: Sprain or Injury of straight Ligament of Hock.
Foment.
Lead acetate solution; Refrigerants.
Counter-irritants.
Mercury red iodide ointment.
Firing iron.
High-heeled shoe.
Rest.
COW-POX; see VARIOLA VACCINA.
CYSTITIS: Inflammation of Bladder.
Aconite; Belladonna; Opium.
Laxatives.
Rugs wrung out of boiling water, or sheepskin to loins.
Emollient anodyne clysters.
Linseed tea; Barley water; Alkalies and Diluents.
Iodoform suppositories.
Syringe female bladder with alkaline solutions.

DEBILITY.
Easily assimilated nutritive food.
Alcoholic stimulants.
Calcium phosphate.
Acids and bitters.
Sodium sulphite.
Iron salts; Arsenic.
Good nursing.
Baths and sponging.
DELIRIUM.
Cold affusion; Ice to head.
Laxatives.
Belladonna; Chloral hydrate.
Cautious inhalation of ether or chloroform.
Blood-letting.
Potassium bromide.
DENTITION FEVER.
Soft laxative food.
Rest; Pure air.
Salines.
Lancing of gums.
Remove irregular temporary teeth.
DIABETES INSIPIDUS: Polyuria.
Iodine with potassium iodide.
Iodine with iron sulphate.
DIABETES, SACCHARINE.
Soup; Cooked animal food.

Diabetes, Saccharine—*Continued.*
Acids.
Opium.
Iodine.
Diarrhœa : Scouring.
Laxatives.
Grey powder or calomel.
Spirit of chloroform ; Chlorodyne.
Chalk and bitters.
Oak bark ; Gallic acid.
Opium and lead acetate.
Starch gruel and opium clysters.
Digestible light diet.
Mineral acids and metallic astringents.
Nux vomica ; Ergot.
Arsenic and iron salts.
Antiseptics.
Diphtheritic Sore Throat.
Ice sucked.
Hydrochloric acid and glycerine gargle.
Iron perchloride tincture.
Spray with chlorine, iodine, and iodoform solutions.
Nutritive fluid food.
Dislocations : Luxations.
Reduce.
Retain in position by splints, bandages, or plasters.
Abate inflammation by fomentations or cold water.
Distemper in Dogs.
Emetic ; Gentle laxative.
Milk diet.
Salines.
Belladonna, internally and externally.
Ether ; Alcohol.
Iron salts.
Antiseptics internally.
Counter-irritants.
Disinfectants.
Prevent by inoculation with cultivated lymph.
Dropsy.
Remove vascular obstruction.
Diuretics ; Laxatives.
Potassium iodide ; Digitalis ; Jaborandi.
Friction, and other external stimulants.
Sweet spirit of nitre ; Oil of turpentine ; and other stimulants internally ; Trocar and canula.
Acupuncture.
Dysentery.
Occasional laxatives.
Opium and mineral astringents.
Gallic and tannic acids.
Dysentery—*Continued.*
Starch gruel and laudanum clysters.
Easily digested food.
Small doses of grey powder or calomel.
Dyspepsia : Indigestion.
Careful dietary.
Acids ; Bitters ; Arsenic.
Sulphites.
Laxatives in bilious cases.
Alcohol.
Alkalies ; Chalk ; Bismuth.
Nux vomica.
Dyspnœa : Difficult breathing.
Chloroform ; Chloral hydrate.
Morphine and atropine subcutaneously.
Belladonna extract and ether.
Mustard and counter-irritants.
Tracheotomy.

Eczema : Tetter : Grease.
Laxatives ; Diuretics.
Salines ; Alkalies.
Arsenic ; Sulphur.
Fomentations with warm water and soft soap.
Lead acetate lotion in acute weeping stages.
Alkaline carbonate solutions.
Zinc oxide, powder, or ointment.
Glycerine of borax ; Tannin.
Potassium cyanides or camphor.
Empyreumatic oils in chronic cases.
Carbolic acid ; Creasote.
Sulphur iodide.
Silver nitrate ; Copper sulphate.
Eczema Rubrum of Dogs : Red Mange.
Avoid heating food such as oatmeal.
Laxatives.
Zinc oxide ointment.
Glycerine of carbolic acid.
Antiseptics and arsenic.
Elephantiasis : Chronic Weed.
Laxatives.
Diuretics.
Salines ; Iodine ; Potassium iodide.
Friction ; Stimulants.
Counter-irritation.
Empyema : Pus in Chest.
Carbolic acid.
Sulphurous acid and sulphites.
Iodine.
Drainage tube.
Emphysema : Pneumatosis ; Wind Swelling.
Puncture.
Pressure.
Counter-irritation.

EMPHYSEMA—*Continued.*
Diuretics.
Tonics; Arsenic.
EMPHYSEMATOUS LUNGS.
Careful dietary; concentrated damped food.
Occasional linseed mash.
Water given an hour before work.
Arsenic.
ENTERITIS: Inflammation of Bowels.
Laxatives.
Aconite.
Calomel and laudanum.
Foment; Rugs wrung out of hot water.
Mustard to abdomen.
Anodyne clysters.
Belladonna and opium.
Morphine, atropine, and ergotine subcutaneously.
ENTROPIUM: Inversion of Eyelids.
Excision of elliptical portion of lid.
Metallic suture.
Caustic.
Antiseptic dressing.
EPILEPSY: Fits.
Bowels in order.
Worms removed.
Digestible nutritive diet.
Iron and arsenic.
Potassium bromide.
Amyl nitrite; Nitro-glycerine.
Cold affusion.
Spinal ice-bag.
EPIZOOTICS.
Destroy disease germs by carbolic or sulphurous acids.
Separate infected subjects.
Sponge sick and healthy with sulphurous or carbolic solutions.
Administer sodium sulphite, carbolic acid, and antiseptics.
Enjoin cleanliness.
Use disinfectants.
EPIZOOTIC APHTHA: Aphthous or Vesicular Epizootic; Foot-and-Mouth Disease.
Soft laxative food brought to patient.
Cleanliness.
Comfortable soft bed.
Gargle with hydrochloric acid and treacle.
Alum and potassium-chlorate gargles.
Condy's fluid for mouth, udder, and feet.
Lead acetate solution.
Milk cows frequently.
If teats tender, use syphon.

EPIZOOTIC APHTHA—*Continued.*
ERYSIPELAS.
Laxatives.
Aconite, one or two doses.
Hot fomentations.
Salines; Potassium chlorate.
Ferric chloride and other styptics.
Alcohol; Ether; Oil of turpentine.
Ergot.
Belladonna and aconite lotion.
Silver nitrate.
Carbolic acid.
ERYTHEMA: Inflammation of the Skin; Mud fever.
Laxatives; Salines.
Fomentations; Emollients.
Zinc oxide powder ointment or solution.
Lead and zinc acetates.
Silver nitrate.
Arsenic and quinine internally.
EXOSTOSIS: Deposit of Bone.
Fomentations.
Cold applications.
Counter-irritants.
Mercury iodide ointment.
Firing iron.
Periosteotomy.
Laxatives; Febrifuges.

FAINTING.
Fresh air.
Removal of pressure from neck.
Ammonia in vapour and solution.
Alcohol and ether.
Amyl nitrite.
FALSE QUARTER OF FOOT OF HORSE.
Close and secure any wound.
Bar shoe to relieve pressure.
Blister coronet.
FARCY OF HORSES.
Buds dressed with mercury iodide ointment.
Iron and copper sulphates; Arsenic.
Salines.
Liberal diet and fresh air.
Separate from healthy animals.
Slaughtered by order of Council.
FARDEL-BOUND: Impaction of Third Stomach of Cattle and Sheep.
Epsom and common salt.
Calomel; Croton.
Aromatics and treacle.
Diluents.
Stimulants externally and internally.
FAVUS: Honeycomb Ringworm.
Soft soap and water.
Iodide of sulphur.
Iodine solution or ointment.

FAVUS—*Continued.*
Zinc chloride solution.
Corrosive sublimate.
Silver nitrate ; Benzine.
FEVER ACUTE ; see also FEVER INFLAMMATORY.
Aconite.
Purgatives ; Salines.
Mercurials ; Antimonials.
Ammonium acetate ; other Sudorifics.
Warm bath or sponging, followed by cold affusion.
Ice swallowed.
Laxative food ; Clysters.
Cool air ; warm clothing.
Remove or soothe local irritation.
FEVER, LOW, OR TYPHOID.
Laxatives ; Diaphoretics.
Salines, alkalies, antiseptics.
Digitalis, alcohol.
Quinine.
Baths or sponging with sulphurous or acidulated water.
Clothe comfortably ; Bandage legs.
FILARIÆ, BRONCHIAL : Strongulus filaria.
Oil of turpentine in milk or oil.
Lime-water.
Sulphurous and chlorine inhalation and solution.
Chloroform inhalation.
Liberal dietary.
Change from old grass.
FISTULÆ.
Cut open sinuses.
Dependent opening.
Seton.
Carbolic dressings.
Astringents.
Corrosive sublimate plug.
Pressure to keep granulations in contact.
FLEAS : Pulex irritans.
Soap and warm water.
Turpentine ; Volatile oils.
Aniseed oil.
Persian insect-powder.
Tobacco-water.
Stavesacre.
Pine sawdust for dog's bed.
FLUKE WORM IN SHEEP; see HYDATID IN LIVER.
FLY BLOW IN SHEEP.
Corrosive sublimate solution.
Turpentines.
Tar oil.
FOOT-ROT IN SHEEP.
Remove diseased horn.
Mercury nitrate solution.
FOOT-ROT—*Continued.*
Nitric acid.
Turpentine and oil.
Silver nitrate.
Zinc chloride.
Carbolic acid.
FOUL IN THE FEET OF CATTLE ; see also BUSTIAN FOUL.
Foment ; Poultice.
Carbolic dressings.
Zinc chloride.
Generous diet.
Salines and tonics.
Amputation.
FOUNDER ; see LAMINITIS.
FRACTURE.
Bones in apposition.
Splints of leather lath or block-tin.
Bandages dry and starch.
Rest ; Slings.
Wounds treated in usual way.
FRAGILLITAS or MOLLITIES OSSIUM.
Liberal oleaginous dietary.
Calcium phosphate.
Tonics.
FROST BITE : Gelatio.
Turpentine and oil.
Soap liniment.
Friction.
Mustard.
FUNGUS HÆMATODES.
Remove with knife.
Stay bleeding with hot iron.
Dress with carbolic acid.
Equable pressure.

GANGRENE : Mortification.
Sulphurous acid lotion.
Carbolic dressings ; Bromide.
Iron salts internally.
Copper sulphate.
Alcohol ; Stimulants.
Antiseptics ; Sodium sulphite ; Potassium chlorate.
Remove dead portions with knife.
GARGET ; see MAMMITIS.
GASTRIC or TYPHOID FEVER IN HORSES.
Calomel and laudānum.
Salines.
Alcohol and stimulants.
Belladonna and opium.
Iron salts ; Digitalis.
Mineral acids ; Turpentine.
Ergot hypodermically.
Rest and quiet.
Warm clothing ; Bandage legs.
Soft digestible food.
Sponge with sulphurous acid.
Rubefacient over abdomen.

GLANDERS IN HORSES.
Incurable; Immediate slaughter.
Life may be prolonged by generous diet.
Copper sulphate and arsenic.
GLANDULAR SWELLINGS.
Counter-irritants round or near.
Mercury oleate; Mercury red iodide ointment.
Iodine ointment.
Administer salines.
Calcium sulphide.
Iodine and potassium iodide.
Iron salts in anæmic patients.
GLASS EYE; see AMAUROSIS.
GLAUCOMA: Disease of Vitreous Humour of Eye.
Not amenable to treatment.
Atropine and astringent lotions.
GLOSSANTHRAX: Blain in Cattle.
Wash mouth with sulphurous acid solution or Condy's fluid.
Hydrochloric acid and treacle gargle.
Cathartics.
Silver nitrate.
Soft nourishing food.
GLOSSITIS: Inflammation of tongue.
Oxymel.
Treacle and vinegar.
Mild astringents.
Soft food; Scarify.
GONORRHŒA; see also URETHRITIS.
Metallic astringent injection.
Salines; Alkalies.
Diluents.
Fomentations.
Laxative and anodyne clysters.
GRAPES: Inflammation of Skin of Horses' Heels.
Remove by hot iron or caustics.
Zinc sulphate or chloride solution.
Carbolic acid dressing.
Laxative diet.
Sulphur arsenic, and salines internally.
GREASE: Eczema Impetiginodes.
Removal of hair; Thorough washing.
Salines; Arsenic.
Zinc sulphate and lead acetate lotion.
Carbolic acid dressings.
Sulphurous acid solution.
Sulphur iodide.
Poultices.
GROGGINESS; see NAVICULAR DISEASE.

HÆMATURIA: Bloody Urine.
Laxatives.
HÆMATURIA—*Continued.*
Belladonna and opium.
Fresh sheepskins to loins.
Sulphuric acid.
Iron salts.
Lead acetate.
Turpentine oil.
Gallic acid; Ergot.
Spinal hot-water bag.
HÆMATURIA: Red Water in cattle.
Saline purge.
Iron salts.
Turpentine.
Stomachics and bitters.
Ammonium chloride.
HÆMORRHAGE: Bleeding.
Secure bleeding vessel.
Pressure; Plugging; Ligature.
Styptics.
Refrigerants; Ice.
Cautery.
Lead acetate and opium internally.
Iron chloride solutions.
Sulphuric and gallic acids.
Turpentine; Ipecacuan.
Ergotine subcutaneously.
HÆMORRHAGE, POST PARTUM.
Ice introduced into uterus or rectum.
Iron perchloride injection.
Ergot solution.
Ergotine hypodermically.
Raise hind quarters.
Hot-water bag to dorsal region.
HEART, IRRITABLE.
Digitalis.
Belladonna.
Aconite, small doses.
Rest.
Digestible, rather concentrated, food.
HEPATITIS: Inflammation of liver.
Cathartic.
Salines.
Aconite.
Ammonium chloride.
Laxative diet.
External stimulation.
HERNIA, INGUINAL or SCROTAL: Rupture.
Taxis from scrotum and rectum.
Opium in large doses.
Anæsthesia.
Tobacco-smoke clysters.
Ice; Refrigerants.
Cast patient.
Liberate herniated bowel by enlarging internal ring.
Covered operation in entire animal.

HERPES: Patches of Vesicles.
Salines.
Sodium sulphite.
Lead acetate solution.
Sulphurous acid solution.
Silver nitrate ointment.
Calomel ointment.
HIGH BLOWING IN HORSES.
Atropine and morphine subcutaneously.
Rubefacients over frontal sinuses and throat.
Syringe nostrils with astringents.
Nasal pad.
HOOSE IN CALVES; see FILARIÆ, BRONCHIAL.
HOVEN IN CATTLE: Distension of First Stomach.
Ammonia and ether.
Turpentine and alcohol.
Exercise and friction.
Probang.
Opening through abdominal walls.
Cathartic.
HYDATID IN BRAIN OF SHEEP or CATTLE: Cœnurus cerebralis.
Trocar and canula.
HYDROCELE: Dropsy of Scrotum.
Trocar and canula.
Injection of iodine or astringent.
HYDROCEPHALUS: Dropsy of Brain.
Generous oleaginous diet.
Calcium phosphate.
Iron salts (iodide); Tonics.
Trocar and canula.
HYDROPHOBIA; see RABIES.
HYDROTHORAX: Water in Chest.
Salines; Potassium iodide.
Rubefacients; Mustard.
Trocar and canula.
Diuretics; Jaborandi.
Tonics and stimulants.
HYSTERITIS: Inflammation of the Uterus.
Laxatives.
Fomentations to loins.
Fresh sheepskins.
Aconite and opium.
Belladonna, by mouth and injection.
Syringe with tepid water and Condy's fluid, sulphurous acid, or astringents.

IMMOBILITE: Shivering; Crick-back.
Light work without weight on back.
Occasional rubefacient along spine.
Sling at night.
Nux vomica and strychnine.

IMPETIGO: Crusta Labialis.
Laxatives and salines.
Zinc oxide ointment.
Mercury nitrate ointment.
Glycerine of tannin.
INDIGESTION: see DYSPEPSIA.
INDIGESTION, ACUTE, OF HORSES: Stomach or Grass Staggers.
Aloes in solution.
Calomel and oil.
Oil of turpentine.
Ammonia; Alcohol; Ether.
Hot fomentations to abdomen.
Hand-rubbing; Mustard.
Gentle exercise.
Frequent laxative stimulant clysters.
INFLAMMATION, ACUTE.
Fomentations; Poultices.
Refrigerants.
Ice and anodynes locally.
Cathartics; Salines.
Aconite; Sedatives.
Antiseptics; Alteratives.
Sloppy food; Diluents.
Opium, belladonna; other anodynes internally and externally.
INFLAMMATION, CHRONIC.
Refrigerants.
Counter-irritants.
Salines; Antiseptics.
Liberal dietary.
Linseed and fatty matters.
Bitters and tonics.
Stimulants.
INFLAMMATORY FEVER; see also FEVER.
Laxatives; Salines.
Clysters.
Antiseptics.
Aconite.
Calomel and opium.
Remove or soothe any local irritation.
Pure cool air.
Sloppy food; Diluents.
INFLUENZA IN HORSES.
Salines.
Laxative nutritive diet.
Pure cool air.
Rug and bandages.
Alcohol; Ammonia.
Ether and belladonna.
Mineral acids and bitters.
Mustard.
Sponging with sulphurous acid or Condy's fluid.
INTERDIGITAL INFLAMMATION SHEEP.
Zinc sulphate solution.

Interdigital Inflammation in Sheep—*Continued.*
Silver nitrate.
Carbolic and tar dressings.
Laxative diet.
Avoid beans and forcing food.
Remove from wet pastures.
Iritis.
Cathartics.
Calomel and opium.
Salines.
Belladonna or atropine.
Dark box.
Seton.

Jaundice: the Yellows.
Laxatives.
Aloes and calomel.
Salines; Glauber salt.
Oil of turpentine; Stimulants.
Mustard over region of liver.

Kennel Lameness: Rheumatism.
Castor oil.
Clysters.
Alkalies.
Salicylic acid.
Flannel wrung out of hot water to joints or loins.
Soap and turpentine liniment.
Potassium iodide.
Tonics.
Comfortable dry lodgings.
Knees, Broken; see Broken Knees.

Laminitis: Acute Founder of Horses.
Shoes removed.
Hot fomentations and poultices.
Bleed from toe.
Aconite; Nitre, full doses.
Laxative clysters.
Vapour bath.
Blisters to coronet.
Frog setons..
Neurotomy.
Lampas: Congestion of Gums and Palate of Horses from Teething.
Soft food.
Astringent wash.
Scarify.
Laryngitis: Inflammation of Larynx.
Steaming of head and throat.
Belladonna and vaseline electuary.
Hydrochloric acid and treacle gargle.
Sulphurous acid inhalation.
Aconite; Belladonna.
Calomel and opium.
External stimulants.

Laryngitis—*Continued.*
Cathartics.
Tracheotomy.
Leucoma: Opacity of Cornea.
Silver nitrate.
Generous diet.
Tonics.
Leucorrhœa: Fluor Albus; the Whites.
Laxatives.
Syringe uterus with tepid alkaline solution.
Zinc sulphate.
Carbolic solution; Belladonna.
Turpentine and cantharides internally.
Lice: Pediculi.
Essential oils.
Corrosive sublimate solution.
Mercury oleate.
Zinc chloride diluted solution.
Stavesacre decoction.
Sulphur iodide liniment.
Tobacco-water.
Lichen: Papular Eczema; Rat tails.
Mercurial oleate or ointment.
Mercury nitrate ointment.
Tar ointment.
Arsenic and alkalies internally.
Lithiasis: Gravel; see Calculi and Urinary Deposits.
Lock-Jaw; see Tetanus.
Louping Ill in Sheep; Inflammation of Brain and Spinal cord, caused by parasitic germs.
Laxatives; Salines.
Change of pasture.
Sodium sulphite and other antiseptics.
Luxations; see Dislocations.
Lymphangitis: Weed; Shot of Grease in Horse.
Fomentations persisted with.
Purgatives and Aconite.
Clothing for body.
Alteratives and antiseptics.
Diuretics.
Rest or gentle exercise.

Mad Staggers; see Phrenitis.
Maggots: the Fly.
Turpentine and oil.
Corrosive sublimate solution.
Mallenders; see also Eczema and Psoriasis.
Soft soap and water.
Mercury nitrate ointment.
Tar ointment.
Laxatives, salines, and arsenic internally.

Mal-Nutrition.
Liberal oleaginous dietary.
Calcium phosphates.
Iron salts ; Iron iodide.
Alteratives ; Antiseptics.
Tonics ; Alcohol ; Stimulants.
Mammitis : Garget ; Inflammation of Udder.
Cathartic.
Aconite ; Salines.
Fomentations.
Poultices of spent hops.
Support.
Frequent milking.
Teat syphon.
Belladonna.
Mercurial liniment.
Open abscesses.
Amputate gangrenous quarters.
Mange : Irritation caused by Parasites of Genera Sarcoptes, Dermatodectes, and Symbiotes ; see also Eczema Rubrum.
Destroy acarus.
Soap and water scrubbing.
Sulphur iodide ointment.
Stavesacre solution.
Corrosive sublimate solution.
Carbolic dressing.
Mercurial oleate.
Mange, Follicular or Pustular.
Shaving affected parts.
Scrubbing with soap and water.
Creasote alkali and oil.
Nourishing food.
Occasional laxatives.
Megrims : Vertigo ; Giddiness.
Remove pressure from neck.
Cold affusion.
Laxative diet.
Cool stable.
Arsenic and tonics.
Melanosis : Black Cancer.
Remove by knife or caustic.
Dress with antiseptics.
Metritis : Inflammation of Uterus and Bowels after Parturition.
Oil and laudanum.
Aconite.
Anodyne clysters.
Antiseptic and anodyne injections.
Fomentations, hot cloths and sheepskins to loins.
Belladonna and opium.
Chloroform and ether.
Moon Blindness ; see Ophthalmia, Periodic.
Mortification ; see Gangrene.
Mud Fever ; see also Erythema.
Rest.
Mud Fever—*Continued.*
Fomentations.
Laxatives ; Salines.
Zinc oxide ointment.
Lead acetate solution with oil.
Glycerine carbolate.
Mumps ; see Vives.
Murrain : Foot-and-Mouth Disease ; see Epizootic Aphtha.
Myositis : Inflammation of Muscle.
Rest.
Foment.
Belladonna or opium liniment.
Cathartic.
Rubefacient.
Galvanism.
Nux vòmica.

Nasal Gleet : Ozœna.
Blister over sinuses.
Remove faulty teeth.
Zinc chloride injections.
Sulphurous acid inhalations.
Bleaching powder scattered in box.
Copper sulphate and arsenic.
Turpentine drenches.
Trefine sinuses.
Navicular Disease : Grogginess.
Remove shoes.
Hot poultices.
Rest.
Cold wet swabs.
Cathartic.
Laxative diet.
Mildly blister coronet.
Frog setons.
Neurotomy.
Diminish concussion by shoeing with leather ; Shoes thick in quarters, thin at toe and heels.
Nebulæ of Cornea.
Silver nitrate.
Necrosis : Death of Bone.
Removal of sequestrum.
Antiseptic dressings.
Nettle Rash : Urticaria ; see Surfeit.
Nephritis : Inflammation of Kidney.
Linseed ; Barley water ; Diluents.
Alkaline bicarbonates.
Anodyne clysters.
Fomentations ; Mustard or fresh sheepskins to loins.
Aconite.
Gentle laxative.
Belladonna ; Opium ; Camphor.

Obstruction of Bowels.
Laxative and nutritive clysters.
Fluid food ; Diluents.

Obstruction of Bowels—*Continued.*
Hypodermic injection of morphine and atropine.
Mustard externally.
Linseed oil.
Œstrus Equi ; see Bots.
Open Joints.
Close wound by suture.
Rest horse, and prevent muscular twitching by slinging.
Splints and bandages.
Antiseptic dressings.
Carbolic acid and oil.
Cold water irrigation over dressings.
Laxatives and salines.
Blister.
When wound small, close by cautery.
Ophthalmia, Periodic : Moon Blindness of Horses.
Cathartic.
Aconite.
Salines and mercurials.
Fomentations ; Anodynes.
Belladonna or atropine internally and externally.
Ophthalmia, Simple ; see also Conjunctivitis.
Remove any irritant.
Foment.
Poppy-heads.
Belladonna or atropine solution.
Astringent solution.
Osteo-Sarcoma.
Remove tumours.
Antiseptic dressings.
Soft nutritive diet.
Ostitis : Inflammation of Bone.
Fomentations.
Cold applications.
Cut through periosteum.
Purgatives.
Salines.
Alteratives.
Blister and fire.
Otorrhœa : Inflammation of Lining Membrane of Ear.
Hot fomentations.
Cathartic.
Laudanum and lead acetate dropped into ear.
Morphine subcutaneously.
Glycerine of tannin and other astringents.
Over-reach ; see also Bruises.
Foment.
Cold Water.
Protect with pad.
Shorten and round off offending shoe.
Ozœna ; see Nasal Gleet.
Pain, Inflammatory.
Foment.
Cathartic.
Aconite, generally and locally.
Calomel and opium.
Opium and belladonna, locally.
Counter-irritant.
Rest.
Pain, Nervous.
Aconite.
Cold affusion.
Refrigerants.
Chloral hydrate.
Morphine and atropine subcutaneously.
Acupuncture : conium in muscular pain.
Paralysis.
Remove causes of irritation.
Rest and quiet.
Laxative.
Light digestible food.
Mustard embrocations.
Counter-irritants.
Friction.
Nux vomica or strychnine.
Phosphorus : Calabar bean.
Electricity.
Parturient Apoplexy ; see Apoplexy, Parturient.
Patella Dislocation.
Keep limb extended.
Cord round fetlock to neck.
Shoe horse high at toe and projecting forward.
Blister stifle.
Pericarditis : Inflammation of Serous Covering of Heart.
Digitalis.
Hyoscyamus and Opium.
Counter-irritants.
Perfect rest.
Peritonitis : Inflammation of Serous Covering of Bowel.
Aconite.
Calomel and Opium.
Hot fomentations.
External irritants ; Mustard.
Morphine and atropine subcutaneously.
Phlebitis : Inflammation of Vein.
Blister.
Cathartic.
Laxative diet.
Phrenitis : Inflammation of Brain ; Mad Staggers.
Bleeding.
Cathartic.

PHRENITIS—*Continued.*
Laxative clysters.
Aconite.
Cold to head.
PHTHISIS PULMONALIS: Pulmonary Consumption.
Generous oleaginous dietary.
Alcoholic stimulants.
Comfortable warm lodgings.
Tonics; Iron salts.
Rubefacients; Mustard.
Sulphurous acid, inhalation, and sponging.
Terebinthinate and carbolic inhalations.
PITYRIASIS: Bran-like scales.
Good feeding; Linseed.
Sulphur and stavesacre ointment.
Salines; Alkalies; Arsenic.
PLEURISY: Inflammation of Serous Covering of Lungs.
Aconite.
Calomel and opium.
Laxative clysters.
Salines.
Counter-irritants.
Morphine and atropine subcutaneously.
Remove fluid by operation.
Iron chloride and iodide.
Jaborandi.
PLEURODYNIA: Non-inflammatory Pain in Chest.
Hot fomentations.
Hot smoothing-iron.
Counter-irritants; Mustard.
Morphine and atropine subcutaneously.
PLEURO-PNEUMONIA, EPIZOOTIC: Contagious Pleuro-Pneumonic Fever of Cattle.
Sloppy food.
Good nursing.
Epsom salt, nitre, and gentian.
Potassium chlorate; Sodium sulphite.
Hydrochloric acid and treacle.
Sulphurous acid, inhalation, and sponging.
Mustard to sides.
Slaughtered by Order of Council.
Isolate infected subjects.
Disinfectants.
Prevent by inoculation.
PNEUMONIA: Inflammation of Lungs.
Salines.
Alcoholic and other stimulants.
Bleed to relieve action of heart.
Fomentations and poultices.
Counter-irritants.
PNEUMONIA—*Continued.*
Aconite.
Ammonia chloride, and acetate.
Cool pure air.
Soft nutritive food.
Diuretics.
In dogs, emetics and antimonials.
POLL EVIL; see FISTULOUS WOUNDS.
POLYURIA; see DIABETES INSIPIDUS.
PRICKS IN HORSE'S FOOT.
Remove shoe.
Search for injury.
Dependent opening.
Poultice.
PROLAPSUS ANI AND UTERI.
Return viscus carefully after cleaning and washing with dilute spirit, laudanum and carbolic acid.
Close external opening with suture.
Control straining by opium, chloral, and ice.
Soft digestible food.
PRURIGO: Pruritus, Itching.
Hot fomentations: Warm bath.
Alkaline wash: Borax.
Sulphurous acid solution.
Goulard's extract and Prussic acid lotion.
Potassium cyanide solution.
Aconite tincture.
Calomel ointment.
Sulphur and tar ointment.
PSOÆ MUSCLES STRAIN.
Rugs wrung out of hot water.
Sheepskins over loins.
Anodyne clysters.
Slings.
Rubefacients to loins.
PSORIASIS: Chronic Eczema; Mallenders.
Soap and Water: Warm bath.
Tar ointment.
Oil of cade.
Carbolic acid.
Sulphur iodide ointment.
Mercurial nitrate ointment.
Salines internally.
Arsenic and mercurials.
Potassium iodide.
Cantharides.
PUERPERAL FEVER IN CATTLE; see APOPLEXY, PARTURIENT, and METRITIS.
PUMICED FOOT IN HORSES.
Bar shoe with wide web.
Lessen concussion by leather soles.
Tar dressings.
Stimulate coronet.
PURPURA HÆMORRHAGICA: Swelling

PURPURA HÆMORRHAGICA—*Contd.*
and Ecchymosis of Skin and Mucous Surfaces, usually with Low Fever.
Oil of turpentine and iron.
Salines, potassium chlorate.
Stimulants; Digitalis; Ergot.
Antiseptics externally.
Wash swellings with diluted Goulard's extract and carbolic acid.
Disinfectants.

PYÆMIA: Septicæmia; Formation of Pus with Fever.
Thoroughly cleanse wound.
Zinc chloride solution.
Fomentations.
Carbolic acid; Antiseptic dressings.
Mineral acids; Iron; Quinine; Alcohol; other tonics.
Sodium sulphite and hypo-sulphite; Salicylic acid.
Liberal dietary: Milk; Eggs; Soup.
Pure air and water.

QUARTER EVIL; Black Quarter; Congestive Fever of Young Cattle and Sheep; Carbon.
Treatment rarely successful.
Cathartics.
Stimulants, externally and internally.
Ward off avoidance of any check and by regular feeding and exercise.
Seton in dewlap.
Sodium sulphite and potassium chlorate given twice a week.
Sulpho-carbolates.
Prevent by inoculation with cultivated lymph.

QUITTOR: The Pipes; see also FISTULÆ.
Dependent opening.
Remove irritant.
Poultice.
Lay open sinuses.
Core out with corrosive sublimate or arsenic.
Bar shoe and rest.
Blister coronet.

RABIES: Hydrophobia.
Incurable.
Symptoms abated by Chloral hydrate and belladonna.
Ammonia subcutaneously.
Excise and cauterise at once the bitten part.
Probably prevented by inoculation with cultivated lymph.

RHEUMATISM.
Purgatives.
Salicylic acid.
Salines; Alkalies.
Turpentine externally and internally.
Fomentations.
Rugs wrung out of hot water.
Vapour or hot bath.
Sulphurous fumigation and solutions.
Wet compress to painful joints.
Hot salt; Smoothing-iron.
Mustard blisters.

RICKETS: Rachitis.
Calcium phosphate.
Lime water.
Iron salts.
Nourishing oleaginous diet.
Milk; Linseed; Cod-liver oil.
Sulphurous fumigations and sponging.
Splints and bandages.

RINDERPEST: Cattle Plague; Contagious Enteric fever.
Rarely curable.
Sloppy food.
Potassium chlorate; Sodium sulphite.
Sulphurous acid inhalation and sponging.
Carbolic acid internally and externally.
Tonics; Stimulants.
Mineral acids and bitters.
Separate healthy from sick.
Disinfectants.

RINGBONE: Exostosis on Horse's Coronet.
Cold wet swab.
Bar shoe.
Cathartic.
Counter-irritants.
Mercury iodide ointment.

RINGWORM; see FAVUS and TINEA TONSURANS.

ROARING IN HORSES.
Seldom curable.
Seton; Blister.
Damped food.
Nux vomica and strychnine.

ROT IN SHEEP: Hydatid in Liver.
Salines.
Antiseptic.
Iron salts.
Turpentine and gentian.
Dry nutritive food.

SALLENDERS; see PSORIASIS.

Sand Crack: Fissure of Horn of Horse's Foot.
Bottom the crack.
Cut it off above and below.
Replace ordinary with bar shoe, or shoe with clips.
Shoe so as to remove pressure from crust adjoining crack.
Poultice.
Rest.
Stimulate growth of new horn.
Scab in Sheep; see also Acari.
Potashes and soft soap solution.
Sulphur iodide solution.
Mercurial ointment.
Tar oil.
Tobacco juice.
Stavesacre.
Scarlatina: Blood Disease of Horses, characterised by Subacute Inflammation of Skin and Mucous Surfaces, with Low Fever.
Ammonia.
Alcohol; Ether.
Oil of turpentine.
Iron salts.
Warm clothing.
Laxative clysters.
Diuretics; Antiseptics.
Hand-rub and gently stimulate swellings.
Soft digestible food.
Scirrhus: Hard Cancer.
Excision.
Antiseptic dressings.
Scrofula; see Tuberculosis.
Seedy Toe: Perverted Secretion of Detached Horn of Horse's Toe.
Cut away diseased horn.
Tar or carbolic dressings.
Nitric acid.
Shoe to guard from pressure.
Bar shoe and leather sole.
Blister coronet.
Septicæmia; see Pyæmia.
Shoulder Slip: Strain of Muscles of Horse's Shoulder.
Foment.
Purgative.
Rest.
Blisters; Seton.
Side Bone: Ossification of Lateral Cartilages.
Bar shoe.
Cold applications.
Rest.
Blisters; Firing.
Neurotomy.
Sitfast: Gangrenous Patch of Skin.
Foment and poultice.
Sitfast—*Continued.*
Dissect out.
Silver nitrate.
Carbolic dressings.
Small-Pox in Sheep: Variola Ovina.
Good nursing.
Soft laxative food.
Salines.
Condy's fluid externally.
Sore Throat: Pharyngitis; Cynanche Tonsillaris; Angina.
Steam head and throat.
Laxative; Clysters.
Salines.
Belladonna.
Sulphurous acid gargle and spray.
Belladonna and vaseline electuary.
Hydrochloric acid and treacle gargle.
Mustard embrocations.
Sore Shins; see Ostitis.
Spasm: Cramp.
Warmth; Friction.
Opium and belladonna.
Ether; Chloral hydrate.
Hydrocyanic acid; Conium.
Amyl nitrite.
Spavin, Bog; see Bog Spavin.
Spavin (Bone).
Cathartic.
Rest.
Counter-irritant.
Mercury iodide ointment.
Firing iron; Seton.
Periosteotomy.
High-heeled shoe.
Splenic Apoplexy; see Apoplexy, Splenic.
Splints.
Fomentations.
Refrigerants.
Purgative.
Rest.
Counter-irritants.
Mercuric iodide ointment.
Subcutaneous periosteotomy.
Diminish concussion by leather soles.
Speedy Cut; see also Bruises.
Hot fomentations.
Laxative.
Cold water and antiseptic dressing.
Well-fitting shoes, narrow in inner web.
Boot.
Counter-irritant.
Sprains of Muscles, Tendons, and Ligaments.
Foment.
Cathartic.

Sprains of Muscles, etc.—*Continued.*
Relieve tension.
Cold applications.
Counter-irritants.
Mercuric iodide ointment.
Seton; Firing iron.
Staggers; see Indigestion, and Phrenitis.
Stomach Staggers in Horses; see Indigestion.
Strangles: Catarrhal Fever of Horses.
Foment and Poultice.
Steam head.
Soft nutritive diet.
Cool air.
Salines.
Sodium sulphite.
Blister tardy swelling.
Tonics and stimulants.
Strangury: Difficult and Painful Passage of Urine, which dribbles away.
Remove cause.
Pass catheter.
Warm or Vapour bath.
Diluents.
Laxative and soothing clysters.
Fresh sheepskins or rugs wrung out of hot water to loins.
Sweet spirit of nitre and diuretics cautiously given.
Belladonna inunction.
Stringhalt: A spasmodic Movement usually of the horse's Hind Limb.
Incurable.
Relieve any aggravating spavin or other lameness.
Nux vomica or strychnine.
Nerve-stretching.
Sturdy; see Hydatid in Brain.
Surfeit: Urticaria; Nettle Rash.
Purgative.
Diuretic.
Alkalies.
Laxative diet.
Lead acetate solution.
Sulphurous acid solution.
Potassium Cyanide solution; Benzoin compound tincture. Dilute nitric acid allays itching.
Synovitis: Inflammation of Synovial Membrane usually from open joint.
Refrigerants; Cold water.
Anodynes; Poppy heads.
Rest.
High-heeled shoe.
Slings if needful.
Laxative.
Synovitis—*Continued.*
Aconite, internally and externally.
Mercury and morphia oleate.
Blister.
Tabes Mesenterica: Tuberculosis of Bowels.
Generous oleaginous diet.
Sodium sulphite.
Iron chloride.
Calcium phosphate.
Tape-worm: Tænia.
Turpentine and oil.
Copper sulphate.
Iron chloride tincture.
Male shield-fern.
Areca-nut and santonin for dogs.
Tendons Contracted (Horses).
Careful shoeing.
Blisters.
Tenotomy.
Tendons or Ligaments Ruptured; see also Sprains (Horses).
Rest.
Foment; Allay inflammation.
Splints; Starch bandages.
Slings.
Cold water.
Afterwards stimulate externally.
Tetanus: Lock-Jaw.
Purgative.
Chloral hydrate; Conium; Prussic acid; Calabar bean.
Conine; Nicotine hypodermically.
Cool air; Warm clothing.
Spinal ice bag.
Perfect quiet.
Soothe any wound.
Vapour bath.
Thick Wind.
Seldom curable.
Damped food.
Regulated water supply.
Calomel, opium, and digitalis.
Professor Dick's recipe.
Occasional dose of Epsom salt.
Thorough-pin of Hock or Knee.
Foment.
Cathartic.
Rest.
Blister.
Spring truss; Bandage.
Thrombus: Extravasation of Blood in Areolar Tissue from Bleeding.
Tie up head.
Foment; Scarify; Blister.
Thrush in Mouth; see Aphtha.
Thrush in Horse's Frog.
Cleanliness.
Carbolic acid and oil, equal parts.

Thrush—*Continued.*
Calomel.
Tar-stopping; Laxatives.
Shoe with tips.
Ticks in Sheep: Melophagus Ovinus.
Baths of sulphur, potashes, and soft soap.
Baths of sulphur, arsenic, and soft soap.
Tar oils.
Carbolic dressings.
Tinea Tonsurans: Ringworm.
Destroy cryptogamic parasite.
Remove crusts with warm water and soap.
Mercury oleate; Iodine ointment.
Corrosive sublimate solution.
Epilation.
Sulphurous acid solutions.
Cleanse premises and clothing.
Toothache.
Extract offending tooth.
Tannin dissolved in alcohol and ether.
Morphine and atropine.
Collodion.
Creasote.
Mustard or warmth externally.
Treads about Horse's Feet; see also Bruises.
Poultice; Foment.
Cathartics.
Antiseptic dressings.
Heels of shoes well rounded off.
Tuberculosis.
Generous diet.
Linseed and oily food.
Antiseptic treatment.
Iron salts.
Warmth; Comfortable surroundings.
Tympanitis; see Hoven.
Typhoid Fever; see Gastric Fever.

Udder, Inflammation of; see Mammitis.
Ulcer: Degenerate Sore.
Remove irritation.
Physiological rest.
Promote healthy circulation by astringents.
Caustics.
Bandages; Laxatives.
Change of diet.
Antiseptics.
Tonics.
Urinary Calculi; see Calculi, Urinary.
Urinary Deposits: Lithiasis; Gravel; see also Calculi.
Diluents.
Urinary Deposits—*Continued.*
Laxative food.
Alkalies.
Exercise.
Urticaria; see Nettle Rash.
Urethritis: Inflammation of Urethra.
Foment; Laxatives.
Anodyne clysters.
Belladonna internally and locally.
Astringent injections.
Cast and caustic.
Uterus, Inflammation of; see Mammitis.

Varicose Veins.
Cold wet bandages.
Friction.
Obliterate vein.
Variola Ovina; see Small-Pox.
Variola Vaccina: Cow-Pox.
Foment udder.
Poultice of spent hops.
Laxative; Salines.
Draw away milk with teat-syphon.
Vertigo; see Megrims in Horse.
Vives: Bastard Strangles.
Blister; Salines.
Alteratives.
Sodium sulphite.
Calcium sulphide.
Generous diet.
Tonics.
Villitis: Coronitis; Inflammation of Coronary substance in Horses.
Rest; Remove shoes.
Foment and poultice.
Purgatives; Febrifuges.
Cold applications.
Blister coronet.
Vomiting.
Grey powder; Ipecacuan; Alkalies in small doses.
Bismuth; Arsenic.
Creasote; Prussic acid.
Morphia swallowed and hypodermically.
Chloral and Potassium bromide.
Spinal ice-bag.

Warts.
Excision; Ligature; Torsion.
Nitric acid; Chromic acid.
Mercury and Silver nitrates.
Glacial acetic acid.
Weed: Shot of Grease; see Lymphangitis.
Whistling in Horses.
Seldom curable.
Setons; Blisters.
Potassium iodide.

WINDGALLS: Ganglions; Enlarged Synovial Bursæ.
Equable pressure by bandages.
Hand-rubbing.
Cold applications.
Blisters.
Careful shoeing.
WIND SUCKERS (HORSES).
Spiked strap on throat.
Laxative.
Alterative dose of aloes.
Damped food.
Alkalies; Bitters.
WITHERS, FISTULOUS; see FISTULÆ.
WORMS, INTESTINAL; see also ASCARIDES, FILARIÆ and TAPEWORMS.
Turpentine and other volatile oils.
Aloes and other purgatives.
Areca nut and santonin for dogs.
Tobacco-smoke clysters.
Clysters of soap and water, turpentine, iron chloride, or oak bark solution.
Quassia and bitters.
WORMS, INTESTINAL—*Continued.*
Copper Sulphate and arsenic.
Prevented by properly regulated dietary, access to rock salt, and cleanliness of premises.
WOUNDS.
Cleanse from foreign bodies.
Wash with zinc chloride or saturate with water dissolved in carbolic.
Bring gaping surfaces together with stitches or suture.
Maintain aseptic by carbolic, boracic, sulphurous, or other antiseptics.
Rest, support by splints, bandages, etc.
Check excessive granulation by silver nitrate and other caustics.
Foment contusions.
Refrigerate with cold water applied over dressings.
Allay pain with opium and belladonna.
Laxatives and laxative diet.

II. INDEX OF MEDICINES.

	PAGE
Absorption of medicines	6, 109
Acacia, gum	365
Acetate of ammonia	184
copper	319
lead	419
morphine	504
potash	536
zinc	636
Acetic acid	133
ether	342
Acetone	101, 134
Acetum	133
Acids	41
Acid, acetic	134
antimonic	189
arabic	366
arsenious	201
benzoic	234
boracic	235
camphoric	550
carbolic	259
chromic	41
cincho-tannic	303
cinnamic	234
cresylic	260
crotonic	324
ferulaic	218
gallic	354
gentianic	359
hydrochloric	377
hydrocyanic	537
igasuric or strychnic	471
kinic or quinic	303
linoleic	423
margaric	363
meconic	491
muriatic	377
myronic	461
nitric	466
nitro-hydrochloric	470
nitrous	467
oleic	483
phenic	259
phosphoric	467
piperin	510
prussic	537
pyroligneous	134
salicylic	547
sclerotic	337
silvic or abietic	612

	PAGE
Acid, strychnic or igasuric	471
sulpho-carbolic	272
sulphuric	586
sulphurous	590
tannic	352
tartrate of potash	536
valerianic	615
Aconite	137
experiments with	140
extract of	145
Fleming's tincture of	146
poisoning	140
Aconitine	138, 146
Acorns	482
Action of medicines explained—	
chemically	9
mechanically	8
how established	5
how modified	103
in different patients	105
Actual cautery	40, 47
Acupuncture	46
Aquapuncture	46
Adeps or hog's lard	219
Adhesives or plasters, 122, 347, 354, 357, 418, 414.	
Administering of medicines	105, 109
Adulterations	104
Ærugo	319
Æther, acetic	342
chloric	298
nitrous	594
sulphuric	341
æthereal oil	342
Ætheris nitrosi spiritus	594
Age of patients	108
Akazga, an African ordeal plant	48
nux vomica alkaloid	477
Alcohol	147
absolute	148
amylic	149
methylic	149, 458
phenic	259
poisoning	158
Aldehyde	101
Ale	149
Alkalies	43
Allopathy	11
Allspice	516
Almond oil	420

PAGE

Aloe, characters of . . 157
spicata . . . 160
Socotrina . . 159
vulgaris . . 158
Aloes, Barbadoes . . 158
caballine or horse . 161
Cape . . . 160
comparative effect of different varieties of 164
East Indian . . 159
hepatic . . 159
Mocha . . 159
Socotrine . . 159
solutions of . . 169
tinctures of . . 169
Aloetic masses . . 168
Aloïn 169
experiments with . 171
good purge for horses . 172
useful febrifuge . 172
Alteratives or alterants . 17, 82
Alterative prescriptions, 83, 199, 309, 378, 383, 432, 470, 527, 532, 562, 565, 569, 582.
Althæa radix . . . 434
Alum, ammonia . . 173
potash . . 173
soda . . . 173
Alumen . . . 173
Aluminum and its compounds 173
chloride . . 176
sulphates . . 173
Ammonia alum . . 173
Ammoniac gum . . . 218
Ammoniated mercury . 455
tinct. opium . 502
Ammonium and its compounds 177
aqua . . 177
acetate . 184
carbonates . 181
chloride . 183
copper sulphate 315
hydrate . 177
muriate . 183
sesqui-carbonate 181
spirit . . 183
Amorphous quinine . . 303
Amygdalin . . . 537
Amyl hydride . . 102
nitrite . . . 92, 185
Amylene . . . 103
Amylic alcohol . 149, 185
Amylum ; wheat flour . 575
Anæsthetics . 96, 295, 343, 459
local, 100, 136, 139, 145, 291, 296, 346, 627
Angustura bark, false . 471
Anise 187
camphors . . 188

PAGE

Aniseed . . . 187
Anodynes . . . 94
Anodyne prescriptions, 95, 123, 145, 186, 228, 250, 285, 289, 322, 347, 355, 370, 421, 493, 498, 626.
Antacids . . . 43
Antacid prescriptions, 180, 241, 243, 428, 442, 521, 562, 564, 573.
Antagonism between medicines, 38, 506.
Anthelmintics (see also Vermicides, Parasiticides) . 55
Anthelmintic prescriptions, 56, 197, 199, 217, 317, 350, 367, 398, 403, 408, 450, 453, 555, 599, 608, 616.
Anthemidis flores . 77, 280
Antidotes . . . 38
Anti-emetics, 54, 286, 322, 392, 501, 513.
Antilithics . 44, 522, 524, 561
Antimony and its compounds 189
butter or oil of . 196
chloride or muriate of 190
crocus of . . 190
crude or common . 189
glass of . . 189
golden sulphuret of 140
oxides of . . 189
sulphides of . 190
tartarised . . 191
tests for . . 193
white . . 189
Antiparasitics, see Anthelmintics and Parasiticides .
Antipareses . 81, 339, 471, 478
Antipathy . . . 10
Antiperiodics, 77, 210, 305, 534, 634.
Antiphlogistics, alteratives, febrifuges . . . 87
Antiputrescents, antiseptics . 18
Antipyretics, see also Febrifuges, 43, 62, 68, 74, 87, 89, 90, 92, 144, 167, 185, 264, 305, 406, 532, 534, 548, 628.
Antiseptics, 18, 136, 156, 176, 181, 212, 234, 236, 263, 273, 281, 283, 288, 305, 322, 364, 379, 387, 403, 420, 454, 459, 509, 527, 533, 548, 564, 572, 580, 588, 591, 606, 635.
Antiseptic surgery, 25, 236, 265, 387, 536, 549, 592, 635.
Antispasmodics . 80, 90
Antispasmodic prescriptions, 155, 166, 180, 185, 286, 296, 305, 345, 370, 376, 381, 498, 545, 595, 599, 606, 615.
Antizymotics . . . 18, 35
Aperients, see Laxatives . 59
Aphrodisiacs . . 54, 254

PAGE

Apomorphine . . . 490
Apothecaries' measure . 128
weight . 128
Aqua 622
ammoniæ . . 177
-fortis . . . 466
potassæ . . . 520
regia . . . 470
Arabin . . . 466
Areca catechu . . 199
Areca nut . . . 199
Argente nitras . . 555
Argol or crude tartar . 536
Arnica . . . 200
Arnicin . . . 200
Aromatics 49, 77, 188, 273, 360, 362
Aromatic bitters . 77, 273, 465
Arrow poisons . . 90, 91
Arrowroot . . . 575
Arsenic and its compounds . 201
antidotes for . . 209
poisoning by . . 205
sulphurets of . . 205
tests for . . 203
white . . 201
Arsenical sheep dips . . 212
solution . . 216
Arsenicum album . . 201
Arsenious acid . . 201
Arsenite of potash, solution . 216
iron . . 395
strychnine . 481
Arseniuretted hydrogen 204, 205
Artemisia or wormseed . 56, 217
Asafœtida . . . 217
Aspidium filix-mas . . 349
Astringents, 84, 174, 199, 244, 246, 279, 317, 340, 352, 355, 379, 398, 402, 420, 453, 482, 498, 589, 612, 633.
Atomisers . . . 65, 128
Atropa belladonna . . 222
Atropaceæ . . 222, 374, 596
Atropine . . . 229
and Calabar bean . 232
compared with morphine 506
Autumn crocus . . 311
Aurantiaceæ . . . 508
Avoirdupois weight . . 128
Axunge or hog's lard . . 219

Balls or boluses . . 115
Balsam, Canada . . 603
Friar's . . 235
of Gilead . . 603
of Peru . . 234
of Tolu . . 234
Balsamodendron Myrrha . 465
Barbadoes aloes . . 158

PAGE

Barbadoes tar . . . 512
Barbaloin . . . 169
Bark, cinchona . . 299
oak . . . 482
Barley . . . 221
Barley sugar . . . 578
Barm 221
Bassorin . . . 366
Baths . . . 92, 628
cold . . . 629
hot . . . 629
medicated tepid . . 628
vapour or Turkish . 629
Bdellium or false myrrh . 465
Bear's foot . . . 367
Beebeeru bark . . 305
Beer 149
Bees' wax . . . 630
Belladonna . . 102, 222
Benzine or benzole . . 513
Benzoated lard . . 219
Benzoic acid . . . 234
Benzoin . . . 234
compound tincture of . 235
Berberis bark . . 305
Betel-nut . . . 199
Bhang 380
Bicarbonate of potash . 522
soda . . 562
Bismuth . . . 76, 88
Bisulphate of potash . . 525
Bittern . . . 429
Bitters, 17, 168, 305, 359, 465, 473, 545
Bitumen . . . 512
Black, animal . . 281
bone, or ivory . . 281
hellebore . . 367
oils . . . 426
sugar . . . 426
wash . . . 443
Bleaching powder , . 245
Blisters, 45, 198, 257, 327, 349, 388, 456, 463, 610, 266.
Blisters, general actions of . 44
fly . . . 257
Blood-letting . . . 92
topical . . 93
Blood-purifiers . . 83
Blue pills . . . 441
ointment . . . 439
Prussian . . . 539
stone . . . 315
vitriol . . . 315
Boluses, how made, etc. . 115
mass for . . 424
Bone or ivory black . . 280
Boracic acid . . . 235
Borax 563

PAGE

Borneo camphor . . 248
Boro-glyceride . . 364
Bottles . . . 117
Brandy . . . 149
Brimstone . . . 581
British gum . . 366, 575
Bromal hydrate . . 285
Bromide of ammonium . 530
potassium . 529
sodium . . 530
Brucine or brucia . 471, 481
Buckthorn . . . 237
syrup of . . 237
Burgundy pitch . . 604
Burnett's disinfecting liquid . 636
Butter of antimony . . 190
zinc . . . 635

CABALLINE aloes . . 161
Cajuput oil . . . 234
Calabar bean . . . 238
Calamine . . . 633
Calcareous spar . . 242
Calcined magnesia . . 427
Calcis carbonas . . 242
Calcium and its compounds . 240
oxide of . . 240
carbonate . . 242
chlorata . . 245
chloride . . 240
phosphate . . 240
Calefacients, stimulants . 78
Calisaya bark . . . 300
Calomel . . . 444
Calumba bark . 77, 305
Calvert's disinfecting powder 272
Calx 240
chlorinata . . 245
usta . . . 240
Cambogia or Gamboge . 355
Camphor . . . 247
artificial . . 248
oil or liquid . . 248
Borneo . . 248
Camphora officinarum . 247
Camphoric acid . . 550
Canada balsam . . 603
Cane sugar . . . 578
Cannabene . . . 381
Cannabis Indica . . 380
sativa . . 380
Cantharides . . . 251
liniments of . 258
ointments of . 257
plasters of . 259
tinctures of . 256
vinegars of . 257
Cantharadin . . . 252
Cantharis vesicatoria . . 251

PAGE

Capsaicin . . . 510
Capsicin . . . 510
Capsicum . . . 510
Caraway . . . 187
Carbo animalis . . 280
ligni . . . 280
Carbolic acid . . . 259
Carbon . . . 280
Carbonates of ammonia . 181
iron . . 396
lead . . 417
lime . . 242
magnesia . 428
potash . . 522
soda . . 561
zinc . . 633
Cardamoms . . . 188
Cardiac sedatives, 89, 139, 332, 375
stimulants, 80, 155, 227, 298, 333, 595, 606.
Carminatives (see Stomachics), 49, 81, 188, 218, 243, 246, 362, 409, 461, 508, 596, 606.
Carron oil . . . 242
Carthagena barks . . 301
Carum carui . . . 187
Casa or doom . . . 89, 332
Cascarilla bark . 77, 273
Cassia acutifolia or Senna . 408
Castor oil . . . 274
seeds . . . 274
Catalytics or alteratives . 82
Cataplasms or poultices . 124
Catechin . . . 278
Catechu . . . 278
Acacia . . . 278
Areca . . 199
brown . . 278
infusion of . . 279
tincture of . . 279
Cathartics ; see Purgatives . 58
Cattle, action of medicines on, 61, 107.
astringents for, 279, 317, 352, 398, 420, 482.
counter-irritants, 180, 198, 257, 456, 462, 611, 626.
febrifuges, 144, 305, 432, 448, 533.
purgatives, 61, 277, 326, 356, 425, 432, 571.
tonics, 210, 317, 360, 362, 398, 473.
stimulants, 156, 180, 182, 345, 595, 607.
vermifuges, 263, 288, 592, 600, 609.
Caustic ammonia . . 171
lunar . . . 555

PAGE
Caustic lime . . . 240
potash . . 521
soda . . . 561
Caustics, 40, 41, 44, 190, 212, 317, 380, 453, 468, 521, 589, 635.
Cautery, actual, . . 40, 47
Cayenne pepper . . 510
Centaury . . . 77
Cephaëlis ipecacuanha . 389
Cera alba . . . 631
flava . . . 630
Cerates . . . 121
Cerevisia or yeast . . 221
Ceruse, white lead . . 417
Cetaceum, cetine . . 574
Cevadilla or Sabadilla . 312
Chalk 242
mixtures . . 243
Chamomile flowers . . 280
Charcoal, animal . . 280
wood . . 280
Charges . . . 122
Chemical action . . 9
Chemical combination modifies the actions of medicines, 105, 233.
Chilies . . . 510
Chiretta . . . 274
Chloral . . . 283
hydrate . . 283
Chloralum . . . 176
Chlorate of potash . . 533
Chloric ether . . . 298
Chloride of aluminium . 176
ammonium . 183
lime . . 240
sodium . . 568
zinc . . 635
Chlorides of mercury . 444, 451
Chlorinated lime . . 245
soda . . 573
Chlorine . . . 287
Chlorodyne . . . 298
Chloroform . . . 589
of belladonna . 229
spirit of . . 298
Chloro-methane . . 101
Cholagogues, 63, 235, 313, 390, 408, 518, 526, 546, 565.
Chondrine . . . 357
Christmas rose . . 367
Chromic acid . . . 41
Cicuta virosa . . . 369
Cimicifuga; black snake root 81, 339
Cinchona . . . 299
alkaloids of . . 301
colouring matters . 303
Condaminea . . 300
grey, or pale . 299

PAGE
Cinchona, red . . 300
tincture of . 306
yellow . . 300
Cinchonaceæ . . . 299
Cinchonine or cinchonia . 302
Cinchonism . . . 303
Cincho-tannic acid . . 303
Cinnabar . . . 444
Citrine ointment . . 458
Classifications of medicines . 13, 17
Clay 174
Clysters . . . 126
anodyne 127, 228, 287, 502
astringent 244, 352, 482
laxative 126, 169, 425, 608
nutrient . . 127
Coal gas . . . 102
tar . . 458, 512
Cobra poison . . . 90
Cocculus Indicus . . 80, 96
Cocoa 77
Codeia or Codeine . . 491
Cod liver oil . . . 308
for feeding purposes 309
Colchicine or colchicia . 312
Colchicum autumnale . 311
Cold applications, 78, 86, 184, 572, 627.
natural tonic . 78, 87, 627
poultices . . 125
water-cure . . 628
Collodion . . . 347
flexible . 347, 603
Collyria . . . 126
Colocynth . . . 408
Colophony, resin . . 611
Colza oil . . . 426
Combination of medicines . 105
Common mass . . . 424
salt . . . 568
Condiments . . . 50
Condy's Disinfecting Fluid . 535
Confections . . . 121
Congelation . . . 86, 627
Conhydrine . . . 369
Conia or conine . 369, 375
Coniferæ . . . 601
Conium maculatum . . 368
Contagious disorders . . 30
Convolvulin . . . 407
Convolvulus Scammonia . 408
Cooper's salts . . . 23, 32
Copper and its compounds . 314
acetates . . 319
ammonio-sulphate . 318
iodide . . . 318
poisoning . . 314
sulphate . . 315
sulpho-carbolate . 273

PAGE
Copper, tests for . . 314
vitriol of . . 315
Copperas . . . 396
Coptic or gold thread . 77, 359
Cordials . . . 80
Coriander . . . 187
Corn flour, Oswego . . 575
Corrosive poisons, 41, 136, 378, 452, 467, 521, 587.
Corrosive sublimate . . 451
antidotes for . 453
poisoning by . 452
Cortex quercus . . 482
Cotton . . . 434
Counter-irritation . . 44, 255
irritants (see also Blisters and Rubefacients), 45, 180, 198, 255, 327, 349, 368, 388, 440, 441, 456, 462, 609, 626.
Cough mixtures, 65, 185, 227, 250, 333, 345, 372, 387, 580, 613.
Cream of tartar . . 536
Creasote . . . 320
Cresylic acid . . 260, 262
Creta preparata . . 242
Croton . . . 324
cake . . . 324
Cascarilla . . 273
chloral . . 101, 285
oil . . . 324
seeds . . . 324
Tiglium . . 324
Croton chloral hydrate 101, 285
Crotonic acid . . . 324
Crotonis oleum . . 324
Cryptopine . . . 490
Cubebs pepper . . 509
Cuca 74, 77
Cupri acetas . . . 315
ammonio-sulphas . 318
iodidum . . 318
oxyacetas . . 315
sulphas . . . 315
Cuprum . . . 314
Curara, motor paralyser . 91, 239
Curative action of medicines . 8
Cumulative medicines . 102
Cutch 278
Cyanide of potassium . 544
silver . . 540
Cyanides . . . 542
Cyanogen gas . . 537, 540

DANDELION . . . 217
Datura stramonium . . 225
Daturine . . . 230
Deadly nightshade . . 222
Decoctions . . . 116
PAGE
Decolorisers . 245, 281, 288, 417
Delphinium Staphisagria . 576
Demulcents, 17, 85, 221, 357, 363, 366, 424, 427, 434, 574, 576, 580, 618, 631.
Deobstruents, 269, 383, 397, 438, 453, 456, 528.
Deodorisers, 36, 177, 242, 246, 282, 288, 535, 566, 573, 591, 604.
Depressants or sedatives . 87
Depresso-motors (see Motor depressants) . . 89
Derivation or counter-irritation 45
Desiccants, 168, 176, 241, 243, 246, 272, 281, 417, 576, 633.
Detergents 123, 522, 559, 563, 628
Dextrin . . . 366
Dextrose—grape sugar . 578
Diachylon plaster . . 418
Diaphoretics, 66, 155, 185, 197, 345, 390, 404, 459, 595, 598, 629.
Dick's, Professor, cough balls 333
iodine balls . 384
white lotion 421, 636
Digitalin . . . 328
Digitalis . . . 328
experiments with . 330
purpurea . . 328
Diffusible stimulants . 80, 197, 345
Digitoxin . . . 329
Diluents . . . 18, 625
Discutients, 85, 123, 157, 176, 185, 201, 421, 610, 618, 626, 636.
Disease treated by inoculation . . . 3, 20, 39
Diseases modify actions of medicines . . . 111
Diseases how cured . . 8
Disinfectants, 27, 246, 270, 288, 380, 566, 573, 592.
Diuretics . . . 68
prescriptions, 70, 333, 345, 409, 459, 532, 595, 612.
Dogs, action of medicines on 108
anodynes for, 227, 286, 372, 500.
counter-irritants, 181, 255, 440, 464, 510, 626.
emetics, 53, 197, 318, 391.
febrifuges, 144, 185, 197, 595.
purgatives, 238, 277, 408, 425, 442.
tonics, 307, 310, 360, 396, 402.
stimulants, 155, 182, 345, 359.
vermifuges, 199, 217, 350, 608.
Dolomite . . . 429
Doses of medicines . . 104
infinitesimal . . 11
Dover's powder . . 392

PAGE
Drastic cathartics . . 59, 325
Drenches, draughts, or drinks 116
Drenching horn . . 117
Dryobalanops camphora . 248
Dutch liquid . . . 103
Dynamic action of medicines . 48

Ecbolics . 54, 253, 339, 544
Elaterium . . . 408
Elecampane . . . 200
Elective affinity . . 57
Electricity . . . 82
Electuaries . . . 121
Elemi resin . . . 466
Eliminatives or evacuants . 14
Ellerman's deodorising fluid 32
Emetic, tartar . . 191
Emetics, general actions . 50
Emetics, 53, 197, 312, 391, 464, 559, 598, 572, 634.
Emetine . . . 390
Emollients, 85, 123, 364, 366, 424, 434, 484, 576, 618, 626, 631.
Emplastra . . . 122
Emplastrum adhesivum 314, 328
cantharidis . 259
Endermic applications of medicines 140
Enema or enemata . . 126
of opium . . 503
of starch . . 576
of tobacco . . 600
of turpentine . . 611
Epsom salt . . . 429
Ergot or spurred rye . . 335
oil of . . . 336
Ergotine . . . 336
Ergotinine . . . 337
Errhines . . 49, 444, 621
Escharotics; caustics, 41, 44, 190, 212, 317, 323, 453, 469, 589, 635.
Essences . . . 119
Ether 341
acetic . . . 342
chloric . . . 298
nitrous . . . 594
sulphuric . . 341
Ethereal oil . . . 342
tincture of iodine . 386
tincture of opium . 592
Ethiops, mineral . . 444
Ethyl bromide . . 102
Ethylene, or olefiant gas . 102
dichloride . . 103
Eucalyptus globulus . 24, 77, 89, 551
Euonymin a cholagogue . 63
Euphorbiaceæ . 273, 348
Euphorbium . . . 348
Euphorbon . . . 348
Evacuants . . 58, 66, 68

PAGE
Excipients, 115, 220, 364, 424, 427, 434, 559, 580, 618, 631.
Excitants, stimulants . 78
Exogonium Purga . . 406
Expectorants, 64, 185, 192, 218, 234, 391, 613.
Experiments on actions of medicines . . . 3
External circumstances modify actions of medicines . 112
Extract, Goulard's . . 421
Extract of aconite . . 145
belladonna . 229
conium . . 373
hyoscyamus . 376
nux vomica . 473
opium . . 502
Extracts, how made . . 119

Fæx sacchari . . . 579
Farina or flour . . 575
lini . . . 402
Fats and fixed oils . 220, 423
Febrifuges, 43, 62, 87, 92, 155, 167, 171, 185, 197, 264, 305, 432, 448, 531, 595, 628.
Fennel . . . 188
Fenugreek . . . 188
Fermentation, acetous . 134
vinous . . 147
Fern root . . . 349
Ferri carbonas . . 395
carbonas saccharatum . 396
fila . . . 395
iodidum . . . 399
oxidum . . . 406
sulphas . . . 396
sulpho-carbolate . . 272
valerianas . . 616
Ferric salts . . . 593
chloride . . 401
Ferricyanides . . . 538
Ferrocyanides . . 538
Ferrous salts . . . 393
sulphate . . 396
Ferrum . . . 393
Ferrugo . . . 400
Fever medicines. *See* Febrifuges.
Flax, common . . 422
Flexible collodion . . 347
Flies, blistering . . 251
Spanish . . 251
Flowers of sulphur . . 581
Fomentations . . . 122
Fool's parsley . . . 369
Foot-rot dressings, 190, 269, 317, 380, 457, 469, 614.
Forms of administering medicines, . . . 109

PAGE

Fowler's solution . . 216
Foxglove . . . 328
Frankincense . . . 465
Freezing mixtures, 78, 86, 184, 572, 627.
Friar's balsam . . 235
Friction . . . 82
Fructose or lævulose . . 578
Fuller's earth . . . 176

Galangal . . . 362
Galbanum . . . 218
Gallic acid . . . 354
Galls or gallæ . . 351
Galvanism . . . 82
Gambier . . . 278
Gamboge . . . 355
Ganja 381
Garcinia Morella . . 355
Gargles, anodyne, 65, 236, 250, 364, 372, 618.
astringent, 269, 354, 379, 567, 580.
stimulant, 184, 269, 379, 387, 564.
Gelatine . . . 356
Gelsemium . . . 92
Gentian . . . 358
infusion of . . 360
tincture of . . 360
Gentiana lutea . . 358
Gentianin . . . 359
Gentiopicrin . . . 359
Gin or Geneva . . 149
Ginger . . . 360
black . . . 361
Jamaica . . 361
Malabar or Barbadoes. 361
preserved . . 361
tincture of . . 362
white or bleached . 361
Glauber salt . . . 564
Glucose or dextrose . . 578
Glucosides . . 353, 578
Glue 357
plasters . . . 358
Glycerine . . . 363
of carbolic acid . 364
starch . . 364
tannin . 354, 364
hydrate . . 363
Glyceryl oleate . . 484
Glycyrrhizæ radix . . 426
Glycyrrhizin . . . 427
Glysters or clysters . . 126
Golden eye ointment . . 457
Gold thread or coptic . 359
Goose grease . . . 219
Gossypium . . . 434

PAGE

Goulard's extract . . 421
Grape sugar . . . 578
Gray powder . . . 442
Green vitriol . . . 396
Gregory's mixture . . 547
Grindelia . . . 90
Gum acacia . . . 365
ammoniac . . 218
African . . . 365
Arabic . . . 365
Australian . . 366
Bassorin . . . 366
Benzoin . . . 234
British . . . 366
Cape . . . 366
Senegal . . . 366
tragacanth . . 366
Gun-cotton, solution of, in ether . . . 347

Habit modifies the action of medicines, . . . 111
Hæmatics act on the blood . 13
Hæmatoxylon, or logwood . 279
Hæmostatics, 85, 124, 175, 340, 355, 402, 420, 606.
Hartshorn . . . 181
Hashish . . . 380
Heart sedatives and stimulants. (*See* Cardiac) . 80, 89
Heat 82, 125
Heat and moisture . 123, 124, 626
Heat as a disinfectant . 21
a stimulant . 123, 125
Heating lotions, 201, 235, 268, 288, 364, 420, 549, 553, 593, 635.
Heating ointments, 236, 272, 318. 364, 388, 417, 633.
Hellebore, black . . 367
white . . 619
Helleborin . . . 367
Helleborein . . . 367
Helleborus niger . . 367
Hemlock . . . 368
extract . . 373
succus . . 373
tincture . . 373
water . . 369
Henbane or hyoscyamus . 374
Hepatic aloes . . 159
Hog's lard . . . 219
Hoffmann's anodyne . . 347
Hollands . . . 149
Homœopathy . . . 9
Honey or mel . . . 579
Horse, action of medicines on, 106
anodynes, 227, 286, 372, 500
astringents, 279, 317, 352, 398, 420, 482.

PAGE

Horse, action of medicines on—
counter-irritants, 255, 440, 456, 464, 626.
diuretics 69, 530, 595, 607
febrifuges 144, 167, 432, 448
purgatives 60, 164, 277, 425, 449.
tonics 76, 155, 210, 317, 360, 398.
stimulants 155, 182, 345, 359, 595, 606.
vermifuges 55, 317, 350, 402, 608.
Hordeum . . . 221
Hot iron . . . 40, 47
Huile de cade . . 409, 553
Hydragogue cathartics . 59
Hydrargyri bichloridum . 451
chloridum . 444
creta et magnesia 442
emplastrum . 442
iodida . . 455
linimentum . 440
nitratis . . 457
unguentum 457
oleatum . . 440
oxidum nigrum . 443
rubrum . 443
perchloridum . 451
pilulæ . . 441
subchloridum . 444
sublimatum corr. 451
subsulphas flavus 444
sulphidum . 444
unguentum . 439
Hydrargyrum . . 435
Hydramel or Pentane . 102
Hydrastes Canadensis . 305
Hydrochloric sesquioxide of iron 400
Hydrochloric or muriatic acid 377
Hydrocyanic or prussic acid . 537
Hydrogen peroxide . . 551
sulphate . . 586
Hydropathy . . . 68
Hyoscyamine . . . 376
Hyoscyamus niger . . 374
Hyoscine . . . 375
Hypnotics productive of sleep, 94, 285
Hypodermic injection 40, 233, 507
Hypochlorates . . 573
Hyposulphites . . 565

Ice . . . 86, 92, 627
Ice-bag . . 86, 124
Idiosyncrasies . . 111
Igasurine . . 471, 482
Indian hemp . . . 380
Inebriant narcotics . . 95, 150

PAGE

Infusion of catechu . . 279
cinchona . . 306
ergot . . 340
gentian . . 360
ginger . . 362
opium . . 502
tobacco . . 600
Infusions, how made . . 118
Inhalation of medicines, 65, 288, 322, 344, 372.
Injections or clysters . . 126
into the rectum . 109
subcutaneous . 110
into the veins . 109
Inoculation in treatment of disease . . . 4, 39
Insecticides, parasiticides, and vermicides (see also Anthelmintics) . . . 55
Iodide of copper . . 318
iron . . . 399
lead . . . 418
mercury . . 455
potassium . . 526
starch . . . 385
sulphur . 389, 585
Iodine 381
ointment of . . 388
solutions of . . 388
tinctures of . . 388
Iodism . . . 384
Iodoform . . 291, 389
Iodum . . . 381
Ipecacuan . . . 389
Ipecacuanha cephaëlis . 389
Irrigation of throat . . 128
Iris, contraction of, by belladonna . . . 228
Iris, dilatation of, by Calabar bean . . . 239
Iron and its compounds . 393
and quinine citrate . 395
arsenite . . . 395
carbonate . . 396
chloride . . . 401
hydrated sesquioxide . 400
iodide . . . 399
oxyhydrate . . 395
phosphate . . 395
red oxide . . 400
rust . . . 400
saccharine carbonate . 396
sulphate . . . 396
tests . . . 393
tincture . . . 401
valerianate . . 616
Isinglass . . . 357
Issue or rowel . . . 46
Ivory black . . . 281

	PAGE
JABORANDI	404
Jalap or jalapa	406
Tampico	408
Jamaica ginger	361
pepper	510
James's powder	189
Java Upas antiar	3
Jervine	619
Jesuit's bark	299
Jonah's gourd	274
Juniper tops and berries	409
Juniperus communis	409
Sabina	553
oxycedrus	409, 553
Jute	422
KALADANA PURGATIVE SEEDS	408
Kalium or potassium salts	519
Kamela, a vermifuge	56
Kelp	281
Kermes mineral	190
Kino	84, 279
Kousso, a vermifuge	56
Krameria triandra	279
Kreasote or creasote	320
Kutch or catechu	278
LABARRAQUE'S soda disinfecting fluid	573
Labiatæ	49, 508
Lactose or Lactine	579
Lævulose—left-handed sugar	578
Lapis infernalis	555
Lard	219
Larix europea	602
Larkspur or stavesacre	576
Laudanum or tincture of opium	502
Laughing gas	103
Laurus Camphora	247
Lavender	
Laxatives, 59, 221, 425, 428, 442, 448, 484, 546, 559, 580, 583.	
Lead and its compounds	410
acetates	419
carbonate	417
iodide	418
oxides	417
oleate	418
plaster	418
poisoning with	411
antidotes for	416
post-mortem appearances	412
sugar of	419
white	417
Leopard's bane or arnica	200
Light, a stimulant	78
Lime, burnt	240
carbonates	242
chloride	240
chlorinated	245
hydrate	240
phosphate	244
saccharated	242
slaked	240
sulpho-carbolate	273
water	240
Liniment of ammonia	181
camphor	250
croton	328
lime	242
mercury	440
opium	502
plumbum	421
soap	560
turpentine	611
Liniments, how made	121
Linseed	422
cake	422
meal	422
oil	422
Lint	422
Linum usitatissimum	422
Liquor ammoniæ	177
acetatis	184
arsenicalis	216
calcis	240
chlori	288
hydriodatis arsenici et hydrargyri	386, 440
iodidi compositus	388
morphiæ murias	503
potassæ	520
Liquors	120
Liquorice root	426
sugar	426
Litharge—oxide of lead	417
Lithium carbonate	43
Liver of sulphur	524
Liver stimulants	63, 83
Lobelia—Indian tobacco	91
Logwood, an astringent dye	279
Long pepper	509
Lotions	120
Lubricants	220, 424, 484, 618
Lunar caustic	555
Lytta vesicatoria	251
MACDOUGALL'S disinfectant, 30, 37, 272	
sheep-dipping mixture	269
Magnesium and its compounds	427
calcined	427
carbonate	428
oxide	427
sulphate	429
tests for	427

PAGE

Male shield fern . . 349
Mallows . . . 434
Malt 221
Malvaceæ . . . 434
Manganate of potash . . 535
Manganese salts . . 76
Mange and scab dressings (see also Insecticides), 57, 212, 269, 389, 440, 453, 514, 585.
Marble . . . 242
Marjoram . . . 508
Marsh gas oils . . 512
Marshmallows . . 434
Marsh's test for arsenic . 204
Mass, common . . 424
Massicot, a lead oxide . 417
Materia medica, definition of 1
Matico leaves . . . 510
May apple or podophyllum . 514
Meadow saffron . . . 311
Measures . . . 128
domestic . . 130
Meconic acid . . . 491
Meconine . . . 490
Medicinal naphtha . . 459
Medicines, absorption of . 6
acting chemically 9
by counteraction 9
by mouth . 6
rectum 6
skin . 6
mechanically 8
classification of 13, 15
curative action of 8
doses . . 103
dynamic effects . 4, 8
elective affinity . 5
inherent properties of 8
modifying circumstances of . 103
on different patients 106
physiological action of 8
therapeutic action of 8
Mentha piperita . . 508
pulegium . . 509
viridis . . 509
Menthene . . . 508
Menthol . . . 508
Mercurial compounds . 434
disease . . 437
liniments . . 440
ointments . . 439
pills . . 441
plaster . . 442
Mercurialism . . . 437
Mercuric salts . . 435
Mercurous salts . . 435
Mercury and its compounds . 434
ammoniated . 455

PAGE

Mercury—*continued.*
chlorides . 444, 451
corrosive sublimate 451
iodides . . 455
liniment . . 440
muriate . 444, 451
nitrate . . 457
ointment . 457
ointments . . 439
oleate . . 440
oxides . . 443
pills . . 441
poisoning . . 436
plaster . . 442
sulphate . . 444
sulphides . . 444
tests for . . 435
with chalk and magnesia 442
Methylated alcohol . . 149
spirit . . 149
Methyl alcohol . . 458
bichloride . . 101
chloride . . 101
conine . . 369
strychnine . . 473
Methylic or pyroxylic spirit 149, 458
Milk sugar . . . 579
Mindererus spirit . . 184
Mineral, Ethiops . . 444
Kermes . . 190
tar . . . 512
Turbith . . 444
Mineral waters . . 623
Minium, a lead oxide . 417
Mint r. . . . 508
Mixtures . . . 117
freezing 78, 86, 184, 627
Modes of exhibiting medicines 109
Molasses, treacle . . 579
Monkshood . . . 137
Morphine . . . 489
acetate . . 504
compared with atropine 506
muriate . . 503
Morphiæ acetas . . 504
hydrochloras . 503
murias . . 503
Morrhuæ oleum . . 308
Mortars . . . 114
Motor depressants, 91, 186, 238, 283, 541, 599.
excitants 81, 339, 471, 478
Mucilage . . . 367
Muriate of ammonia . . 183
antimony . . 190
mercury . 444, 451
morphia . . 503
soda . . 568
zinc . . 535

PAGE
Muriatic or hydrochloric acid 377
Muscarine . . . 67, 90
Muscle contractors, 81, 337, 471, 478, 491.
relaxers, 223, 239, 286, 296, 344, 372, 599.
Mustard . . . 460
applications . . 463
black . . 460
compared with other irritants . . 462
leaves . . 464
oil of . . 461
white . . 460
Mydriatics, dilators of the pupil . . . 81, 228
Mylabris Cichorii . . 252
Myricin . . . 631
Myrosin . . . 461
Myrrh . . . 465
tincture of . . 466

Naphthas . . . 512
medicinal . . 458
Narceine . . . 490
Narcotics, 94, 153, 260, 283, 381, 595
inebriant, 95, 153, 261, 346, 459, 609.
Narcotine . . . 490
Narthex asafœtida . . 217
Nataloin . . . 169
Nauseants . . 192, 391, 598
Nerve paralysers 91, 239, 370, 493
stimulants 81, 223, 471, 479
tonics, 317, 402, 470, 473, 480, 616, 617, 634.
Neurotics act on nerves . 14
Nicotiana tabacum . . 596
Nicotine ; nicotianin . . 597
Nightshade, deadly . . 222
Nitrate of mercury . . 457
potash . . 529
silver . . 555
Nitre or saltpetre . . 529
sweet spirit of . . 594
Nitric acid . . . 466
Nitrite of amyl . . 185
Nitro-glycerine . . 92, 186
Nitro-muriatic acid . . 470
Nitrous acid . . . 467
oxide . . 103
Nut-galls . . . 351
Nutrients, 72, 76, 220, 221, 244, 309, 357, 423, 484, 497, 576, 579, 624.
Nux vomica . . . 470
alkaloids of 471, 476
poisoning . 471

PAGE
Oak bark . . . 482
galls . . . 451
Oakum . . . 422
Oatmeal . . . 575
Œnanthe crocata . 92, 369
Œnanthic ether . . 149
Oil, anise . . . 187
black . . . 426
cake . . . 423
carron . . 242, 423
castor . . . 274
chamomile . . 280
cod-liver . . . 308
croton . . . 324
drying . . . 426
expressed or fixed . 483
fixed . . . 483
linseed . . . 422
olive . . . 483
of cade . . 409, 553
ergot . . . 340
grain or fusel oil . 149
juniper . . . 409
linseed . . . 422
mustard . . 461
myrrh . . . 465
peppermint . . 508
poppy . . 426, 485
savin . . . 553
tar . . . 613
tobacco . . 597
turpentine . . 605
vitriol . . . 568
volatile . 508, 605
wine . . . 342
Ointments, how made, etc. . 121
Ointment, arsenical . . 216
blistering . . 257
cantharides . 257
carbolic . . 272
digestive . . 631
galls . . 352
iodide of sulphur . 389
iodine . . 388
mercury . . 439
nitric acid . 467
resin . . 612
savin . . 554
simple . 612, 631
silver . . 558
sulphur . . 585
zinc carbonate . 633
Olea europea . . . 483
Olefiant gas . . . 102
Olein 484
Oleum aetherum . . 343
aloes . . . 162
anisi . . . 187
anthemidis . . 280

PAGE

Oleum calcis . . 242, 423
crotonis . . 324
ergotæ . . . 340
jecoris aselli . . 304
juniperi . . 409
lini . . . 422
menthæ piperitæ . 508
morrhuæ . . 304
olivæ . . . 483
picis . . . 613
piperis . . . 510
ricini . . . 274
sabinæ . . . 553
terebinthinæ . . 605
tiglii . . . 324
vitrioli . . 568
Olibanum or frankincense used in myrrh . . . 465
Olivæ oleum . . . 483
Olives 483
Olive oil . . . 483
Opianyl . . . 490
Opium . . . 484
alkaloids . . 489
ammoniated tincture . 502
antidotes . . 496
clysters . . 503
compared with belladonna 225
other narcotics 95
Constantinople . 486
Egyptian . . 486
English . . 487
European . . 487
Indian . . . 487
liniment . . 507
Malwa . . . 483
Persian . . 487
poisoning by . . 494
preparations of . 502
purity and strength of 488
Smyrna . . 486
tests for . . 491
tincture of . . 502
Turkey . . 486
Ordeal bean of Calabar . 238
Orizaba root . . . 407
Orpiment . . . 203
Oxide of antimony . . 189
arsenic . . 202
calcium . . 240
iron . . . 400
lead . . . 417
magnesia . . 427
mercury . . 443
potassium . . 521
zinc . . . 632
Oxymel . . 137, 519
Oxytocics or ecbolics . 54, 339, 553
Ozone 29

PAGE

Pain relievers, 89, 96, 145, 233, 286, 289, 345, 364, 373, 381, 421, 493, 498, 626
Palma Christi . . . 274
Pancreatin . . . 74
Papaverine . . . 490
Papaver somniferum . . 485
Rhœas . . 485
Papaveraceæ . . . 485
Paraffin oils . . . 512
Paralysers, cerebro-spinal, 95, 97, 151, 261, 283, 292, 343, 529
—— cardiac 89, 139, 238, 548
—— gastric 88, 321, 544
—— motor, 91, 124, 139, 185, 187, 370, 404, 411.
—— motor nerves 91, 239, 370
—— reflex action, 96, 238, 283, 372, 529, 541.
—— respiratory centre 99, 140, 238.
—— sensory nerves, 98, 100, 123, 139, 187, 188, 249, 297, 346, 619
Paramorphine . . . 491
Parasiticides (see Anthelmintics and Vermicides), 55, 136, 212, 235, 249, 269, 288, 317, 321, 346, 387, 389, 398, 403, 440, 450, 453, 513, 559, 567, 577, 584, 592, 600, 604, 613.
Parturients . . . 54, 339
Patent foods . . . 188
Pearl ashes . . . 522
barley . . . 221
Penny-royal . . . 508
Pepper . . . 509
black . . . 509
Cayenne . . 510
cubebs . . . 510
Jamaica . . 510
long . . . 509
volatile oil of . . 510
white . . . 509
Peppermint . . . 508
oil of . . 508
water . . 509
Pepsin . . . 74
Percolation . . . 119
Peroxide of hydrogen . 551
Persian opium . . 487
Perspiration . . . 66
Peru, balsam of . . 234
Peruvian bark . . 299
Petroleum . . . 512
Pharmacology . . 1
Pharmacy . . . 114
Phenic or carbolic acid . 259
Phenol . . . 259
Phenyl hydrate . . 259
Phlebotomy . . . 395

	PAGE
Phloridzin	304
Phosphate of iron	395
lime	244
Phosphoric acid	467
Phosphorus	72, 78
Physic masses	168
Physiological actions of medicines	8
opposites	38
rest	74
Physostigmatis faba	238
Picric acid	259
Picrotoxin	80, 96, 477
Pigs acted on by medicines much in the same way as men and dogs	108
Pills, blue	441
how made	115
Pimento or allspice	510
Pimpinella anisum	187
Pines	602
Pinus sylvestris	602
Pipeclay	176
Piperaceæ	509
Piper album	509
angustifolium	510
chili	509
cubeba	519
longum	509
nigrum	509
Piperidine	510
Piperin	510
Pitch	614
Burgundy	604
Pix Burgundica	604
liquida	614
Plaster, adhesive, 357, 418, 441, 604, 614.	
carbolic	267
blistering	259
Burgundy pitch	604
for sore heads in sheep	614
glue	357
lead or sticking	418
Plasters how made, etc.	122
Plumbi acetas	419
emplastra	418
iodidum	418
oxydum	417
Plumbism	411
Plumbum	410
Podophyllin	514
Podophyllum, experiments with	516
Poisons and antidotes	38
Pomegranate root bark	56
Poppy heads	485
red, white, and purple	485
petals	485
seed cake	485
oil	426, 485
Porter	149
Potash salts	519
Potashes or pearl ashes	520
Potassæ acetas	536
aqua, or liquor	521
fusa, or caustica	521
Potassium and its salts	519
acetate	536
bromide	529
carbonates	522
caustic	520
chlorate	533
ferrocyanides	538
fusa	520
hydrate	520
hydriodate	526
iodide	526
nitrate	529
permanganate	535
soaps	558
sulphate	525
sulphide	524
tartrate	536
tests	519
Potatoes	575
Poultices	124
antiseptic	221, 269
bran	221
charcoal	282
linseed	424
mustard	464
yeast	221
Powder, antimonial	189
Dover's	392, 525
Dr. Gregory's	547
James's	189
Tennant's bleaching	245
Powders, how made, etc.	114
Prescribing	105
Prescriptions	105
Printer's ink	423
Proof spirit	148
Prussic acid	537
poisoning with	541
antidotes for	543
tests for	539
Pulsatilla	90
Pulvis antimonii	189
Doveri	392, 525
rhei compositus	547
Pumpkin seed	56
Purgatives, cathartics (see also Laxatives), 58, 163, 276, 325, 356, 425, 430, 448, 564.	
Pyroligneous acid	134
ether	459
Pyroxylic spirit	458
QUANTITIES of medicines	103

PAGE

Qualities of medicines . 104
Quassia . . . 544
Quassin . . . 544
Quercus cortex . . 482
Quicklime . . . 240
Quicksilver . . . 434
Quinæ sulphas . . 306
Quinine or quina . 301, 306
amorphous . . 307
sulphate or disulphate 306
valerianate . . 617
Quinic acid . . . 303
Quinidine . . . 302
Quinovin . . 303, 308

Rape seed oil . . . 426
Rectified spirit . . 148
Red cinchona barks . . 300
Red lead . . . 417
oxide of iron . . 400
mercury . 443
precipitate . 443
Refrigerants, 43, 86, 92, 136, 156, 421, 532, 589, 595, 627.
Remedies, hygienic . . 113
Resin or rosin . . 611
Resorcin . . . 24
Rest, a restorative . . 74
Restoratives, 72, 155, 183, 394, 401, 459, 497, 568, 624.
Retarders of tissue waste, 74, 77, 211
Retine . . . 613
Revulsion or derivation . 46
Rhamnus catharticus . 237
succus . . 238
syrupus . . 238
Rhatany . . . 84, 279
Rheum . . . 545
Rhœadine . . . 485
Rhubarb . . . 545
Chinese or East Indian 546
compound powder of 547
English or European 546
Turkey . . 546
Rice starch . . . 575
Ricini oleum . . . 274
Ricinus communis . . 274
Rock oil . . . 512
Rosaceæ . . . 508
Rosemary . . . 508
Rosin or resin . . 611
black or fiddler's . 611
yellow . . . 611
Rowel or issue . . 46
Rue an ecbolic . . 339
Rubefacients (see also Blisters and Counter-irritants), 45, 136, 150, 180, 510, 606.
Rum 149

PAGE

Ruminants, medicine acting on, 107, 196.
Rust of iron . . . 400
Rye, ergot of . . . 335
spurred . . . 335

Sabadilla or Cevadilla 312, 619
Sabina or savin . . 553
Saccharated lime . . 242
Sacchari fæx . . . 579
Saffron, common meadow . 311
Sago starch . . . 575
Sal-ammoniac . . . 181
Sal-prunelle . . . 530
Sal-volatile . . . 182
Salicin . . . 547
Salicylate of iron . . 550
sodium . . 548
Salicylic acid . . 547
Salt, common . . . 568
Epsom . . . 429
Glauber . . . 564
Saltpetre . . . 529
Sanitas . . . 550
Santonin . . . 56, 217
Sapo 558
Savin 553
Scammony . . . 408
Secale cornutum . . 335
Sedatives . . . 87
Sedatives (see Motor Depressants and Paralysers), 89, 144, 312, 448, 541, 548, 599.
Semina crotonis . . 324
ricini . . . 274
Senna leaves . . . 408
Setons . . . 46
Sheep acted on by medicines much in the same way as cattle . . 108
purgatives for 61, 425, 432
dips 57, 212, 269, 600, 610
precautions in dipping 215
Shot 410
Sialogogues . . . 71, 404
Sieves 114
Silver and its compounds . 555
cyanide . . 540
nitrate . . . 555
ointment . . 558
solution . . 558
Silvic acid . . . 612
Sinalbin and Sinigrin . . 461
Sinapis alba . . . 460
nigra . . . 460
Sinapisms, or mustard applications . . . 464
Size of patients . . 108
Size—weak glue . . 357

PAGE

Skin, functions of . . 66
actively absorbing . 110
Smelling salts . . 183
Smoothing-iron . . 47
Snake-wood . . . 471
Sneezing, how produced . 49
Snuff . . . 597
Soaps . . . 558
Castile . . . 559
glycerin . . 559
hard or soda . . 558
liniment . . 560
soft or potash . . 558
Soda salts . . . 560
water . . . 562
Sodium and its compounds . 560
bicarbonate . . 561
borate . . 563
carbolate . . 273
carbonates . . 561
chlorates . . 573
chloride . . 568
liquid, Labarraque's . 573
hydrate or caustic soda 561
hyposulphite . 565
nitrate . . 570
soap . . 558
sulphate . . 564
sulphite . . 565
Soft soap . . . 558
Solutio arsenicalis . . 216
chlorini . . 288
morphiæ murias . 508
plumbi diacetatis . 421
Solution, Fowler's . . 216
Soporifics . . . 94
Southernwood . . 217
Spanish flies . . 251
Spatulæ . . . 121
Spearmint . . . 509
Species of patient differently affected by drugs, 105, 152, 196, 231
Specifics . . . 83
Spermaceti, cetaceum . 574
Spinal hot bag . 124, 628
ice bag . 124, 627
Spirit of ammonia . . 181
chloroform . . 298
salt . . . 377
ether . . 347
turpentine . . 605
wine . . 147
Spirit, proof . . . 148
pyroxylic . . 458
rectified . . 148
Spirits or essences . . 119
Spiritus ætheris nitrosi . 594
sulphurici . 347
ammoniæ . . 180

PAGE

Spiritus Mindereri . . 184
rectificatus . . 148
tenuior, or proof spirit 148
Spongio-piline . . 126
Spray, medicated . . 128
producers . . 65
Spurred rye . . . 335
Staphisagriæ semina . 576
Starch . . . 575
iodide of . 382, 575
Stavesacre seeds . . 576
Steaming horse's head . 626
Steel, tincture of . . 401
St. Ignatius bean . . 476
Stibium or antimony . 189
Stimulants (see Motor excitants) . . . 78
——— of bronchial secretion, . 65, 182, 288, 390
——— cilia, 64, 182, 531, 534, 562, 613.
—— cerebro-spinal, 79, 155, 343, 595, 606, 615.
—— cardiac, . 80, 155, 227, 330
—— diffusible, 79, 197, 345, 595, 606
—— gastric, 81, 155, 188, 305, 362
—— liver, 63, 81, 235, 390, 408, 470, 565.
—— reflex action, 80, 124, 471, 480, 613.
—— respiratory centre, 180, 182, 197, 211, 227, 261, 390.
—— skin and mucous surfaces, 44, 66, 211, 255, 383, 390, 440, 458, 513, 552, 559, 584, 604, 613.
—— urino-genital system, 70, 228, 253, 554, 606.
—— vaso-motor, 81, 124, 156, 223, 233, 305, 330, 332, 337, 477, 606.
Stomachics (see also Carminatives), 49, 81, 155, 188, 242, 280, 305, 359, 362, 409, 461, 466, 473, 508, 510, 547, 552, 568, 596.
Storax, or Styrax Benzoin . 234
Stopping for horses' feet . 614
Stramonium . . . 225
Strychnine . . . 475
arsenite of . 481
poisoning . 417
Strychnic or igasuric acid . 471
Strychnos nux vomica . 470
Styptic colloid . . 354
Styptics (see also Astringents and Hæmostatics), 85, 340, 353, 403, 421, 612.
Subcutaneous injection . 110
Sublimate, corrosive . . 451
Succi—expressed juices . 119
Sucrose—cane sugar . . 578

PAGE

Sudorifics or diaphoretics . 66
Suet 219
Sugar 577
brown or raw . . 577
candy . . . 578
cane . . . 578
grape . . . 578
liquorice . 427, 579
of fruits . . 578
lead . . . 479
milk—lactose . 479
tests for . . . 478
Sulphate of alumina and potash 173
copper . . 315
iron . . 396
magnesia . . 429
mercury . . 444
potash . . 525
quinine . . 306
soda . . 564
zinc . . 633
Sulphite of soda . . 565
Sulphur . . . 581
anhydride . . 586
flowers of . . 581
iodide of . 389, 585
liniments of . . 585
liver of . . 524
milk of . . 581
ointments of . 585
roll or stick . . 582
sublimed . . 581
vivum . . 581
Sulphides of antimony . 190
arsenic . . 203
mercury . 444
potassium . 524
Sulpho-carbolic acid . 259, 272
phenic acid . . 259
Sulphuric acid . . 586
ether . . 341
Sulphurous acid . . 590
Suppositories . . 128
Suppurants . . . 45
Surgeon's lint . . 422
Surgical antiseptics (see Antiseptic Surgery) . 25, 265
Sweating medicines . . 66
Sweet spirit of nitre . . 594
Syringes, clyster . . 128
Syrups . . . 121
simple . . 121, 580

TABLE of medicines physiologically arranged . 15, 16
Table of weights and measures 129, 131
Tannin or tannic acid . 352
Tansy 217

PAGE

Tapioca starch . . 575
Tar 612
Barbadoes . . 512
coal . . 259, 512, 612
Tar, oil of . . . 613
ointment of . . 614
Tartar, cream of . . 536
crude . . . 536
emetic . . 191
Tartarised antimony . 191
experiments with . 195
Tartrate of potash . . 536
Tennant's anæsthetic fluid . 103
Terebene . . 248, 611
Terebinthina venata . . 602
vulgaris . 601
Terebinthinæ . . 601
Terebinthinæ oleum . . 605
Terpenes . . . 550
Thebaine . . . 491
Theine . . . 77
Therapeutic action of medicines 8
Theriaca, treacle . . 579
Thermometer, Fahrenheit and Centigrade . . . 131
Thus or frankincense . 603
Thyme . . . 508
Thymol . . . 24, 551
Tiglii oleum . . . 324
Tinctura aconiti . . 146
aloes . . 169
ammoniæ . . 183
belladonnæ . . 229
cantharidis . . 256
catechu . . 279
cinchonæ . . 306
conii . . 373
ferrichloridi . 401
gallæ . . 352
gentianæ . . 360
hyoscyami . . 376
iodinei . . 388
myrrhæ . . 466
nucis vomicæ . 475
opii . . . 502
zingiberis . . 362
Tinctures, how made, etc. . 119
Tobacco . . . 596
clysters . . 600
smoke . . 597
mountain . . 200
Virginian . . 596
volatile oil of . 547
Tolu balsam . . . 234
Tolerance of medicine . 111
Tonics, general actions . 75
Tonics, 75, 168, 177, 210, 273, 305, 309, 317, 359, 398, 402, 467, 470, 633
Tonics, heart, 332, 375, 397, 402

PAGE

Tonics, nerve, 317, 402, 470, 473, 480, 616, 617, 634.
Tow 422
Tragacanth . . . 366
Treacle . . . 579
Trichloromethane chloroform 289
Turkey opium . . 486
rhubarb . . 546
Turkish baths . . 622
Turmeric . . . 362
Turpentine . . . 601
American . 601
Bordeaux . 602
Chian or Cyprus . 603
common . . 601
oil of . . 505
spirit of . . 605
Venice . . 602
Turpeth or Turbith mineral . 444

UMBELLIFERÆ . . 703
Unguenta . . . 121
Unguentum acidi nitrici . 458
æruginis . . 320
arsenici . . 216
cantharidis . 257
carbolas . . 272
ceræ . . 631
cupri acetatis . 320
gallæ . . 352
hydrargyri . 439
hydrargyri nitratis 458
hellebori . 368
iodinei . . 388
resinæ . . 612
sabinæ . . 654
simplex . 612, 631
veratriæ . . 621
zinci oxidi . 633
Upas antiar . . . 91, 332
Urari or curara . . 91
Urine, secretion of . . 69

VALERIAN . . . 615
Valeriana officinalis . . 615
Valerianate of iron . . 616
quinine . 617
soda . . 616
zinc . . 616
Valerianic acid . . 615
Vapour bath . . . 629
Vaseline . . . 617
Vaso-motor depressants (see also Sedatives and Paralysers), 92, 95, 124, 140, 223, 283, 353, 370, 404, 529, 620.
—— stimulants, nerve stimulants, 81, 124, 156, 223, 233, 305, 330, 332, 337, 477, 606.

PAGE

Vegetable medicines, collection of tonics . . . 77
Veins, injection into . . 109
Venice turpentine . . 602
Veratrine or veratria . 619
Veratrum album . . 619
sabadilla . . 619
viride . . 619
Verdigris . . . 319
ointment of . 320
Vermifuges (see Anthelmintics and Parasiticides) . . 55
Vermilion . . . 444
Vermin-killers . . 481
Vesicants (see Blisters) . 44
Veterinary Pharmacy . 1, 114
Vienna paste . . . 522
Vinegar . . . 134
British . . 135
distilled . . 134
foreign . . 135
of cantharides . 257
of colchicum . 313
wood . 134, 458
Virginian tobacco . . 596
Vitriol, blue . . . 315
green . . 396
oil of . . 586
of copper . . 315
white . . . 633
Vomica, nux . . . 470
Vomiting, how produced . 50

WALNUT OIL . . . 426
Wash, black . . . 443
yellow . . 443
counter-irritant . 626
Water . . . 622
restorative . 73, 624
blistering . .
cure . . 68, 628
dressings . 123, 626
lime . . . 240
hemlock . . 369
mineral . . 623
of ammonia . . 177
tar . . . 613
Wax . . . .
Weights and measures . 128
Whisky . . . 149
White arsenic . . 201
hellebore . . 619
lead . . . 417
White lotion . . 421, 635
mustard seed . . 460
pepper . . 509
poppy . . 485
vitriol . . 633
wax . . . 631

	PAGE
Wine	149
Wolfsbane	137
Wood charcoal	280
naphtha	458
snake	471
spirit, or pyroxylic spirit	459
tar	612
Wormwood	217
Woorara or curara poison	91
Yeast	221
poultices	221
Yellow cinchona bark	300
prussiate of potash	538
resin	611
Yellow sulphate of mercury	444
wash	443
wax	611
Zinc and its compounds	632
acetate	636
butter of	635
carbolate	273
carbonate	633
chloride	635
oxide	632
sulphate	633
valerianate	617
Zingiber officinale	361
Zingiberis tinctura	362

THE END.

Edinburgh University Press:
THOMAS AND ARCHIBALD CONSTABLE, PRINTERS TO HER MAJESTY.