VETERINARY MEDICINES

THEIR

ACTIONS AND USES

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FIFTH EDITION, REVISED AND ENLARGED

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PREFACE TO THE FIFTH 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 Fifth Edition—unavoidably delayed in its publication—has been thoroughly revised, many of the articles have been rewritten, and much new matter is added.

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of the domestic animals; but such matter being somewhat out of place in a text-book of Materia Medica, it has been superseded by an Index of Diseases, in which, under each disease, are set forth appropriate remedies, arranged chiefly in the order of their value, or of their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.,
April 1878.

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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 that branch of Veterinary Materia Medica which is sometimes styled Veterinary Pharmacology, or the description of the medicines or drugs used in the cure of disease 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 the same pharmaceutical processes. Two preliminary sections will therefore be advantageously occupied with general observations on the actions of medicines, and on the more important operations of pharmacy. The description of the medicines themselves occupies the body of the volume.

SECTION I.

ON THE GENERAL ACTIONS AND USES OF MEDICINES.

EVERY medicine is endowed with certain inherent characteristic actions, which distinguish it as decidedly as its physical and chemical properties. Thus some medicines act on the bowels, causing purgation; others on the kidneys, stimulating the secretion of urine; and others on the brain and nervous system, causing insensibility; in fact, there is no part or organ of the body which is not influenced, and that often in several different ways, by some medicinal agent. There appears to be an elective affinity between certain drugs and certain organs; but it is impossible to explain why a medicine should act in one way rather than in another; why, for example, aloes is purgative, and not diuretic, narcotic, or anæsthetic; or why chloroform is anæsthetic, and not caustic, diuretic, or purgative. Mainly by observation and experience have the actions and uses of medicines been gradually ascertained. Seldom can they be certainly predicted from the physical condition, botanical order, or even from the chemical relations of the drug. Of these actions, or dynamical effects of medicines, the student must endeavour to conceive in the same manner as he does of their more familiar properties of colour, odour, taste, or density.

In order to facilitate the discussion of the general 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 a local effect, have a remote or indirect action on organs at a distance from the part with which they are first brought in contact.

The great majority of medicines capable of solution are taken up by the blood-vessels from the surface of the mucous membranes, skin, or other part to which they have been applied. Medicines given by the mouth, and in a solid state, are prepared for absorption by the secretions of the alimentary canal. The alkaline saliva, besides mechanically moistening, cracks starch granules ; the acid pepsin-containing gastric juice dissolves iron, mercurial and other salts ; the alkaline bile and pancreatic fluid, with the glucose of the intestinal juices, emulsify fats and dissolve resins. The blood being alkaline, flowing rapidly, with a specific gravity of 1·050, which is higher than that of the other animal fluids, presents conditions eminently favourable for the absorption or endosmose of medicines. There are, however, great differences in the manner in which different medicines act upon and get through the moist digestive membranes into the circulation. Through the capillary veins which ramify on the surface of the stomach and intestines, the dissolved medicines enter the general circulation by the mesenteric and portal vessels, and are carried to all parts of the body. Their effects on the blood and soft solids will receive further notice in a subsequent section. Some medicines, such as turpentine and camphor, are rapidly changed in the blood, and soon defy detection ; but many are unchanged, or only slightly changed, usually by oxidation, and exhibit an affinity for certain organs through which they are removed from the body. Thus aloes and full doses of oils and neutral salts are excreted through the bowels, causing in their transit increased action. Nitre and ethers are chiefly got rid of through the kidneys, exciting them to increased outpouring of fluid. The rapidity with which most substances are thus absorbed and make the round of the circulation is almost incredible. 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.

Medicines, it is believed, also produce nervous impressions on the part to which they are applied, or on the interior of the blood-vessels after absorption, and these impressions are sometimes propagated through the nervous system to remote parts. In support of this view, it is urged that the rapid operation of such poisons as prussic acid and aconite, which act almost instantaneously and kill in a few seconds, does not allow even the brief period necessary for the distribution of the poison; whilst even stronger evidence is derived from the effects of local injuries in producing constitutional disturbance. A blow on the region of the stomach sometimes causes fatal swooning; distension of the stomach often produces hiccough; the presence of worms in the intestines will induce epilepsy; and local injury frequently causes fever and disordered action of important organs. The connection between cause and effect in such cases obviously depends on the transmission of nervous impressions only. And if topical causes are thus productive of remote effects, it is fair to infer that medicines and poisons may operate in a similar manner.

In fine, although it would appear that most medicines are absorbed, and actually conveyed to the parts on which they act, and that such absorption and actual contact are essential to their action, yet it is highly probable (though not yet positively ascertained) that some substances, especially the more active poisons, astringents, and emetics, owe their effects to the production of a nervous impression, and its propagation to remote organs. Nor is it at all improbable that, under different modifying influences, certain substances operate sometimes in one or other, or both of these two ways.

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 the malady. 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. Two centuries ago, before chemistry and physiology were studied, it was thought that the diverse actions of medicines resulted 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 those more complex and less understood vital principles, which must be taken into account in any satisfactory explanation of the actions of the majority of remedies.

Medicines were generally believed to cure by stimulation, which erroneously presupposes that all diseases depend upon debility; by elimination, some morbid matter being invariably thought to be the source of mischief; by alterative or revulsive action, which leaves, however, unexplained the operation of eliminatives and other large classes of medicines. These views are too confined and partial to explain satisfactorily the diversified complex actions of remedies, which probably cure by many methods.

No single rule or formula has been propounded which can account for the actions of all medicines; but 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.*

* 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 homœopathy, 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

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 physiological 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 an effect which, though in itself unnatural, overcomes the disease to be cured; or, in other words,

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 ensure 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 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 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 remove œdema or dropsy. Those numerous and important zymotic diseases which result from the maturation of a poison within the body, or in 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.

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 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 a man in very minute doses, to produce 930 distinct symptoms; oyster shell, 1090 symptoms; and the ink of the cuttle-fish, 1242 symptoms. The extraordinary powers supposed to be conferred on these and other medicines, even when given in doses of inconceivable minuteness, are chiefly ascribed to the magic influence of careful and continued triturations and often repeated shakings, performed according to most precise directions. Some homœopathic authorities declare that there is little difference of activity between different dilutions of the same medicine; and it is said that, if the medicine be well selected, it matters little whether the tenth, hundredth, or thousandth of a grain be used (Gunther and Haycock). There is probably some truth in this observation, for, with most medicines, especially when administered to the lower animals, all the dilutions mentioned would be equally 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 with-

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

"For the proper perfection of medicine as a rational science, two things are in the main needed; the first is a right understanding of the causes and symptoms of disease; the second, a correct knowledge of the action of medicines."—(*Headland.*) The latter of these two branches of medicine, as already indicated, is still, however, so incomplete, that it is difficult to arrange remedial agents in satisfactory groups. Subjoined is an excellent and comprehensive classification by the late Professor Headland, who included the articles of the materia medica under the four following heads:

out 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.

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 or identity with the constituents of the body, are assimilated as food or restoratives. Certain salines probably 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 probably 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."

TABLE OF THE 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.

			Examples:
Agents which increase local action and secretion.	Purgatives.	Evacuate the bowels.	Aloes, croton, oils, jalap, neutral salts.
	Expectorants.	Increase secretion 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 the 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 energy, and thus exalt action of the heart and other functions.	Ammonia, alcohol, ethers, volatile oils.
Agents which improve state of blood.	Alteratives.	Neutralise or counteract morbid materials or processes in the blood.	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, blood-letting.
	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.

III. Astringents cause the 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 their activity, increase their discharges, and thus carry noxious matters out of the system. Purgatives, diuretics, and diaphoretics are examples of this class.

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.)

Classifications of medicines, although confessedly imperfect, are nevertheless of considerable practical utility, and I accordingly give on the two previous pages a tabular view of a classification which I sometimes 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 the air, of acrid secretions, or of irritating and poisonous matters; if 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 remove from the body 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 the pungency of the urine. In febrile cases they are usually 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 the decomposition of organic bodies. The breaking up, fermentation, or putrefaction, to which complex organic subjects 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, germs, sporules, or living organisms, consisting of vegetable fungi, like the yeast plant; or of bacteria, vibrios, or allied animal bodies. Bacteria are believed to be either the carriers of the septic poison or the poison itself. Although minute, often not exceeding $\frac{1}{100000}$ of an inch, seldom demonstrable by the highest microscopic power, and not discernible by chemical tests, each particular germ or ferment in the presence of suitable organic matters indicates its presence and exerts its own particular action. These living germs have considerable vitality; in suitable situations they have wonderful powers of reproduction. They readily float, and are carried about, in the atmosphere. Complete exclusion of air, in which they are so constantly present, prevents their access. Exposure to a temperature over 212° usually destroys them. Charcoal, dry earth, and cotton wool, mechanically entangle them, and hence often 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 positively poisonous action on the septic 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.

From remote antiquity antiseptics have been used. 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,* 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 kreasote 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. Considerably lower in the scale come in order oil of juniper, aniline, oils of peppermint and rue, with turpentine 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

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

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 "	$C_{14}\ H_8\ O_2$		$C_7\ H_8\ O$

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 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 attained 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, has recently been used. Although not so active an antiseptic as the metallic salts first enumerated, and wanting the diffusive power which makes an effective disinfectant, it proves convenient both for external and internal use. The advancement 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 the 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; it 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 kreasote, 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.)

To Dr. Angus Smith's list must now be added salicylic acid ($C_7 H_6 O_3$), a very concentrated effectual antiseptic, more powerful even than carbolic acid, unlike it 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 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. The minute addition of carbolic and cresylic acids prevented, for the three months during which the experiments continued, development of fungi, vibrios, or putrid odours. 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 has no influence either on the animal or vegetable germs, but prevents odour. Sulphurous acid has somewhat similar effects, but being volatile loses its power, and putrid smell becomes noticeable in 45 days.

Zinc and iron chlorides, with other mineral substances, have long been used in surgical practice as antiseptics. For centuries pitch and tar, tinctures of myrrh and of benzoin have been applied both in human and veterinary surgery. 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 ensure the 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 recommends 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. Pus and other degenerate cell-growths being, however, certainly arrested in their development and multiplication outside the body, should in like manner be checked and destroyed when they circulate in the blood and other soft solids. As has been pointed out by Dr. Lionel Beale, diseased germs or bioplasms being of rapid growth, have scarcely any protecting envelope, and hence are more readily attacked than the living tissues amidst which they are placed by antiseptics introduced into the blood. Two striking experimental observations may be adduced in favour of the efficacy of antiseptics when given internally. 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 glycerin 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.

Potassium chlorate and permanganate, with other salines, sulphites, sulpho-carbolates, mineral acids, salicylic acid, and many valuable alteratives, doubtless owe their efficacy to their antiseptic properties; or, in other words, to their destruction of disease germs, and to the alteration or removal of the pabulum on which these germs subsist. But results much beyond those at present attained may yet flow from the medicinal use of antiseptics. Appropriate antiseptics may yet be discovered which will retard the development or destroy the specific germs of tubercle and cancer, of febrile complaints, of glanders and farcy, of quarter-evil and parturient apoplexy. Their employment might be greatly extended in abating acute fever, lowering elevated temperature, relieving capillary congestion, and removing the fœtor and contagion of the dejecta. The recent discovery of the power of salicylic acid to control and arrest rheumatic fever encourages the belief that special antidotes may be found for each form of blood-poisoning. Nay more, the experiments of Professor Polli and Mr. Crookes, above referred to, afford good hope, that by the administration of antiseptics, especially during the prevalence of epizootic and contagious diseases, animals may be rendered comparatively safe from their attacks.

Antiseptics are given medicinally by the mouth, by subcutaneous injection, and by inhalation; and the two latter modes of introducing them into the system are especially deserving of extended use in veterinary practice.

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,* 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

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

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. Again, dilution with air or water would proportionally diminish, or entirely destroy, the specific action of any gaseous or volatile body; but the matter of contagion 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 organic, perhaps an organised body; and probably resembles the pollen of flowers, or the odorous dust given off by plants or animals. It retains its characteristic activity although carried for considerable distances through the air, or retained for a long time in clothes, or other such substances. Suspended in air or water, these contagious particles find access to the healthy body mostly through the pulmonary or the alimentary mucous membrane. A sufficient dose having entered the body of a susceptible patient, produces, after a varying period of incubation, its notable effects; and each virus develops its own distinctive train of symptoms. Two views are entertained regarding the way in which the matter of contagion, or "contagium," as it is now termed, produces its effects. Many chemists believe that the organic particles communicate their own motion or activity to the decomposable materials with which they come in contact. Pasteur, Beale, and other physiologists, teach that contagium consists of organised germs possessed of inherent vitality and power of reproduction. These germs are probably distinct from microzymes, bacteria, vibriones, or such animalcules, found in the textures in various diseases. Dr. Lionel S. Beale declares that under the microscope he has seen the specific virus of cattle plague, of vaccine, and of other diseases; that its visible granular particles are $\frac{1}{100000}$ of an inch in diameter. He terms it bioplasm. Other microscopists, however, have not hitherto been so fortunate as to separate or demonstrate these contagious germs. Of the existence of the contagious virus in a distinctive solid form there can be no doubt. The germs of many contagious diseases, such as cattle plague, pleuro-pneumonia, and foot-and-mouth disease, cannot, so far as is known, be developed by any combination of circumstances; they spring only from parent germs given off in their turn from patients infected with the specific contagion. Occasionally, however, distinctly contagious germs are developed *de novo*, probably from degenerate cells, during the progress of accidentally occurring cases of glanders, farcy, puerperal peritonitis, or typhoid fever.

In the absence of sickness, perfect cleanliness of the animals and their surroundings, with abundance especially 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. Subdivided and 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 its 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.

Mould, and other descriptions of vegetable cells, infusorial animalcules, decaying organic matters, are all notably affected by antiseptics and disinfectants. Growth, change, and decay are thereby arrested, and there can scarcely be any doubt that the analogous organic matter constituting contagium is similarly affected. As pointed out by the late Professor George Wilson, the matter of contagion is probably made up of two or more of the four organic elements—carbon, hydrogen, oxygen, and nitrogen. If the particles floating in the air or lurking in fomites can only be got at, they ought not to be difficult to destroy. "Oxidising agents will plainly be 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." But many substances, such as common salt and the tar acids, exert a feeble chemical action, and yet have admittedly powerful antiseptic and disinfectant properties, probably depending upon their destroying the active organic particles.

Heat is an effective disinfectant; but whether it actually destroys the contagious virus, or, according to the more chemical view, merely disturbs its complex and unstable constitution, it is impossible at present to determine. In albuminous and other solutions, microscopic life is effectually destroyed when the temperature reaches 400°. 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 cleaning 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 in their pores the particles of contagion brought into immediate contact with them. 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 carcases 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, waggons, etc., carbolic acid in its brown impure form should be 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 the 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 not in amount sufficient 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 attract any floating particles of disease, and also to evolve the carbolic vapour. Such an atmosphere of the tar acids is not injurious to animal health, and in it contagious particles cannot retain their vitality. To reduce the risks of attendants carrying any 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 the 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 the further spread of the contagion. 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; but within 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 of a virulent type 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 virus, whilst yet floating in the air or adhering to fomites, as already pointed out, can certainly be attacked and robbed of its power of evil. When the germs of contagion, in small numbers, 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 good 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 multiplied a millionfold, and engendered a degenerate condition of the blood and soft solids. The work of the disinfectant is now greatly complicated. Not only have myriads of active virus germs to be destroyed, but their destructive effects on the functions of life have also to be counteracted. Mr. Crookes' experiments in cases of cattle plague prove, however, very satisfactorily that sulphites, bisulphites, and carbolic acid, retain their power of destroying virus 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 seeds or germs of zymotic, contagious, or other such diseases. Objectionable smells are largely made up of sulphuretted hydrogen, phosphorus and nitrogen gases, 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 the odorous principles. Of this description are fumigations with aromatic and balsamic substances, such as benzoin, 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; ammonical emanations, by hydrochloric or nitric acids. Smells from decomposing organic matters are usually most effectually got rid of by going to the source of the mischief and arresting the decomposition by antiseptics, such as carbolic acid, kreasote, 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 rather 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, is volatile, 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 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, when properly administered, prove valuable medicines. Some antidotes, as charcoal and demulcents, act mechanically, enveloping the particles of the poison, retarding its absorption, or ensheathing and protecting 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, on account of their forming with it insoluble Prussian blue. Some antidotes counteract or relieve the symptoms produced by the poison: ammonia, for example, overcomes the sedative effects of prussic acid; and opium lessens the unpleasant consequences of irritants. An interesting class of antidotes are those which are physiologically opposed to the poison. Thus, nux vomica, with its alkaloids strychnine and brucine, excite the motor centres and tetanise the voluntary muscles; chloral hydrate, coneine, and curare, on the other hand, depress and paralyse these 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 tetanus-producing strychnine. Tobacco depresses and paralyses the nervous system generally, and usually destroys life by arrest of the respiratory movements. Its nearest physiological opposite is atropine, which is a nerve stimulant, especially of the sympathetic system, and, used subcutaneously, combats the poisonous effects of tobacco. Theine, which 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 generally. 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.

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 carnivorous animals by emetics. The early administration of such absorbent substances as charcoal, and even of lard, glycerin, 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 the 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 in smaller doses or of less activity are often rapidly excreted and mischief averted by the judicious administration of purgatives and diuretics.

Caustics—Escharotics.

Caustics (καίω, *kaiō*, I burn; καυστικός, *kaustikos*, burning) decompose both the solid and fluid animal tissues. They act in the first instance chemically, separating water from the tissues, and combining with their albuminoid constituents. This chemical action, which is true combustion, although lowering or destroying the vitality of the part attacked, produces increased vital action in the 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. These differ chiefly in the intensity of their action, some being so mild that they have no effect on the sound skin, and scarcely any on the mucous surfaces; others so active as to cause extensive deep sloughing, when they receive the special title of escharotics (ἐσχάρα, *eschara*, an eschar, scar, or scab). There is little difference between solid and fluid caustics, excepting 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 a chemical and then a highly exalted vital action. Besides being used as a caustic, it is also much employed as a counter-irritant (p. 39).

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 ones; 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, *stŭphō,* I constringe; στυπτικός, *stŭptikos,* 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 greater precision, and with as little destruction as possible of the 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 has recently been recommended for the destruction of warts, and otherwise as an escharotic. Carbolic, salicylic, and boracic acids are chiefly valuable for their antiseptic properties. In large doses and concentrated form the mineral acids and acetic acid decompose the tissues, uniting 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. They are antidotes in poisoning by alkalies. When given internally, they must be sufficiently diluted to avoid corrosion. They act so differently from their several salts that they are believed to be absorbed in part without being neutralised. With a high diffusion power they rapidly reach the blood, in which they seem to neutralise excess of alkali, especially of ammonia, which is often abundant in fever cases. According to the late Professor Headland, they may promote the formation or temporarily supply the place of lactic acid, which is regarded as the natural blood fuel of the system, and appears to be deficient in low fevers. That lactic or some such weaker acid is developed when the stronger acids are given medicinally, appears evident from the invariable increased acidity of the urine.

It is a fact in therapeutics that alkaline secretions are stimulated by acids, and acid secretions by alkalies. Acids stimulate salivary secretion, but check gastric secretion, which is excited by alkalies. Acids in moderate doses given before meals counteract indigestion depending upon excessive secretion of gastric juice, or irregular or excessive fermentation of the 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 ill-managed calves suffering from acidity, hoven, or diarrhœa. As astringent tonics, they are serviceable in low fevers and convalescence from exhausting disease. Hydrochloric and lactic acids appear to be especially helpful in dissolving the albuminoids of the food. Nitric acid is stated to benefit long-standing cases of congestion and even cirrhosis of the liver. Although in the main closely alike in their effects, Professor Waring says that hydrochloric acid promotes digestion, nitric acid secretion, sulphuric acid constriction. 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.

Acids and acid salts act as refrigerants, or, in other words, they reduce the animal heat and lower the pulse. A practical physician and high therapeutic authority, writing in the *Monthly Journal of Medical Science* for March 1853, remarks: "We have often endeavoured to observe whether they ever do produce any real diminution of the animal heat, and whether therefore their title, refrigerant, is really merited. We have not been able to satisfy ourselves of this; but we know, both from active and passive experience, that they give for the moment a *sense* of coolness which renders them truly delicious, either under a fever or a hot sun." The refrigerant effect which such acids produce when given internally, consists, therefore, in the gratefully cooling, though very temporary, impression which they make on the nerves of the throat and stomach; whilst the permanent good which often follows their exhibition depends on some of their physiological effects already enumerated. Weakly perspiring patients are often benefited by sponging with tepid water, acidulated with vinegar or other acid. 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 which they form with vegetable acids, which are converted into carbonic acid 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. Such active antacids as the alkalies are in large quantity corrosive, dissolving albuminoids and saponifying fat. 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 all acid secretions, notably that of the gastric juice, but in indigestion they are apt to be given too largely and indiscriminately. Prescribed for patients with stomach derangement they are usefully conjoined with vegetable bitters. Rapidly diffusing themselves, they readily enter the blood, probably increase its alkalinity, assist in maintaining the normal amount and solubility of its fibrin, and promote oxidation. They are administered in rheumatic disorders, eczema, and some other skin diseases, as well as in inflammatory and febrile cases. In large quantities some of these antacids 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. Alkalies will again be noticed under the head of Alteratives.

Rubefacients—Vesicants—Suppurants.

These three varieties of irritants, when applied externally, stimulate and inflame the skin, but differ in the degree and intensity of their action. *Rubefacients* (*ruber*, red; and *facio*, I make) include substances which produce slight redness and inflammation, and are represented by alcohol, ammonia liniment, mustard, and mild preparations of cantharides. Smart friction and moderate heat are also included in this class. In the lower animals, however, owing to the colour of the skin and abundance of hair, this reddening 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. The quantity and rapidity of the effusion vary with the substance used, but are especially great in the case of steam and boiling water. The blisters 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 one part of turpentine and ammonia, and ten of water. 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. If 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 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, probably in virtue of their continued irritation, which, although insufficient to interfere with health, is yet adequate to promote the formation in the blood of the fibrin which is found to be so deficient in this fatal disease. In like manner they also counteract the tendency to splenic apoplexy. An issue or rowel acts in much the same manner as a seton, and consists in a wound 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 the counter-irritation and discharge, is sometimes smeared with irritant dressings.

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 is 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; though, for a short time after the operation, the skin is corrugated and tightened, 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' 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. They produce revulsion or withdrawal of blood from one part of the body, and conduct it to another. Applied to the skin surfaces, they counteract congestion of internal organs. 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, are of much benefit in equalising circulation and reducing temperature. Counter-irritants are in common use in certain stages of inflammation of the joints and of the eyes, lungs, and intestines, and their investing membranes. In the outset of inflammatory attacks, by reflex action, external irritants lessen hyperæmia by stimulating the dilated paralysed capillaries, and thus favouring resolution; in the 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 disease is more circumscribed, or has somewhat abated, counter-irritants are, however, again useful in promoting absorption of exudation; whilst in many chronic cases, by acting on the vaso-motor nerves, they invigorate enfeebled, over-distended capillaries, and substitute higher formative for lower debased action. 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. 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, of the hot iron, or of 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 expedited 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 much tissue-destruction, is rarely requisite. Better curative results are usually 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. 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 fomentation, whilst undue constitutional excitement is removed by diluents, a mash diet, and a saline draught. Two or three days after a blister has been applied, the part should be dressed with oil, glycerin, 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 mucous 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 mucous membrane, act as errhines; but the most notable are ammonium muriate, 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 various other seeds from the natural family *Umbelliferæ*, and several volatile oils, as peppermint and rosemary, from the *Labiatæ*. 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 an 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 the 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 the 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. These motor impulses are conveyed by the intercostal phrenic and pneumogastric nerves 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 acute pain even of injuries of the comparatively remote extremities. Vomiting, however, is generally produced by medicines acting on the stomach, and the irritation being thence conveyed to the vomiting centre by the afferent nerves, usually the vagus and splanchnics. But the vomiting centre is probably directly acted upon by such emetics as tartar emetic and apomorphine, which, when injected hypodermically, or into the veins, act as certainly and more rapidly than when given by the mouth. That absorption of the emetic from the stomach, or actual irritation of the stomach itself, is not necessary to produce vomiting, is further 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 him 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 not constituted for vomiting, the vomiting centre of the medulla may, moreover, 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 appear to act mainly by direct irritation of 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, the acid products of fermentation, poisons and foreign bodies. Relaxing the longitudinal fibres of the gullet, and exciting antiperistaltic movements, they are serviceable in clearing out 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, and provoke mucous secretion, hence are of signal service in the dry stage of catarrh and bronchitis in vigorous animals. It has been observed that all emetics paralyse muscular fibre; hence doubtless the muscular weakness which follows their use, and the fact that over-doses often fail to cause vomiting.—(*Practitioner*, Dec. 1874.) When frequent or serious 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 teacup of tepid water. A more prompt and certain effect is 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. A more permanent sedative result follows 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 uterus and expulsion of its contents. Savin, rue, and cantharides, with active purgatives and diuretics, irritate the bowels and kidneys, and by reflex action stimulate 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, and has a special power of contracting the uterus, and thus expelling its contents. Ergot is occasionally given to the domesticated animals to excite labour pains, when these are weak or slow, to help the 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 the venereal appetite. They include phosphorus, cantharides, peppers, and turpentines. On the Continent they are still given to the domesticated animals, especially to cattle; but their employment is unnatural and unscientific, and further fails to produce the desired effect. 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 will consist in generous diet and tonic medicines.

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 the evacuation of fæces. The husks of grain, vegetable fibres, and other indigestible substances, with resinous and comparatively insoluble purgatives, previous to their absorption, produce merely topical irritation. All active purgatives, however, 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 first taken up by the capillary veins of the stomach and small intestines, and thence enter the general circulation. Being unfit for remaining in the blood or becoming assimilated, they are speedily returned to the intestinal mucous membrane, where they are separated from the blood by innumerable active 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 the peristaltic motions, which, when excessive, occasion the pain and spasm accompanying the action of violent purgatives. Different purgatives appear to be excreted from different parts of the alimentary canal. Jalap is believed to be chiefly separated from the surface of the small intestines; aloes from the large intestines; 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 all active purgatives; for aloes, salts, and the like, lose their purgative effect when administered in combination with articles which prevent their excretion, or 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 from the skin, and acted as a diaphoretic.

Purgatives vary much in the intensity of their action. When mild, they are *laxatives* or *aperients;* when they induce copious watery discharges, they are termed *hydragogue* cathartics; when they induce griping, they are styled *drastic;* and when accompanied by profuse discharge of bile, they 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 too frequently the case, cathartics are apt to produce dyspepsia; used injudiciously, or in excessive doses, they cause much weakness, and occasionally lead to paralysis of the hind limbs; sometimes they induce fatal superpurgation, and sometimes enteritis; and these 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 other less potent medicines. Salines in cathartic 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 purgatives are preferable, and their action may be materially expedited by encouraging the drinking of water, which may be rendered more 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 very 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 dropping on his tongue, 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.

1*st*, Purgatives are given to remove from the alimentary canal undigested food, feculent matters, poisonous substances, and worms. Purging away offending matters, they relieve dyspepsia, colic, and many cases of diarrhœa. They are the obvious remedies in constipation and torpidity of the bowels, which, when depending upon atony of the muscular coat, requires that the purgative be combined with strychnine or mineral acids.

2*d*, Employed for the expulsion of worms, purgatives received the special title of anthelmintics or vermifuges. By increased peristaltic motion and copious secretion of fluid, they sometimes mechanically cause the parasites to unloose their hold, and wash them away. But the more effectual anthelmintics are vermicides; they poison the worms. Such are turpentine, and various volatile oils, quassia and other bitters, and areca nut. To ensure the poison being freely taken by the parasites, it should be given when the digestive canal is empty, along with milk or other material to which the worms are partial, and unless itself purgative a dose of physic should be given with it, or a few hours later. To remove bots in horses, one-fourth part of an ounce of aloes and asafœtida is dissolved in hot water, an ounce each of oil of turpentine and ether are added when cold, and the mixture administered in gruel or linseed tea, and repeated for several mornings. For destroying tape and other worms in horses, this prescription is also useful. Like most other vermifuges, it is most effective when the stomach and bowels are tolerably empty. Mr. Robert Littler of Long Clauson gives, for three or four consecutive mornings, a ball containing one-fourth of an ounce 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 and a half each of calomel and savin, 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. For dogs infested with tape-worm, nothing answers so well as areca nut. Other remedies are occasionally used, such as one-fourth of an ounce of the pomegranate root bark; the flowers of the Abyssinian kousso; kamala, a euphorbiaceous plant effectually used in India; the unexpanded flower-heads of a species of artemisia or worm-seed, and its active crystalline principle santonine; with the root-stalks, scales, and rootlets of the male shield fern, now generally regarded as the most certain remedy for tape-worm in man. Round and thread worms in all animals are more readily got rid of than tape-worm, and are usually expelled by turpentine, iron chloride tincture, or bitter infusions. Ascarides in the rectum are evacuated by turpentine and lime water, which is also the most effectual combination for the destruction of thread-worms in the air-passages or digestive canal of calves or lambs. By small doses of saline medicines, by tonics when required, and by careful feeding, it is important to secure the healthy state of the mucous lining of the canal, and thus prevent the reappearance of the parasites.

3*d*, Cathartics not only purge the intestines, they purge the blood as well. Through the active secreting intestinal surfaces, they remove water, act as depletives, abate arterial pressure, and drain away dropsical effusions. Moreover, they hasten and increase the separation from the blood of effete matters produced by the disintegration of the tissues, and of morbid matters which have found their way into the blood, or been engendered there. 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, always prove a serious aggravation to any complaint, often form the pabulum on which contagious germs fasten and grow, and are especially prone to impair the functions of the nervous system. 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 nervous diseases, curing some itching skin complaints, combating most inflammatory disorders, abating lameness in horses, and favouring the healing of wounds.

4th, Purgatives are further serviceable by producing counter-irritation; they attract to the extensive intestinal surfaces an unwonted amount of blood. In this way may in part be explained the prompt relief which a full dose of physic gives in congested states of the brain and nervous centres in all animals, in wounds and injuries accompanied by irritability and pain, and in acute lymphangitis in horses.

5th, Most active cathartics act on the liver, increase secretion of bile, and hence are termed *cholagogues.* Relieving the portal circulation, they combat congestion of the liver and spleen, and also of the urino-genital system. Hence their value in torpid states of these organs. The most important cholagogues are calomel and other mercurials, which notably increase the biliary matters of the fæces. Corrosive sublimate given to dogs was observed by Orfila to produce abundant vomiting of biliary matter. Manganese sulphate was found by Emelin to induce an extraordinary secretion of bile. Podophyllin, the amorphous resinoid extract of the *Podophyllum peltatum* or May-apple, is said to act specially on the liver, slowly develops its purgative action, occasionally with some pain and spasm, and in small doses proves alterative. Dr. A. Röhrig, experimenting upon curarised dogs, introduced various purgatives into the duodenum, and observed the amount of bile excreted through a glass tube placed in the gall duct. The secretion was most 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.) Quinine and other bitter tonics sometimes prove serviceable in torpidity of the liver; they do not, however, appear materially to increase the 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, and in bilious diarrhœa, and bilious influenza of horses, when the mucous membranes continue yellow and the bowels irregular, nitro-muriatic acid exerts a special but not easily explained curative effect.

Expectorants.

Expectorants (*ex*, out of; and *pectus*, the breast) increase the natural secretions of the mucous membrane lining the fauces, trachea, and bronchi. Some of them exercise topical effects, as chlorine, iodine, ether, tobacco smoke, inhalation of the vapour of water, and hot fomentations externally. Some astringents and emetics exert on the throat and upper part of the digestive tract stimulant or sedative effects, which are propagated by reflex action to the air-passages. Others, as ipecacuan, balsams, gum resins, and antimonials, become absorbed, and, entering the circulation, stimulate the mucous glands of the respiratory mucous membrane, through which they are excreted. Expectorants are uncertain in their action, even on man, and still more so on the lower animals, in which there is little evidence of expectoration. Some of the benefits formerly supposed to be attained by expectorants are now tolerably certainly secured by irrigating the fauces with tepid medicated fluids from a spray-producer, of which the most effective is 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.

Diaphoretics—Sudorifics.

Diaphoretics (διαφορέω, *diaphoreō*, I throw off by perspiration) and sudorifics (*sudor*, sweat; and *facio*, I make) are similar in their nature, actions, and uses. Strictly speaking, the former increase the insensible, and the latter the sensible, perspiration. This is, however, a difference only in degree.

In all the higher animals the skin performs several very important functions. Besides protecting the sensitive parts alike from cold and external injury, and being intimately connected by vessels and nerves with all parts of the body, by diminution of fluid it regulates animal temperature, and as a pneumatic apparatus excretes carbonic acid, and probably also absorbs oxygen. The excretion of carbonic acid is of such essential importance to life and health, that asphyxia soon occurs in any of the higher animals when the functions of the skin are arrested by covering it over with a thin varnish. The skin is, further, the channel through which the system ejects a very large, though variable, amount of refuse fluid, holding in solution various salts and effete organic matters. These latter are in much greater amount than is generally supposed. In man, it is estimated that 100 grains of azotised matter are excreted daily from the skin (Carpenter); and in horses and cattle the quantity must be at least three or four times greater. Sanctorius' experiments show that, of eight parts of food taken into the healthy body, three parts leave it in the fæces and urine, three by the lungs, and two by the skin. These important excretory functions are seriously interfered with by cold and damp; the cutaneous capillaries are unnaturally constricted; blood is hence determined internally, animal heat is unduly raised; and thus are constantly produced colds and febrile attacks in hard-worked and exhausted horses. During those diseases in which the functions of the kidneys, lungs, or bowels are disturbed or arrested, the depurative action of the skin is of the greatest possible service in preventing the blood from being poisoned by the accumulation of deleterious matters. In such cases the skin takes on a vicarious action, and excretes those effete matters which are usually disposed of by other channels. Such considerations indicate the importance of preserving the skin in a clean and healthy state. In all animals cutaneous transpiration is the result of two actions; first, a physical process of evaporation, depending on the porosity of the tissues, and occurring alike in animate and inanimate objects; and, secondly, a vital process of transudation or secretion, analogous to that occurring in other parts of the body, and capable of being modified by external agencies. Diaphoretics accelerate the latter of these processes, either by exciting the general circulation, as is the case with active exercise; or more commonly by stimulating the cutaneous glands and vessels, as is the case with friction, warm clothing, and certain medicines.

In the lower animals diaphoretics are less prompt and certain than in man; and this chiefly depends on the skins of quadrupeds being thicker and more plentifully covered with hair or wool, and on the fact that most medicines of this class are especially apt to pass off by the kidneys or bowels, rather than by the skin. Horses naturally perspire more abundantly than cattle, and are more easily acted on by diaphoretics. Sweating can scarcely be said to occur at all either in the dog or cat. The waste fluids which pass from the bodies of men and horses in cutaneous transpiration appear to be got rid of in dogs by their frequent micturition, and by the evaporation from their open mouths and moist extended tongues. The wool-clad pelt of the sheep, and thick bristled hide of the pig, alike prevent free perspiration; and in these animals sweating medicines are mainly discharged by, and hence chiefly act upon, the kidneys. The best and simplest methods of causing diaphoresis in horses or cattle, are to administer warm diluents freely, apply smart friction over the surface of the body, and subsequently keep the animal well covered with horse-cloths, and in a dry atmosphere about 70° Fahr.—the temperature most favourable for the free action of the skin. In conjunction with this treatment, small and repeated doses of some of the following medicines should also be given: ammonium acetate, sweet spirit of nitre, sulphuric ether, diluted spirits, ipecacuan, volatile oils, Dover's powder, or antimonials. General stimulants in small doses usually increase skin secretion; but when there is undue arterial pressure, as in the early stage of acute inflammation, sedatives, such as aconite or even blood-letting itself, by reducing the heart's action and arterial pressure, also increase skin secretion. Dr. William Craig, of Edinburgh, has investigated and brought into notice one of the most prompt and powerful of diaphoretics—the leaves and small branches of jaborandi, a Brazilian shrub, of which a drachm, infused in water, in twenty minutes causes perspiration to rain from human patients for four or five hours, and so profusely that ten to fifteen ounces have been collected. Jaborandi and its alkaloid have also remarkable sialogogue properties. Diaphoretics, like other evacuants, become absorbed; they do not, however, remain long in the blood; where the conditions already insisted on are duly attended to, they are attracted to and stimulate the skin, and are carried out of the body in the increased secretion they provoke.

Warm and vapour baths, at temperatures varying from

100° to 120°, are ready diaphoretics, augment the healthy functions of the skin, and are used successfully in veterinary practice. 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 or half-a-dozen 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 mode of 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.

Diaphoretics are applied to the following useful purposes:

1*st,* They restore arrested action and secretion of the skin, and hence are of eminent service in equalising irregularities of the circulation, counteracting congestion of internal organs, and lowering exalted temperature. They are especially valuable in checking those chills which so frequently usher in febrile and inflammatory complaints. It would, indeed, be difficult to estimate how many serious colds, febrile attacks, and inflammations amongst horses are opportunely nipped in the bud by the use of a couple of comfortable horse-rugs, bandages to the legs, and a warm diaphoretic drink.

2*d,* By the determination of blood and nervous influence, with consequent increase of secretion to the skin, they exert a species of counter-irritation which is useful in overcoming internal congestion, and in diminishing such excessive secretion of the kidneys or bowels as occur in diabetes, in chronic diarrhœa, or in the earlier stages of dysentery.

3*d,* Like other evacuants, they remove superfluous fluid and morbid matters from the blood, and hence are useful in relieving febrile, inflammatory, rheumatic, and dropsical diseases. For these important purposes their value is greatly enhanced in cases where, from any cause, the eliminating and purifying function of the bowels or kidneys is impaired or arrested.

Diuretics.

Diuretics (διά, *dia*, through; οὐρέω, *oureō*, I make water) are remedies which increase the secretion of urine. This may be effected by large quantities of fluid, or certain saline, resinous, or other soluble substances, which are absorbed into the blood, and thence excreted in the urine. In horses, hard work and bad food, such as heated oats or musty hay, produce similar effects. Some substances, as belladonna and henbane, increase the solid as well as the fluid parts of the urine; whilst most potash and soda salts by oxidation of effete matters produce urea; but diuretics generally, although greatly augmenting the watery parts of the urine, do not increase, but, on the contrary, usually diminish, the proportion of salts and organic matters expelled in it in a given time. Mr. Bowman, in explanation of this, supposes that all such medicines stimulate the Malpighian bodies, which are intended for the secretion of the watery parts of the urine, but have no such effect on the uriniferous tubes or their capillary plexuses—the apparatus concerned in the secretion of the characteristic solids of the urine. It may be that diuretics cause so much congestion of this uriniferous apparatus as to arrest its functions; indeed, when the diuretic doses are too large, similar congestion and arrested function appear to extend to the Malpighian bodies, completely suspending the secretion of urine.

The diuretics commonly used in veterinary practice are—alkalies, with alkaline and neutral salts, which must be given in moderate quantity, for in large doses they act chiefly on the bowels; turpentine, with most resins and many volatile oils; sweet spirit of nitre, and most etherous and alcoholic fluids; digitalis and cantharides. All diluents and full doses of diaphoretics, when not eliminated by the skin, usually act as diuretics. Exposure to cold checks the action of the skin, and favours the action of the kidneys. Active purgatives and mercurials, by relieving congestion of the portal system, overcome congestion of the kidneys, and thus indirectly act as diuretics. A suitable diuretic ball for the horse is made with half an ounce each of nitre, resin, and soft soap. Three-fourths of an ounce of each of the three ingredients dissolved in water make a good diuretic drench for the cow. Stonehenge advises for a medium-sized dog about 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 of saltpetre in a little water. Diuretics usually act certainly and speedily on all classes of veterinary patients. Their actions are best ensured 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 by promoting the excretion of the medicine by the kidneys, rather than by the skin or bowels.

In the treatment of disease, diuretics are used for the following important purposes:—

1*st*, To maintain or restore the healthy action of the kidneys in febrile or other diseases, in which the secretion of urine is diminished or arrested. Although serviceable when diminished urinary secretion results from functional disturbance of the kidneys, diuretics are contraindicated when the urinary organs themselves are congested or inflamed; further irritation is then injurious; rest is required, and the bowels and skin must for a time be got to perform the chief excretory duties of the kidneys.

2*d*, To promote the elimination of poisons from the blood, a purpose for which diuretics are recommended by Orfila and other toxicologists, who find that doses of arsenic and other drugs sufficient to poison may be given with impunity, provided active diuresis be speedily induced. Diuretics sometimes also hurry out of the body, before they do serious harm, organic poisons taken into the body or formed there as a result of disease.

3*d*, To assist in combating inflammation of most organs, excepting the urinary, by exciting counter-irritation, diminishing the fluid parts of the blood, and in more advanced stages by carrying away products of inflammation, or deleterious matters accumulated in the system from the general impairment of secretion.

4*th*, To promote absorption of dropsical effusions, by removing water from the blood, which, in order to recover its normal density, absorbs the anasarcous or dropsical swellings.

5*th*, To augment the proportion of water in the urine, and thus prevent the deposition of its solid parts in the bladder or urinary passages. For this purpose diuretics are frequently used in the human subject, occasionally in dogs and sheep, but seldom either in horses or cattle, which are little subject to gravel.

Sialogogues.

Sialogogues (σίαλον, *sialon*, saliva; and ἀγωγός, *agōgos*, evoking) increase the salivary and buccal secretions. Some are local irritants, like ginger, mustard, tobacco, and radish; others, being absorbed, excite the oral branches of the fifth nerve, and stimulate the salivary glands and mucous follicles, as is the mode of operation of salts of mercury, gold and antimony, of iodine, jaborandi, and almost all nauseants. 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 quality to nourish the blood, whence the textures extract the several materials needful for their continued restoration. Water constitutes four-fifths of the total weight of most animals, is being constantly removed chiefly 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 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.

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 powers 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 the addition of milk and eggs. 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 should be 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, and 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. Saline matters, 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, they 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 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 in recovery from exhausting disease, alike in horses and cattle, a warm rug or two, and bandages to the legs, help to maintain an equable temperature, 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, and a more natural moist state of skin, and hence 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 the performing 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, they should be relieved from extra duty, and the skin and bowels got vicariously to undertake the chief of the excretory service. But when acute disease has passed away, the gradual use of an affected part generally does good. Exercise in such circumstances also proves a healthy restorer, improving appetite, and promoting the various excretory functions.

Of more purely medicinal restoratives those in most common use are linseed, in the form of gruel, tea, or cake, 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 the normal secretions, and produced skin eruption and itching, often met with amongst hard-worked liberally-fed horses.

Tonics.

Tonics (τόνος, *tonos,* tone) are agents which increase the general tone and vigour. They do this mainly by aiding nutrition. 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." Dr. Billing, in his *First Principles of Medicine,* designates them as "substances which neither immediately nor sensibly call forth actions like stimulants, nor depress them like sedatives; but give power to the nervous system to generate or secrete the nervous influence by which the whole frame is strengthened." The late Professor Headland taught that tonics act primarily and directly on the blood as restoratives, and certainly some of them, such as iron-salts and cod-liver oil, supply the blood with natural materials of which it may be temporarily deficient. But whatever their *modus operandi,* all tonics become absorbed; many have been detected in the blood, and in various of the secretions. They appear to be retained in the system in larger amount, and for a longer period, than alteratives or stimulants; and in weakly subjects in properly regulated doses they gradually induce a more healthy state, both of primary and secondary nutrition. Many of them favour oxidation and excretion, and expedite tissue metamorphosis. In whatever manner they act, all tonics, judiciously administered, produce these obvious effects: they increase the appetite, the fulness and firmness of the pulse, the activity of the bodily functions, the muscular power, and the capacity for endurance. These effects, though somewhat slowly developed, are usually very well marked, especially when tonics are given in cases where the appetite is deficient or capricious, the pulse weak and compressible, and the muscular system soft and flabby. Given to healthy animals in large and repeated doses, they do not, however, improve health; but, on the contrary, sometimes disorder digestion, and occasionally in men and dogs cause febrile symptoms. Similar effects are apt to ensue from their injudicious administration to sick animals. Tonics resemble general and nerve stimulants, but their action is more slowly and gradually induced, is more permanent, and not succeeded by subsequent depression; whilst the action of stimulants is speedily developed, but proves temporary, and is succeeded by depression often corresponding with the previous excitation. In short, tonics give strength, whilst stimulants call forth strength previously latent. Tonics also closely resemble astringents, but act more slowly, and, properly used, exert no corrugating chemical influence.

Tonics are prescribed in indigestion and mal-assimilation, when these depend on debility; in most chronic and subacute disorders when unaccompanied by acute fever; in scrofulous and other exhausting complaints; and during recovery from debilitating disease. Such tonics as quinine and arsenic have in man a remarkable power of arresting ague and other periodic diseases, whilst salicylic acid is recently found with almost equal certainty to arrest rheumatic fever. Tonics are generally withheld where there is active inflammation or acute fever; they seldom do much good, unless the bowels be in a tolerably regular and normal state. To ensure their full effect, they should be given in moderate doses, at short intervals, and for a considerable period. With the absurd idea of making up for their being carelessly given at irregular and unduly long intervals, they are frequently prescribed in unnecessarily large doses, which are very apt to disorder digestion. The mineral tonics in general use, in veterinary practice, are salts of iron, zinc, and copper, arsenic, and the mineral acids. The common vegetable tonics, sometimes subdivided into bitters and aromatics, comprise gentian, quassia, cinchona and its alkaloids, with such aromatic bitters as anthemis and cascarilla. Alcohol, judiciously employed, is a most valuable cardiac tonic, reducing the frequency and increasing the strength of the pulse. Digitalis and henbane are also heart tonics, steadying and quieting irregularity and irritability. Mineral being generally more active than vegetable tonics, are more extensively prescribed for horses and cattle. Many vegetable tonics contain an alkaloidal or neutral principle of remarkable bitterness. They are mild, and hence well suited for early convalescence, for cases where more active medicines might prove irritating, and for dogs. Cod-liver oil is the only tonic of animal origin prescribed, and its use is confined to canine practice. 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 equalising circulation.

Stimulants, Calefacients, or Excitants.

Stimulants promptly but temporarily increase nervous energy. They do not give strength, like tonics or restoratives, but rather call forth dormant strength. Amongst natural stimulants are cool, dry air exercise, hand-rubbing, and warmth variously applied. Medicinal stimulants include alcohol, ethers, volatile oils, and ammonia. They become absorbed, and may often be detected in the blood and the various secretions and excretions. They usually excite the organs by which they are removed from the body, and hence frequently exhibit subordinate actions as diuretics or diaphoretics. Those which act with rapidity, such as ammonia and ethers, are sometimes termed diffusible stimulants ; but these rapidly-developed effects are evanescent, and can only be maintained by frequently-repeated doses. Acting as they do on so many different organs, stimulants have a varied and extended field of usefulness. Defective and irregular nervous power, depending upon debility, is the chief indication for their use.

Stimulants are sometimes classified according to the organs on which they chiefly act, and the special uses to which they are applied. General stimulants, such as alcohol, ether, ammonia, and turpentine, are of signal service in sustaining the action of the heart and the powers of life in animals sinking from sudden shock, from loss of blood, and from poisoning by sedatives and some narcotics. They are effectual in combating congestion of the lungs, caused either by exposure to cold or by violent continued over-exertion, in controlling those shivering attacks which are so often the precursors of internal inflammation, in moderating exalted animal temperature, and in abating tissue waste, as in influenza, typhoid fever, and other debilitating diseases.

Cardiac stimulants, represented by alcohol, ammonia, turpentine, and digitalis, are specially indicated in failure of the heart's action from shock, profound anæsthesia, severe continued labour, or exhausting disease. Used for such purposes, they sometimes receive the special title of cordials.

Stomachics, such as ginger and the fruits of the umbelliferæ, are stimulants of which the effects are confined to the stomach; they improve the appetite and promote digestion. Carminatives gently stimulate the stomach and intestinal mucous membrane, excite contractions of the muscular coat, and expel flatus. The carminatives in general use are spirits and warm water, ether, ammonia, essential oils, ginger, aniseed, and other umbelliferous fruits, asafœtida and other fœtid gum resins.

Most active diffusible stimulants are antispasmodic. They exalt and control nervous force, and thus overcome that depressed and perverted condition of the nerves or nervous centres on which spasm depends. In combating spasm, particularly of the intestines, such antispasmodics as alcohol, ether, ammonia, and turpentine, are conjoined with such anodyne narcotics as opium or Indian hemp, or such paralysers of motor centres as conium, Calabar bean, or anæsthetics.

Some stimulants, such as alcohol, ether, and chloroform, act specially on the brain and spinal cord, particularly when given in large doses, and after a brief stage of excitement paralyse sensibility and consciousness, and form the connecting links between stimulants on the one hand, and narcotics and anæsthetics on the other. Some stimulants act specially on the motor centres and nerves, excite, and in large doses tetanise, voluntary muscle. The representatives of this class are nux vomica, strychnine, benzine, thebaine, codeine, and theine. They are given in chronic paralysis and epilepsy, and in chorea depending upon debility.

Stimulants, such as belladonna, hyoscyamus, digitalis, and ergot, with their active principles, directly excite the sympathetic nervous system, and besides sustaining the force and power of the heart, stimulate other involuntary muscles, control spasm, rouse the vaso-motor nerves, and counteract capillary congestion and stasis. Belladonna, hyoscyamus, and stramonium, three solanaceous plants, with their active principles, besides more general effects, are mydriatics; they stimulate the sympathetic ganglia and nerves of the eye, consequently dilate the pupil, and are useful in ophthalmia and in examinations of the interior of the eye. Ergot of rye is a general constrictor of the blood-vessels, and is accordingly used for the arrest of bleeding, whilst it also specially stimulates the uterus, inducing its contraction and the expulsion of its contents.

Electricity and galvanism, although hitherto little used in veterinary practice, are valuable stimulants. Galvanic 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.

Active inflammation and acute fever usually contra-indicate the use of stimulants for horses and dogs; but in many such disorders amongst cattle and sheep, stimulants sensibly used overcome congestion, equalise irregularities of temperature, remove irritability, subdue subacute inflammation, rouse the excretory organs to healthy activity, and restore that harmonious working of the bodily functions which constitutes health.

Alteratives.

A large and important class of diseases appear to depend upon some faulty or morbid materials or actions in the blood. Such are scrofulous affections and rheumatism, eruptive fevers, various skin diseases, typhoid fevers in horses and cattle, with distemper and several nervous disorders in dogs. A very few of these blood diseases are readily removed by remedies which act with almost as much certainty as antidotes. Quinine promptly cuts short ague and intermittent fevers in man, salicylic acid controls the fever and pain of acute rheumatism, and iodine arrests polyuria in horses. Medicines thus producing with certainty special curative results are frequently termed *specifics*. As therapeutics become better understood, the present very limited number of specifics may probably be increased, and particular blood poisons may in time have their appropriate antidotes.

These blood diseases, when under medical control, are usually counteracted and annihilated by a useful class of medicines, termed alteratives, alterants, or catalytics. As their name indicates, they alter for the better the condition of the system. They have been defined by Professor Müller as remedies which are neither stimulant nor sedative, and have the power of effecting changes in the state of the living solids, and hence in the functions they perform. They include iodine, sulphur, arsenic, salts of mercury, antimony, silver, zinc, copper, and lead, alkalies and saline matters, mineral acids, and carbolic acid, with colchicum, veratrum, and cod-liver oil. They are mostly of inorganic origin, are soluble in some of the secretions of the alimentary canal, are absorbed, and exert in the blood or soft solids their special influence, neutralising or arresting morbid processes. Frequently they alter the chemical character of fluids and solids; they check waste and disintegration of healthy textures; they prevent development of bioplasm or degenerate cells; often they accelerate oxidation, and the consequent removal of effete or poisonous matters. In excessive or poisonous doses they sometimes impoverish the blood; thus mercury diminishes its plastic elements, and causes the development of fœtid matters; whilst salines induce solution of its fibrine, and increase of its watery portions. In medicinal doses the curative effects of alteratives, although often only gradually established, are tolerably permanent. Being mostly unnatural to the blood, they do not long remain in it; and during their excretion, chiefly through the skin and kidneys, increase their activity. Alteratives bear some resemblance to tonics and astringents, and, as pointed out below, are related to antiseptics and disinfectants.

Although assured by practical observation that alteratives do counteract or annihilate disease, their *modus operandi* is not yet definitely settled. Liebig and other chemists believe that many diseases, and especially those known as blood diseases, result from and are propagated within the body, by a species of fermentation; and that alteratives arrest this fermentation, or establish a species of rival fermentation, which checks that previously going on within the system. Professor Headland taught that alteratives act by catalysis or contact, somewhat in the manner in which spongy platinum, without any change in itself, causes combination of oxygen and hydrogen, or the emulsin of bitter almonds resolves the amygdalin into prussic acid and other compounds, or the albuminoid ptyalin promotes the change of starch into sugar. The recent investigations of Pasteur, Dr. Angus Smith, Mr. W. Crookes, Dr. Lionel Beale, Dr. A. E. Sansom, and other physiologists, show that mineral salts and acids, with carbolic acid and other bodies, recognised, be it noted, as alteratives, arrest fermentation and putrefaction, and destroy the lower forms of life, whether occurring without or within the body. (See Antiseptics and Disinfectants.) The operation of many alteratives may doubtless be similarly explained. They neutralise or destroy morbid germs, whether developed within the body or introduced from without; they probably preserve or modify the material on which such germs grow and multiply; whilst many alteratives besides expedite the removal from the system of used-up or dangerous materials. Some alteratives have special distinctive actions. Thus mercurials are found to deprive the blood of one-third of its fibrin, one-seventh of its albumin, and one-sixth of its globules. Alkalies dissolve fibrin, retard its formation and deposition, and cause its removal in the urine. Salines resemble alkalies in their effects, and, when used for some time, increase, moreover, the alkaline salts of the blood. Cocoa and its analogues tea and coffee are conservors of energy, and arrest undue tissue-metamorphosis and excretion of urea.

Alteratives are employed in most febrile and inflammatory attacks, and in rheumatism. In epilepsy and chorea, unattended by nervous lesion, and depending upon a faulty state of the blood, potassium bromide, arsenic, and metallic salts are specially indicated. Eczema, and other skin diseases, are benefited by arsenic, sulphur, and potassium iodide. Whilst alteratives usually require to be given for some time before they develop their curative results, the tendency which some of them exhibit to impoverish the blood will indicate the propriety of their discontinuance so soon as their desired effects are produced, or any of their untoward symptoms are presented.

Many alterative prescriptions are used in veterinary practice. When acute febrile or inflammatory symptoms are to be subdued in horses or cattle, a scruple of calomel is given every three or four hours, conjoined with a drachm of opium, which prevents the mercury being carried out of the system too rapidly, and before its desired effects are produced. In the later stages of inflammation, during early convalescence, and in typhoid affections, mercury proves too lowering, and saline or alkaline alteratives are indicated. A useful formula, either for horses or cattle, consists of two ounces of Epsom salt, one ounce each potassium chlorate and Mindererus' spirit, mixed with a pint of water or cold gruel, and repeated twice or thrice daily. An ounce of sulphur, with a drachm each of nitre and sal-ammoniac, constitutes a useful alterative draught when mixed with a little gruel, oil, milk, or treacle-water, to ensure the proper admixture of the sulphur. A drachm each of nitre, sal-ammoniac, ginger, and gentian, repeated thrice daily, either in bolus or draught, is prescribed both for horses and cattle. In colds, febrile attacks, and the second stages of many inflammations, a useful alterative draught consists of two ounces Epsom salt, one ounce potassium chlorate, and ten minims hydrochloric acid, dissolved in water, gruel, or beer, and repeated twice daily. In rheumatism, a drachm each of potassium iodide, nitre, and sodium carbonate, with or without sulphur, prove useful, especially if acute symptoms have been previously counteracted by calomel and opium, or other more powerful remedies. Change of food and of air, properly regulated exercise, rock-salt in the manger or box, and electricity, are included amongst alterative remedies.

Astringents.

Astringents (*ad*, to; and *stringo*, I bind) corrugate the softer animal solids and coagulate the fluids. They comprise cold, in the form of baths and freezing mixtures, the mineral acids, and most of the soluble salts of the metals, aluminium, zinc, iron, lead, copper, mercury, and silver. Astringents of vegetable origin include tannic and gallic acids, oak bark, galls, catechu, and creasote; many owe their effects chiefly to the tannin they contain. Most astringents produce, in the first instance, a topical chemical action. Concentrated metallic solutions unite with the elements of the tissues, diminishing their bulk and solubility. Most vegetable astringents, in large amount or concentrated form, tan them, causing their partial conversion into leather—the tough, insoluble tanno-gelatin of chemists. This chemical action, exerted equally on dead and living tissues, on the living tissues is, however, speedily succeeded by a vital constringing effect. Textures become lessened in volume, their blood-vessels diminished in calibre, their exhalations and secretions decreased. These primary local impressions often produce beneficial reflex actions. Cold applied to the loins often arrests bleeding from the uterus; ice swallowed checks bleeding from the nose or lungs; astringents to the mouth and fauces occasionally relieve atony of the respiratory mucous lining. But astringents sometimes have a still more extended action; most of them become absorbed, and constringe the unstripped muscular fibres of the arterial and capillary vessels, and of the mucous membranes and glands, giving firmness to the pulse, promoting digestion, and improving general health. In producing these effects, astringents resemble tonics, and, in practice, may be substituted for them, or combined with them. The most marked difference between them probably consists in the vital action of astringents being preceded by, and resulting from, a purely chemical effect.

Astringents are prescribed internally to counteract relaxation with the morbid conditions dependent thereon, to arrest excessive mucous secretion resulting from defective tone, and to stay hæmorrhage. Ergot of rye has a special power of contracting involuntary muscular fibres, and hence acts as a styptic, whether when swallowed or when its active principle, ergotine, is injected hypodermically. As external agents, astringents counteract relaxation and excessive secretion both of serum and pus; suppress pale flabby granulations; hasten the formation of healthy cicatrices; diminish the volume of protruded organs, and thus facilitate their return, as in cases of protrusion of the rectum or uterus; coagulate blood, and as styptics stop the mouths of bleeding vessels; constringe dilated and paralysed capillaries, and hence remove inflammation,—a mode of treatment specially applicable to slight contusions, conjunctivitis, and other cases of circumscribed and superficial inflammation. The internal use of astringents should be avoided in serious and extensive inflammation and fever, and in undue irritability of the alimentary canal. Their local application is usually contra-indicated where the parts are abnormally hot, dry, or tender. In such circumstances they cause irritation.

Emollients.

Emollients (*mollio,* I soften) soften, soothe, and relax the parts to which they are applied. They resemble demulcents; and besides the various substances already mentioned as belonging to that class, they include poultices, fomentations, moistened lint, flannel, sponge, or spongio-piline, with hot water, soap and water, decoction of poppies, oil, glycerin, 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 the 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 or moderate the excessive temperature of those parts of the body with which they come into actual contact. They act as local tonics and stimulants, and sometimes remove circumscribed and superficial inflammation, especially in parts of low organisation. Cold air and cold water are not only the most common, but the most convenient refrigerants. All solid substances in becoming fluid, absorb heat, and this fact suggests the expediency of dissolving in the water, immediately before application, such saline matters 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, and are effectual on account of their abstracting heat during evaporation. Saline and some other refrigerants, when given internally during fever and inflammation, are often useful in relieving thirst. They usually reduce exalted temperature, and expedite recovery, probably in virtue of some alterative, antiseptic, or stimulant property. The healthy glow or reaction which follows the use of refrigerants, whether employed internally or externally, usually affords some criterion of their curative value. In excessive doses, as when ice or ice-cold water is freely and rapidly swallowed, dangerous sedative effects sometimes ensue, especially in weakly or exhausted subjects.

In using refrigerants externally, when the temperature is to be reduced below the point that can be attained by cold water frequently renewed, or with saline matters dissolved in it, the usual appliance consists of ice, broken small, and mixed with about half its weight of salt, the mixture being applied either in a gauze bag or in a thin metallic vessel. A piece of metal immersed in the freezing mixture is occasionally applied to the part. Such treatment is applicable to cases of sprained tendon, open joint, chronic rheumatism, simple and deep-seated ophthalmia, and phrenitis, and also in relieving the irritation of ulcerating and other wounds. So entirely does extreme cold, or congelation, as it is termed, remove sensation, that abscesses have been opened, and other minor operations performed, without pain. The skin shortly becomes bloodless; the subjacent parts tense, firm, and numbed; congestion disappears; while superficially inflamed structures recover their tone. The cold application, repeated several times daily, may be continued for five or ten minutes; but to avoid undue reaction, cold water should for some time after be applied. In the human subject congelation was successfully used by Dr. Arnott in the treatment of erysipelas and other skin diseases; but, as the vitality of the chilled parts is apt sometimes 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 application too suddenly or for too prolonged a period, and to moderate the reaction, which is sometimes dangerously violent.

Sedatives.

Sedatives (*sedo*, I calm, or allay) depress nervous force. They are sometimes termed antiphlogistics, or depressants. They include blood-letting, aconite, prussic acid, tartar emetic, and hellebore. Through the mucous surfaces, the skin, or wounds, sedative medicines find entrance into the blood, are conveyed to the nervous centres or nerves, blunt reflex irritability, and derange and depress the functions of most of the vital organs. They have a tolerably uniform action on man and the several domestic animals. They reduce the force and frequency of the pulse, diminish arterial pressure, decrease the number of the respirations, lower animal heat, and hence are serviceable in combating febrile attacks, and inflammation of the lungs, intestines, and other organs. Relaxing muscular fibre, they control spasm. They destroy life by syncope, or arrest of the heart; or by asphyxia, or arrest of the respiratory movements. They 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.

Sedatives include a number of medicines, which, although they have depressent actions in common, exert their effects on different organs, and are applicable to different therapeutic purposes. Many possess subordinate actions and uses. Thus antimonials are emetic as well as sedative. Aconite, in addition to its reducing the heart's action, has a curious anæsthetic effect, which renders it a useful application in rheumatism and neuralgia. Many irritant and corrosive poisons have secondary sedative effects.

Sedatives are conveniently divided into two groups—(1) those which act more primarily and prominently on the heart; and (2) those which act more notably on the spinal cord, and are sometimes distinguished as depresso-motors.

(1.) Aconite is the best illustration of a heart sedative. It attacks the heart, or its contained ganglia, causes gradual dilatation of the ventricles, and slower, feebler action; in poisonous doses, within a minute it produces fatal syncope; it acts upon the heart even when removed from the body, exhausting its contractility. In moderate doses it reduces the force and frequency of the heart beat, lowers arterial pressure and temperature, and controls spasm. Tartar emetic, in men, dogs, and cats, diminishes the heart's action; but, according to the dose in which it is given, is besides emetic, expectorant, diaphoretic, and a gastro-intestinal irritant. Veratrum and its alkaloid veratrine rank both as heart and spinal sedatives, produce muscular weakness and trembling, clonic spasms, progressive declension of the heart's action, probably caused by direct effect on the heart muscle and its contained ganglia. Veratrine is irritant, causes preliminary excitement, convulsions, muscular paralysis, increase and subsequent steady lowering of the pulse and blood pressure. Prussic acid is a tolerably general paralyser and sedative, but acts primarily and prominently on the cerebro-spinal axis; attacks directly the heart and its contained ganglia; in full doses causes gasping, tetanic or clonic convulsions, and death, in a few minutes, from cardiac or respiratory arrest. Digitalis, long included amongst sedatives, although in moderate doses slowing the action of the heart, is in reality a heart stimulant and tonic. The Borneo and Madagascar arrow-poisons, and the Java Upas antiar, rapidly paralyse and arrest the action of the heart. The cobra poison, in full doses, is also a deadly cardiac sedative.

(2.) The following are some of the more important spinal sedatives or depresso-motors :—Lobelia, which in some respects resembles tobacco, constitutes a connecting link between sedatives affecting the heart and those affecting the spinal cord. It is a local irritant, and causes vomiting, followed by muscular prostration, stupor, coma, and convulsions. Tobacco and its alkaloid nicotine are rather complex in their actions, are topical irritants, paralyse the brain and motor nerves, cause relaxation of muscles, but in certain doses excite the medulla, producing cardiac and general tetanus. Calabar bean causes muscular tremors and relaxation, suspension of reflex irritability, and death by paralysis of respiration. It has been used in tetanus, and for contracting the pupil, and is the physiological opposite of strychnine. Curare, also called woorali—a South American arrow-poison—paralyses the motor system, is allied to Calabar bean and coneine, and antagonistic to strychnine. Potassium bromide causes progressive paralysis, depression of temperature, asphyxia, or cardiac arrest in diastole; the cerebrum is more affected than by Calabar bean. It is prescribed to lessen reflex activity in epilepsy and other spasmodic diseases. Hemlock and its alkaloid coneine are paralysers of motor nerves ; their peripheral extremities are probably primarily attacked ; the hind limbs are first affected ; clonic spasms occur; cessation of respiratory movement kills ; neither consciousness nor sensation is impaired. Its physiological opposite is strychnine. Water hemlock also causes giddiness, reeling, and paralysis of the functions of the cord. Œnantha crocata, the umbelliferous hemlock water dropwort, is also a depresso-motor poison. 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. Amyl nitrite is very volatile, when inhaled acts rapidly on the motor tract of the cord, causes hurried, panting breathing, muscular flaccidity, loss of reflex action, and fatal failure of respiration, but without impairment of consciousness or sensation. Chloral hydrate occupies debateable ground between sedatives and narcotics ; affects the brain, causing sleep ; sensibility and reflex irritability are blunted ; the muscles are relaxed ; the pupils dilated ; respiratory movements gradually and fatally paralysed. It is prescribed to allay reflex irritability and spasm. Bromine exerts a special sedative influence on the sympathetic or organic system, as well as on the nerves of common sensation, reduces vascular tension, and thus diminishes secretion. Cold, properly regulated, is a powerful sedative. Dr. Chapman has shown that ice applied to the spine acts as a sedative to the spinal cord, diminishing excessive muscular tension, as of tetanus, epilepsy, or chorea, and lessening undue irritability and excretion, as of the bowels in diarrhœa or dysentery.

Blood-letting, the most prompt and powerful of sedative remedies, is also on that account the one most liable to abuse. It is chiefly serviceable in the earlier stages of acute inflammation of the pleura, peritoneum, brain, and feet, and in apoplectic affections—in fact, wherever there is high fever, with a tense, firm, incompressible pulse, or a full, slow, indistinct pulse. It lessens the quantity of the blood, reducing especially the proportion of the red globules and fibrin, and to a lesser extent the albumin and saline matters; whilst, by diminishing vascular tension, it weakens the force of the circulation. Hence, judiciously used, it may relieve venous congestion, counteract undue reaction, stay the progress of acute inflammation, favour absorption, and render the system more amenable to subsequent treatment. In all cases 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 down, 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 a pulse of this kind indicates weakness; and bleeding in all such cases increases exudation and effusion, instead of preventing them, whilst it unnecessarily debilitates the patient, retarding his recovery, and diminishing his capacity of coping with and throwing off the 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 a mischance should, however, never happen; for whenever there is the least question as to the propriety of blood-letting, give the animal the benefit of the doubt, and avoid a remedy, of which the reducing effects are so serious and so slowly repaired.

Narcotics.

Narcotics (νάρκωσις, *narkōsis*, a benumbing) are mostly 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 deleriants; 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, as it were, 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 depresso-motors as hemlock, 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 the dose and other modifying conditions. Opium is described by Dr. John Harley "as a hpynotic 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 induce 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 sleeplessness, spasm, and pain. Belladonna causes more preliminary excitement than opium; large doses produce delirium rather than stupor; properly regulated doses stimulate the heart and vascular system; 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 rather than diminishes secretion, and is chiefly used by veterinarians as an antispasmodic 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. Cocculus 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.

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 ensure their full effects, they are given at intervals of one or two hours. Most narcotics contain concentrated active principles, which can be conveniently and effectually used hypodermically.

Anæsthetics.

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

The possibility of inducing anæsthesia seems to have been thought of at a very early period. 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. In the succeeding February it was first used in midwifery by the late Sir James Y. Simpson, who, before another year had elapsed, discovered the more potent and convenient chloroform. It 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 Professor 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 of them have proved so safe and serviceable as chloroform and ether.

Anæsthetics being volatile or gaseous are usually introduced into the system through the lungs; they have a remarkable power of diffusion; but how they determine their characteristic effects is not easily explained. It has been stated that they impair oxidation, that they contract and tend to liquefy the blood globules, that they exert a direct effect on the nerve textures. But in what manner soever they establish their action, the brain and nervous centres are speedily affected; and three tolerably distinct stages are noticed in the operation of the anæsthetic. (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, suspension 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 is quiet and automatic, unconsciousness is perfect. This is the stage required for all serious operations. The anterior or motor centres, it should be remarked, are not so readily or so fully acted on as the posterior or sensory centres. (3.) The centres of the sympathetic and the medulla are the last to yield to the continued action of the anæsthetic, and as they are acted on, the involuntary processes of organic life become 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 about 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; 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, 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. The 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 administration, 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 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 the inhalation can be effected. A skilled assistant is necessary to regulate the administration; nausea and depression occasionally continue for several hours. Anesthetics have, however, been successfully exhibited in all formidable surgical operations. In parturition they afford, as in human patients, immunity from pain, but do not interfere 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 anesthesia proves useful. In some of these cases diluted solutions are injected into the rectum, and exert, often by reflex action, an anodyne effect 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 may be laid over the circumscribed spot; or, with a spray producer, a finely divided stream may be 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. The agents generally used are ether, 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. 71), and even electricity, have somewhat similar benumbing effects. Local anæsthesia has been used by veterinarians in castration, removing tumours, probing and excising fistulæ, opening abscesses, reducing herniæ, extracting teeth, inserting setons, firing, and neurotomy. Those who have used it most do not, however, give it an 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, anæsthesing 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 volatile bodies which have also been used as 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. Proxylic 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 chloromethyl ($C\ H_3\ Cl$), 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. Methyl 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, but not so safe as ether or chloroform. 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 $(C_2\ H_5)_2\ O$. Aldehyd ($C_2\ H_4\ O$) 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.

Amyl hydride, 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 the calm sleep; scarcely any appreciable reduction occurs in the animal temperature until continued inhalation is pushed nearly to a fatal issue, when the temperature suddenly falls from $1\frac{1}{2}°$ 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 methyl bichloride; and more recently a mixture of equal parts of amyl hydride and ether, the product being slower and more persistent in its effects than the hydride alone, and adapted either for general or local anæsthesia. Amyl nitrite ($C_5\,H_{11}\,NO_2$) requires to be used with especial caution. It appears to paralyse the sympathetic nervous system, and in larger amount to increase arterial tension and throbbing of the heart and arteries.

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 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_5H_{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_2O), is successfully used for the brief minor operations of human surgery. It is free from unpleasant smell and taste; it resembles oxygen in its effects, disturbs the proper proportion of gases in the blood, after two or three minutes of excitement produces unconsciousness and stagnation of blood, especially in the pulmonary capillaries. 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; as by the quantity, quality, and form of administration of the medicine itself; by the species and age of the patient, and by the channel by which he receives the medicine. 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 a variation in dose produces a difference in the 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 ensured 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 one or two 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, for example, 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 the 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. 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 all the simple substances in the Materia Medica 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. Substances which are incompatible, or react chemically on each other, should not be used together. 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. The differences, however, are chiefly 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. Great 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. In the domestic animals the cerebrum is about five times the weight of the posterior parts, which regulate motor energy; whilst the cord is relatively larger than in man. This relative development explains 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, although the stomach is small, the intestines are capacious, highly vascular, and abundantly supplied with nerves—provisions which, while they ensure the thorough absorption of nutriment from bulky and comparatively innutritious food, render the animal peculiarly liable to superpurgation and inflammation of the bowels. Here again is an illustration of the general rule that the perfection and development of any organ render it more susceptible to those medicines which specially act upon it. 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 smallness of the stomach; by its distance from the diaphragm and abdominal muscles, and the consequent difficulty of its compression; 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 the absence or imperfect development of the vomiting centre (p. 43). 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. Sudorifics are less active and useful 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 in its action than in men, dogs, or horses. The first and third compartments of the stomach always contain food, often in large quantity. These facts help to 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 and 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 a number of 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 so-ever they be given, 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, whilst 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, and diaphoresis can scarcely be said to occur at all—the skin not being adapted for cutaneous transpiration. 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 of the quantity of any medicine given to an adult horse; a two-year-old, one-half; and a three-year-old, two-thirds. A similar ratio is applicable to cattle. Such calculations are, however, merely approximative. The size of the patient obviously affects the action of all remedies, but the regulation of this modifying circumstance must be left to the judgment of the practitioner. 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 Exhibition.—The channel by which medicines enter the body frequently modifies the degree of their action, for different organs and tissues vary much in their powers both of absorption and decomposition. Medicines are readily absorbed from the mucous and serous surfaces, from the areolar tissues, and from wounds. They are also sometimes injected into the veins, 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, and have, moreover, intimate nervous connection with all the important organs of the body. To secure medicines being promptly absorbed without undesirable change, they should generally be introduced into the stomach whilst it contains the minimum of food. Many restoratives, tonics, and alteratives, as well as irritants, such as iodine, probably however act best when given with food or immediately after eating. The surface of the rectum is less sensitive and vascular than that of the stomach, and there is no gastric fluid to aid the solution of insoluble medicines, which hence act less promptly and powerfully than when swallowed. Medicines capable of ready absorption, such as solutions of most saline matters, of strychnine, quinine, or opium, act, however, as promptly and freely when given by the rectum as by the mouth. The pulmonary mucous membrane has a superficies stated to be 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 could be introduced into the lungs along with the vapour of water or of other fluids. Medicines thus introduced into the body, being 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 applied for the cure of skin diseases, frequently become absorbed, and develop their poisonous action. Absorption is, however, greatly facilitated by removing the cuticle, by means of a small blister, and then 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.

Subcutaneous injection of concentrated medicines has now, however, 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, and other veterinarians, ensures the medicine being brought very near to the affected part, 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 the human subject of untoward effects. 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 somewhat uncertain, 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 a 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 persons unaccustomed to the poison. 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.

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 hence act more powerfully. Conversely, when excretion is active, as in diuresis, diabetes, or diarrhœa, many medicines, such 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 (Royles' *Materia Medica*, 6th edition). Influenza, low fevers, and most extensive inflammations 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 have often a material influence in altering the action of remedies. Diseases, whether in horses, cattle, or dogs, when 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. 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 irritability of the digestive organs, and indeed from most debilitating diseases; constipation and torpidity of the bowels interfere with the 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.

In the present section I shall briefly notice the more important pharmaceutical compounds used in veterinary practice, as powders, boluses, tinctures, extracts, etc., adverting chiefly to the best methods of making, preserving, and administering them. 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. Instead of being got by 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. Medicine is occasionally administered in the state of powder scattered over, or mixed with, the food; but this method of administration is only admissible in the case of very simple and tasteless remedies, and should not be relied on where a decided or speedy effect is desired.

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, liquorice powder, treacle, syrup, glycerin, and conserve of roses, the choice being determined by the nature of the active ingredients. The four 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 soft and moist, 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, for example, in making the aloetic mass. 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 unchanged through the whole extent of the alimentary canal. For cleanliness and facility of administration, balls are given either rolled up in soft paper, or elegantly and conveniently covered with a coating of gelatin. For horses they are the most common and handy method of administration; for dogs they are 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 very 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.

DRAUGHTS—DRENCHES—DRINKS.

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 a large absorbing surface of mucous membrane, and passes on more speedily towards the second and fourth stomachs. 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 may be 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 a few stout tin bottles of two sizes, capable of holding a pint and a quart, made either round or flat—the latter the more convenient for the pocket—and closed by a screw at 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.

INFUSIONS.

Infusions are solutions of vegetable substances prepared by digesting the drug 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 half an hour or an hour; 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 whilst hot infusions soon spoil, especially in hot weather. Their keeping properties are 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 ensure perfect solution, the medicine is bruised or cut into small pieces, and occasionally digested in the fluid for some time. 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 then pouring off the supernatant fluid. Decoctions when intended to be kept beyond a week or two should have a little spirit added to them, 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, 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 several 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 marcerating 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. An endeavour has been made by the revisers of the British Pharmacopœia to have all tinctures of such uniform strength that one drachm should be the average dose for an adult human patient. Much trouble and risk of accident would be avoided if this uniformity of strength could be carried out. 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.

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. The best solvent for making the solution from which the extract is subsequently prepared is that which removes the active principles without acting on 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.

LIQUORES.

Thirty-nine liquors appear in the British Pharmacopœia, 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 perchloride; 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.

MIXTURES.

Mixtures are fluids containing two or more ingredients, either mechanically commingled or chemically combined. They differ little from draughts or drenches, are usually prepared extemporaneously, are turbid, and deposit a sediment on standing. Camphor, chalk, and catechu mixtures are examples of such preparations.

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 ensure 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 British Pharmacopœia 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.

LOTIONS.

Lotions are fluid preparations intended for external use, and generally made up extemporaneously. Lotions for the eye are usually called *collyria*.

OINTMENTS—UNGUENTA.

Oils, fats, and wax, constitute the basis of ointments, which are of the ordinary consistence of butter, are intended for external use, and are applied with or without friction. To improve their keeping they are now generally made with lard or oil, impregnated with benzoin or other balsams. When lard or oil is the excipient, the several ingredients may be mixed in a conveniently-sized mortar; but when wax or resin is used, it must be melted over a slow fire, the other constituents then added, and the whole mass stirred until it has acquired a proper consistence. Ointments, of which thirty-four figure in the British Pharmacopœia, 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 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.

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. They are less useful in veterinary than in human practice; for, in the lower animals they are apt to be displaced from the greater power of the panniculus carnosus, and from the 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. They are beneficial from their stimulating properties; from their preventing, when large and thick, undue motion of injured parts; and from their ensuring the patient several weeks' release from work.

FOMENTATIONS.

Fomentations are applied for local bathing or stuping. They often consist 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; while for enteritis, pleuro-pneumonia, or other cases in which they are intended promptly to produce active counter-irritation, they are most effectual when almost scalding hot. 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 some oil-skin or piece of mackintosh 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; and 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 light dressing of mustard. Heat applied along the spine excites the sympathetic ganglia; a greater amount of nervous influence hence passes to the blood-vessels of internal organs, their diameter is lessened, and, according to Dr. Chapman, heat thus applied acts beneficially in arresting bleeding from the nose and lungs. Conversely, cold, as in the form of the ice-bag, applied along the spine, lessens the amount of nervous current from the spinal cord; an increased flow of blood thus follows through the vessels regulated by those parts of the cord, and hence vital activity is augumented. In this manner, according to Dr. Chapman, may be explained the advantages of cold applied to the spine in cases of diarrhœa and tetanus.

POULTICES—CATAPLASMS.

Poultices are external applications of a soft and pulpy consistence, and are usually intended to act locally. 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 the late Mr. Liston's observation that they are associated with putrefaction and nastiness. Heat, without the 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. Hot poultices allay pain and irritation, reduce circumscribed and superficial inflammation, and promote suppuration. They directly soothe, soften, and relax the surfaces with which they come in contact, and by reflex action indirectly propagate these good effects to remote parts. Encouraging suppuration, they are unsuitable for wounds which, if let alone, will heal by first intention or adhesion, and for cases of long-standing inflammation, where the parts have become relaxed and deficient in tone. In such cases, cold applications are indicated.

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 keep them at a uniform temperature, hot or cold solutions are poured over them every hour; or, better still, fresh poultices are supplied as the old ones become dry, altered in temperature, or foul. As they are apt to sodden the skin and destroy its reparative power, they ought not to be used longer than they are really required. Unwieldy to apply, and often troublesome to regulate as to temperature, they are now generally 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 poultice.

CLYSTERS—GLYSTERS—ENEMA—ENEMATA—INJECTIONS.

Clysters are in frequent use for all the domesticated animals for evacuating the bowels, for allaying irritation of the rectum and adjacent organs, when they should be tepid, of a mucilaginous, soothing description, and used at short intervals, and for introducing food and medicines when, as in sore throat, tetanus, or apoplectic cases, they cannot readily be swallowed. Medicines may usually be given by the rectum in the same doses as by the mouth. Tonics, restoratives, astringents, and sedatives are sometimes given by the rectum in a solid form as a suppository, made up with soap, lard, or starch. A cylinder of soap introduced and held for a minute encourages the action of the bowels in dogs and cats, and also in young foals and calves. Clysters, when employed in constipation, usually consist of soap and water, sometimes with oil, turpentine, or solution of aloes, and occasionally with tobacco smoke; in diarrhœa, they principally consist of starch-gruel, with the addition of vegetable astringents and opium. No remedies are more safe and effectual for keeping the bowels in order, whether in health or disease; and their diligent use, especially in horses, often safely and effectually fulfils the purposes of purgative medicine given by the mouth. They frequently prove a convenient vehicle for exhibiting food and stimulants in debilitating disorders. Lime water and turpentine, solution of quassia, and other medicated injections, are useful means of expelling ascarides. An ounce or two of cold water, thrown up every morning, relieves piles in dogs. Injected in large amount, and with an extra long tube, they occasionally overcome intussusception. These copious tepid injections, with full doses of opium or anæsthetics to relax spasm, are the only hopeful treatment for obstruction and intussusception, whether in horses or dogs. By reflex action tepid clysters, retained if possible for a short time, relieve irritation and pain of the bowels, kidneys, and uterus. When intended to be retained and absorbed, clysters should be limited in quantity, not exceeding two or three pints in the horse, or two or three ounces in a dog of 20 lbs. weight. Where intended to produce evacuation of the bowels, their quantity may be trebled or quadrupled. Of the many kinds of apparatus for giving clysters, those in common use are—the old-fashioned bladder tied on a piece of leaden 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 kinds 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 out 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 relieving sore throat, 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 of weights, 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. ʒj.), 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 British Pharmacopœia.

APOTHECARIES' MEASURE OF WEIGHT.

1 Grain, gr.j.			
1 Scruple, ℈j	....	=20 grains.	
1 Drachm, ʒj	....	= 3 scruples	= 60 grs.
1 Ounce, ℥j	....	= 8 drachms	= 480 grs.
1 Pound, lb.j.	....	=12 ounces	=5760 grs.

The measures of the British Pharmacopœia 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,	fʒj	....	=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, it is also well to send out medicines for external and internal use in differently shaped and differently coloured bottles, and to label carefully all potent preparations "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, about five fluid ounces; wine-glasses, about two 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. 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 British Pharmacopœia, 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 heat still retained by the British Pharmacopœia, 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° Fahrenheit, 10° centigrade = 18 Fahrenheit, or 5° centigrade = 9° Fahrenheit; 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 ($HC_2\ H_3\ O_2$). 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 requires 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. These salts are distinguished by the acetous odour they emit when heated with sulphuric acid; the peculiar ethereal odour and pungent taste of acetone they evolve when heated with lime; and the red-brown colour they produce in neutral solution when treated with iron perchloride.

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 from 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, redissolved and distilled with sulphuric acid. An imperfectly purified acid still containing some residual tarry matters is sold as pyroligneous acid. The diluted acid of the British Pharmacopœia 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 the attraction of oxygen from the air, supplies it to the alcohol, and hastens its conversion into acetic acid as shown by the formula—

$$C_2H_6O \text{ (alcohol)} + O_2 \text{ (Oxygen)} = C_2H_4O_2 \text{ (acetic acid)} + H_2O \text{ (water)}.$$

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 the density and the 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 the 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 the pharmacopœia 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 as in vinegar it is applied externally as a stimulant and refrigerant, and is employed pharmaceutically as a solvent.

It is rather less irritant than the strong mineral acids; but it kills dogs with the same symptoms of uneasiness, vomiting, and abdominal pain, weakness of the hinder extremities, and exhaustion. An ounce of acetic acid destroyed a medium-sized dog in an hour; a quarter of an ounce in from five to nine hours; and four or five ounces of vinegar in ten or fifteen hours

(Christison on Poisons). Horses take from 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. In the human subject, in diluted solution, it proves refrigerant and stimulates digestion; but in large amount it retards both digestion and assimilation, and has hence been sometimes foolishly used to reduce corpulence. This it can only do at the sacrifice of health.

Rubbed into the skin, acetic acid speedily causes redness, and the 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 gelatin, 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 containing creasote and similar empyreumatic principles. 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 sorts of vegetables.

Doses, etc.—Diluted with water or any simple fluid, in about the same doses as the mineral acids, namely, f℥i. to f℥ij. for horses or cattle; ♏x. to ♏xx. 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 plants, with tapering, carrot-shaped, brown roots, from which, after the first year's growth, are formed one or more oval-shaped tubers, which are at first nourished by the decaying parent-root; several annual erect stems from 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 cylindrical, white, pungent, bitter root of horse-radish, for which it has sometimes been fatally mistaken. According to Professor 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 gray colour, and a strong earthy odour; yield their active principle readily to alcohol; and owe their poisonous and medicinal actions to an alkaloid termed aconitine or aconitia ($C_{30}H_{47}NO_7$) generally obtained from the root of any active variety grown in this country or imported from India, by maceration with rectified spirit, recovering the spirit by distillation, dissolving the residue in water, separating the alkaloid from its special acid, the aconitic (H_3, $C_6H_3O_6$), washing and purifying. About 12 grains are extracted from 1 lb. of dried roots. Aconitine is a transparent, colourless, or pale yellow powder; bitter; crystallisable with some difficulty; 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. Other active crystalline bases, napelline, atisine, and aconella, have recently been discovered and isolated by Messrs. T. and H. Smith of Edinburgh.

Actions and Uses.—Aconite paralyses both the sensory and motor tract of the medulla and spinal cord, causes spasm of the muscles of respiration, and death from asphyxia. Used medicinally, it is sedative, antispasmodic, and anodyne. As a sedative it is more safe and manageable than blood-letting; more certain and effectual than calomel and opium or tartar emetic. When chewed, or rubbed on the 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.—The investigations of Dr. John Harley *

* *St. Thomas' Hospital Reports*, vol. v. New Series, 1874.

and M. Liégeois and Hottot* indicate that aconite, so soon as it enters the circulation, depresses and paralyses first the sensory roots of the medulla and spinal cord, and shortly afterwards the corresponding motor roots. That the sensory centres and nerves are affected before the motor appears evident from the early local numbness produced when any active aconite is chewed or rubbed on the mucous or cutaneous surfaces; from the peculiar numbness and tingling sensations in the throat which so speedily produces the characteristic insalivation and champing of the jaws; from the general numbing and insensibility which precedes any loss of voluntary power, and from the shallow feeble breathing. But full doses soon show that paralysis of motor function is setting in. The feeble breathing becomes irregular and distressed from the paralysis of the respiratory muscles and the spasmodic closure of the respiratory passages; mainly from this restraint on breathing, the heart's action is reduced in force and frequency; there is vascular depression and lowered temperature; the animal loses the power of supporting itself, and drags its hind extremities. But neither the brain nor special senses, excepting perhaps taste, are affected. Death results from asphyxia depending upon paralysis of the muscles of respiration, particularly of the diaphragm, and spasmodic closure of the glottis. The right side of the heart becomes enormously 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.

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 British Pharmacopœia 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

* *Journal de Physiologie*, 1861; also Dr. H. C. Wood, "Treatise on Therapeutics."

eight ounces of the root and lower leaves of Aconitum Napellus, became very uneasy, breathed slowly and with difficulty, attempted to vomit, exhibited a depressed, irregular, and 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 ensure perfect quietude. The pulse was then found to be 56, and the respirations 12. The animal had a good appetite and regular evacuations. At 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 all 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 the patient unable to eat 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 till 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 hinder extremities as to be unable to walk except by supporting itself on its fore limbs and dragging the hind ones after it. It gradually recovered, however, in about two hours. In some other cases a drachm 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 are full of frothy mucus, which could not be dislodged, owing to the 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.

Among ruminating animals the action of aconite, when introduced into the stomach, is rather less prompt and powerful than in horses or dogs; and the late Professor Fleming found that the activity of aconite was sensibly 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. Emetics or the stomach-pump must then be promptly used to get rid of any of the poison that may still remain unabsorbed. The only chemical antidote of any value is tannic acid, which owes its efficacy to its forming an insoluble compound with the aconitine; but to be of service it must be used very promptly. By movements 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 congestion of the lungs may be somewhat relieved by moderate bleeding from the jugular.

Medicinal Uses.—For all the domestic animals aconite is a prompt and effectual sedative. In the first edition of this work, published in 1853, its use was strongly recommended. It has since found growing favour with veterinarians; but it still deserves more extended and general employment. Ten or fifteen minutes after a medicinal dose is administered, the number of the pulse-beats is often lowered by one-fourth, their force is weakened, vascular excitement is thus abated, elevated temperature is reduced, pain is assuaged. No sedative is so certain and successful in the earlier stages of pneumonia, pleurisy, or bronchitis; of enteritis, peritonitis, or laminitis; of acute rheumatism or weed: it is indeed the most effectual agent which veterinarians at present possess for controlling in their outset attacks of acute inflammation and fever, whether amongst horses or cattle. Mr. Balfour of Kirkcaldy for twenty-five years has advantageously used it in the treatment of contagious pleuro-pneumonia in cattle. Hard-worked horses exposed to a chill are frequently brought in with acute sore throat, scarcely able to swallow, feverish, with elevated temperature. A couple of doses of aconite, with inhalation of steam, and mustard externally, promptly abate the throat congestion and inflammation, as well as the accompanying constitutional fever. In enteritis in horses, Mr. Hill of Wolverhampton has repeatedly found that within five minutes after aconite tincture is swallowed the pulse falls 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.) Aconite cuts short and controls inflammation, and thence is specially serviceable in the outset of acute attacks. For the removal of inflammatory products other medicines must be used. Combined with a purgative, aconite often exerts a serviceable sedative and antispasmodic effect in cases of colic. In acute rheumatism it usually relieves both the constitutional fever and the local inflammation. In frequently repeated doses, I have found it of benefit in the outset of both forms of puerperal fever in cattle; and many 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 the 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 rather 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 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 British Pharmacopœia—Macerate $2\frac{1}{2}$ 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 the 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 fʒss. to fʒi.; for cattle about fʒi.; 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 about ♏ x.; for cattle, from ♏ x. to ♏ xx.; for sheep, ♏ ij. or ♏ iij.; and for dogs, from ♏ j. to ♏ ij. Whichever tincture is used, should be given in water or gruel, repeated at intervals of one or two hours, and may usually be persevered with until its desired effects are produced, or until five or six doses have been swallowed. Used hypodermically, less than half the above doses 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 or $\frac{1}{10}$th kills cats, the latter quantity in twenty minutes or half an hour; $\frac{1}{2}$ grain given to a shepherd's dog, weighing 20 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 causes 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. The alkaloid has been used in human medicine, especially as an external application, in the forms of alcoholic solution or ointment, and is so uniform in its strength, that, but for its expense, it would probably supersede all other preparations of aconite.

ALCOHOL.

Ethyl Alcohol. Spirit of Wine. Rectified proof and other Spirit, obtained by the 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 several forms of wines and spirits. The various alcoholic fluids are obtained, either directly or indirectly, from the fermentation of saccharine solutions ; in this country, from infusions of malt ; in most parts of the Continent, from the juice of the grape ; in Germany, from potatoes ; and in Jamaica and other rum-producing countries, from molasses. In such 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, carbonic acid, and water, as set forth in the following formula :—

$$\begin{array}{c} \text{1 Equiv. of Grape Sugar} \\ C_6\,H_{14}\,O_7 = \end{array} \left\{ \begin{array}{l} 2\ C_2\,H_5\,HO = \text{Alcohol.} \\ 2\ CO_2 = \text{Carbonic Acid.} \\ 1\ H_2\,O = \text{Water.} \end{array} \right.$$

Alcohol is believed to be the hydride of a basylous radicle ethyl ($C_2\,H_5$), and is hence sometimes termed ethylic alcohol. Ethyl forms various other compounds of medicinal value—namely, ethyl oxide $(C_2\,H_5)_2O$ or common ether ; ethyl nitrite,

$C_2H_5NO_2$, the etherous principle of sweet spirit of nitre; ethyl acetate C_2H_5, $C_2H_3O_2$, 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 the distillation be several times repeated, the fluid at 60° reaches the specific gravity ·825, which, according to the British excise, constitutes alcohol or pure spirit. It still, however, contains from 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. This *absolute* or real alcohol is a mobile, colourless fluid, with a spirituous odour, an intensely fiery taste, and a specific gravity of ·793. It is entirely volatile, boils at 173°, burns without producing smoke, becomes viscid at −166°, but has never been frozen; has a 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 aldehyd 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 the 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 Pharmacopœia, 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 methylic alcohol, CH_4O, obtained from the distillation of wood.

(See *Methylic Alcohol.*) This mixture, sold free of duty in quantities of ten gallons and upwards, 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 the distillation of the weaker wines, contains about 53 per cent of excise alcohol; *rum,* a fluid of about the same strength, is made by the 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 (density ·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 to the spirit 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, whilst distillation off 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, antispasmodics, cardiac tonics, and antiseptics. During their excretion from the body, they act as diuretics and diaphoretics. Carefully used in small doses, alcohol is a readily assimilable article of food. Locally, it is irritant and refrigerant. 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 produces increased vascularity, with heat, redness, and irritability; but these soon give place to diminished vascularity and sensibility. Similar characteristic opposing effects also occur when alcohol is taken in full doses internally; the general excitement first observed is followed by deranged and depressed action. It coagulates albumin, and destroys those organic germs which excite fermentation and putrefaction. It exerts similar effects by whatever channel it enters the body, whether injected into the veins, placed in the areolar textures, inhaled, or swallowed. Moderate doses, given by the mouth, increase the gastric secretions and aid digestion, but large doses and strong solutions destroy the pepsin, arrest secretion, irritate and inflame the mucous coat, and thus interfere with absorption. It has a high diffusion power, speedily becomes absorbed from the veins both of the stomach and intestines. It attacks the red globules, diminishing their power of giving off oxygen; rapidly acts on the nerves and nerve centres, especially on those within the cranium, inducing exhilaration and general excitement. The action of the heart becomes fuller and stronger; in health it usually gets quicker, but in weakness and disease, in which alcohol is beneficial, it generally becomes steadier and slower. The excitement caused by poisonous doses is quickly followed by imperfect automatic control, unconsciousness, gradual failure of the heart, and paralysis of respiration. The treatment in such poisoning cases consists in emptying the stomach by emetics or the stomach-pump, and warding off deadly stupor by keeping the patient moving about; by cold affusion and the cautious use of the magneto-electric apparatus.

There has been much controversy as to the dietetic value of alcohol. It contains no nitrogen, and hence it is not available for the building up of the albuminous 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, and when used in excess, 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 in febrile diseases this retarding of oxidation adds greatly to its value; undue tissue waste is checked; temperature is lowered; whilst in such circumstances alcohol is more readily digested and assimilated than most ordinary food.

On animal temperature, as in so many other of its effects, alcohol acts in a twofold way. Dr. B. W. Richardson's valuable experiments (*Cantor Lecture* for 1874) demonstrate that soon after a full dose has been given, concurrently with the early excitement stage, whilst the heart's action is increased, and the capillary vessels are relaxed, blood is driven to the surface, and a rise of external temperature occurs, 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 has taken place, amounting in birds to fully five degrees, in dogs, rabbits, and other animals to about three degrees, in man himself to two and a half to three degrees.

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 the motor functions. A like prominent disturbance of the motor functions—the prancing, striking with the feet, the unsteady gait, loss of co-ordination, dragging of the hinder extremities—is observed in horses and other of the lower animals. In fatal cases the stupor is sometimes broken by convulsions.

The effects of alcohol vary somewhat, according to the dose and degree of concentration. Whilst full doses produce a primary stage of excitement, with increased action of the heart and perverted motor function, followed by perverted and depressed reflex action, still larger doses exert a very rapid narcotic and sedative effect, 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 by Sir Robert Christison in his work on 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 about 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. Cattle and sheep, and indeed all ruminants, are less susceptible of its influence than dogs, or even horses; and Hertwig mentions, that when it is 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 a 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 regions. 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 sometimes terminating fatally.

As a diffusible stimulant alcohol resembles ether and ammonia, but is scarcely so evanescent. Compared with ether and chloroform it is less volatile, incapable of administration by the lungs, and hence having no general anæsthetic action. Moreover, its primary stimulant stage is more marked and prolonged; and 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 more slowly absorbed; their stimulating effects, consequently, are more slowly produced, and are also more lasting.

Medicinal Uses.—Few articles are more frequently and extensively used medicinally. In small repeated doses it is given to rouse or regulate weak or disturbed nervous power, and hence is useful in many cases of indigestion in stimulating gastric secretion, as an antispasmodic in colic, in arresting chills, in antagonising shock, and in combating the sedative effects of such poisons as aconite and tobacco. For many of these purposes it is advantageously conjoined with ammonia. It strengthens the action of the heart, dilates the capillaries, and thus diminishes arterial tension, and, in conjunction with warmth, for a time increases animal temperature. These properties recommend it in influenza, in debilitating disorders, and in convalescence from acute attacks. Under its influence appetite improves, the surface heat becomes normal, temperature is lowered, and the quick weak pulse is firmer and steadier. In many such cases advantage also results from the antiseptic properties of alcohol, and its notable power of controlling and diminishing tissue waste. In most colds and sore throat cases amongst hard-worked horses, when the pulse is quick and weak, the breathing quickened and embarrassed, the temperature over 103°, no treatment is so successful as a saline draught, a dressing of mustard to the throat, and a couple of ounces of spirits or a pint of ale or stout repeated every two or three hours. The following case of double pneumonia in a horse, communicated to me by Mr. Israel Print, illustrates the value of alcohol as a heart tonic and stimulant. The patient is seen after twenty-four hours' illness, his pulse is 100, scarcely perceptible, his respirations 52, his temperature 106°. He is ordered a wineglassful of whisky in a few ounces of water every two hours; gets a quart in the twenty-four hours. His pulse has then fallen to 84, his respirations to 46, his temperature to 104°. The spirit is persevered with for another twenty-four hours, with continued abatement of fever and distress, and the animal makes a steady recovery. In farcy cases, where the appetite is indifferent and the temperature at 105°, a pint of ale or a glass of spirits thrice a day, in conjunction with full doses of iron sulphate, improves the appetite, lowers temperature, 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. 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 the curative advantages obtained, and prevent the secondary depression apt to ensue, repeated doses at intervals of two to three hours are generally required. To the larger veterinary patients alcohol is frequently given in the form of spirits, ale, and stout; to the smaller, in the shape of wine. Given 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 the more 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 stimulant and refrigerant for bruises, wounds, and strains, it is used throughout Scotland in the familiar form of whisky-and-water; whilst a cooling lotion is made with an ounce each of rectified spirit, vinegar, and ammonium chloride, dissolved in a quart of water, and applied on a fold of lint. As a refrigerant in brain disease, ice is however 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, fʒij.; and dogs, about fʒj. The doses of whisky, brandy, ales, and wine, vary much according to the condition of the patient, and the purpose they are given to serve; but in exhausting disorders, they should be given in moderate quantity, tolerably diluted, at frequent intervals of one or two hours, and usually answer best given at meal times.

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 sorts of commercial aloes, are succulent plants, having short round 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. Underneath the leathery cuticle and thick cortical epidermis of the aloe leaf, and exterior to the loose mucilaginous pulp, lie parallel vessels 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 causes a mixture of the mucilaginous sap of the mass of the leaf with the cathartic juice, whilst 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; sword-shaped leaves, with hard reddish spines, a tough and leathery cuticle, with a light-brown parenchyma; and tubular yellow flowers. 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 the 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; the plants under good cultivation last for several years. The leaves are chopped off close to the stem, and placed in tubs with their cut ends down; from their 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 piece of shell let in, and secured in its place by a 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 cwt., 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 appearance of East Indian aloes are very variable. When of good quality it has a brown-red colour; in small fragments is red, sparkling, and tolerably transparent; its powder is reddish brown; its fracture more shining, and its odour less disagreeable than that of either Barbadoes or Cape aloes; its taste, like that of all the varieties, is bitter and nauseous. Spirit of the strength of sherry does not fully dissolve it, but leaves a fleecy 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. Sir Robert Christison and other good authorities are of opinion that much of the aloes sold as Socotrine consists 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 powder, which is of a golden-yellow colour, and almost entirely soluble in spirit of the specific gravity ·950, the strength of sherry. It is generally quoted at from £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 aloes 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.

He considered it to be the raw or unboiled juice of the plant, and proposed to call it Socotrine aloe juice. It 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 gray-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 from 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, it is 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, it causes equally copious but less watery discharges, whilst its 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 powder of a gamboge-yellow colour.

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 wants the compact structure of the better kinds; has a strong and disagreeably fetid odour; usually contains a quantity of 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 property. 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-gray 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—alöin, which is noticed more in detail at the end of this article; about the same proportion of an equally active, soluble, uncrystallisable aloin into which the crystallisable form is convertible by heat, much in the same way as uncrystallisable treacle is formed during the careless manufacture of crystallisable cane sugar. A pale-yellow, mobile, mint-flavoured volatile oil, of which an ounce only is obtained from 400 lbs. of aloes, imparts its characteristic odour. Besides mineral matters and albumin, aloes further contains about 30 per cent of a transparent brown resin, deposited from hot watery decoctions, seven-eighths of which is soluble in rectified spirit. This resin occurs in unusual amount in inferior samples, being formed at the expense of the aloin usually by exposure of the juice during inspissation to high temperatures, and has been found by Dr. William Craig of Edinburgh to possess little, if any, 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; repeated 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 emulsified 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 glycerin, and rolled in white tissue paper, were given to a horse, which, thirty-three minutes later, was killed by dividing the carotid artery. When examination was made an hour after the ball was entirely dissolved, a distinct odour of aloes was found in the stomach and duodenum, but had not 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. Being a foreign matter, 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 glandular apparatus covering the intestinal mucous membrane, induces there irritation and copious secretion, along with which it is poured into the canal, and especially, it is believed, into its more posterior parts. The increased peristaltic motion so obvious during the operation of aloes, and which so much enhances its purgative effect, is a reflex action depending on the irritation excited during the solution, absorption, and subsequent excretion of the drug. The augmented secretions render the fæces fluid, whilst the increased peristaltic motion accelerates their discharge.

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, 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. Aloes is believed specially to increase 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 all true 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 qualities 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 the activity of aloes by converting the active aloin 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 giving 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 acceleration of one or even two degrees in the animal temperature, a somewhat quickened pulse, and occasionally nausea, colic, and copious secretion of urine. This diuretic effect occasionally occurs even with good Barbadoes aloes, especially when the bowels have previously been much constipated, or otherwise out of order; whilst it is still more common with inferior specimens of Cape and other kinds, in which the aloin has been converted into resin. Combination with jalap, calomel, or other such 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 diet upon which the animal has been previously kept. A dose of four to six drachms generally operates in from sixteen to twenty-four hours. The degree and continuance of the action are also liable to considerable variation. In some horses, the 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 other anterior parts of the alimentary canal; on its acting particularly on the great intestines, which in such animals are neither very sensitive nor vascular; and on its chiefly operating by increasing the peristaltic motions, which are especially 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 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 the human subject or to the horse. 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 some 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. Many bad colic cases are relieved by conjoining with the aloes in solution thirty to forty minims of Pharmacopœia 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. 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. Often a dose of aloes allays the irritation of wounds and lamenesses. It is a valuable auxiliary in the treatment of inflammation of the brain, eye, lungs, pleura, absorbents, and joints, and in these and other such cases owes its efficacy to one or other of the following causes:—It clears the intestines of undigested food and other crudities, which often occasion much uneasiness, and aggravate the original disease; it removes from the blood many of those noxious matters which have been developed by disease, or accumulated there during its existence; it establishes extensive counter-irritation, and by reflex action promotes a healthier state of diseased parts. 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 bitter medicines, it is occasionally prescribed in weakness and relaxation of the digestive apparatus, where there is impaired secretion of bile, or tendency to the production 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 ʒij. to ʒx., the dose depending upon the rapidity and amount of catharsis required. For foals several months old, the dose may be readily ascertained by allowing grs. v. for every week of the patient's age. Cattle take ℥i. to ℥ij.; sheep, ℥ss. to ℥i.; dogs, grains xxx. to ʒiss. and swine, ʒij. to ʒv.

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 several 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, or glycerin. 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, appears to expedite the effect, and diminish nausea and griping. The ingredients are mixed over a slow fire, and constantly stirred until properly melted, great care being taken to prevent the temperature from 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 mass, less bulky than the last, 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 glycerin and a few ounces 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 a little glycerin, is a good purge for a large dog, and will make two doses for a smaller animal. Of the fluid preparations of aloes, 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 in preference to the crude drug. 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.

ALOIN.—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 Aloin (C_{34} H_{36} O_{14}, H_2 O). 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 Barbaloin, and to which he gives the name Nataloin (C_{25} H_{28} O_{11}). Still more recently an allied active neutral principle, more soluble than Nataloin, and separable in tufted acicular prisms, has been isolated by Histed, and received the title Socaloin (C_{34} H_{38} O_{15}, $5H_2$ O). A few particles of these three aloins are distinguished by Histed as follows :—A drop of nitric acid produces with Barbaloin a brilliant crimson which rapidly fades; with Nataloin a brilliant crimson which is permanent unless heat be applied; with Socaloin little effect follows. A drop of sulphuric acid similarly applied, and a rod dipped in nitric acid passed over the mixture, has no effect on Barbaloin or Socaloin, but develops with Nataloin a fine blue. Messrs. Smith prepare aloin as follows :*—Barbadoes aloes is powdered with sand to prevent agglutination, macerated in successive quantities of cold water, and the solutions thus obtained mixed and concentrated *in vacuo* to the consistence of a syrup. This, after being kept in a cool place for two or three days, becomes filled with minute brownish-yellow granular crystals of impure aloin, which is purified by drying between folds of bibulous paper, and by repeated solution in hot water, filtration, and crystallisation. Ultimately it is dissolved in hot rectified spirit, from which the pure aloin crystallises in radiating masses of 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

* *Paper on Aloin*, by Messrs. T. and H. Smith, in *Monthly Journal of Medical Science*, Feb. 1851.

aloin, 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. It is soluble in rectified spirit, but less so in cold water, an ounce of which dissolves about a grain of aloin. The solvent power both of water and alcohol is greatly increased by heat. Barbaloin is also dissolved by acetic acid and 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 aloin 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 aloin, when mixed, produce an abundant yellow precipitate.

Actions and Uses.—For upwards of twenty years aloin has been used with growing favour in medical practice, and with some practitioners it has entirely superseded aloes. The dose for an adult is 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 aloin, I administered drachm doses made up with flour and glycerin 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 aloin. No effect was observable on the pulse, temperature, appetite, or secretion of urine; the bowels were relaxed to a slight extent in two of the animals, when they were exercised twenty-four hours after receiving their ball; whilst in two of the subjects of experiment fulness and itching about the joints disappeared, although no sensible effect was observed on the bowels. Drachm doses of aloin conjoined with half an ounce each of gentian and ginger 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 aloin given to strong five and six year old hunters, well prepared by mashes for upwards of twenty-four hours, caused, in thirteen or fourteen hours, abundant fluid evacuations. Nothing notable was observed as to the pulse or temperature; there was less dulness and loss of appetite than usually accompany the full action of 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 the aloin 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 aloin on London horses, which are generally more susceptible to the action of physic than country patients. Five carriage horses, $15\frac{1}{2}$ to 16 hands high, prepared by mashes during two days, received two drachm doses of aloin, made up with ginger and treacle, and were purged with less dulness, nausea, and griping than attend the administration of full doses of aloes. In several cases the purging came on within twelve hours; full and fluid evacuations occurred; but there was less prostration and interference with appetite than usually attends 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 aloin, made up with ginger and treacle, and in eighteen hours were as fully physicked as if they had got six drachms of good Barbadoes aloes. As in the better bred animals, dulness, nausea, loss of appetite, tenesmus, and diuresis were looked for in vain. Mr. Dollar concludes that, comparing aloin with the crude drug, a little less than half the quantity acts in horses with more certainty and equal effect.

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 $1\frac{1}{4}$ lb. Epsom salt. English terriers, 20 lbs. in 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 aloin. 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, aloin 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. $NH_4\ Al\ 2SO_4 + 12H_2\ O$.

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 subsequently unites with the liberated 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 the 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, octahedral 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 white precipitates of aluminium hydrate with ammonium sulphide, and with 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.

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. Bourgelat 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 small and repeated doses of sodium carbonate, followed by demulcents.

Alum closely resembles zinc oxide and acetate, but is scarcely so active. It coagulates the albumin of the 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 by, kept up, and extended by a vital astringent action. The soft animal tissues are constringed, the calibre of their blood-vessels lessened, and secretion arrested. When swallowed, alum becomes absorbed, and these topical astringent effects are developed more or less generally throughout the body; 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 glycerin 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 slow poisoning by lead. 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 the irritation and hastens the healing of the blisters and ulcers of mouth and foot complaint. An injection is useful in ozœna, and a gargle in sore throat. 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 albumin, the soothing protecting coagulum is re-dissolved by excess of the alum.

Doses, etc.—Horses and cattle, ʒij. to ʒiv.; sheep and pigs, grs. xx. to ʒij.; 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. The burnt or dried alum of the Pharmacopœia 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 contract with growing plants nascent hydrogen is believed to be produced, and unites directly with gaseous nitrogen, supplying the ammonia so essential for plant food. (*Dic. de Mat. Med.* Merat and De Lens, i. p. 255.) 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. (*British Pharmacopœia.*) Purity is ensured 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. (*British Pharmacopœia*). 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 recently been successfully used in the preservation of fresh meat brought from America.

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 irritant; if respired, it violently inflames the throat and bronchi; in concentrated solution it is an irritant caustic poison; in medicinal doses it is stimulant, antispasmodic, antacid, antiseptic, diaphoretic, and diuretic; applied externally it is irritant 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 difficulty of 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). When injected into the veins, ammonia causes spasms, convulsions, and death, which usually occurs within a few minutes, and depends, according to Mr. Blake, on sudden arrest of the action of the heart. The most effectual antidotes are vinegar and other diluted acids, with diluents and demulcents. In tolerably concentrated form, whether swallowed or inhaled, it probably operates by reflex action, and acting on the sympathetic ganglia, stimulates especially the heart and general capillary circulation. As a stomach and general antacid, it is not so permanent and effectual as potash or soda. 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. They specially stimulate the heart; controlling and arresting irregular or inordinate nervous force, they act as antispasmodics; preserving putrescible materials out of the body, they probably exert a similar antiseptic effect in various blood disorders; preventing oxidation, they may further retard wasteful tissue-degeneration; stimulating the several channels by which they are excreted from the body, they increase the secretions of the lungs, skin, and kidneys, and in so doing aid in the removal of waste or poisonous matters from the body. The effects of ammonia, although readily and tolerably uniformly produced in all classes of animals, are transient. 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 has not such a destructive action on the tissues as the fixed alkalies.

Medicinal Uses.—Ammonia is beneficial in influenza, scarlatina, purpura, chronic bronchitis, and pneumonia: wherever, indeed, there is failure of the heart's action, cold extremities, or sudden depression of the vital powers. It relieves congestion of the lungs brought on by over-exertion or exposure. For all such purposes it may be both inhaled and swallowed. When given by the mouth it is usually conjoined with alcoholic stimulants. In chronic bronchitis, particularly in horses, ammonia inhalations, besides acting as general stimulants, lessen over-abundant secretion, but great care must be taken that the pungent gas is not used too freely or too concentrated. In indigestion, hoven, and tympanitis, its twofold action as a stimulant and antacid render it especially useful. Controlling irregular or inordinate nervous force, it counteracts the spasms of colic and epilepsy, and in the latter disease may be given by the mouth as well as cautiously inhaled. It is a valuable antidote in poisoning by prussic acid, opium, tobacco, and other sedatives. A few drops 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, by neutralising the formic acid, abate the irritation induced by stings of wasps, 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 disease 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 fʒij. to fʒvi.; cattle, fʒij. to fʒx.; sheep and pigs, fʒj.; 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 require to be given repeatedly, at intervals of two or three hours; on account of their pungency, they must be largely diluted with water, or, better still, with cold gruel or mucilage. A useful stimulant draught, either for horses or cattle, may be 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, but 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 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. For all classes of patients it is a most convenient ammoniacal compound, and is employed often advantageously conjoined with alcohol, 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 the puerperal apoplexy of cows. It frequently averts epileptic fits in weakly dogs.

Doses, etc.—Horses take ʒij. to ʒiv.; cattle, ʒiij. to ʒvj.; sheep and pigs, grs. xv. to grs. lx.; dogs, grs. iij. to grs. viij. It is given either in a bolus with linseed meal, or, better still, dissolved in gruel, which, to prevent the ammonia being volatilised, 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 fetid 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, adding some aromatic oil, as that of bergamot or lavender.

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, produce peculiar remote symptoms, believed to depend on some special action on the sympathetic or 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 stimulates the action of the heart and the secreting organs, exerts probably some solvent effect on albuminoids, diminishes solid matters in the urine, and proves of service in the second stages of inflammation. Being less actively stimulant, it may be used in cases where the liquor ammoniæ and carbonates 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. Dissolved in water or spirits, it is a favourite application for inflammatory swellings, bruises, and sprains. A good cooling mixture which will lower the thermometer from 50° to 10° Fahr. (Pereira) is made with four ounces each of sal-ammoniac and nitre, dissolved in eight ounces of water. For ordinary purposes six or eight times this amount of water may be used, and care must be taken in applying such freezing mixtures that they do not dangerously reduce the vitality of the part.

LIQUOR AMMONIÆ ACETATIS. An aqueous solution of ammonium acetate ($H\ N_4$, $C_2\ H_3\ O_2$). 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 British Pharmacopœia :—Reduce $3\frac{1}{4}$ 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 $2\frac{1}{2}$ 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 fʒij. to fʒiv, 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 the 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 throats; the addition of an ounce of sweet spirit of nitre or ether makes it more stimulating. Like the chloride, the solution of the acetate is sometimes used externally as a 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 sympathetic system. It produces similar effects whether inhaled, subcutaneously injected, or swallowed. Rapidly entering the blood, it combines with its oxygen-carrier, the hæmoglobulin; absorption and giving off of oxygen are impaired; the arterial becomes the same colour as the venous blood (Dr. Arthur Gamgee). When dogs or rabbits inhale it, the breathing becomes hurried and panting, the heart's action stronger, probably owing to the sense of impending suffocation rousing, by reflex action, the lungs and heart to increased effort; but this stage is very transient. Consciousness and sensation continue unaffected, but reflex activity and voluntary power are depressed. From paralysis of the sympathetic and vasomotor ganglia, and perhaps also owing to direct action on the muscular coat of the arterioles, there occur dilatation of the capillaries and diminution of arterial pressure. These effects and the special impairment of oxidation, explain the notable diminution of temperature which in dogs amounts to three or four degrees, and in rabbits has reached thirteen degrees (Dr. H. C. Wood, *Treatise on Therapeutics*). Death results from paralysis of the muscles of respiration.

It is prescribed in human patients in asthma, angina pectoris, and epilepsy, relieves most descriptions of spasm, has been effectual in tetanus, in experiments with rabbits antagonises strychnine poisoning. It is stated to act better when swallowed or given by subcutaneous injection than when inhaled. Dogs take ♏v. to ♏x. administered in spirit and water.

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 grayish-brown fruit, about the size of a small oat seed, is covered by minute hairs, encircled with ten light-coloured ridges, containing 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 has sometimes been 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), 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 an aromatic stimulant, stomachic and carminative. It is used to relieve indigestion and flatulence, to communicate an agreeable flavour to many medicines, and to diminish the nauseating and griping effects 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, about ℥i.; cattle, ℥i. to ℥ij.; sheep and swine, ʒij. to ʒiij.; dogs, grains xx. to grains lv.; 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 is too expensive for ordinary purposes as a carminative, but is used as a flavouring ingredient, especially for ball masses, and is useful for destroying lice, especially in pet dogs and other small animals.

Carraway, cardamoms, coriander, fennel, and fenugreec, resemble anise in their actions and uses, and may be given in similar doses. Small quantities of these seeds are much used in England amongst feeders of pigs, sheep, and cattle, and amongst waggoners and others, for improving the coat and condition of their horses. Fenugreec 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 patent "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 with water and a solution of an alkaline carbonate, to free it from adhering traces of chlorine and hydrochloric acid. The oxide thus purified is a grayish-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 British Pharmacopœia 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 gray or black antimony. When purified by fusion, it occurs in dark-gray, metallic, heavy, brittle cakes, or as a heavy, gray-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 the 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 perchloride, 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 ($Sb\ Cl_3$, $Sb_2\ O_3$), which, if washed, yields the sesquioxide. The true butter of antimony—a soft, gray, crystalline, fusible solid—is got by evaporating and then distilling the commercial solution.

Actions and Uses.—Although less used than formerly, the chloride solution is still employed as a caustic for 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, contains the bibasic tartaric acid united with one atom of potassium and one 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. 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 the 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. In dogs and other carnivora it is an irritant poison, and in medicinal doses an emetic, expectorant, cardiac sedative, and diaphoretic. It is still occasionally prescribed as an alterative and sedative for horses and cattle. In common with other antimonials, with arsenic and phosphorus, full doses repeated for upwards of a week disintegrate the albuminoids, and cause fatty degeneration. (*Centralblatt für die Med. Wiss.*, No. 18, 1876.)

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 (described under Emetics, p. 42) which, in periods varying from five to thirty minutes, expel the contents of the stomach. But a portion of a medicinal dose is also absorbed, and by a species of affinity 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 bronchial secretion—the explanation of the efficacy of small doses given to human and canine patients in the dry stages of catarrh and bronchitis. Full medicinal and poisonous doses, as in emesis, acting on the nervous centres, lessen the frequency and force of the heart's contractions ; arterial pressure is diminished, temperature lowered. The cut-out heart of a frog loses irritability with unusual rapidity when placed in a solution of tartar emetic, showing its direct effect as a cardiac sedative. (Ackermann and Wood.) 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 as is generally believed; 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.

The continued use of antimonials appears to cause 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. 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 given, efforts are immediately made to get rid of the drug by promoting vomiting, by giving warm demulcent drinks; tannin or oak bark solutions are administered to render any unabsorbed portion insoluble. 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.

But 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 the administration of three or four ounces given in solution. Quantities of half an ounce have no effect on horses, even when repeated three or four 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.

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

11th.—At 10 A.M. the pulse was 42, respirations 7, appetite and bowels quite normal. Got an ounce in a ball as before. In the evening the pulse was 40, no perceptible nausea, appetite good, bowels and kidneys regular. Dose of an ounce repeated.

12th.—In the morning the pulse was 37½, somewhat weaker than yesterday, but still firm. The appetite was very good, and there was no change in the state of the kidneys or bowels. Got a dose of an ounce. In the evening the pulse was 40, and the patient in other respects as in the morning. Gave an ounce, being five ounces six drachms in four days.

13th.—At 10 A.M. the pulse was 35, the appetite good, and the bowels and kidneys normal. About 11 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 same as in the morning, the respirations 6, the appetite and evacuations natural: gave fourteen drachms.

14th.—10 A.M. No change from last night. Got an ounce; but when having it put over, the animal ran back, and went down. At 1 she was raised, still continued to eat, and at 1.30 got another dose of an ounce. She remained down all day, and appeared nauseated. The pulse was not quite regular, probably owing to the 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 the 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 a 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 aconite tincture. On dissection, not a single morbid appearance referrible 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 destroyed a one-year-old sheep. The insusceptibility of horses, ruminants, and rabbits to the action of tartar emetic may probably be explained as follows:—their anatomical structure shows that they were not intended to vomit (p. 42); 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 antiphlogistic 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 intelligent and observant veterinary practitioners, both in England and Scotland, have now entirely abandoned its use amongst horses and cattle, and rightly consider it perfectly useless. It appears highly improbable that it can exert any therapeutic effect either in horses or cattle, since 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 any special vermicide action, it is sometimes given with Epsom salt, or other purgatives, as a vermifuge for horses; and the mixture is often tolerably effectual, from the smart purgation which tartar emetic induces when given along with a cathartic. In febrile and inflammatory complaints, when combined with other remedies, tartar emetic sometimes hastens their effects; for it favours vascular relaxation, and thus facilitates their absorption.

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. Under its influence, carbonic acid and urea are eliminated in increased amount, but whether from increased production, or merely from increased excretion, has not been determined. (Ringer.)

As an external irritant, it 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. The familiar antimonial wine is made by dissolving forty grains tartar emetic in a pint of sherry. Quantities of one grain or less, insufficient to produce vomiting, are used in these 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—the last mixture being with some practitioners 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 either of saturated watery solution or 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.

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 paun so extensively chewed in Eastern countries.

Actions and Uses.—Areca-nut is an effective vermifuge, especially for dogs, and proves destructive alike to tape and round worms. The bowels should previously be cleared out by any simple laxative, and their further emptiness ensured by several hours' fasting. The parasite, thus starved, greedily swallows the poison prepared for it. 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 the 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 a 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; whilst, 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 he 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 plant, 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 a cylindrical contorted brown root, one to three inches long, two or three lines thick, and marked with the scars of fallen leaves. All parts of the plant have a peculiar aromatic odour, an acrid, peppery, nauseous taste, and contain 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 irritant and stimulant. Viborg gave a horse 6 drachms of the infusion of the flowers, and noticed quickening of the pulse and diruesis. In infinitesimal doses it was a favourite homœopathic remedy before it was tried in veterinary practice. 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 *Mat. Med.*) Amongst the lower animals, it has been given as an alterative and stimulant in rheumatism, the secondary stages of pleurisy, weakness of the loins, and muscular strains; but Mr. Dollar, of New Bond Street, London, has, without benefit, tried it repeatedly in horses suffering both 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 used as a popular healing remedy in strains, bruises, and wounds, and especially in broken knees and sore shoulders. For such purposes an ounce of the tincture is dissolved in twelve to twenty ounces of cold water, and 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 the following prescription:—

Tincture of arnica	1 drachm.
Sulphate of zinc	2 drachms.
Water	10 ounces.

For painful or irritable wounds the tincture may be used 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 Anhyride. 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 ($Fe S_2 As_2$), 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 sweetish 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 ($M\ As_2\ O_3$). When the familiar sesqui- or tri-oxide ($As_2\ O_3$) is acted upon by diluted nitric acid, arsenic pentoxide, or arsenic acid, is produced ($As_2\ O_5$), which forms a series of arseniates, 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 tri-atomic metals as antimony and bismuth. (Roscoe.)

Special Tests.—Arsenic is readily discovered—(1) by sublimation producing the characteristic crystals of sesquioxide; (2) by reduction developing a distinctive mirror of metallic arsenic, which may be again oxidised; and (3) by chemical reactions in solution.

1. A few grains of arsenic, placed in a common test tube, and heated in a spirit lamp flame to about 380°, 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, 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-gray 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. Unlike the only

other yellow metallic sulphide, that of cadmium, the arsenic sulphide 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 the 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 one 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 the 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 encrusted, 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.

4th, A strong solution of caustic soda or potash, and a few pieces of clean zinc, are put into a test tube with the suspected fluid; over the mouth of the tube is placed a cap of filter paper moistened with silver nitrate; the contents are carefully heated nearly to boiling, avoiding spurting; arseniuretted hydrogen, produced as in Marsh's process, reduces the silver salt to the metallic state, leaving on the filter paper a purple black stain. This test, proposed by Fleitmann, is valuable, as the reaction is not developed with antimony salts.

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; is administered as an alterative and tonic; and applied externally as a stimulant, caustic, and destroyer of parasites.

General Actions.—It acts on all animals as a destructive poison. It causes irritation, inflammation, and sloughing of any mucous or abraded skin surface with which it comes in contact; is readily absorbed; produces, while it remains in the system, loss of appetite, emaciation, various nervous disorders, and depression of the circulation. Like other metallic bodies, retained for a time in the body, arsenic is said to be found chiefly with the red corpuscles (Ringer). It is removed by the stomach, intestines, perhaps also by the liver, and in large amount by the kidneys, irritating these execretory channels as it passes through them. It exerts its poisonous action with nearly equal certainty by whatever channel it enters the body. All its compounds are poisonous; and, as usual with other poisons, the most soluble are the most active. Arseniuretted hydrogen, the most deadly of its compounds, has occasioned the death of three chemists, who were so unfortunate as to inhale small quantities of it. Orfila found that the sulphides, in doses of forty to seventy grains, destroyed dogs in from 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.* Beissenhirz gave a horse one, four, three, two, and eight drachms, on successive days; but death occurred on the ninth day after the last dose.† Hertwig gave it to eight different horses, in doses beginning with 20 grains, but gradually increasing to a drachm. He continued the administration for thirty or 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 condition was sometimes improved.‡ Mr. William Percivall, experimenting on a horse affected with glanders, began with one drachm daily, made into a bolus with linseed meal and treacle; increased this dose by 20 grains per day, and continued the medicine for seventeen days. On the seventeenth day the animal got, in one dose, 380 grains, and had then taken upwards of seven ounces, or nearly half a pound, of arsenic. Yet no physiological effect was obvious, no loss of appetite, no uneasiness or pain, and no alteration of the pulse or respiration.§

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 of arsenic daily in the form of bolus, were attacked, one on the eighth and 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.|| These very different effects depend in part on varying susceptibility; 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

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

† Pereira's *Elements of Materia Medica.*

‡ *Praktische Arzneimittellehre für Thieraerzte*, Berlin 1847, p. 656.

§ *Veterinarian* for 1843, p. 347. || *Ibid.* pp. 349-351.

such changes on the coats of the alimentary canal as prevent in great part the absorption of the poison. Corroborating these views, it may be recollected that arsenic given in solution, as it should be when prescribed medicinally, is greatly more certain, regular, and active, than when used in the solid state. Thirty grains given daily, dissolved in potassium carbonate, destroyed a horse in four days.—(*Veterinarian*, 1843, p. 350.)

Mr. Baldwin, in the *Veterinarian* for January 1858, reports the case of six horses poisoned by drinking from a pail in which some arsenical sheep-dipping mixture had been made. 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 symptoms presented by the others were dulness, succeeded by colicky pains, the pulse 72 and wiry, extremities cold, visible mucous membranes highly injected, with active purging. 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* for Sept.) 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 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 in four hours. Rabbits have died from nibbling the bright green prize-cards. An aged donkey is recorded to have died, poisoned by 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; blunted perception; and death with convulsions followed in from six to thirty hours.

Arsenic produces similar effects both on pigs and poultry. Two grains in the form 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 in the body. A. Kossel gave sodium arsenite to dogs in doses of $1\frac{1}{2}$ to 3 grains for ten days, and found that the amount of nitrogen excreted rose even in inanition to 48 or 60 grains, and in 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 the administration of emetics; or, where these are ineffectual, as in horses or cattle, 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. It should be given as soon as possible, in repeated doses, at intervals of ten minutes, until a quantity at least twelve times greater than that of the poison has been swallowed. Some authorities recommend instead the precipitation of two to three ounces of iron perchloride solution with one ounce of the crystals of sodium carbonate; these quantities, freshly prepared, suffice to neutralise ten grains of arsenic, converting it into the insoluble iron arseniate (Fe_3 $2As$ O_4). 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, glycerin, mucilage, and milk, exercise a similar mechanical influence, and some of these bodies also slightly diminish the solubility of arsenic. For removing the remote effects of poisonous doses, opium and demulcents are freely given where inflammation is acute or diarrhœa troublesome; oleaginous laxatives and clysters, where there is constipation and griping; and in chronic cases, plenty of easily digested nutritive food to sustain the powers of life, with occasional diuretics, highly recommended by Orfila, and indicated by the fact that the kidneys are the chief channels by which arsenic is excreted from the system. Excretion also, however, occurs through the liver and alimentary mucous membrane.

Medicinal Uses.—Arsenic has no restorative action like iron, exerts no immediate neurotic effect like aconite or strychnine, but, like mercury and iodine, counteracts certain blood disorders. It is administered as an alterative, tonic, and antiperiodic, and a stimulant of the skin and mucous surfaces. It is chiefly serviceable in chronic rheumatism and neuralgia, in epilepsy and chorea, especially in dogs, as well as in eczema, psoriasis, impetigo, scab, and mange, in many of these skin complaints being fittingly used 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). Amongst horses I find it is sometimes serviceable in checking farcy, especially if used with iron; it relieves chronic irritable cough, especially when remaining after attacks of influenza and sore throat; and in such cases an ounce of Fowler's solution is united with an ounce of potassium chlorate and a drachm of belladonna extract, and made into a draught with water or gruel. It imparts tone to the relaxed nasal membrane in many cases of ozena. In dogs small repeated doses abate asthmatic symptoms, chronic cough, ulcerations in the mouth, and irritability of the stomach. It is stated to have some influence in warding off splenic apoplexy and congestive fever in cattle. In properly regulated doses it is safely persisted with until some of its earlier physiological effects are developed—until the eyelids are 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 throughout some portions 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 tumours; in solution it is employed for stimulating unhealthy ulcers, removing the scurfiness of psoriasis, poisoning the acari of scab and mange, and destroying other vermin 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 the solutions of tobacco, spirit of tar, and the 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. On inquiry in various parts of the country, I find that the usual allowance for a hundred sheep is two pounds of arsenic dissolved in a hundred gallons of water; but that 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. 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. For this end, a pint or two of naphtha, or a little impure carbolic acid, is also sometimes added. The ingredients are best dissolved in ten to twenty gallons of boiling water, and 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 amongst 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. Each 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 falling off of the wool 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.

On the other hand, in defence of Mr. Elliot, it was shown 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 passes through his hands several thousands of sheep without losing one, has for years employed $2\frac{1}{2}$ 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.

It seems therefore fair to infer that arsenical sheep-dipping mixtures are little liable to be absorbed through the healthy skin. The risk of using such dips 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 176 grains of arsenic,

—a quantity quite sufficient, if swallowed, to destroy eight or ten sheep. The sheep are turned out hungry, and at once begin to eat; and the drippings falling the while, 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. We can thus understand how the donkey, the two oxen, and the horses which died suddenly about the same time, 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. 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 all risk of dripping over.

Doses, etc.—Horses and cattle take grs. v. to grs. x: sheep, gr. j. to grs. ij.; and dogs, gr. $\frac{1}{15}$ to gr. $\frac{1}{10}$. To obtain its curative effects, it is usually necessary to give it for a week or longer. When it causes such physiological action as acceleration or hardness of the pulse, tenderness of the conjunctiva, indigestion, or diarrhœa, its administration must be carefully watched, and the doses somewhat diminished or remitted for a few days. With all animals, and in all doses, it is most active when administered in solution. 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 made with six grains to an ounce of lard is sometimes convenient for external use. 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 arsenic, every purchase 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.

ARTEMESIA.

Artemesia absinthium. Wormwood.
Artemesia maritima. The Santonica or Wormseed plant.

Nat. Ord.—Compositæ Corymbiferæ. *Sex. Syst.*—Pentandria Syngenesia.

The artemesia 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 Artemesia 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, present in the liqueur absinthe, and occasionally mixed with spent or inferior hops.

The unexpanded flower-heads of santonica, an undetermined artemesia, imported from Russia, contain a volatile oil, resin, and one to two per cent of a crystalline neutral principle santonin ($C_{15} H_{18} O_3$), used as a vermicide, without effect on tæniæ, but destructive to round and thread worms, 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 Affghanistan and the Punjaub, by incision from the living root of Narthex asafœtida. *British Pharmacopœia.*

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

The *Narthex asafœtida* has a long 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 a series of branches which terminate in a cluster 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. The 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; 3 to 5 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.

Actions and Uses.—Asafœtida is a mild diffusible stimulant, 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 mucous surfaces, the skin and kidneys, gently stimulating the excreting organs. 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 a vermifuge, but not very active. The two gum-resins, ammoniac and galbanum, are closely analogous to asafœtida, but scarcely so active, and are chiefly used for making charges and plasters.

Doses, etc.—Horses take ʒij. to ʒiv.; cattle, ℥ij.; sheep, ʒi.; and dogs, grs. x. to grs. xx. As its stimulant effects are transient, it requires to be given repeatedly, and is conveniently administered in a watery or alcoholic 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 sweetish 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 the 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 the 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 the sheep or ox—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, and 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 support of animal heat, or are stored away for investing and protecting important organs. Fats are emulsified 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 the digestive functions, 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 also applied externally as a simple dressing for ulcers and blistered surfaces, softening and protecting them from the action of the air, and of acrid discharges. It is sometimes effectual in removing mange and scab, and appears to act simply by preventing access of air to the minute 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 Pharmacopœia 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 albumin, 2 fatty matter, 2 saline matters, and 14 water. When moistened and exposed to a temperature of about 100°, barley begins to germinate; and if the process of germination be arrested by drying, the altered barley is converted into *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 other such glands.

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 yellowish-brown frothy scum, known as *yeast* or *barm*, the Cerevisiæ fermentum of the British Pharmacopœia, 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.

Deadly Nightshade. Belladonnæ folia. 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 Pharmacopœia 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 vasomotor nerves and adjacent ganglia, contracts the blood-vessels, and produces an increased 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. Full doses are excitants of the sympathetic nervous system; they immediately and notably stimulate the cardiac ganglia, and increase both the number and force of the heart-beats. They stimulate the vasomotor centres generally, contract arterioles, increase blood pressure, improve nutrition, and heighten temperature. 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, the vessels 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. Belladonna is prescribed as a stimulant of the heart and vascular system; it controls spasm, especially of the hollow viscera; it is excreted by the kidneys, acting as a diuretic and topical anodyne. Acting directly on nerve tissue and antagonising hyperæmia, it is applied locally for the relief of pain. Whether applied locally to the eye, or absorbed by any other less direct channel, it dilates the pupil.

General Actions.—Belladonna stimulates the sympathetic nerves and ganglia, and hence increases the activity of all the organs presided over by this system. Medicinal doses, within an hour, act directly upon the cardiac ganglia, increasing both the force and number of the heart-beat; but the pneumogastric terminal filaments being paralysed, inhibitory control is lessened. The respiratory centres being similarly stimulated, the number and depth of the respirations are increased; but circulation is earlier and more prominently acted on than respiration. The vasomotor centres are stimulated, as is well illustrated in the web of the frog's foot, in which, when moistened with a solution of atropine, the ramifications of the arteries are seen to contract, often to three-fourths of their former calibre, inducing such increased movements 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 relieved; nutritive changes are more rapid; temperature is elevated; excessive sweating is controlled. The secretion of the mucous membrane lining the nostrils, mouth, and fauces is checked, doubtless explaining the efficacy of belladonna in combating colds and sore throat. A like diminution of secretion occurs in the udder, and belladonna applications in garget have the twofold advantage of checking secretion of milk and relieving congestion. This power of arresting secretion does not, however, extend to the vascular system generally. Dr. John Harley considers that belladonna is a chologogue. 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 and delirium ensue. The excitability of the motor nerves and end-organs is impaired, accounting for the motor paralysis which follows the administration of large doses. The functions of the sensory nerves are not so much impaired as those of the motor. The involuntary muscles under control of the sympathetic system are notably acted on, and their spasms combated; but the voluntary are little affected by medicinal doses of belladonna. 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. Some of its actions, such as its combating pain and spasm, ally it 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. 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. A donkey ate a pound of the berries with equal impunity. Münch says that goats and sheep devour it with apparent satisfaction, and without any obvious harm. But Hertwig, experimenting on upwards of twenty horses, observed tolerably decided effects. He gave four to six ounces of the dry pulverised herb, with meal and water, in four separate doses, and within a period varying from four to eight hours. In four or five hours, and still more on the succeeding day, he observed dulness, languor, dilatation of the pupils, an uneasy look, and a feverish mouth. The appetite was gone, and digestion impaired, gas being abundantly evolved in the stomach and intestines. The pulse numbered about 90, was small, hard, and scarcely perceptible. The breathing was short, quick, and accompanied by flapping of the nostrils. The sensibility was slightly diminished, but there was no appearance of drowsiness. Some of the cases exhibited much abdominal pain; others, imperfect power of moving the hinder extremities; others terminated fatally in thirty to fifty hours after the 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.* 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 got dry and hot, and the gait tottering from inability to move the hinder extremities.

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

After some time the animals became rather 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 effects, but more pronounced and prolonged heart symptoms. Half an ounce of the ordinary watery extract is fatal to 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). 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. 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 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 to be removed by emetics or the stomach-pump. No good chemical antidote is yet known, but lime-water partially neutralises the atropine. Calabar bean is antagonistic in many other particulars, as well as in its action on the iris. Artificial breathing, and ammonia cautiously swallowed and inhaled, help to sustain the flagging breathing and circulation; opium in small amount quiets nervousness and restlessness; diuretics expedite the expulsion of the poison.

Medicinal Uses.—In influenza, scarlatina, and purpura amongst horses, in sore throat, bronchitis, and pneumonia in all classes of patients, belladonna imparts vigour and firmness to the weakened heart, braces up lax capillaries, combats congestion, and soothes excitability of the sympathetic nervous system. It directly antagonises the excessive discharges and irritability of catarrh and sore throat in horses. In such cases, whilst fever continues, it is used with aconite; in later stages with alcohol, ether, ammonia, or camphor. No other medicine gives such immediate relief, especially if used subcutaneously, in laryngitis in horses, in the roaring noisy respiration which accompanies some cases of epizootic sore throat, and in spasmodic cough. 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 in its effects 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. Amongst the lower animals excessive sweating chiefly occurs in horses overworked when in poor condition, but this, as well as profuse perspiration, depending upon general weakness, is abated by repeated doses of belladonna. In conjunction with purgatives, perfect quiet, and repeated doses of chloral, belladonna is said to abate the continued exhausting spasm of tetanus. In hydrophobia, epilepsy, and chorea, it is given without much success. During its elimination by the kidneys it develops its characteristic stimulant effect upon the sympathetic nervous system of the kidney and bladder, abating congestion and irritation, increasing the secretion of urine and the proportion of urea phosphates and sulphates, 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 those involuntary fibres of the hollow viscera which are under the influence of the sympathetic system.

Used externally, belladonna relieves irritable and painful wounds, the raw surfaces following frost-bite, the cracks of mud fever, over-sensitiveness of the skin and subjacent muscles.

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). In the form of an injection it allays irritation of the bladder and rectum, and counteracts 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 intraocular pressure, and 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. 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 all such purposes the most convenient form of application is a few drops of a four-grain solution of atropine dropped into the conjunctival sac.

Doses, etc.—Of the dried powdered leaves horses and cattle take about ℥ij.; 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 British Pharmacopœia process, which orders bruising the fresh leaves and young branches, gradually heating the juice, getting rid of albumin 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 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 composition, 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 plant or root is 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. 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 an 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, 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. were killed in three hours by $\frac{3}{4}$ gr. 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, 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. Atropine and Calabar bean are antagonistic as regards their action on the eye, but only partially so in their general effects. In a limited degree, especially as to the cerebral symptoms, atropine and morphine are also antagonistic. (*Report on 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).

A direct stimulant of the sympathetic nervous system, atropine, like belladonna, is prescribed as a heart stimulant, an excitant of capillary circulation, an antidote for nervous pain and spasm, a certain mydriatic, and occasionally as a diuretic. Its concentrated form specially adapts it for subcutaneous injection. In enteritis, nephritis, and other veterinary cases, this mode of administration commends itself 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 have as much effect as 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-tenth 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, and are often favourably exerted in enteritis in horses.

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 it 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, embedded 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. When of inferior quality, it is dark-brown or nearly black, and devoid of amygdaloid structure. Besides traces of volatile oil, moisture, and impurities, it 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 then decomposing the calcium benzoate. Some samples also contain as much as 10 per cent of the allied cinnamic acid ($HC_9 H_8 O_2$).

Actions and Uses.—Benzoin belongs to a class of mild stimulants and expectorants once much used in veterinary practice, and including storax and balsams of Peru and Tolu. It was formerly in high repute as a remedy for coughs, most pectoral complaints, and consumption; it is excreted mainly by the kidneys, part of the benzoic acid being converted into hippuric acid; but 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 stimulates foul sluggish wounds; with blood and albuminous fluids it forms an odorous coagulum which long resists putrefaction; as a healing agent it is used in the form of the Friar's Balsam, or of its pharmaceutical imitation, the compound tincture of benzoin, 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.* Ten grains of benzoin mixed with the ounce of lard constitutes the well-keeping benzoated lard used for making ointments.

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 potassium acid tartrate, it constitutes the soluble cream of tartar of the shops. When heated, the three atoms of water of crystallisation are driven off, and anhydrous vitreous boracic acid remains. (B_2O_3).

Actions and Uses.—Boracic acid is a non-volatile, unirritating, cheap antiseptic, similar in its uses, but less irritating than salicylic acid, and differing from carbolic acid in being neither irritating nor volatile. The antiseptic effects of boracic dressings, hence, do not extend beyond the spot to which they are actually applied, but as the antiseptic does not evaporate, they have the advantage of not requiring frequent changing. Boracic acid arrests fermentation and putrefaction. For surgical purposes it is used as a lotion, made with about one part of acid to twenty of water; as an ointment, prepared by melting one part of powdered acid with one part of wax and two parts of paraffin and of almond oil; and as boracic lint, made by soaking lint, cotton wool, or oakum in a saturated boiling watery solution, from which the acid crystallises, adhering to the fibrous material. Wounds, whether incised, lacerated, or contused, ulcers, or burns, are washed with the saturated watery solution, and where practicable, covered with several folds of the boracic lint, retained in position by bandages or plasters. Access of irritating germs, ever floating in the air, and the prolific cause of suppuration and putrefaction in wounds, is thus prevented; healing by first intention is favoured; wasteful discharges and bad smells are checked. In extensive wounds, where the tissues are seriously damaged and discharges are abundant, the dressing may require to be renewed daily, and the parts irrigated with carbolic or boracic lotion; or occasionally washed with zinc chloride solution, but after a few days, and in less serious cases from the beginning, the boracic dressings will not require changing for several days, and if they get dry, may be moistened occasionally with the watery solution. To the boracic lotion it often answers well to add a few grains of salicylic acid. Wounds treated in the first stages by the more active carbolic acid, when beginning to cicatrise, usually heal more rapidly if the more irritating carbolic is superseded by the milder boracic dressings. In ringworm affecting calves, and, alternated with zinc ointment, in the cracked and eczematous greasy heels of horses, boracic lotion and ointment prove useful. Being bland and unirritating, the solution, diluted as required, and used either tepid or cold, is a good antiseptic wash for raw, ulcerating, sloughing, noisome surfaces.

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; 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 fʒiv. 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. Any of these formulæ prove a convenient laxative 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 suffruiticose 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 or eserine (C_{30} H_{21} N_3 O_4) soluble in alcohol, chloroform, acids, and partially in water.

Actions and Uses.—Calabar bean is a depressor of the spinal cord. It paralyses the voluntary and subsequently the involuntary muscles, and kills by respiratory arrest, and in large doses by paralysis of the cardiac sympathetic (Professor Fraser). In all animals, and howsoever applied, it contracts the pupil. It does not affect the brain or special senses, and has little or no action on motor or sensory nerves. It closely resembles hemlock, differing from it, however, in contracting the pupil, in producing some amount of gastro-intestinal irritation, and lowering more quickly and decidedly the action of the heart (Dr. John Harley). It is the physiological opposite of strychnine, and also of chloral hydrate and atropine, which, when hypodermically injected at the same time, or shortly after a fatal dose of Calabar bean, successfully antagonises it. It has been given to human patients in tetanus, chorea, and epilepsy, and as an antidote in strychnine poisoning, but without any very encouraging effects. Professor Fraser believes, however, that the alkaloid, when injected subcutaneously, is one of the most effectual means of controlling the spasms and lowering the temperature in tetanus. In traumatic cases nerve-stretching should also be tried in horses. Dilatation of the pupil from affections of the third nerve is removed by a few drops of a solution of half a grain of alkaloid to the 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 alkaloid the dose for the larger quadrupeds is about gr. $\frac{1}{8}$; for dogs, gr. $\frac{1}{20}$; but half these doses suffice for subcutaneous injection.

CALCIUM AND ITS MEDICINAL COMPOUNDS.

Calcium Oxide. Lime. Quicklime. Calx. CaO.

When limestone, chalk, or marble, or any 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 grayish-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 60° 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 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 allied compounds of aluminium and magnesium. Lime salts further give a green tinge to flame.

Actions and Uses.—Lime is irritant, corrosive, desiccant, and antacid. It is a natural constituent of the animal textures, in which it probably 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 the hydrochloric acid, slowly absorbed as chloride, 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 the mucous and abraded skin surfaces, attracts water, forms a coating of carbonate, and in larger amount irritates and corrodes. Orfila mentions that $1\frac{1}{2}$ drachm administered to a little 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 the alkalies in its antacid properties, 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.

Slaked lime and lime-water are used as antacids in indigestion, hoven, and diarrhœa, especially among cattle. One-fourth or one-sixth of lime-water given with their milk often prevents indigestion, flatulence, and diarrhœa amongst young calves, probably by counteracting undue acidity, and the coagulation of the milk 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. Even where there is no indigestion, lime-water is often serviceable in ill-thriving calves and lambs. It is occasionally given as an antidote in poisoning by the mineral acids. By itself, but better still when conjoined with turpentine, it destroys bronchial filaria, often so troublesome in calves and lambs, and, as a clyster, brings away ascarides lodged in the lower bowels. Mixed with oil or glycerin, 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 solution, lime-wash is used for cleansing and deodorising foul stables, cow-houses, and piggeries.

Doses, etc.—Of quicklime, horses or cattle take ʒi. to ʒij.; sheep, grs. xx. to grs. xxx.; dogs, grs. v. to grs. xx. Of lime-water the larger patients take f℥iv. to f℥v.; and the smaller, fʒij. to f℥i., given alone, or with glycerin, oil, or milk. Two ounces each of lime-water and gentian infusion, repeated twice or thrice daily, check diarrhœa amongst feeble calves; half the dose answers for sheep. For calves and dogs, saccharated lime may be used as an antacid and stomachic. It is made by rubbing an ounce of slaked lime with two ounces of sugar, transfering 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 preparata of the Pharmacopœia. 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, but when such hard waters are heated, the carbonic acid gas is driven off, and calcium carbonate deposited in the kettles and boilers.

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 the air and the host of ferments suspended in it.

Doses, etc.—For horses, ℥i. to ℥ij.; for cattle, ℥ij. to ℥iv.; for sheep, ʒij. to ʒiv.; for pigs, ʒi. to ʒij.; for dogs, grs. viij. to grs. xij. It is conveniently given in a 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 and mild astringents:—For the horse, an ounce each of chalk, gentian, and ginger, made up in the usual way with linseed meal and treacle; or chalk ℥i., opium ʒi., creasote ♏xx., made up as before; or again, chalk, catechu, and ginger, of each an ounce, opium ʒi. For either horses or cattle these prescriptions may be given dissolved in ale; for sheep, similar combinations may be 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.

Calcium Phosphate. Calcis Phosphas. Phosphate of Lime. $Ca_3\ 2PO_4$.

Calcium phosphate is prepared by roasting bone earth until its animal and carbonaceous matter is removed, dissolving it in diluted hydrochloric acid, precipitating the phosphates by ammonia solution and washing. Thus purified, it is a light, tasteless, white, amorphous powder, insoluble in water, but soluble without effervescence in hydrochloric and nitric acids.

Actions and Uses.—Calcium phosphate is present in bones 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, and, conjoined with iron, is of service in those cases of anæmia and chronic diarrhœa so common in badly-nourished young cattle and sheep. 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 ʒi. to ʒij.; 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, $Ca\ 2Cl\ O + Ca\ Cl_2 + 2H_2O$, 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, gray-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. 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 chlorine and hypochlorous acid it so readily evolves.

Hertwig has given it to horses and cattle in doses of one ounce to two pounds; to sheep and goats in one to eight drachms; and to dogs in 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, an 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 about twenty or thirty minutes, and lasted from two to five hours. Considerable doses, when given repeatedly, did not impair the 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 from repeated and careful trials made at the Edinburgh Veterinary College, it appears to be 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. Notwithstanding its being so cheap and effectual a deodoriser, it has the disadvantage of a sickly smell, which is disliked both by horses and cattle; is gradually converted into calcium chloride, which, having a 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 compounds, greatly diminishes the agricultural value of any manure to which it is added. Scattered about the stables or cowhouses, it keeps away flies; whilst neither rats nor mice frequent places where it is sprinkled, especially when mixed with sulphur.

Doses, etc.—Horses take ʒi. to ʒij.; cattle, ʒij. to ʒiv.; sheep, about ʒi.; 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. Sys.*—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. Judging from experiments made by Sir Robert Christison, it probably yields about 1-500th of its weight of camphor, which is sometimes extracted by exposing the wood to dry distillation. In Formosa, whence comes most of the camphor imported to this country, the branches are steeped in water and boiled; the fluid is strained, and allowed to stand until it concretes; the crude camphor, with alternate layers of dry earth, is placed on copper vessels, over which domes are inverted, into which, on the application of heat, the camphor sublimes. On reaching this country, further purification is effected by mixing with a little charcoal, sand, lime, and iron filings, and re-subliming.

Properties.—Camphor occurs in concavo-convex masses, about 10 inches in diameter and 3 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 a little spirit, 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. It is the oxide of a hydrocarbon terebene ($C_{10}H_{16}$), present in chamomile, cardamoms, cloves, valerian, and other such oil-yielding plants.

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 a hydrocarbon, isomeric with oil of turpentine ($C_{10}H_{16}$). Artificial camphor is got by the action of hydrochloric acid on oil of turpentine.

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 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 doses of two ounces produced in horses convulsive movements and acceleration of the pulse, unaccompanied, however, by fatal results. Hertwig mentions that, when doses varying from two to four ounces are given to horses and cattle, two to four drachms to sheep, or one to three drachms to dogs, respiration and pulsation are accelerated, the breath acquires a camphoraceous odour, sensibility appears to be heightened, and convulsions supervene. 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 the 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 the nervous irritability of chronic cough, diarrhœa, especially in young animals, 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. In 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. 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 to allay the irritation of skin diseases, wounds, and articular rheumatism, as well as chilblains in human patients.

Doses, etc.—For horses, ℥j. to ℥ij.; for cattle, ℥ij. to ℥iv.; 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 emersion 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 a pair of 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 grayish-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, 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 solid volatile oil, 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 intestinal canal and urino-genital organs; medicinal doses are irritant, stimulant, and diuretic; external applications are rubefacient and vesicant.

General actions.—Cantharides primarily irritates and inflames any part with which it comes in contact. Absorbed and diffused, large quantities, after primary irritant effects, 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. In all the instances in which it was administered by the stomach, that organ was found much inflamed after death; and generally fragments of the poison were discernible if it was given in the form of powder. 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 the 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 sheepskins laid over the loins.

When cantharides is swallowed the active principle appears to be dissolved by the alkaline matters 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 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 only produced 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 effusion of serum in circumscribed spots betwixt the true skin and the epidermis, constituting vesicles or blisters. These usually appear in from 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 cicatrix. 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, causing 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. For the withdrawal of blood from distant parts, in other words, for acting as a revulsive, or 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.—When applied to skin surfaces, which overlie textures in a state of disease or pain, by reflex action, perhaps by some electric change in the impaired nervous tissues, it overcomes that dilatation and paralysis of the capillaries which occur in congestion and in the early stages of inflammation. In a later stage of inflammation, when many capillaries are occluded, by stimulation, it 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. 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. A like improved state of circulation of blood and nervous influence, probably also depending upon reflex action, doubtless occurs when blisters are applied 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; and either dissipates or brings to a head tardy abscesses, such as those met with in 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 inducing increased vitality, and determining reparative instead of destructive inflammation. For inducing these more permanent deep-seated effects, mercury 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 grs. ij. Repeated once or twice a day; usually given with aromatics and bitters, in the form of bolus or tincture; administration suspended if strangury or any untoward effects occur.

Cantharides is used externally 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 ensure 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, or resinóus ointment. 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 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 ten 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 British Pharmacopœia 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 ensure 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 induces 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 day after the blister has been applied, the part should be fomented with warm water, and dressed with oil, lard, or any simple ointment; 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, occupy a mediate place between ointments and tinctures. They generally consist of one part of cantharides, and from six to ten parts of 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 1843; 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 95°, 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 glycerin, oils, alcohol, ether, and acetic acid. It coagulates albumin. 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—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. Heated with ammonia in a sealed tube there results the celebrated aniline dye.

Carbolic acid is distinguished by its odour. An aqueous solution, even if containing one 1000th part, when treated with a drop or two of iron perchloride solution, produces a beautiful mauve colour. The British Pharmacopœia 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, is used in medicine and surgery as a stimulant and antiseptic, and is extensively employed as a disinfectant.

General Actions.—A strong solution applied to the skin or mucous surfaces acts as a topical irritant, coagulates albumin, 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, and in carnivora usually causing vomiting, it is readily absorbed, probably 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. 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, 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 caused 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, and high-coloured, smoky-smelling urine. Scabby sheep too freely dressed occasionally suffer from congested and inflamed lungs, linger for weeks, and even then die. Dogs are particularly susceptible, and even a single incautious dressing will produce 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 animal 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*). In many cases of poisoning from the dark impure acid, the active cresylic acid, which is largely present, shares the blame with the carbolic acid. Both poisonous and medicinal doses are excreted by the lungs and skin, but chiefly by the kidneys, deepening the colour 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, whitening of the mouth and fauces, and sometimes of the stomach; strong solutions leave patches of redness and inflammation in the stomach and small intestines; a smoky creasote odour pervades the body; the internal organs are congested; the vessels of the brain are full of fluid blood; serous effusion is generally observed on the surface and within the ventricles of the brain (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 will be combated by white of egg and mucilaginous drinks, 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.

The great value and manifold applications of carbolic acid depend upon its antiseptic power. It arrests as well as prevents fermentation, but for these purposes a larger amount is required than of corrosive sublimate; yeast treated with it fails to exert its familiar effects upon sweetwort; in its presence mould and other such fungi cannot grow, and, if already in existence, are speedily killed. Nor are large doses requisite to produce these effects: $1\frac{1}{2}$ per cent destroyed all organised life in putrefying solutions; putrefactive taint, and usually fungi as well, were prevented in solutions of meat or of bread and milk by $\frac{1}{250}$ to $\frac{1}{1000}$ of carbolic acid; butyric fermentation was arrested by $\frac{1}{230}$; peptonification of albumin by $\frac{1}{500}$; whilst alcoholic fermentation required 4 per cent (Plugge). Meat steeped for an hour in a solution of one per cent 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. Dr. P. Crace Calvert, in a series of comparative experiments, found carbolic and cresylic acids superior to acids, alkalies, chlorine, sulphurous gas, and other antiseptics, in preventing in albuminous solutions the development of vibrios and fungi, and in effectually destroying them in solutions in which they had been produced. Their power to preserve gelatin-containing solutions was not, however, so great. This antiseptic effect of carbolic acid does not result from oxidation or deoxidation, from the coagulation of albumin, from other chemical action, but from a special power of destroying germs, whether of vegetable or animal origin. Not only does carbolic acid destroy the lowly 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 simple animalcules, such as bacteria, vibrios, and monads, but creatures higher in the scale, such as fleas, moths, ticks, earth-worms, ascarides, and lumbrici. All the lower forms of life are quickly killed by solutions containing one part of acid to a hundred of water. Sprinkled on the doorway, it alarms and turns aside the advancing armies of ants which in some parts of Mexico cause so much annoyance and destruction. On the threshold of wounds it is found by Professor Lister to be 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 granular matter of its characteristic activity. Mr. W. Crookes' 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 which are given off during the progress of other catching diseases, are doubtless also destroyed when brought into contact with carbolic acid; indeed, no substance proves so generally serviceable as a disinfectant.

Medicinal Uses.—Destroying septic germs and preventing their formation, the administration of carbolic acid is evidently indicated in those diseases 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, as president of the commission appointed by the French Academy of Sciences to investigate the subject of 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 was twelve ounces each of carbolic acid and sodium bicarbonate, mixed with four fluid ounces of glycerin; the dose of the mixture being two table-spoonfuls thrice daily in a quart of water. 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. Two drachms given thrice daily to horses with farcy and glanders afforded only temporary benefits. It deserves further trial in checking 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 such contagious diseases, it probably checks the reproduction of the specific virus, and thus prevents or greatly 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.

Antiseptic surgery, recently reduced to a scientific system, and extensively applied by Professor Lister, has saved both men and animals an enormous amount of suffering, has prevented blemishing, conserved useful members, and expedited cure. For general surgical purposes, no antiseptic is so convenient and effectual as carbolic acid. Wounds, whether made by accident or by the surgeon's knife, at once freely irrigated with the carbolic solution, and kept covered with lint and other appliances well soaked with the antiseptic, heal rapidly without untoward results. The air, before reaching the raw surface, is filtered, as it were, through these antiseptic dressings, and deprived of those germs which are so prone to excite irritation, with its concomitants of undue exudation, degeneration, and suppuration. Blood and exudate from serious wounds immediately saturated with carbolic acid, and protected from irritating aerial particles, have no tendency to putrefy or develop those acrid foul discharges common in wounds treated in the ordinary way. Not only is the comfort and health of the individual promoted, but annoyance and injury to adjacent animals are also prevented. Portions of dead muscle, tendon, or bone, if they cannot readily be separated or extracted, when kept wet with carbolic solution and covered in by the carbolised dressings, are frequently mummified and cease to irritate. In this way fistulæ of the poll, withers, and lateral cartilages, carefully attended to and protected from the harmful germs which float in ordinary air, may sometimes be radically cured without operation. The cells of cancer, melanosis, and other malignant diseases, are also destroyed by the antiseptic. In serious surgical cases the fullest benefits of the antiseptic treatment are secured only when it is adopted at once. After twenty-four hours, often in less time, the irritating germs will have found entrance to the wound, and preservation and condensation of effused blood and serum will be impracticable. In such cases zinc chloride followed by water dressings is often preferable to the carbolic treatment.

Following Professor Lister's instructions, a wound, whether incised, lacerated, punctured, or contused, should as soon as possible be thoroughly washed with a watery solution containing one per cent of carbolic acid; any lacerated bleeding or envenomed portions may be irrigated with a stronger solution; where the wound cannot be securely covered up, it should be wetted several times daily with the one 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 direct contact of considerable amounts of carbolic acid, there is first applied a protective of oil silk varnished with copal and then coated with dextrine, which allows the silk to be uniformly wetted with the antiseptic dressing. Over this protective, or in ordinary cases directly upon the wound, are laid six or eight folds of coarse muslin imbued with a mixture of one part of crystallised carbolic acid, five of resin, and seven of solid paraffin (Professor Lister). To prevent undue evaporation of the volatile antiseptic, there is usually next applied a fold of hat lining—a light description of Mackintosh cloth—also wetted with the carbolic solution, and corresponding to the oiled silk of the familiar water dressing. Over this, and underneath the appropriate strappings, are placed a few folds, as required, of carbolised lint, tow, or oakum, like the other dressings applied wet, with from one to five per cent of the acid. Professor Lister sometimes also uses a plaster made with one part of crystallised carbolic acid and three of shellac, incorporated with soft cloth. When, after one or more days, the dressings require renewal, usually indicated by irritation or pain of the injured part, or by the discharge having extended beyond the gauze, it is most essential to the success of the antiseptic treatment, that, with an ordinary hand ball atomiser, or better still by a Siegle's steam atomiser, the raw surfaces so soon as exposed shall be kept wetted, and surrounded by a carbolised atmosphere, until again enveloped in their protecting dressings. To prevent the introduction of irritating germs, the sponges and ligatures, the surgeon's instruments, his hands, and everything brought into contact with wounds, should be moistened with a weak carbolic solution. No treatment answers better for badly broken knees, and for burns and scalds. Abscesses and bursal enlargements opened by an instrument wetted with the antiseptic, and at once covered in by the antiseptic dressing, heal up usually by first intention, and without wasteful discharge or irritating fever. Adhesion and obliteration of secreting sacks is further expedited by injection of a weak solution. An occasional dressing often promotes healing of farcy buds and ulcers. Overreaches, troublesome ulcers, and quittors, after being douched or injected with the watery solution, are covered with a few folds of carbolised lint or oakum, and when painful or irritable enveloped in a large bran poultice, also saturated with acid, and left undisturbed for one or two days. In conjunction with or after fomentations a strong solution is often serviceable in carbuncle of the coronary frog band occurring in hard-worked horses in wet cold weather. A five per cent solution usually answers well in foot-rot amongst sheep; but where, in chronic cases, reparative power is deficient, it is usefully alternated with turpentine and oil; or where granulations are abundant, by copper sulphate ointment.

The impure brown carbolic acid of the shops, or a strong solution containing more than one part of acid to six or eight of oil, glycerin, or diluted acetic acid, acts as a stimulant and mild caustic; has also been used as a rubefacient in scrofulous swellings of the joints and sore throat; and further exerts a benumbing or local anæsthetic effect sufficient to abate topical irritation, and enable abscesses to be opened with diminished pain. A five per cent solution in acetic acid destroys the epiphytic growths of ringworm, and is suitable for cases of psoriasis and prurigo, and also for eczema and lichen. In many of these skin cases it is usefully conjoined or alternated with preparations of zinc. Few remedies more rapidly remove the itching pain and swelling occasioned by stings of bees, wasps, and scorpions. In diluted solution, often in the form of M'Dougall's Sheep-Dipping Composition, it is used for the destruction of ticks, and of the acari of scab and mange, and has been favourably reported on by the Australian Government Commissioners appointed to investigate the cure and spread of scab in that colony. One part to ten of oil suffices for mangy dogs. Injections or spray are useful in atonic conditions of the fauces, uterus, or lower bowels, especially when accompanied by noisome discharges. Inhalation either with air or steam is commendable in malignant sore throat, nasal gleet, and unhealthy strangles abscess. Caution must, however, be had in using carbolic acid, whether by inhalation, injection, or as an external dressing; for it is liable, as above mentioned, to become absorbed; and if in considerable amount, develops its irritant narcotic properties.

As an antiseptic and 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 ensure 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. In large buildings, besides smearing the walls and woodwork with the crude brown acid, sheets wetted with it should be suspended here and there to catch floating particles of contagion. Along with carbolic acid, sulphurous acid or sulphites may be fittingly used. To neutralise the virus as it is formed, 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, will prevent, 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. In 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' 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 melted is best for internal use. It is made into a 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 glycerin. One part by weight of acid rubbed in a mortar with four of glycerin 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 linseed oil. For external purposes it is often usefully mixed with soap. On account of its comparative insolubility in water, simple aqueous solutions 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 loses strength unless kept in stoppered bottles.

SULPHO-CARBOLIC or SULPHO-PHENIC ACID ($H, C_6 H_5 SO_4$) 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 a 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 tasteless, a safe and useful internal antiseptic and alterative, and 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 cases of indigestion, diarrhœa, and dysentery. The iron salt acts as a tonic and antiseptic. The zinc and copper salts conjoin the antiseptic and astringent properties of their components. These sulpho-carbolates are excreted in the urine, and so effectual are their antiseptic properties that the urine of animals receiving medicinal doses has been kept by Dr. Sansom for six months without undergoing putrefaction.

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 ($C_{12}H_{18}O_4$).

Actions and Uses.—Cascarilla is an aromatic and bitter tonic, resembling cinchona, but less active. It is occasionally used for the several domesticated animals in indigestion, diarrhœa, and convalescence from exhausting diseases.

Doses, etc.—For horses, ʒij. to ʒiv.; for cattle, ℥i.; for sheep and swine, ʒi. to ʒij.; 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 Palmi 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 from four to 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 officinal part 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 albumin, 18 of cellulin, 2·4 of sugar and mucilage, and a small quantity of an acrid purgative principle, which has not been isolated, and mostly remains after the expression of the oil. Professor Tuson, of the Royal Veterinary College, London, exhausting the seeds with boiling water, extracted a crystalline substance, devoid of 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 albumin are got rid of by heating the expressed oil with boiling water, and straining it through flannel. In America, the seeds, deprived of husk, are exposed to gentle heat, in order that the oil may be more readily expressed; the crude oil is freed from mucilage and albumin by boiling with water until perfectly transparent when cool; 25 per cent of best oil is thus got from the seeds. 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). The 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 glycerin, palmitic acid, and the special ricinoleic acid ($HC_{18}\,H_{33}\,O_3$).

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 rarely causes griping, and increases the peristaltic motions as well as the secretions of the intestines. It may usually be observed in oily flakes amongst the dejections, giving them a glazed appearance. When injected into the veins of man, it causes laxative effects, and produces in the mouth the same disagreeable oily taste as when swallowed. In the horse, castor oil, like other oleaginous substances, is not very certain or prompt in its effects, and is seldom to be recommended where a speedy or full purgative effect is desired. In cattle and sheep its action is more to be depended upon; but in these animals, especially in cattle, it is generally superseded by linseed oil, which is similar in its action, and less expensive. 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 preferable to the castor oil alone. Its occasional action 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, or some aromatic.

Acting without 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, and wherever more drastic purgatives might unduly irritate. Its anthelmintic effects have sometimes been over-estimated, are in reality slight, and entirely dependent upon its purgative action. In cattle practice it is not very active when given alone, but proves useful in diarrhœa and inflammation of the digestive organs. United with Epsom salt, in doses of half or three quarters of a pound of each, it produces prompt and certain effects. For young calves it is the best of purgatives. It proves a safe and easy purge for dogs and pigs. The bruised seeds are much used by the native Indian farriers for the cure of mange; and Mr. Thomas Pritchard, V.S., of

Madrás, informs me that two or three dressings usually suffice to remove the disease. As a clyster, it is generally superseded by linseed oil. As an external demulcent, it is unsuitable on account of its tendency to become rancid.

Doses, etc.—The castor oil seeds are conveniently given to the dog or pig to the number of six or eight, triturated with linseed meal, and made into a bolus, or rolled in a piece of meat or such other food. The dose of castor 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.

CATECHU.

An aqueous extract of the leaves and young shoots of Uncaria Gambier; of the wood of Acacia Catechu; and of the kernels of Areca Catechu.

Three different plants yield the catechus of commerce and medicine: the Uncaria Gambier, a stout, climbing shrub, belonging to the natural family Cinchonaceæ, inhabiting the islands of the Indian Archipelago, and yielding the pale catechu, gambier or terra japonica; the Acacia Catechu, an East Indian leguminous tree, fifteen to twenty feet high, yielding the black or brown catechu; and the Areca Catechu, or betel-nut tree, a tall, beautiful palm, with a fibrous fruit, containing the astringent seed or betel nut (p. 171). Similar processes are followed for the extraction from these different sources of the catechu (*cate*, a tree, and *chu*, juice.) The leaves, young shoots, or seeds, are bruised, or the wood cut into chips, and 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.

Pale catechu (Catechu pallidum) occurs in yellow-brown cubes, with faces about an inch square; and sometimes in masses made by the aggregation of these cubes. It has a bitter astringent taste, with a sweet after-taste, is free from grittiness, is without odour, soluble in alcohol and ether, partially soluble in cold water, almost entirely dissolved by boiling water, with which it forms a red-brown solution. It consists of about equal portions of catechu-tannic acid, soluble in cold water, and of catechin or catechuic acid ($C_{13} H_{12} O_5$), deposited from a boiling watery solution in acicular crystals, soluble in ether, and divisible into two astringent principles.

Black or brown catechu (Catechu nigrum), or cutch, comes chiefly from Bengal and Burmah, in masses weighing about a hundredweight, and made up of layers of small pieces of two to four ounces, enveloped in glaumes or husks of rice. Besides being darker coloured, it is more bitter and astringent, and dissolves in the mouth more slowly than the best pale catechus. Like them, it owes its value for tanning and medicinal purposes to the presence of tannic acid and catechin.

Actions and Uses.—Catechu is astringent. Like other tannin-containing substances, it combines with the gelatin and albumin of the tissues, lessens their calibre, and diminishes their solubility and tendency to putrefaction. Hence its value in the preparation of tanno-gelatin 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 a 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, ℨi. to ℨiij.; for cattle, ℨij. to ℨvi.; for sheep and swine, ℨi. to ℨij.; and for dogs, grs. iv. to grs. xx. These doses are administered three or four times a day, with a 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 single, or Scotch, contain more oil, and hence are more active than the double, or English. Both 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 one to two per cent of an active volatile oil, usually got by distillation of the whole plant, of a blue or green colour, gradually becoming yellow, and containing a hydrocarbon isomeric with oil of turpentine, present in cardamom, caraway, and other aromatics, and associated with it an oxidised portion ($C_{10} H_{16} + C_5 H_8 O$).

Actions and Uses.—Chamomile flowers are mildly stimulant, aromatic, tonic, and stomachic; 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 a purified animal charcoal is required, and 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 deodoriser, and much 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 is ready to decompose and deodorise any 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, is deprived of odorous and harmful particles if passed over trays of charcoal. It also absorbs the colouring particles of organic substances filtered through it or boiled with it. Solutions of brown sugar, passed through a layer of charcoal, are decolorised. Drinking water, filtered through it, is deprived of organic impurities. Urine, heated with it, parts with its 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 retards putrefaction. It does not, however, like carbolic acid, zinc chloride, or other powerful antiseptic, effectually arrest putrefaction when once it has begun; but it merely condenses in its pores any septic or noxious particles given off. Being fixed, it has not such a wide and effectual range of action as a volatile agent like carbolic acid, to reach or destroy floating germs of contagion. Being insoluble in water, charcoal, when swallowed, exerts only topical effects. It checks fermentative changes, and lessens the 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, and is sprinkled by a dredger either directly on the unhealthy surface, or mingled with poultices.

Doses, etc.—For the horse, ʒiv. to ℥i.; for cattle, ℥i.; for sheep and pigs, ʒi. to ʒiij.; 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; and since then upwards of fifty tons of it have been manufactured, or sufficient for some thirty-six million doses!

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 (C_2HCl_3O) is purified by distillation with sulphuric acid, and when mixed with water becomes the solid hydrate (C_2HCl_3O, H_2O), 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, in alcohol, ether, petroleum, and oil of turpentine.

The caustic alkalies, with ammonia, and in a less degree, the alkaline carbonates, decompose it with evolution 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. Applied locally, it is irritant, and hence, when swallowed, sometimes causes vomiting and purging. 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 $1\frac{1}{2}$ to 2 grains; mice by one-third of a grain; rabbits, weighing 85 ounces, by 30 grains (*Medical Times and Gazette*, vol. xi. 1869). 180 grains produce fatal effects in man, but dangerous symptoms have occasionally been developed by one-fourth of that amount. Mr. T. A. Dollar, of New Bond Street, gave a horse suffering from spasmodic colic two ounces in water; the spasms were speedily removed, but for twelve hours the patient remained very dull and 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 in great part exhaled unchanged 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). Moderate doses act primarily on the brain and motor centres, producing natural sleep. Somewhat larger doses, with only occasional and slight over-excitement, depress the functions of the cerebro-spinal axis, causing slower respiration, slower, weaker heart action, probably vasomotor paralysis, leading to general relaxation of the arterioles, and consequent lowering of temperature to the extent of three or four degrees. In a rabbit Dr. Richardson observed a depression of 6°. Still larger doses cause narcosis and anæsthesia, paralyse the respiratory centre of the medulla; respiratory movements cease; the heart's action is arrested.

Chloral hydrate resembles opium in its hypnotic and anodyne properties. Although more effectual in paralysing involuntary muscular fibre, it is not so useful in antagonising pain, 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 aldehyd, 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 the best 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 a wonderful effect in soothing the irritability, and quieting the maniacal tendencies of insanity in man, it may prove useful in the more chronic cases of phrenitis in 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 also antagonistic to Calabar bean; 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. A five per cent aqueous solution of chloral hydrate relieves itching of the skin in horses and dogs, removes scurf, and favours growth of hair. 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. xxx.; 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. Injected hypodermically, 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 injection in human patients. The narcotic paralysing effects of overdoses are combated by the free use of ammonia and alcohol, by the hypodermic injection of 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 the mixture 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. The irritation of the imperfectly diluted gas is counteracted by inhaling ether, 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 the bronchial filaria of calves and lambs. When a considerable quantity of the gas is to be cheaply evolved for the breathing of 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. The destruction of these bronchial parasites is effectually accomplished by the less irritant sulphurous acid gas, or by a drench of oil of turpentine. The liquor chlori diluted is occasionally used as a stimulant antiseptic and deodorant.

The bleaching, antiseptic, and other properties of chlorine 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 red within and unchanged, at the end of twenty-eight days. Dr. G. 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 the 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 the 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. Terchloride of formyl. $C\,H\,Cl_3$.

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 British Pharmacopœia 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) the evolution of oxygen and chlorine from the chlorinated lime; and the reduction of alcohol into aldehyd; (2) the formation of hydrochloric acid and trichloraldehyd or chloral, by the action of the chlorine; and (3) the 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.) $C_2 H_6 O + O = H_2 O + C_2 H_4 O$ (Aldehyd).
(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 $\frac{1}{200}$th 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 generally regarded as the chloride of the triatomic radicle methyl ($C H_3$); marsh gas is the hydride ($C H_3 H$)

methylic or wood spirit the hydrate or alcohol ($C\ H_3\ H\ O$ or $C\ H_4\ O$). Other anæsthetics belonging to this series have already been referred to (p. 83). 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. It is irritant, irrespirable, and in its actions resembles iodine and its salts.

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 spec. grav., causes cloudiness at temperatures approaching 32°. Any 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 paralyse and narcotise the cerebro-spinal nervous system, by whatever channel they enter the body; 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; it is applied externally as a rubefacient 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 rapidly 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*, 6th 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 a 56th 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 hinder 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. 83), 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 instantly be 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 galvanic current applied over the phrenic nerve has been advised; but, if used at all, it must be with the greatest caution.

Death usually results from the 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.

Chloroform bears favourable comparison with other anæsthetics, 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. Smaller quantity is required than of ether; its effects 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 lives of six persons in every hundred subjected to surgical operations. With proper precaution, it is a very safe remedy. 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 assistant 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 the 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 the administration of the chloroform. In diseases accompanied by violent exhausting pains, as 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 pleuro-pneumonia of cattle. Small doses, either inhaled or swallowed, frequently arrest epileptic fits in dogs.

When swallowed, it proves a useful antispasmodic in all animals, in colic, asthma, and troublesome cough. After epizootic sore throat, horses sometimes have violent spasmodic coughs, which are greatly benefited by diluted chloroform or chloric ether, given in ounce doses, with a drachm of belladonna extract, dissolved in about a pint of cold linseed gruel, and swallowed very slowly, so as to insure more prolonged topical effect. 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; and, mixed with a little spirit, 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.

Doses, etc.—It is somewhat difficult to fix the precise quantity of chloroform necessary to produce anæsthesia. Two or three ounces are generally effectual for horses or cattle, one to two ounces for sheep and pigs, two to four drachms for dogs. The 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 sponge saturated with chloroform in a nosebag, 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. Whilst anæsthesia continues, the respiration, the pulse, and the reflex sensibility of the conjunctiva must be carefully watched. If an undue effect be produced, the inhalation must be immediately stopped, free access of fresh air allowed, water thrown over the head and neck, and artificial respiration 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. Chloroform is a solvent for gutta percha, and the solution is occasionally employed as a substitute for collodion.

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 cool fluid, it is prescribed for horses in doses of f℥i.; for cattle, f℥ij.; for sheep and pigs, fℨij. to fℨvi.; and for dogs, fℨi. to fℨij. Conjoined with opium, its effects are intensified and increased, and it 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 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 beautiful fragrant flowers. They abound on the slopes and valleys of the Andes; extend from about 10° N. latitude to 19° 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 eight 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; 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 usually packed in 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 into 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 gray 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 the 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, and red-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. 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. For mixing with the superior pale, yellow, and red barks, inferior sorts, such as ash, rusty, and Carthagena bark, are collected. The tests of the value of any specimen are its general appearance, fracture, colour, odour, taste, and percentage of the alkaloids, which are the active principles of the bark.

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 kinic 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 ($C_{20}H_{24}N_2O_2, 3H_2O$) 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. 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 precipitate is thrown down; precipitates are also 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).

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 as powerful as quinine. An alkaloid has been isolated from C. succirubra allied to quinine, and termed quinamine.

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 accidulated 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 the mineral acids is used in the 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 about as active, they deserve the attention of veterinarians.

Kinic 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 benzol and benzoic acid, which it resembles in its action, and when taken internally it is excreted by the kidneys as hippuric acid. Kinovic or quinovic acid, probably a modified condition of kinic acid, forms tasteless, insoluble, hexagonal scales.

Cincho-tannic acid ($C_{14} H_{12} O_7, H_2 O$), 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, gelatin, and tartar emetic. Alkalies convert it into cinchonic red.

Cinchona red, or cincho-fulvic acid ($C_{12} H_{14} O_7$) is an amorphous hygroscopic insipid colouring matter, partially soluble in water, more soluble in spirit, and forming an intensely red solution with alkalies (Royles' *Mat. Med.*, 6th edition).

Actions and Uses.—Cinchona bark is an antiseptic and topical astringent. Full doses of the bark or its alkaloids produce symptoms of nausea, giddiness, and delirium, 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 kinic acid, allied to benzoic acid; but its special tonic and antiperiodic virtues are due to its alkaloids.

General Actions.—The bark, and in still greater degree, its alkaloids, have valuable antiseptic properties. Quinine is scarcely inferior to carbolic acid, arsenic, corrosive sublimate, or strychnine, in its power of arresting fermentation and putrefaction, and destroying fungi and other vegetable and animal organisms. One part in 300 preserves meat, butter, milk, and wine, and prevents the formation of acid in blood, even when exposed for a considerable time to the air. Diluted even with 800 parts of water, it prevents fermentation, destroys fungi and infusoria, and arrests the movements of vibrios and bacteria. It is readily absorbed and diffused, and slowly excreted by the kidneys unchanged, excepting that it is reduced from the crystalline to the amorphous form. The manner in which its curative effects are produced is still a matter of speculation. Professor Binz, of Bonn, arguing from its effects outside the body, teaches that it hinders the hæmo-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 it attacks and destroys the special germs or unstable albuminoids liable to degenerate change (*Practitioner*, Dec. 1876 and August 1877). Dr. John Harley does not consider that these ingenious conclusions are established. The oxides of carbon, which notoriously reduce the oxidising function of the blood, produce coma instead of delirium, are devoid of tonic and antiperiodic properties, and increase the uric acid excretion, instead of diminishing it, as cinchona does. 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 the vasomotor nerves; they produce cinchonism by their direct effect on the nerve vesicle; their beneficial influences, he adds, "are seen in those cases where, so to speak, the nevous system is unstrung—where, from sheer debility and relaxation of the nerve vesicles, the nerve currents are jarring and painful" (Royles' *Mat. Med.*, 6th ed.) Its stomachic and tonic properties ally cinchona with calumba and beebeeru 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 (Sir Robert Christison *on Poisons*).

Medicinal Uses.—Cinchona bark is prescribed for all animals as a vegetable tonic. Along with gentian, hydrochloric acid, and a little spirit, I often use it for young calves that have suffered from diarrhœa. It counteracts that relaxed over-secreting state of mucous membrane, which affords a favourable nidus for worms; it checks other inordinate mucous discharges depending on defective tone; and is useful in passive hæmorrhage, convalescence from debilitating complaints, consumption, and other forms of scrofula, diabetes, glanders, and sheep-rot. In these last two diseases, although, like other tonics, a valuable palliative, it is not, as some have considered, a perfect cure. Its antiseptic virtues lead to its use in cases of septic poisoning, as in purpura in horses, in puerperal metritis in cows and ewes, and in pyæmia. Its antiperiodic properties recommend it in intermittent fevers, in chorea in dogs, in periodic ophthalmia or moon blindness in horses, in which it is highly extolled by French veterinarians, and in rheumatic affections both of horses and cattle which occasionally exhibit considerable periodicity. To arrest such intermittent attacks, a full dose should be given four or five hours before the seizure is anticipated. It is contra-indicated in inflammatory attacks, and where the stomach is irritable and the bowels constipated. It is occasionally used externally as an astringent and antiseptic.

Doses. etc.—For horses, ʒij. to ʒiv.; for cattle, ℥i. to ℥ij.; for sheep and pigs, ʒi. to ʒiv.; for dogs, grs. xx. to ʒi.; 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 all the 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 its 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 seven of water of crystallisation ($2\ C_{20}\ H_{24}\ N_2\ O_2,\ H_2\ SO_4,\ 7\ H_2\ O$).

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 equally effectual, are the most powerful and certain of vegetable tonics, and are active antiseptics and antiperiodics. Their expense alone precludes their more extended use in veterinary practice. They are suitable for all animals suffering from loss of appetite, weak digestion depending on debility; convalescence from acute complaints; or chronic exhausting diseases. They are prescribed for horses in 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 is used in the same doses; cinchonine in double the quantity. These doses are repeated thrice a day; and when given as a tonic 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 endeavour to combine the good results of the best mineral and best vegetable tonic by administering the 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. Good samples 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 olein and 15 per cent of palmitin, united with propyl, a substance allied to glycerin; small portions of cholic and butyric acids, and other biliary matters; acetin, a compound of acetic acid and glycerin; less than one-half per cent of phosphorus, iodine, bromine, and chlorine, with phosphoric and sulphuric acids, lime, magnesia, and soda (Royles' *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 a source of heat and of force, nourish the nervous and other organs, increase intercellular fat, and usually add to the patient's weight.

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 induced a decided improvement in 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 itself 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 the speedy and economical fattening of animals. They do not, however, suffice to establish the individual superiority of cod-liver oil. Equally satisfactory results might have been obtained from the use of linseed, lard, rape, or other mild fixed oils.

As a nutrient tonic, cod-liver oil, in human patients, is, however, preferred to other oils, mainly on account of its readily assimilable nature,—a property probably depending upon the biliary matters associated with it. It is extensively prescribed in debilitating and chronic complaints, accompanied by faulty nutrition, in the several forms of scrofula, in epilepsy, chorea, and various nervous disorders associated with weakness. It may be advantageously given to dogs and cats in scrofulous disorders, protracted cases of distemper, inveterate skin disease, epilepsy, chorea, and chronic rheumatism, especially that variety known as kennel lameness, and depending upon damp, bad feeding, and faulty nutrition. I have given two-ounce doses twice daily to delicate horses, thriving badly after influenza and strangles. It helps the 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.

Doses, etc.—Horses take f℥ij.; cattle, f℥ij. to f℥iv.; sheep about f℥j.; pigs, fʒiv. to f℥i.; dogs, fʒi. to fʒiv.; cats, about fʒi. 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 or gruel, beat up with an egg, conjoined with some aromatic, mixed with lime water, or better still, with ether, and swallowed 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 on 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, which is 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 their 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 grayish-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 an irritant and sedative; medicinal doses are emetic, cathartic, diuretic, diaphoretic, and sedative. It nearly resembles the other Melanthaceæ, Veratrum album, V. viride and cevadilla, and is allied to aconite, which develops, however, sedative actions, without the objectionable irritant effects.

The powdered corm, 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. In men and dogs colchicum is even more active than in horses or cattle. 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*). The emetic and cathartic effects of colchicum are violent and irregular; and its diuretic action is uncertain. Its sedative influence, best developed by the administration of small and frequently repeated doses, conjoined with alkalies or salines, caused its recommendation by the late Mr. Hallen, 6th Dragoon Guards, and by Mr. Phillips, 7th Hussars, in the treatment of rheumatism and rheumatic influenza, especially in those subacute cases in which the inflammation flies from joint to joint. Other British and foreign authorities speak favourably of it in constitutional ophthalmia.

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 octohedrons 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 is made up of 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 officinal salts are the 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 test:—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 astringent and tonic. The activity of the several salts differs according to their solubility. They resemble compounds of silver and zinc. 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 10 to 15 grains of sulphate or acetate; but 40 to 60 grains induce loathing of food, diarrhœa, and in some instances death (*Practitioner*, July 1877). The soluble salts are absorbed; are diffused as an albuminate; like other metallic poisons, accumulate in the liver, spleen, and kidneys; and are slowly eliminated by the liver and skin, mainly by the intestines and kidneys. Animals despastured in the neighbourhood of copper-smelting works are occasionally affected by loss of appetite, impaired digestion, falling off in 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. 180.) 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 a 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, which at the same time is freely exposed 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 ($Cu_2\ S,\ Fe_2\ S_3$), 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 strong 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 its 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 colic and chronic intestinal irritation; but, unlike lead salts, do not cause nervous disorders. Medicinal doses are astringent, tonic, and antiseptic. For carnivora it is a prompt emetic. 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. Copper salts become absorbed, are detected in the blood and most of the internal organs, exist there probably as albuminates, remain in considerable amount even weeks after the medicine has been ceased; and are eliminated chiefly by the bowels and kidneys.

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. No astringent is so generally 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 the appetite, increases general vigour, and where it does not cure, it often retards a fatal result. In such cases it is 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, repeated for several consecutive mornings, and administered fasting, it is a useful general vermifuge for the horse. 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 stimulant and astringent in chronic purulent ophthalmia, morbid conditions of the Schneiderian and other mucous membranes, 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 ʒi. to ʒij.; cattle, ʒi. to ʒiv.; sheep, grs. xx. to grs. xxx.; pigs, grs. v. to grs. x.; and dogs, gr. $\frac{1}{4}$ to grs. ij. These doses, repeated twice or thrice a day, are administered either in bolus or dissolved in some mucilaginous solution. As a prompt emetic for the dog, the dose is grs. vi. to grs. x., dissolved in water; for pigs, about double that amount. 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 hogs' lard. A more convenient and adhesive application is prepared by carefully mixing over a slow fire one part of powdered vitriol with three of tar.

Copper Ammonio-Sulphate. Cuprum Ammoniatum. Cupric Ammonio-Sulphate.

The 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 redissolved, 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. Cupric 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 œdematous enlargements of the legs," and as an astringent in ill-conditioned ulcerations 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. $Cu\,2C_2\,H_3\,O_2, Cu\,O, 6H_2\,O$.

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. When swallowed it irritates the alimentary canal and the several channels by which it is excreted. It is emetic, astringent, and tonic, but 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 ($Cu\,2C_2\,H_3\,O_2, H_2O$) appears even more active; for Orfila found that twelve to fifteen grains given to dogs further 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. If prescribed, the doses are the same as 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 effective 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 kreasol ($C_8 H_{10} O_2$), with smaller amounts of phenic acid and several allied volatile oils. It requires for solution 130 parts of water, but readily dissolves in alcohol, ether, acetic acid, and volatile oils. It coagulates albumin, 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, glycerin, 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 prescribed as an antiseptic and astringent; it acts externally as an 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; 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 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 cases the treatment is the same as for carbolic acid.

Medicinal Uses.—Small repeated doses arrest undue fermentative changes in the stomach, 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, catechu mixture, or a little laudanum and some aromatic, it is useful in checking diarrhœa and dysentery. Carbolic acid has superseded creasote for its several uses as an antiseptic, stimulant, and astringent for wounds, as well as for an escharotic in caries, scrofulous tumours, fistulæ, canker, thrush, and foot-rot. Diluted with spirit and water or vinegar, it is occasionally used both externally and internally to relieve the itching and remove the scurf of 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. Human patients suffering from toothache depending on caries, are often relieved by a drop cautiously placed in the hollow of the tooth, where it unites with the albuminoid matters protecting the irritable nervous pulp from the action of 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, fʒss. to fʒij.; sheep, ♏x. to ♏xx.; pigs, ♏v. to ♏x.; dogs, ♏i. to ♏iij. It is given in a mass 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, a drachm each of creasote and sulphur may be made into an ointment with lard, or a liniment with oil. A little creasote is sometimes added to the 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 from 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 the ordinary fatty acids, it contains the volatile acids, acetic, butyric, and valerianic, with the special tiglinic ($C_5 H_8 O_2$) and crotonic acids ($C_4 H_6 O_2$). Its active principle, existing also in the wood and leaves, has not yet been isolated (Flückiger and Hanbury). 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.

General Actions.—Forty seeds destroy a horse in seven hours, with the symptoms of 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; when mixed with the biliary and pancreatic juices, these alkaline fluids intensify its effects, and, like other fats and fixed oils, 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 contraindicated 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 pneumonia, pleurisy, 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 salts, 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, on account of the uncertainty of its effects, it is an ineligible preparation. The bruised seeds and the oil are generally administered made into a 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, they 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 in small quantity to any of the ordinary 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 gray-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.

Digitalin of definite composition is prepared by concentrating a tincture made from the leaves, and adding thrice its weight of water, when a pitch-like deposit is thrown down, which, when dried and purified, yields colourless needle-like crystals of the neutral bitter glucoside ($C_{17}\ H_{30}\ O_7$) (Flückiger and Hanbury). One hundred parts of dried leaves yield about 1·25 of this active principle. The digitalin of the British Pharmacopœia—not now regarded as a perfectly 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.—Medicinal doses contract involuntary muscular fibre, contract especially the heart muscle and arterioles; arterial pressure is raised, and temperature is lowered. Digitalis is hence a heart tonic and stimulant; it is also a diuretic. Poisonous doses, after stimulating, disorder, exhaust and arrest the action of the heart, and besides induce gastric irritation and derangement. These effects depend upon its stimulating the sympathetic, acting especially upon the cardiac ganglia, and still more powerfully on the vagus; whilst frequently repeated or poisonous doses exhaust cardiac and capillary contractions, and kill by cardiac arrest.

General Actions.—Two ounces of the dried powdered leaves destroyed an adult horse in twelve hours (Moiroud). One ounce, and in some cases, six drachms of the leaves, 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 pupils, difficulty of breathing, languor, and, after about twelve or sixteen hours, death (Hertwig). 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, sleepy, attempting to vomit, continually straining and passing 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). The following cases, in which I gave full medicinal doses of digitalis to healthy horses, illustrate its stimulating and deranging action on the heart, and its nauseating and disturbing effect on the digestive organs, traceable to its stimulating and deranging both the sympathetic ganglia of the heart and the vagus.

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, three 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, . .	7½.
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 pluræ 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.

Recent observations made both with digitalis and digitalin indicate that they are rapidly absorbed and exert their action by whatever channel they gain access to the body. Nothing is known of their effects on the blood. They are excreted chiefly by the kidneys. Properly regulated doses stimulate both the sympathetic and the vagus, the latter more powerfully. They thus increase the contractile force of the heart, and diminish the calibre of the blood-vessels. This power of contracting involuntary muscular fibre allies them to ergot, which, however, exerts its effects chiefly on the abdominal and pelvic viscera. Whilst ergot specially contracts the uterus, digitalis specially contracts the heart, arteries, and stomach. It differs from strychnine in contracting involuntary instead of voluntary muscle. (Dr. John Harley, Royle's *Mat. Med.*, 6th Edit.) Dr. J. M. Fothergill, experimenting on birds, fishes, and frogs, found that digitalin firmly contracted the ventricles, depending apparently on stimulation of the cardiac ganglia, resembling in this respect the effects of upas antiar, hellebore, belladonna, and caffein, and directly opposed to aconite and Calabar bean, which cause dilatation of the ventricle. (Fothergill and Ringer.) This knowledge of the physiological action of digitalis makes clear its somewhat diverse effects, and demonstrates how poisonous doses powerfully stimulate the heart, throwing it into fatal tetanic spasms; how smaller, but still excessive, or too frequently repeated, doses, by prolonged over-stimulation, destroy the co-ordinating power, and induce irregularity and intermittence of the pulse, with increased frequency, reaching in horses to 130° and 140° beats per minute; and again, how carefully-regulated medicinal doses, exerting a moderate stimulant or tonic effect, quiet and control the irritable, irregular, or weakly heart.

Medicinal Uses.—Tranquillising the heart, and diminishing the calibre of the blood-vessels, digitalis, especially if conjoined with salines, is useful at the outset of inflammatory attacks, in antagonising congestion, increasing arterial pressure, and lowering temperature. When the heart is enfeebled, as in horses suffering from influenza or other exhausting diseases, in cattle from pleuro-pneumonia or rheumatic fever, in dogs from distemper or over-work, digitalis imparts greater expulsive power to the ventricles, and greater tone to the enfeebled capillaries, and thus renders the irregular and weakened circulation steadier, slower, and stronger. It further usually relieves any difficulty of breathing or dropsical effusion which has resulted from the imperfect action of the heart. In such cases digitalis is 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 hypertrophy of the left ventricle—common in hard-worked, aged horses—and 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. When, in such cases of hypertrophy, the pulse is full and strong, a few small doses of aconite may first be tried. In pericarditis, after the more acute symptoms have been subdued with salines, digitalis lessens the embarrassed breathing and the friction sound. In endocarditis, occurring occasionally in cattle, it renders the heart's beat more regular, and gives more fulness to the small thready pulse. With nutrients frequently administered, it sustains the action of the heart, and reduces excessive temperature in continued and typhoid fever in horses. Quieting and regulating the action of the heart, and contracting involuntary muscle, especially of the 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 calomel regulating the bowels, whilst the other three ingredients abate the irritability of the heart 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 a 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. Applied locally, it produces contraction of the small arteries. (Dr. Fothergill.)

The chief indications for the use of digitalis are an irritable, jerking, irregular, or enfeebled action of the heart, deficiency of arterial pressure, venous obstruction, and regurgitation. It is more suitable for chronic than acute cases. It is of little use in difficulty of breathing or dropsical symptoms dependent on lung disease. It does harm in cases of aortic disease or in hypertrophy, where the pulse continues strong, firm, and regular. The more forcible cardiac impulse which digitalis imparts would evidently prove injurious in such cases, and probably also in enfeebled circulation dependent on advanced fatty degeneration. As with other tonics, it is best tolerated in the 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 overdoses 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, ʒss. to ʒj.; sheep, grs. viij. to grs. xv.; pigs, grs. ij. to grs. x.; dogs, gr. i. to grs. iv. As its effects are prolonged during many hours, full doses should be given only once in twenty-four hours; smaller doses may be repeated both night and morning. 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 a bolus, or dissolved in hot water or spirit. The British Pharmacopœia 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 is often 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 a bolus with liquorice powder and syrup, or with linseed flour and water.

Digitalin is about one 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 using hypodermically. 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 the involuntary muscular fibres of the blood-vessels.

Professor Charles Philips states that the leaves of the common yew have much the same action as those of digitalis. (*Mat. Med. and Therapeutics*, 1874.)

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 the 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 scleroticum or ergot stage early in July; usually remains in a quiescent state during the 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 the development and distribution of these ergot spores, as of other fungi affecting plants. 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 gray fragile excrescence, the shrivelled remains of the style, and is covered by the gray, powdery conidia or spores. It is dark violet-coloured externally, and grayish-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 to the air, it is 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 albumin, 7 of a feebly irritant resin, small quantities of cholesterin sugar and red colouring matter, with about $\frac{1}{500}$th part each of two bitter alkaloids, ergotine and ecboline, the latter the more active, and combined with the volatile ergotic acid.

Impurities.—Ergot is apt to be of inferior quality from long keeping, especially when in powder, and from the attacks of acari. The stock should be renewed every two years or oftener, and should be 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, acts through the sympathetic nervous system, constricts blood-vessels; hence antagonises hæmorrhage, and, where continuously used, so closes the vessels, especially of the extremities, that the tissues are starved, paralysed, and gangrened. It also exerts its contractile power notably on the muscles of the digestive and urino-genital organs. It is used as a general and local styptic, and as an ecbolic to promote expulsive action of the uterus. As a vascular constrictor it resembles digitalis, belladonna, cold, and electricity. As an ecbolic it is allied to savin and rue.

General Uses.—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. Horses, cattle, and sheep are, however, less susceptible to its action. Thirty cows 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 they yielded was bad-tasted. Twenty sheep ate daily amongst them for four weeks 9 lbs. without injury. (Phœbus and Pereira.)

The smaller domestic animals, and patients placed in unfavourable sanitary conditions, are, however, more susceptible of the 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, when given for several weeks to dogs and rabbits it 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 to 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 (Professor Gamgee's *Veterinarian's Vade Mecum*), is very common in Columbia, and the use of it is attended with shedding of the hair, and even of the teeth, both of man and beast. Mules fed on it lose their hoofs, and fowls lay eggs without shells.

Ergot, like digitalis and digitalin, contracts the involuntary muscles, directly constricts the blood-vessels, and thus combats both active and passive hæmorrhage. Its constricting power is especially observable on the digestive and urino-genital organs; it has little direct action on the heart, in this last respect differing from digitalis. By full doses of ergot the stomach of dogs is evacuated; increased intestinal peristaltic movements, with colic and diarrhœa, occur; the bladder is hurriedly and frequently emptied; the uterus is similarly contracted, occasionally so continuously and violently that its fibres have been torn. These muscular contractions sometimes prematurely expel the contents of the gravid uterus; at the full period of gestation they intensify and hasten the natural labour pains. Various competent experimenters using ergot have produced abortion in guinea-pigs, sows, rabbits, cats, bitches, and cows. (Stillé, *Therapeutics*, 2d edit.) 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.

Owing, however, to insufficient doses, poor quality of the drug, or special tolerance, such as is usually enjoyed by rabbits, ergot is sometimes given to pregnant animals in full and repeated doses without expelling the contents of the uterus. Cows, bitches, cats, swine, and rabbits in all stages of pregnancy, have got large and repeated doses without causing abortion. Dr. Wright (*op. cit.*) administered half an ounce of ergot 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. He gave a bull-terrier bitch half an ounce daily during the last three weeks of pregnancy, but she also went her full time (Experiment 38). Its effects on ruminants, both during gestation and at other times, are always less marked than on dogs or cats. In the rabbit very large doses have been given without influencing 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, the rabbits were to all appearance in a healthy state, and the young were born of good size and well nourished.

Medicinal Uses.—As a parturient ergot is not often needed in the lower animals. The offspring, coming naturally at the full period, can generally be got hold of by the hand or forceps, and brought away with gentle traction. When used it is in cases 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 the 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 the 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.

Doses, etc.—As a parturient or styptic, for the mare or cow, ℥ss. to ℥i.; 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 British Pharmacopœia, is still occasionally used in human practice, in lingering parturition, and also externally as a styptic and an anodyne in rheumatism and toothache. The remarkable power of 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 digitalis, which has a similar power of diminishing the calibre of the 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_2H_5O, or $(C_4H_5)_2O$.)—*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_2H_5) unites with the sulphuric acid, forming hydrogen ethyl sulphate, or sulpho-vinic acid and water, thus (Roscoe):—

Alcohol and Sulphuric Acid yield Water and Hydrogen Eythl Sulphate.

$$\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O + \left.\begin{matrix}H\\H\end{matrix}\right\}SO_4 = \left.\begin{matrix}H\\H\end{matrix}\right\}O + \left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}SO_4$$

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.

$$\left.\begin{matrix} C_2\,H_5 \\ H \end{matrix}\right\} O + \left.\begin{matrix} C_2\,H_5 \\ H \end{matrix}\right\} SO_4 = \left.\begin{matrix} C_2\,H_5 \\ C_2\,H_5 \end{matrix}\right\} O + \left.\begin{matrix} H \\ H \end{matrix}\right\} SO_4$$

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 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 at −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 hydrocarbons, and possessed of anodyne and hypnotic properties.

Acetic ether (æther aceticus, $C_2\,H_5$, $C_2\,H_3\,O_2$), 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 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; its vapour inhaled causes rapid anæsthesia; it kills by paralysing the respiratory centres. 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, and 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 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. 79. 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 fore-limbs 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 stage of excitement is occasionally prolonged for some minutes; whilst, for many hours, and even for a couple of days, some patients continue dull and off their feed. Dropped upon the skin, especially when in the finely-divided form of 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 does not weaken or paralyse the action of the heart. 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 often 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. In hard-worked horses, especially in towns, when struck down by any of the forms of catarrhal fever, ether proves serviceable; it gives tone to the enfeebled heart, it equalises the irregular circulation, promotes the imperfect action of the skin and kidneys, and even 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 much 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. In this form it is also often useful in relieving spasmodic affections of the intestines. The administration 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. 257). It is poured on a sponge placed in the bottom of a nose-bag perforated with holes for the 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. In this way it is occasionally used 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 the 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 an antiseptic, and for several weeks preserves meat fresh and almost unchanged.

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, fʒij. to fʒiv.; dogs, fʒss. to fʒi. As an anæsthetic, the pure absolute ether must be used: the larger animals take f℥iij. to f℥vi.; the lesser, fʒiv. 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, whilst, 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, and is made by mixing together six fluid ounces of collodion, 120 grains Canada balsam, and one drachm of castor oil, and is kept in a well-corked bottle. A styptic, antiseptic protective is made by thoroughly mixing with 100 parts of collodion five parts each of carbolic tannic and benzoic acids. Three or four drops of carbolic acid, two parts of glycerin, and 100 of collodion, form a useful application for fissured sore teats in cows or ewes. 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, and cascarilla bark. The cactus-like plants producing the 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 a large pea, 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 gray, 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 about 38 per cent of an amorphous, burning, acrid-tasting resin ($C_{20} H_{32} O_4$); 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 destroyed a horse, with all the symptoms of gastro-enteritis; 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 are obliged to wear masks or handkerchiefs over their faces, and, in spite of all 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 injure the deep-seated parts of the skin, prevent the future growth of hair, 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 parts of Europe, 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 8 of the colourless crystalline filicic acid, probably its most active constituent. The root should be collected late in autumn, preserved in stoppered bottles, and the supply renewed annually; for, when long 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.—Dr. John Harley considers that male shield 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 violent peristaltic movements, induced when it is swallowed, detach and cast out adhering worms (Royle's *Mat. Med.*, 6th edition). It is given especially for the removal of tænia. It is said to dislodge tapeworm in dogs, sometimes within two or 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; ℥iij. to ℥v. for sheep; ℥ii. 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 British Pharmacopœia 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 in a little oil or gruel, when the bowels have been emptied by a laxative and several hours' fasting, and, if requisite, may, after a few hours, be followed by a dose of physic.

GALLS.

Galla. 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 with its ovipositors, 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 nuts. Galls vary from the size of a bean to that of a hazel nut, are round, hard, and studded with tubercles; of a bluish-gray 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-gray 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 gelatin throws down a gray flocculent precipitate of tanno-gelatin—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 6 of gallic acid, with about 10 of fibre, 11 of moisture, 5 of gum, sugar, and starch, together with lignin, resin, chlorophyll, volatile oil, albumin, and salts (Guibóur).

Actions and Uses.—Galls are powerfully astringent, occupying, as regards activity, a mediate place between tannic acid and oak-bark. Like other tannin-containing substances, they coagulate albumin, are not readily absorbed, but where they can be applied, they constringe mucous, muscular, and vascular textures. 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 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 and styptics.

Doses, etc.—For horses, ʒiv. to ʒvi.; for cattle, ℥i. or ℥ij.; for sheep and swine, ʒss. to ʒi.; for dogs, grs. v. to grs. x.; for cats, gr. i. to grs. iij. The powder is made into a 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 $2\frac{1}{2}$ 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 ($C_{27}\,H_{22}\,O_{17}$), 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 gelatin, 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 any other vegetable astringent. It unites with albuminous and gelatinous textures, constringing them, and forming upon their surface insoluble protecting films. It contracts capillary blood-vessels, and thus relieves hyperæmia, and lessens secretion; it draws together muscular and membranous tissues. These effects are most notable when tannic acid is topically applied; but when swallowed, it is absorbed probably in part as gallic acid; its astringency is thus more widely extended, and is especially serviceable in combating fluxes and hæmorrhages. 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 when absorbed, it is in part converted into gallic acid, which is preferred in albuminuria and hæmaturia. In hæmorrhage, tannic acid is combined with ergot and digitalis, and alternated with metallic salts or mineral acids. In diarrhœa and other excessive discharges, it is conjoined with chalk acids and opium. 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 ulcerations.

Doses, etc.—Horses take grs. xx. to ʒij.; cattle, ʒi. to ʒiij.; 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 glycerin. A drachm each of tannin and opium, with two ounces of lard, makes an excellent ointment for piles in dogs. Glycerin 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 glycerin, and furthering complete solution by gentle heat. Styptic colloid is usually prepared with one of tannin and eight of alcohol, mixed with about four of collodion.

Gallic Acid ($H_3\,C_7\,H_3\,O_5,\,H_2\,O$).—Tannic acid, when boiled with diluted sulphuric or hydrochloric acid, or when exposed during six weeks to air and moisture, undergoes a species of fermentation, takes up water, and yields the tribasic gallic acid and glucose, thus:

$$\text{Tannic acid} + \text{water} = \text{Glucose} + \text{Gallic acid.}$$
$$C_{27}\,H_{22}\,O_{17} + 4\,H_2\,O = C_6\,H_{12}\,O_6 + 3\,H_3\,C_7\,H_3\,O_5.$$

Gallic acid is crystalline 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 albumin or gelatin, 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).

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.

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 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 cocoanut 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 about 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.

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 by itself, an ounce of each, rubbed down and given in solution, proves an effectual purge for ordinary cattle cases.

Doses, etc.—For cattle, ℥ss. to ℥j.; for sheep, grs. xx. to grs. xxx.; given in combination with other purgatives, and in solution.

GELATIN.—GLUE.

Nitrogenous matter extracted by the action of hot water from bones, tendons, and animal membranes. (C_{41} H_{67} N_{13} O_{16}, with lime and magnesia phosphates.)

Gelatin 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 gelatin, is made from similar materials less carefully purified; size is an inferior, weaker variety of glue; isinglass, a natural colourless gelatin, is the swimming bladder or sound of the sturgeon, and various species of Accipenser, prepared and cut into shreds; chondrin is the gelatinous matter extracted from cartilage; osseine the title given to that obtained from bones. Gelatin, when dried, is hard and tough; varies in colour according to its purity; forms a viscid tremulous mass, even when one per cent is dissolved in water and allowed to cool; and is precipitated from watery solutions by tannic acid.

Actions and Uses.—Gelatin, although a product of the disintegration of albuminoid tissues, 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 albumin. Men, dogs, and even horses, recovering from exhausting disease, in which the breaking up and excretion of albuminoids is great, exhibit the dietetic value of gelatin 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 the egress of discharges. 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 ribands or tails, to smear both the cloth and skin with the melted glue, and to 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, gelatin is used for clarifying or fining, and as a neat and cleanly envelope for pills and boluses.

GENTIAN ROOT.

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—

gentianic acid, 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, promoting salivary and gastric secretions. 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 improves the appetite and general tone, and imparts a healthier condition, especially to the gastric mucous membrane. Amongst horses suffering from febrile catarrhal attacks, no combination is 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 most inflammatory complaints such a prescription also proves serviceable, after the first acute stage is passed. Where the bowels are constipated or irregular, or febrile symptoms are insufficiently subdued, two drachms of aloes may be advantageously united with the gentian and nitre. Where a more decided tonic effect is desired, iron sulphate is alternated with the gentian and salts. 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 many other epizootic attacks. 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 a 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 healthier state of the digestive mucous membrane it prevents 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, ℥ss. to ℥i.; for cattle, ℥i. to ℥ij.; for sheep, ʒi. to ʒiij.; for pigs, ʒss. to ʒi.; 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 made up with treacle, glycerin, 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 ensures more thorough solution and better keeping. Gentian is often given with ginger, cardamoms, antacids, alcohol, ether, and with 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 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 zig-zagged pieces or races, from two to four inches in length, with a marbled soft resinous texture, a strong, agreéable 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 calcium chloride; 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 constituents of plants, ginger contains an acrid resin and 0·25 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 nearly 2000 tons of ginger are annually imported.

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 the gastric secretions, 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.

Doses, etc.—For the horse, ʒiv. to ℥i.; for cattle, ℥i. to ℥iij.; for sheep, ʒi. to ʒij.; for pigs, ʒss. to ʒi.; 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 solution 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.

GLYCERIN.

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 $C_3H_8O_3$).

Glycerin 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 atoms of water previously held by the caustic soda, thus:—

Caustic soda + Vegetable oil = Hard soap + Glycerin.

$$3\ \text{Na, HO} + C_3H_5,\ 3\ C_{18}H_{33}O = 3\ \text{Na},\ C_{18}H_{33}O + C_3H_5,\ 3\ \text{HO}.$$

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 glycerin, 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 glycerin. 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.—Glycerin 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 recently been stated that 150 grains act like alcohol, and kill small dogs. Small doses are eliminated by the kidneys, large doses by the bowels, producing laxative effects. It proves a capital emollient for cracked heels, mud fever, blistered or burnt surfaces—indeed, wherever the skin is irritable, dry, rough, or scurfy. For tender or abraded surfaces, when undiluted, it is too heating and irritant, and is best used with water, spirit and water, any bland oil, or as glycerin of starch made by heating an ounce of starch with eight ounces of glycerin. This is a cleanly and useful application for many purposes, notably for sore mouths amongst calves and lambs. Greater antiseptic and astringent effects are secured, as is desirable in bad cases of cracked heels, in harness galls, or in noisome indolent wounds, by the use of glycerin of carbolic acid, easily made by rubbing together in a mortar one part of carbolic acid and four of glycerin. Another soothing and astringent dressing is improvised with equal parts of glycerin and Goulard's extract, diluting it as required with water. Soothing and astringent effects are also combined by using glycerin of tannin, which is specially useful in eczema of young and delicate dogs, in aphtha, and in relaxed sore throat. Glycerin is used as a solvent for tannic and gallic acids, and for alkaloids; as a vehicle for their hypodermic injection; a useful addition for preserving boluses and masses soft and sound; and 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 gray 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 the warm months of 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 imported 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 converts 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-gray 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 ($C_4 H_{10} O_5$), which, gelatin-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 the 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 a goose-quill, 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 helleboreïn ($C_{26} H_{44} O_{15}$) (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 a wound (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 ever 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 tripinnate leaves are large, 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 is found stored 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 carelessness 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 diluted 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, 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 mousy odour. The water hemlock (*Cicuta virosa*), the fine-leaved water hemlock (*Phellandrium aquaticum*), the water parsnip (*Œnantha crocata*), are allied to the conium maculatum, have similar physiological effects, and when freely eaten have poisoned most of the domestic animals (Professor Gamgee's *Veterinarian's Vade Mecum*).

Actions and Uses.—Hemlock and its alkaloid conine paralyse the motor centres first of the corpora striata, afterwards of the cord (Dr. Harley). Poisonous doses paralyse the muscles of respiration, and kill by asphyxia. Medicinal doses are motor depressants, quiet motor irritability, and hence are antispasmodic and anodyne. Hemlock was the State poison of the Athenians, the death potion of Socrates.

General 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, relapsing 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 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 exertion, 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 indistinct vision and imperfect power of focal adaptation. Listlessness, a dragging feeling when walking, and tottering about the knees followed, evidencing paralysis of the nerves of the 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; there is no narcotism; no action on the sensory or afferent nerves; no effect on circulation, secretion, or excretion; temperature is reduced owing to failure of respiration. Applied directly to the nerves, it exerts no topical irritation, but perhaps diminishes the conductivity of the motor nerves. On the unbroken skin it exerts no effect; on wounds large quantities irritate, whilst small quantities soothe and ease pain. 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 curare, which, however, does not poison when swallowed, although it is very active when injected underneath the skin or into the veins. It resembles Calabar bean, which in addition has a paralysing effect on the heart, and excites gastro-intestinal inflammation. It is also allied to prussic acid, which is, however, a more general paralyser of the cerebro-spinal system. Hemlock and conine are directly antagonistic to 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 quiets the jactitations of chorea, occasionally checks the fits of epilepsy, abates the spasms of tetanus and of strychnine poisoning; but does not justify the high expectations formed of it as a certain cure for tetanus in horses. In spasmodic cough, such as sometimes follows epizootic sore throat in horses, hemlock and opium in full doses often prove effectual. In irritable conditions of the respiratory organs in man, hemlock vapour, made by adding any reliable preparation to hot water, is recommended. It relieves the pain of some cases of rheumatism and neuralgia, for which it is used both externally and internally; it abates the irritability and pain of specific ophthalmia in horses; administered by the mouth and also as an injection, it allays irritability of the uterus, bladder, and genital organs.

Doses, etc.—The dried leaves are never 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℥x. to f℥xvi.; for sheep and pigs, f℥ss. to f℥iij.; for dogs, fʒi. to fʒiv. 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, fʒij. or fʒiij.; of the extract, ʒi. to ʒij. 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 arresting 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 even with 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 acts on the cord as well as on 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 grows wild in most parts of this country, is cultivated at Mitcham and Hitchin, and is successfully grown in India. 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-gray 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 principle is an oily liquid—hyoscyamine or hyoscyamia (C_{15} H_{23} N 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 an aqueous solution, resolves it into a volatile alkaloid, hyoscine (C_6 H_{13} N), and the crystalline hyoscinic acid (Flückiger and Royle).

Actions and Uses.—Henbane closely resembles the other Atropaceæ, belladonna and stramonium. It first stimulates and subsequently exhausts and paralyses the sympathetic 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 by the kidneys they exert specially on the urino-genital organs their power of relaxing voluntary muscles and the occluding fibres of hollow viscera. 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, 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 secretion 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 especially in valvular disease. In such cases it will sometimes reduce the pulse of the horse from 60 to 40 beats per minute. 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 their being long kept before being used, or from exposure to high temperatures, 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, fʒj. 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, 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 paralysis of the capillary vessels and respiratory arrest; it dilates the pupil, and parches the tongue and mouth. Small doses accelerate, large doses diminish, the movements of the intestines; small doses augment, large doses lower, temperature; results are not modified by section of the pneumogastric nerve; excretion takes place wholly by the kidneys, and as it is excreted, it exerts its relaxing anodyne effect on the urinary passages (MM. Oulmont and Laurent in *Bartholow's Mat. Med. and Therapeutics*).

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 forms a definite compound of one equivalent of acid and three of water. 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 $26\frac{1}{2}$ 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, occasionally with traces of arsenic.

Actions and Uses.—Concentrated doses are corrosive and irritant; medicinal doses are astringent, antiseptic, tonic, and antidotes for poisoning by alkalies; externally, it is used as a stimulant, astringent, antiseptic, and caustic.

Like the other mineral acids, and strong acetic acid, in concentrated solution, it has a strong affinity for the water bases, and even for the albuminoids of the tissues, and hence is a corrosive irritant poison, inducing gastro-enteritis when swallowed. The fitting antidotes are alkaline bicarbonates, magnesian carbonates, milk, white of egg, and other demulcents.

By administration of acids, acid secretions are checked, alkaline secretions increased. Salivary and mucous secretions are thus promoted, and thirst abated, especially when the acid is conjoined with gentian or other bitters, which, like acids, stimulate salivary secretion. Half an ounce gentian, with twenty drops medicinal hydrochloric acid, dissolved in a pint of water or of cold linseed gruel, and given several times daily, relieves thirst, moistens the dry clammy mouth, aids digestion, checks diarrhœa, and in relaxed chronic sore throat exerts beneficial astringent and antiseptic effects. Where the acid treatment of indigestion is appropriate, hydrochloric acid is specially suitable, on account of its antiseptic properties, and its aiding the solution of albuminoids, which are precipitated by sulphuric acid (Ringer). Small doses, conjoined with bitters, given along with the food, or shortly after eating, are particularly suitable for those cases of atonic indigestion and acidity depending upon undue secretion of gastric juice, or the irregular excessive formation of acetic, lactic, or butyric acids—conditions frequently occurring in lambs and calves, especially whilst feeding on milk. Given alone, or with ferric chloride, it promotes a healthier state of the bowels in animals troubled with worms. In its passage through the digestive canal it becomes neutralised, but probably sets free biliary and other acids (Ringer). It has a remarkably high diffusion power, diminishes the alkalinity of the blood, exerts in all animals tonic and astringent effects, and is advantageously prescribed, especially in convalescence from acute inflammatory attacks, in febrile and exhausting diseases, and in hæmorrhages.

Externally it is used for the destruction of warts, as a caustic and antiseptic dressing for cancerous and poisoned wounds, for foot-rot in sheep, and occasionally as a styptic. 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 ferric chloride.

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.

Most good authorities consider that Indian hemp is derived from Cannabis sativa or common hemp, modified by climate, and 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 churrus ganjah bang and hashish. The dusky green aromatic masses, measuring about two inches long, are made up of the dark-green peculiar-smelling tops, bearing the remains of the flowers with the small leaves and ripe fruit. Rectified spirit extracts an amorphous brown 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_{22}).

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 states that he "has been long convinced 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 sea-weeds—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 gray lustrous scales, resembling black lead. 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 bases, 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 compound 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. Black lead, 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 causes irritation, cough, and spasm of the glottis. Medicinal doses stimulate the secreting glands and vessels, are alterative and deobstruent, arrest thirst and excessive secretion of urine, and have a specific effect in checking polyuria in horses. Given for a lengthened period, it produces wasteful tissue-change, with a debilitated, depraved state, termed iodism. Externally it is used as a stimulant, antiseptic, counter-irritant, and deobstruent. It is a feeble antiseptic, but an effectual deodoriser and disinfectant.

General Actions.—Applied to the skin or mucous surfaces, it causes an orange-yellow stain, redness, and irritation; placed in the areolar textures, it induces inflammation and abscesses; inhaled as vapour, it excites cough and bronchial irritation. 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 stómach, 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 gave 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. In horses and cattle, as well as in other patients, iodine in a properly soluble form stimulates secretion of nasal mucus and saliva, and of the digestive, biliary, and pancreatic fluids; it increases tissue-change and the removal of waste products; it improves the appetite. Under its influence various morbid processes are checked, excessive thirst and inordinate excretion of urine are arrested, and glandular enlargements absorbed.

The condition of iodism produced by prolonged administration is accompanied by loss of appetite, irritation 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 has been observed; and in the bull, atrophy of the testicles, with loss of sexual desire (Morton). 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.

Iodine produces its effects by whatever channel it enters the body. Mingled with alkaline secretions it becomes dissolved; as an iodide, or occasionally as an iodate, it is readily absorbed; even after a single dose it may be detected in many of the secretions, in the blood, sweat, saliva, milk, and especially in the urine, 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. It leaves the body chiefly in the urine. It is closely allied to chlorine and bromine in physiological, as well as in chemical characters. It resembles mercury in its alterative and antiseptic properties, its stimulating secretion, and producing specific blood-poisoning. It is, however, less powerful than mercury, more limited in its antiphlogistic functions, and more suitable for chronic than acute cases. Iodine 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, whilst its effects, unlike those of mercury and lead, cease whenever its administration is discontinued. The potassium and sodium iodides retain the chief properties of iodine, only being less powerful, and more apt to act on the kidneys. The iodides of iron, copper, lead, and mercury, exhibit, however, mainly the actions of their powerful bases.

Medicinal Uses.—Iodine is prescribed as an alterative and resolvent in the second stages of inflammation, after acute symptoms are subdued. It aids the 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, pulmonary consumption, enlarged joints, and other scrofulous affections. 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 from 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; the 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* of iodine in curing this polyuria is not very evident, the removal of thirst being the only apparent physiological action capable of exerting any curative influence. Neither iron, quinine, arsenic, nor other effective alterative or tonic is 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 cough and irritability of catarrh, sore throat, and bronchitis of an epizootic type amongst horses, a useful combination consists of half a drachm each of iodine, potassium iodide, camphor, and belladonna extract. Inhaled in vapour largely diluted with steam and air it soothes the irritable respiratory surfaces in catarrh in horses, and abates hoose in calves. In chorea and epilepsy in dogs, iodine is of little value.

It is seldom applied directly for irritant or caustic purposes, but is much used as a stimulant and resolvent, in chronic swellings of joints, bursal enlargements, strains of tendons, thickening of the periosteum, scrofulous and other tumours, and indurations of the udder. It is occasionally applied in sore throat in horses; whilst it is rubbed into the chest in pleurisy to arrest the formation of exudate, and hasten the removal of what may have been outpoured. To act as a stimulating antiseptic and promote adhesion, it is injected into cysts and abscesses from which serum or pus has been withdrawn. It proves useful in such skin eruptions as eczema, psoriasis, and lupus, as also in scab, mange, and ringworm; often being mixed with sulphur or mercurial preparations, or alternated with them. For the cure of indolent ulcers, the raw surface is sometimes covered by a piece of lint, spread with simple cerate; this is sprinkled with one to five grains of iodine; over this again is placed a piece of oiled silk or tinfoil. Excess of iodine must be avoided, otherwise a corrosive instead of a healing action is produced. For stimulating and deodorising unhealthy and malignant wounds, Professor Spence uses 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 ʒi.; for cattle, ʒss. to ʒiss; 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 some considerable time after eating, so as to prevent their conversion 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 often given with impunity, but usually without increased curative result. Iodine is often given 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 ensures the 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 ensure solution, is used with eight of water or of fatty matters; but where a gentle stimulant effect is desired, with absorption of the iodine, the preparations should be used 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.

Sulphur iodide, useful for skin diseases, is prepared by mixing, in a Wedgwood ware mortar, four ounces of iodine with one of sublimed sulphur, and gently heating the mixture until it liquefies. The red-brown liquid, as it cools, becomes a gray-black crystalline mass, insoluble in water, but soluble in glycerin and fats, with eight or ten parts of which it is mixed for ointments or liniments. Such preparations are particularly suitable for itchy skin complaints; and not being poisonous, are used for mangy dogs, without risk of injury from the dressing 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 gray-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, albumin, 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_{20} H_{30} 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 an irritant. Howsoever introduced into the body of carnivora, it stimulates the vomiting centre, causing emesis. Full or repeated doses paralyse the nervous centres, lower the action of the heart and the animal temperature, and arrest respiratory movement (Dr. Ornellas). It is excreted through the bronchial and gastro-intestinal mucous membranes and skin, and to a less extent through the kidneys, irritates during its elimination these excretory channels, and, in properly regulated doses, acts as an expectorant, diaphoretic, and in larger amounts, as a cathartic. Whilst full doses stimulate the special nervous centre and induce vomiting, small and repeated doses impart tone to the perverted centre, and often arrest vomiting.

The powdered root or alkaloid applied to a mucous surface, or rubbed into the skin, causes irritation and pustular eruption. 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.) 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; whilst it produces less nausea but more direct depression of the heart than tartar emetic. In emetic and expectorant effects it resembles squill. Bracy Clark states that three ounces will kill a horse.

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 contents of the stomach, which usually is evacuated in ten or fifteen minutes after the emetic has been swallowed, there is outpoured a profuse secretion from the respiratory mucous membrane, which often gives great relief in the early dry stages of catarrh, and also 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 morbid matters (p. 45). Even where doses insufficient to cause emesis are used, and in patients where emesis never occurs, ipecacuan frequently promotes salutary discharges from the dry congested respiratory membrane. In mucous catarrh and sore throat amongst horses, where the patient is feverish, the buccal and Schneiderian membranes hot and dry, Mr. Thomas A. Dollar, of New Bond Street, sometimes 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, believing that it gently stimulates the bowels and allays irritation, prescribe half-drachm doses in diarrhœa and dysentery in cattle. Following Dr. Ringer's 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.

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 ʒi. to ʒiij.; sheep, grs. xxx. to ʒi.; dogs, grs. x. to grs. xv.; cats, grs. ii. to grs. v.; repeated four or five times daily, the patient 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 is more active and cheaper than the vinum, and is made by macerating $2\frac{1}{2}$ 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 head and air-passages, and induces symptoms analogous to hay fever. Two grains swallowed by a dog caused violent vomiting, inflammation of the stomach and intestines, stupor, and death in twenty-four hours (Majendie). It irritates the mucous membranes and denuded skin, is eliminated by the mucous surfaces and liver, causing vomiting and alvine evacuations, it paralyses respiration, lowers temperature, and relaxes voluntary muscles (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, gray 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; the 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 radicals, 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 gray precipitates of hydrated protoxide ($Fe\ O, H_2\ O$); with potassium ferrocyanide, a light-blue precipitate, gradually becoming darker by oxidation ($Fe_4\ Fey_3, H_2\ O$); with potassium ferridcyanide, a precipitate dark blue from the first ($Fe_3\ Fdcy_2, H_2O$).

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 sesqui-sulphide ($Fe_2\ S_3, H_2\ O$); with caustic alkalies, a brown-red precipitate of ferric hydrate ($Fe_2\ O_3, H_2\ O$); 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 decoloration; with solution of galls, neutral iron solutions yield a blue-black precipitate—the basis of writing-ink.

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. As filings or pulvis ferri it is occasionally given in poisoning by soluble salts of mercury and copper. Iron salts are astringent, styptic, and tonic; large doses of the more soluble per-salts are also irritant and corrosive. Although exerting little effect on the unbroken skin, the soluble preparations applied to mucous or skin abraded surfaces combine with albumin, coagulate blood, and are powerful astringents. The metal in a finely divided state and the insoluble salts, when swallowed, are dissolved by the gastric fluids. Ferrous salts are converted in the stomach and duodenum into the corresponding ferric; organic compounds are reduced to the carbonate. The salts are probably absorbed as albuminates. In anæmic cases, when iron has been insufficient in the food, or wasted by hæmorrhage or disease, iron salts are direct restoratives. They supply the iron requisite for the formation of the hæmatin, and the production and nutrition of the blood globules, which contain about $\frac{1}{200}$th part of iron. But besides restoratives, iron salts are also general tonics and astringents. Any excess not required for nutrition, reduced in great part to the condition of sulphide, is eliminated in the bile, with the intestinal mucus, and in the urine, often communicating its dark colour to the excreta. 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). In Pereira's and other works on human materia medica, upwards of forty iron salts are enumerated; but as they differ only in the degree of their action, the ferrous carbonate, sulphate, and iodide, with the ferric oxide and chloride, suffice for veterinary purposes. 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. The phosphate is a mild chalybeate, recommended on account of its being the form in which iron occurs in the blood, supposed to be particularly assimilable, and specially suitable in strumous diseases of the bones.

IRON CARBONATE. Ferri carbonas. Ferrous Carbonate. $Fe\ CO_3$.
SACCHARATED CARBONATE of IRON. Ferri Carbonas Saccharata.

The lower or ferrous carbonate occurs in the 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 grayish-green, has a chalybeate inky taste, and dissolves with brisk effervescence in hydrochloric acid. Exposed to the air, it rapidly absorbs oxygen, gives off carbonic acid, 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 gray lumps, has a sweet, very feeble chalybeate taste, and should contain at least fifty-seven per cent of carbonate (*British Pharmacopœia*).

Actions and Uses.—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. 148). 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. 345).

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 the 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 hæmatin, the ferrous sulphate proves a direct restorative. In rapidly-growing weakly subjects, in scrofulous cases, during recovery from debilitating disease, the blood globules are sometimes notably deficient; they are often reduced to half, and even sometimes to one-sixth, of their normal amount. Iron salts cause their gradual increase, and hence impart to the pallid weakly tissues the ruddy hue and vigour of robust health. Restoring iron to faulty hæmatin 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 faulty hæmatin, produce analogous tonic effects. Like these metallic salts and vegetable tonics, in addition to restorative or nutrient powers, iron sulphate exerts chemical astringent and vital invigorating effects, and has besides antiseptic properties. To such influences are due its arresting irritation and inflammation of lymphatic glands, and its diminishing the size and increasing the firmness of the spleen, mentioned by Weinhold as the common effect of its continued exhibition to dogs (Pereira's *Elements*, 3d edit.) 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 administered to all veterinary patients in anæmia, and the various disorders connected with it. No remedy is more effectual in dysentery, consumption, and other forms of scrofula; in relaxed conditions of the mucous membranes; in wasteful serous or bloody discharges, as in diabetes, red-water in cattle, 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. In conjunction with readily assimilable nutritive food no remedy is so valuable in those anæmic cases which affect young cattle and sheep kept late in autumn on grass which has lost its nutritive value. With a bottle or two of ale, two drachms are given twice daily to horses to improve the appetite and check the progress of farcy, nasal gleet, and chronic relaxed conditions of the mucous membranes. Full doses of the powder or strong solution shrivel and destroy intestinal worms, and, farther, impart a healthier condition of the bowels unfavourable to the development of parasites; whilst 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 applied for the ordinary purposes of a stimulant, astringent, and styptic, usually in the form of powder or watery solution. As an antiseptic it is much inferior to ferric or zinc chlorides. Iron sulphate 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.

Doses, etc.—Horses take ʒi. to ʒiij.; cattle, ʒij. to ʒiv.; 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. They are often conjoined with other medicines. Thus, in want of tone and torpidity of the bowels, and for removing worms in horses, a drachm 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 Canada balsam, and repeated twice or thrice daily. The same ingredients dissolved in a pint of ale or gruel prove a valuable tonic for 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 several days, it is advisable to withhold it altogether for a day or two, or replace it during that time by some other tonic. This prevents gastric derangement, and also maintains the continued efficacy of the medicine. Care should further be taken that, during its use, the bowels be kept open by the occasional exhibition of laxatives, which are especially necessary in horses and dogs, on account of their liability to suffer from the astringent and constipating action of iron salts. The dark colour and disagreeable odour which the fæces usually acquire during a chalybeate course, depend on the production, in the intestines, of the sulphide, and generally indicate that the medicine is being given in unnecessarily large doses.

IRON IODIDE. Ferri Iodidum. Ferrous Iodide. $Fe\ I_2,4\ H_2\ O$.

When iodine, iron wire, and distilled water are gradually heated together, combination occurs; and the solution, filtered and evaporated, yields flat 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 and Uses.—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 purging and vomiting; 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. 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. $Fe_2\ O_3,\ H_2\ O$, with about 86 per cent of uncombined water.

The 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 British Pharmacopœia 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 preparēd, 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 ($Fe_3\ 2As\ O_4$). 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 ensure the production of the higher chloride. The strong watery solution of the Pharmacopœia, the Liquor Ferri 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 0·922.

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; whilst in properly-regulated doses, it is a valuable restorative, tonic, antiseptic, astringent, and styptic. Repeated every two or three hours, I have found it especially serviceable in red-water in cattle, in farcy, purpura, and other typhoid complaints in horses, and in distemper in sickly dogs. It is also useful in loss of appetite and indigestion depending on want of tone, where intestinal worms have been troublesome, in 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 preferable to the watery solution for this last class of cases. Its general tonic and topical astringent effects recommend it in relaxed sore throats, such as accompany and follow catarrhal fever in horses. In such cases the medicinal solution is repeated every two hours in half-drachm doses dissolved in six or eight ounces of water, and given slowly, so as to act as much as possible as a gargle; or, better still, the solution is applied several times daily with an atomiser. Externally it is used as a caustic, astringent, styptic, and stimulant. Diluted according to circumstances, it is one of the best dressings for erysipelas. 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. I have with good effect injected it into the uterus in dangerous post-partum hæmorrhage in cows. French surgeons have used it with some success in reducing erectile and aneurismal tumours, a few drops injected into the sac coagulating its contents. The watery solution was found by Dr. Angus Smith (*Third Report on Cattle Plague*) to preserve blood and other such compounds 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 so effective as an 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. Either solution is prescribed with water, ale, or gruel, is often conjoined with hydrochloric acid, gentian, and other tonics, but cannot be used with ammonia, alkalies, or their carbonates, or with tannin-containing substances.

JABORANDI.

Leaves and small branches of Pilocarpus pinnatifolius and other species.—(Lemaire.)

Nat. Ord.—Rutaceæ. *Sex. Syst.*—Pentandria Pentagynia.

The shrubs yielding jaborandi are natives of Brazil; the leaves and bark are aromatic and acrid, with a bitter, hot, pungent taste, and contain an acrid resin, a volatile oil, tannic acid, and an active crystalline alkaloid, pilocarpine or pilocarpia. Dr. William Craig of Edinburgh has carefully investigated the properties of jaborandi, and shown that hot water extracts all, or nearly all, the active principles, and an infusion is hence the most handy preparation.

Actions and Uses.—Jaborandi is sialogogue and sudorific: large doses, especially when including portions of the fibrous stems, are irritant, and induce nausea and vomiting. It directly stimulates the vaso-dilator nerves of the salivary glands and skin, in this respect being antagonised by atropine which paralyses them (Royle's *Mat. Med.* 6th edit.) In three men perspiration and salivation, caused by 60 grains, were arrested by subcutaneous injection of $\frac{1}{100}$th grain of atropine (Bartholow). 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 sweat, have been collected; the pulse rises, but arterial tension is diminished, and temperature lowered; the pupils contract; the symptoms continue four or five hours. Elimination takes place through the salivary glands and skin, which excretes an unusual amount of urea. Mr. Thomas Dollar junior and Mr. I. Print gave horses two to four drachms infused in hot water: in fifteen to twenty minutes profuse salivation occurred, continuing for nearly three hours, but without notable diaphoresis, altered circulation or temperature. In several carriage horses to which I have given two to four drachms, diaphoresis occurred after twenty minutes, but was never so abundant as in human patients; the breathing was accelerated, but no change occurred in the pulse, temperature, or quantity of the urine; in all cases abundant salivation continued for two or three hours. Half a drachm to a drachm caused in English terriers, 15 to 20 lbs.

weight, profuse salivation, but no diaphoresis or other notable effects. The physiological actions of jaborandi specially indicate its use to promote salivary and skin secretion in febrile cases, to eliminate morbid or poisonous matters where the action of the kidneys is impaired, to get rid of urea in chronic rheumatism, and to drain away fluid in dropsies.

Doses, etc.—Horses or cattle take ʒij. to ʒiv.; sheep, pigs, or dogs, ʒss. to ʒi. given as an infusion.

JALAP.

Jalapa. The dried tubercles 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. In this country it thrives well, flowers, and comes to maturity, in the open air. It has a smooth, round, brown, twining, annual stem; long-stalked, cordate, and somewhat hastate leaves; crimson or light-red flowers; and a fleshy perennial root-stock, with numerous pear-shaped tubercles, varying in size from a walnut to an orange, round or pear-shaped, and invested with a thin, brown, wrinkled cuticle. These tubercles are gathered about March or April, just before the young shoots spring, and dried by suspending them in nets over or near the fire. Sections or slices of the tubercles are also met with; are hard and compact, marked and marbled with concentric rings and pieces of shining resin. Jalap is triturated with difficulty, unless mixed with some hard salt, as potassium tartrate or sulphate. In powder, it has a pale-brown colour, a faint disagreeable odour, and a taste at first sweet, 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 sugar, starch, and cellulin, and 10 of gum, jalap contains nearly 18 per cent of a brown brittle resin easily soluble in rectified spirit, but distinguished from ordinary resin by its solubility in oil of turpentine. It consists of about equal proportions of the colourless, amorphous translucent jalapin (C_{34} H_{56} O_{16}), which resembles the resin of scammony, and the less soluble but more active convolvulin (C_{31} H_{50} O_{16}). Jalap of good quality is dark-coloured, dry, heavy, compact, and not worm-eaten. The square or spindle-shaped pieces of the larger-rooted male jalap, or Orizaba root, possess the same properties as the ordinary jalap. Similar cathartic properties also belong to the smaller elongated, corky, paler, wrinkled tubercles of the Tampico jalap, sometimes substituted for the officinal jalap.

Actions and Uses.—Jalap is irritant, cathartic, and feebly vermifuge. Full doses given to dogs or cats usually cause nausea and 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. Professors Rutherford and Vignall, experimenting upon dogs, found that jalap stimulates the secretion of bile, and acts still more notably on the intestinal glands (*Journal of Anatomy and Physiology*, Oct. 1876). For dogs it 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; is more active than senna, the leaves of Cassia acutifolia; is less powerful and less irritant than gamboge, podophyllum, elaterium, or colocynth; as a purgative for horses it is neither so certain nor effective as aloes; as a purgative for cattle it is superseded by salines and oils.

Doses, etc.—Dogs take ʒi. to ʒij.; cats, ʒss.; pigs, ʒi. to ʒiv. It is best given in combination with calomel. Dogs, if fasted for six hours, are effectively physicked in two or three hours by ʒss. to ʒi. 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 Juniperus 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. 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, sweetish taste, followed by bitterness. For flavouring geneva about 2 lbs. are added to the 100 gallons of spirit. They contain 30 per cent of sugar, and yield, when distilled with water, one to two per cent of two volatile oils, one of which is isomeric with oil of turpentine ($C_{10}\ H_{16}$). 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 cutaneous diseases.

Actions and Uses.—The tops, fruit, and oil of juniper are mildly stimulant, stomachic, carminative, and diuretic. They are allied to other substances containing volatile oils, such as anise, caraway, and coriander, the 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 only on the digestive organs; but three or four ounces induce diuresis, and also 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 filaria 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, ʒij. to ʒiv.; 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 ʒi. to ʒij.; dogs, ♏v. to ♏x., repeated at short intervals 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 bluish-gray colour, and a peculiar odour when rubbed; is soft and malleable, readily cut or scratched, and has the specific gravity 11·4. Exposed to the air it oxidises, loses its metallic lustre, and becomes dull and opaque. It fuses at 617°. In ordinary water, with access of air, a hydrated oxide and carbonate is gradually formed. Lead is sometimes quadratomic, but most of its medicinal compounds are diatomic.

Poisonous and Medicinal Actions.—Metallic lead appears to be devoid of medicinal or poisonous action. Shot, an alloy of lead and arsenic, is occasionally used by the lower order of dealers, temporarily 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 are corrosive and irritant, but not so powerful as corresponding zinc or copper salts. The insoluble oxides and carbonates are feebly irritant. All lead compounds, in continuously repeated doses, become absorbed and deposited in the areolar and parenchymatous textures; nerve force is impaired; the voluntary and involuntary muscles are paralysed and wasted; the extremities are enfeebled and bent, for the extensors suffer before the flexors; the bowels are torpid from a like paralysis of the involuntary muscles of the intestines. 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.*, 6th edition).

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. The digestive functions are impaired, the appetite becomes capricious, is sometimes entirely gone, at other times is morbidly increased. Along the margins of the gums a gray or blue line appears—the result of the lead deposited in the connective tissue being blackened by the hydrogen sulphide present in the mouth, or of sulphur in the food. Constipation and colic are not so invariably present as in human patients. Paralysis and wasting are not confined to the muscles of the extremities and bowels, but also affect the involuntary muscles of the 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 gray-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 the 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. The cases survived four or five days. From the fourth stomach of one a pound of the fragments of the 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 the eating of 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 are 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 making 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 the 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, a stunted growth; a 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 3-16ths 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. Water sometimes gets contaminated 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 states 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 effect a solvent action on 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 bowels, which are apt to be torpid, should be opened by saline purgatives, nothing being better than magnesium sulphate. 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 Oxidii. Litharge. Red Lead.
LEAD CARBONATE. Plumbi Carbonas. White Lead. Cerusse.

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 gray 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, a mixture of 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 such decaying organic matters ranged round the coils.

Actions and Uses.—Litharge and white lead are irritant, desiccant, and astringent; frequently repeated doses exert the usual constitutional effects of lead compounds; their liability to become absorbed induces a preference for the harmless zinc oxide and carbonate. 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 4 pounds of litharge in fine powder, one gallon olive oil, $3\frac{1}{2}$ pints of water, by the heat of a steam bath, 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 glycerin, undergoes a change similar to what occurs 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, glycerin, remains in solution (p. 319). 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. 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 the other salts of lead; has been prescribed in scrofula, and applied externally in indolent tumours in the form of ointment or plaster.

LEAD ACETATE. Plumbi Acetas. Sugar of Lead. $Pb\ 2\ C_2\ H_3\ O_2;\ 3\ HO$.

LEAD SUB-ACETATE. Plumbi Subacetas. Lead Oxyacetate. Goulard's Extract. $Pb\ C_2\ H_3\ O_2$, dissolved in water.

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 $3\frac{1}{2}$ 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. 358). Medicinal doses are astringent, styptic, and antiseptic; 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 albumin, 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.

Hertwig exhibited a pound of sugar of lead to horses, and observed nausea, colic, a quick, small, hard pulse, stiffness of the limbs, paralysis of the optic nerve, and sometimes of other parts, insensibility, and often death. Even more energetic effects occur in cattle. Prinz observed that half an ounce given daily for three days produced in cows fever, with a quick throbbing pulse, colic, and other symptoms of abdominal pain, in one case mania, but in none death. Mecke found that eight ounces, dissolved in water, and given in divided doses during two days, destroyed nine cattle; the first on the second, the last on the fourteenth day after the poison had been given. Early in 1857 a farmer near Glasgow lost eight cows from their boiled food having been 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 gray, 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 lungs, and profuse discharges. In purpura in horses and red water in cattle it is often effectual in staying bleeding and wasteful excretion of albumin in the urine. In chronic diarrhœa and dysentery, especially when conjoined with opium, it abates profuse discharges, and quiets violent vermicular movements. Half-drachm doses of sugar of lead and opium, given daily, frequently arrest the dangerous diarrhœa which attacks badly-managed anæmic calves and young 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 dry and abate the irritation and excessive weeping of eczema, nettle-rash, and other cracked, painful, or itching skin complaints. 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 ʒi.; 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). With equal parts of spirit, and diluted with eight or ten parts of water, it is a mild 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 without heat from linseed.

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 cellular matters 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 a downy layer, constitutes the familiar surgeon's lint. Both lint and tow are used 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 the cleansing of wounds to sponges, which are very apt to retain and distribute septic germs. Oakum, consisting of detached fibres of old ropes, when treated with Stockholm tar, has recently been recommended as an antiseptic dressing for wounds.

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 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 albumin and legumin; a little sugar, 30 of oil contained in the albumin and embryo; 8 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 glycerin and linoleic acid ($C_{16}\ H_{28}\ O_2$: Mülder) associated with small amounts of oleic, palmitic, 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 lampblack, 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 are absorbed mainly by the lacteals; they are essential to the repair and growth of every tissue; their combustion develops heat and force. In moderate amount they favour the 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 scrofula, 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. 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 black-quarter. In the state of gruel or decoction, linseed is in every-day 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 and 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 not so actively cathartic as castor oil. Bland and unirritating, it is specially indicated where laxatives are required in irritability of the intestinal canal, in diarrhœa, in irritant poisoning, in young and weakly subjects, where saline or other active purgatives have been given, and their repetition is deemed inexpedient, and as a convenient menstruum for the administration of croton and oil of turpentine. Unless conjoined with other purgatives, it is not a very prompt or effectual cathartic for horses. For dogs, calves, and lambs it is a safe and reliable laxative, especially when given with an equal amount of castor oil. In colic it is usually combined with stimulants and anodynes. One of the colic draughts of the Edinburgh Veterinary College for horses consists of one pint of linseed oil with one or two ounces each of laudanum and oil of turpentine. On account of its lubricant and emollient properties, linseed oil often relieves choking in cattle; mixed with well-boiled starch-gruel and injected into the rectum or bladder, it allays irritation. As a soothing dressing, it is applied to hard, dry, irritable surfaces. From its drying properties, which it has in common with poppy, walnut, and cod-liver oils, it is less suitable than olive, almond, rape, or colza oils, or than lard, for making ointments or liniments.

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, or spirit and water.

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 strong sweet taste, and is soluble in water, and to a less extent in alcohol. Besides ordinary vegetable constituents, it contains asparagin and malic acid, a resinous oil, to which it owes its sub-acrid taste, and a sweet, yellow, uncrystallisable sugar, termed glycyrrhizin ($C_{24}\ H_{36}\ O_9$). 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 its 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 the 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.

Actions and Uses.—Magnesia is antacid and laxative. As an antacid, 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 with acidity and flatulence, acids are usually the appropriate treatment, but if magnesia is prescribed it 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, ʒii. to ℥i.; dogs and cats, ʒss. to ʒi. It is given suspended in milk or gruel, and conjoined with carminatives.

MAGNESIUM CARBONATE. Magnesia alba.
$3\ Mg\ CO_3,\ Mg\ O,\ 5\ H_2\ O.$

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 13 grains of carbonate dissolved in water charged with carbonic acid gas.

The action, uses, and doses of the carbonates are the same as those of the oxides; but in contact with the acid gastric juice, full doses are apt to evolve much gas, and cause distension and discomfort.

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. The 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 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 a copious white precipitate of barium sulphate, with barium chloride; and the white magnesia ammonia phosphate, with a mixed solution of ammonia, chloride of ammonium, and phosphate of soda. Its aqueous solution at ordinary temperatures is not precipitated by oxalate of ammonia (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 the absence of metallic astringency, and by its neutral solution giving no precipitate with hydrogen sulphide. Epsom salt is distinguished from Glauber salt by its neither efflorescing when exposed to the 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, febrifuge, and antiphlogistic. 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 tardily through animal membranes, retards absorption of fluid from the canal, and is itself absorbed chiefly from the stomach and duodenum. Whilst in the blood, it is believed to diminish the cohesive tendency of the red corpuscles, to remove fibrin and retard coagulation (Dr. John Harley, Royle's *Mat. Med.*, 6th edition). It is shortly excreted through the intestinal glands and vessels into the large bowels, along with a large amount of serum and fibrin in solution. This excretory process 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 centre one of which he 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 or five hours after the injection of 85 and 90 minims of saturated solution of Epsom salt. The loops on either side were empty; no congestion or inflammation was noticed. Croton oil, elaterium, and gamboge, tested by like experiment, all caused similar copious secretion, but none so abundant as Epsom salt, which yielded 42 and 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 and antiphlogistic properties. Professor Rutherford's experiments on dogs indicate that magnesium sulphate, unlike sodium and potassium sulphates, has no stimulant action on the liver (*British Medical and Surgical Journal*, November 1875). But 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, it is an uncertain and sometimes violent cathartic for horses, often acts unexpectedly on the kidneys, but in repeated doses of two or three ounces proves a valuable alterative and febrifuge. On dogs its purgative effect is irregular, and often accompanied by nausea and vomiting. For cattle and sheep it is a most 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 cause very fluid evacuations. Besides causing purgation, it diminishes blood pressure and abates fever and plethora; whilst moderate, frequently repeated doses, in all animals, also augment the secretions of the skin and kidneys.

Medicinal Uses.—To ruminating animals it is given for all the ordinary purposes of a purgative—to evacuate the bowels in indigestion, constipation, and the earlier stages of diarrhœa; to remove noxious matters from the blood, as in febrile and inflammatory affections; and to induce extensive counter-irritation, as in inflammation of the brain, eye, and most other organs, except the intestines. Although not a desirable purgative for horses, it is a very 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 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, ʒii. to ʒiv. 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 ten 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 full dose of ginger are added; and all dissolved in a liberal amount of tepid water. In obstinate constipation and torpidity of the bowels 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. For febrifuge and alterative purposes, Epsom salt is conjoined with nitre, mineral acids, gentian, and other bitters.

MARSH MALLOW ROOT.

Altheæ Radix. Dried Root of Althea 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, several inches long, and about an inch in circumference. Its sweet taste depends on the presence of uncrystallisable sugar; it further contains 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 a crystalline neutral inert principle.

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, and are used for drenches and poultices, and for making up 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 synonym hydrargyrum; to its mobility and metallic lustre such appellations as aqua argentum, aqua metallica, and quicksilver. Although occasionally found in metallic globules, its most important source is the sulphide or cinnabar, 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 silvery-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 gray powder, whilst 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*) From a neutral solution, whether organic or inorganic, whether containing a mercurous or mercuric salt, the metal may be extracted by heating in it a slip of clean copper, on which the mercury condenses. (*c*) When a drop of a solution of a mercury salt is placed upon a sovereign, and a key or other convenient 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-gray stain, easily removable by heat. (*d*) In solution, if a mercurous salt is present hydrochloric acid produces 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 gray 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, exert only mechanical effects. In a state of fine division it is, however, readily oxidised or dissolved, and thus acquires active properties. 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 rotting of the 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; whilst trout in the 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 and enter the blood; they are irritant and alterative; they are specially attracted to, and tend to accumulate in, the lymphatic glandular system; they promptly stimulate the salivary and intestinal glands; full or frequent doses disintegrate the blood and soft solids, and produce the specific condition of mercurialism; they are excreted by the mucous and glandular surfaces, and notably by the kidneys. 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, gray powder, and blue pill. Mercury salts resemble those of antimony in increasing waste, but are slower and more permanent in their antiphlogistic effects, and act on the lymphatic glandular organs, rather than on the skin and mucous membranes. They resemble iodine in increasing waste, and producing blood-poisoning, but have a wider range of action, and stimulate more directly the glands and lymphatic system.

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 kidneys and skin are unusually active; 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 trembling paralysis, depending upon irritation and debility of the motor centres (Dr. Harley). The blood forms a soft friable clot, loses in man one-third of its fibrin, one-seventh of its albumin, one-sixth of its globules, and is loaded with a fœtid oil. Mercury remains a considerable time in the body. 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. It has 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 is excreted by the mucous membrane of the intestines, and also by the kidneys. 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.

Mercurials exert various curative actions. Glandular enlargements or indurations are diminished; acute inflammation is mitigated or subdued; exudation of lymph is checked. Such beneficial effects are stated to be especially observable in inflammation of serous and parenchymatous textures, as in pleurisy, liver complaint, and ophthalmia. Mercurialism is producible in any of the lower animals, but with most difficulty in horses, which, like other animals, manifest, 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. In the lower animals, I do not, however, believe that any good results are obtained from mercurialism, which are not more readily and safely secured by salines and other remedies. Whilst mercurialism continues, the patient must be carefully protected from cold and wet. When it is to be arrested, the 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 the removal of chronic effects hastened by sulphurous fumigation or baths, potassium iodide, and small doses of opium.

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 12 hours" (Christison's *Dispensatory*). The proccss is facilitated by adding to the materials a sixteenth part of old ointment, or a small quantity of potassium nitrate or sulphate. The quality and purity of mercurial ointment are estimated by its bluish-gray colour; by its 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 during application, infriction and exposure increase this more active oxidised portion.

Actions and Uses.—Mercurial ointment, when merely laid on the surface of the skin, acts very slightly; when applied with smart friction, it irritates and vesicates. It is used in the several domesticated animals as a stimulant for indolent sores, ulcers, and chronic swellings. For destroying lice and other vermin affecting the skin, it is not superior to many milder and safer remedies. For mange, scab, and other scurfy skin diseases, it is generally applied along with tar, sulphur, or iodine. In some localities it is used much too freely. Professor John Gamgee states that a druggist in Boston sold in one year 25 tons of mercurial ointment, mostly to farmers. It requires very cautious using, for, besides undue irritant effects, it is apt to become absorbed. I have repeatedly known sheep dressed for scab waste and die from mercurial poisoning. In Lincolnshire a lot of sheep were dressed 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 property of absorption is, however, sometimes usefully exerted in aiding the effects of mercury given internally. Two ounces of the stronger mercurial 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 British Pharmacopœia. Its effects are similar to those of the ointment. Two compound liniments suitable for 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 and morphine, made by heating oleic acid to about 300° with five to twenty per cent of mercury red oxide. A grain of morphine to the drachm of oleate is added during cooling. This preparation is stated to have great penetrating power, is applied with the finger or brush; although readily absorbed, it does not, with ordinary care, cause salivation. It has proved useful in chronic inflammation of joints, painful exostosis, rheumatism, garget, and indurations of the udder, with glandular and indolent swellings. It also effectually destroys lice and their ova, and Mr. Marshall urges its use in relieving pain and checking morbid action in pleurisy, pneumonia, and pericarditis.

Mercurial Plaster. Emplastrum Hydrargyri.

For its preparation the British Pharmacopœia gives the following directions :—" 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." It 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. Gray 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 the mixture acquires a uniform gray colour. The mercury with chalk or gray 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 gray powder with good effect to young calves suffering from indigestion and diarrhœa, in doses of ten or 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. As an alterative for dogs, five to ten grains are prescribed. In the earlier stages of distemper, Mr. Mayhew recommends grs. v. to grs. xv. of gray 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 which has been recommended 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 compound 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.

MERCURY BLACK OXIDE. Hydrargyri Suboxidum. Mercurous Oxide. Hg_2 O.

The black, gray, 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 hydrated 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, luxuriant granulations, unhealthy eruptions, and chronic tumours, 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; whilst 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 British Pharmacopœia:—"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:—

$$\underset{\text{Mercurous Sulphate.}}{Hg_2\,SO_4} + \underset{\text{Sodium Chloride.}}{2\,Na\,Cl} = \underset{\text{Mercurous Chloride.}}{2\,Hg\,Cl} + \underset{\text{Sodium Sulphate.}}{Na_2\,SO_4}$$

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 allowed to cool. 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 taste; whilst sublimation leaves as residue any inorganic impurities.

Actions and Uses.—Calomel is irritant, stimulant, alterative, and antiphlogistic. Large or repeated doses cause mercurialism. It is an emetic for dogs and pigs. Passing out of the body, it stimulates the various excreting organs, and proves cathartic, diuretic, diaphoretic, sialogogue, and, according to some authorities, cholagogue. 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 mucous secretions of the canal, and also the bile, further aid the solution of calomel. The opinion sometimes entertained that it undergoes partial conversion into the higher chloride, corrosive sublimate, is contradicted by the fact that the chlorides in the canal are insufficient to effect such a change (*Monthly Journal of Medical Science*, 1851, p. 88).

Calomel is less irritant than corrosive sublimate or the nitrates. Its irritant action, usually followed by its specific constitutional effects, are produced in horses by three or four drachms; in cattle, by two or three drachms; in sheep, by fifteen to thirty grains; in dogs, by six to thirty grains. Hertwig found that such doses caused, in twenty-four to thirty-six hours, and in dogs in less time, occasional colic and copious excretion of fæces, which contained bile, and were grayish-green in cattle, but black in dogs. Such doses, especially if repeated daily for three or four days, further induce thin and stinking evacuations, fœtor of the 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 the 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 imflammation 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.

Regarding the action of calomel on the liver, some differences of opinion still prevail. 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, blue pill, nor even corrosive sublimate, affect the 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 other active mercurials, have no special cholagogue action; that they do not stimulate the secretion of bile, as they notably do of saliva. Stimulant effects are, nevertheless, propagated to the liver by reflex action from the intestines irritated by the mercurial, much in the same way as resinous purgatives, croton, or even the food itself, when in the duodenum, stimulate the functions of the liver, and contract the gall bladder and hepatic ducts.

Medicinal Uses.—Few remedies have been applied to so many and diversified uses, but neither in veterinary nor in human medicine is it as much used as formerly. Amongst the domestic animals it is still prescribed to reduce and control acute inflammation, especially when affecting membranous and parenchymatous textures, as in pleurisy, common and puerperal peritonitis, laminitis, and iritis. These curative effects cannot, however, be very satisfactorily explained. It appears to alter the faulty condition of fibrin, albumin, and red corpuscles, to stimulate most of the secreting organs, and to promote excretion of morbid products. In acute febrile and inflammatory cases it is frequently prescribed after blood-letting or a few doses of aconite, 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. 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 a bolus or a 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, half that amount for foals, calves, or sheep, two or three grains for dogs, given either alone or united with chalk or with laxatives, often prove useful in indigestion, acidity, bilious diarrhœa, and gastric catarrh, 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 early constitutional symptoms present themselves. But this treatment is not justified by recent knowledge of the action of the medicine, whilst clinical experience besides testifies that jaundice and torpid liver are usually best treated by laxatives and small and repeated doses of salines, which sweep away unabsorbed bile, and nitro-muriatic acid, which acts as a liver 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, the 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 its cathartic action are often induced alterative, antiphlogistic, and anthelmintic actions. Its 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, either in solution or ointment, it destroys the acarus of scab and mange, kills lice, abates the itching of those eczematous rashes which affect the hairy limbs of underbred cart-horses, is used as a stimulant for warts, and is one of the best remedies for thrush, and for relieving piles in dogs.

Doses, etc.—As an alterative and antiphlogistic, horses and cattle take grs. xx. to ʒi.; sheep and pigs, grs. x. to grs. xxx.; dogs, grs. ij. 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 the 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 and a half 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 may be 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 a ball 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 irritation of the skin, and kill lice and other vermin, 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. $Hg\ Cl_2$.

Corrosive sublimate and calomel must be carefully distinguished from each other. Both are chlorides of mercury, and, owing to unfortunate differences respecting the combining equivalent of their base, are occasionally described under the same chemical name. Corrosive sublimate contains twice as much chlorine as calomel, is the higher per or mercuric chloride ($Hg\ Cl_2$), and is a very soluble and actively corrosive poison; whilst calomel, the lower or mercurous chloride (Hg Cl), is an insoluble, comparatively mild, and much used 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 hydrochloric acid. 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 the 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 albumin and fibrin, flaky precipitates, soluble in solutions of common salt. It is decomposed by most vegetable solutions, especially when exposed to light. Its powerful antiseptic properties prevent attacks of vegetable and animal parasites, and recommend it for preserving wood, cordage, and anatomical preparations. Its tests have been detailed (p. 378). 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 antiphlogistic; repeated doses cause mercurialism. Externally, it is used as a stimulant, astringent, caustic, and as an antiseptic and parasiticide.

General Actions.—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-gray; 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 also from its constitutional effects. Dogs dressed with it for mange occasionally die from gastro-enteritis.

The best antidote is albumin, 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. It has been prescribed for horses in glanders, farcy, chronic skin eruptions, and thick œdematous legs resulting from repeated attacks of weed. Like other mercurials, it controls inflammation and promotes 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 dysentery in cattle. 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 albumin 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 ringworm parasite. 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. It stands next after zinc and iron chlorides on the list of antiseptics; 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.

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 vermin infesting the skin. 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 the greatest care.

MERCURY LOWER OR GREEN IODIDE. Hydrargyri Iodidum Viride. Mercurous Iodide. Hg I.

MERCURY HIGHER OR RED 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 reduces 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. A strong ointment is frequently rubbed into the rheumatic joints of cattle. It is, however, too powerful to be used, as fly blisters often are, immediately after firing; and when thus employed is apt to cause sloughing and blemishing. One or two 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. The British Pharmacopœia 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.

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. Mr. Duncan, of Messrs. Duncan, Flockhart, and Company, chemists, Edinburgh, first discovered the secret of preparing well-keeping citrine ointment, and his instructions are embodied in the British Pharmacopœia directions:—"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." 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 grayish-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 is used as a stimulant in chronic skin complaints; it is one of the best remedies for eczema; it often abates the scurfiness and irritation remaining in protracted cases of mange; it destroys lice and the fungus of ringworm; cautiously used, diluted with olive oil or lard, it greatly benefits irritable, swollen, discharging conditions of the eyelids; being easily absorbed, if freely applied, it induces the usual specific effects of mercury.

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. 124). 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. 445). 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 other 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 8·17; 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. It is identical in all respects with ethylic alcohol (p. 127), 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 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, fʒi. to fʒij.; 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.

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 Sinapes are annuals one to two feet high, with yellow cruciform flowers, and pods containing several brown seeds. They are indigenous in all parts of Europe, and extensively cultivated throughout Durham and Yorkshire. 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, greenish-yellow in powder, which has a pungent oily taste, smells slightly nauseous when dry, but is powerfully penetrating and irritant when moistened. The seeds of the white mustard are lighter in colour, larger in size, and less pungent and irritating. 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 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 in the epidermis; 4 of inorganic matters; and 10 to 15 of myrosin, an albuminous ferment similar to diastase or the emulsin of bitter almonds. Black mustard contains about $2\frac{1}{2}$ 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, irritating volatile oils—oil of mustard ($C_4 H_5 NS$) from the black mustard, and acrinyl sulpho-cyanate ($C_8 H_7 NSO$) from the white mustard (Flückiger and Hanbury).

Actions and Uses.—Unbruised mustard-seeds have little effect when swallowed, probably because they are only partially and gradually digested. The flour, however, in large doses, is an irritant; in medicinal doses, a stomachic, carminative, and stimulant. A dessert-spoonful, dissolved in several ounces of water, and given to the dog or cat, causes vomiting. It is slightly laxative and diuretic, allied to horse-radish and peppers, but is rarely given internally.

As an external irritant, it is in everyday use as a rubefacient, vesicant, or suppurant. A paste made with water, and rubbed into the skin, within fifteen minutes causes redness, heat, and tenderness. 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. The 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. 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 boiling 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.

For all veterinary patients suffering from catarrh, sore throat, bronchitis, pneumonia, and pleurisy, mustard, especially in the early stages, seldom fails to lessen pain and relieve difficult breathing. During the hepatisation stage of pneumonia it is of little use; but after six or seven days is 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 of mustard often afford relief. In phlebitis, a smart blister reduces inflammation, and hastens absorption of exudate. It 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 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 great risk of disorganisation and sloughing.

Doses, etc.—As a stomachic, carminative, and mild stimulant, horses take ʒiv. to ʒvi.; cattle, ℥ss. to ℥j.; sheep and pigs, ʒi. to ʒij.; dogs, grs. x. to grs. xx. Larger doses, especially in solution, act as emetics in dogs and pigs. To prevent irritation of the fauces, it is given in the form of pill or electuary. As an external irritant, it is used in the form of paste, occasionally as plaster and poultice. The best mustard flour is made, as for table purposes, into a paste with water, which should be tepid, but not hot. When still greater activity is required, the flour made from unmixed black mustard-seed may be used, or the ordinary commercial mustard is mixed with oil of turpentine, or with equal parts of oil of turpentine and ammonia solution. Spirits and vinegar, sometimes advised as solvents, retard the development of the active volatile 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," recently 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 British Pharmacopœia 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 a day. Such repeated moderate external warming up is usually more serviceable than one violent irritant dressing, whether for the relief of pain, the diminution of congestion, or even for the removal of exudate. The 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 the seeds of black mustard after the expression of the fixed oil, is a prompt and powerful vesicant. Two drachms, rubbed into the skin of a dog, caused immediate irritation, with the 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.—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 exudes spontaneously from perforations or cracks in the trunk or branches of at least two species of shrubby thorn-like Balsamodendrons. It is at first of an oily consistence and a yellow-white colour, but 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; 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 stimulant and astringent. It gently stimulates the digestive mucous membrane, improves the appetite, and arrests excessive mucous 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 ʒij.; sheep and pigs, ʒss. to ʒi.; 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, is a definite hydrate ($2HNO_3$, $3H_2O$), 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; dropped on the skin, it produces a yellow stain, deepened in colour by alkalies, and removed only by the wearing down of the part. It 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 ($H\,NO_2$); it gives a yellow stain of xanthoproteic acid to wool and to the skin; 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.

Impurities.—The tests of purity are the specific gravity, which indicates the proportion of water; the absence of colour proves that no ruddy nitrous acid is present. 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, corrosive, 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 alterative and astringent properties.

Readily absorbing water, and parting with oxygen, 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. 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, nutrition aided by good, easily-digested food.

Medicinal doses exert stimulant and antiseptic effects on relaxed and ulcerated conditions of the mouth and fauces. They are very diffusible, form salts in the blood, and diminish its alkalinity; favour the flow of saliva and other alkaline secretions; thus abate thirst, and prove refrigerant. But large repeated doses, as of other acids, interfere with secretion of gastric juice. It is sometimes prescribed in atonic dyspepsia, and where there is excessive fermentation, but in such cases is scarcely so suitable as hydrochloric acid. Both nitric and nitro-hydrochloric acids are administered as alteratives and tonics in atonic diarrhœa, especially of cattle and sheep; in chronic enlargement and fatty degeneration of the liver; in typhoid fever in horses; and, alternated with arsenic, in inveterate mange, eczema, and farcy.

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 which accumulates in neglected cases of scab and mange. It destroys the virus lodged in poisoned wounds, excites a healthier action, and removes noisome odour 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. It is serviceable in abating the itching of nettle-rash. Excessive sweating in horses during exertion or sickness is occasionally 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 skin in scab and mange.

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.—Even the diluted acid is a corrosive, irritant poison; is prescribed medicinally as an alterative and tonic; exerts special stimulant effects on the skin and liver; is believed by Dr. Lauder Brunton to act beneficially in gastric and hepatic derangements 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; gray 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, gray-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 gray albumin 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-gray 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 excites the motor tract of the spinal cord. Large doses produce fatal tetanic convulsions and death by asphyxia. Medicinal doses are bitter nervine tonics. It is a slight topical irritant.

General Actions.—A full dose in a soluble form almost immediately causes rigidity and spasm of the whole voluntary contractile tissues, alternated with periods of quiet, during which the patient is much prostrated; 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 death by asphyxia. There is no direct effect on the brain proper, the muscles, the heart, or the sensory nerves. 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 tetanus, 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 tetanus 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 frequent 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. The post-mortem appearances vary somewhat with the severity and duration of the case; the blood is dark-coloured and liquid; there is usually venous engorgement; congestion of the lungs, of the cerebral and spinal meninges; dilatation of the vessels and sanguineous extravasation of the gray matter of the medulla. When the patient has survived 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 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. Professors Crum Brown and T. D. Fraser have discovered that the ethyl and methyl compounds of strychnine are antagonistic to strychnine; instead of stimulating, they paralyse the centres of motion and reflex action. 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.—Chronic motor paralysis is the indication for the use of nux vomica. I have given it to horses stiffened and partially paralysed from attacks of strangles, influenza, and rheumatism. Mr. David Aitkin, veterinary surgeon, Dunfermline, has prescribed it 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 hinder 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 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 use it with advantage, it should be persevered with until it produces muscular twitching, usually first apparent during the night, noticed first 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, how long soever it be continued. When given in the solid form, violent and even fatal effects have occasionally resulted from several doses 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 ʒi.; cattle, ʒij. to ʒiij.; sheep, grs. xx. to grs. xl.; pigs, grs. x. to grs. xx.; dogs, grs. ij. to grs. viij. 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 often 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 considers 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 ensure 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 5000th 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 stimulants and tonics of motor centres. 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.

General Actions.—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. These 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. Horses and cattle are poisoned by doses both absolutely and relatively larger than those fatal to dogs. A horse had twitching of the muscles after swallowing six grains, and 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. Blood-letting and fomentations gave no relief, and in a convulsive paroxysm the horse died. The membranes of the brain and cord were injected, the lungs engorged (*Veterinarian*, March 1856). Half a grain, injected hypodermically, induced in half an hour general muscular rigidity. All animals are tolerably uniformly affected by strychnine; but chickens are less susceptible than other birds; and guinea-pigs and some monkeys appear in a remarkable manner to resist its effect (Dr. H. C. Wood, *Treatise on Therapeutics*).

Mr. M'Gillivray, 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 by 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. 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, ensures most certain and rapid effect. 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 the 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,* strangles, influenza, or rheumatism, when

* 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 any obvious amendment. Four grains strychnine, made into a 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.

irritation and inflammation have passed away, there sometimes remains impaired action of the limbs, imperfect power of urination, or occasionally of defecation. Weakened 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. 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 of diluted solutions sometimes answer better than the internal administration of the poison; 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. 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 strychnia, and are coloured by soot or Prussian blue. Battle's shilling packets have sixty grains, and the sixpenny twenty-five grains, of strychnia (Dr. S. Macadam).

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.

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. ij. to grs. iij.; for cattle, grs. iv. to grs. vi.; for sheep, gr. $\frac{1}{3}$ to gr. i.; for dogs, gr. $\frac{1}{30}$ to gr. $\frac{1}{10}$. 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 a bolus. The Pharmacopœia solution, which really contains the hydrochlorate, is made by gently heating strychnine grs. iv., water, f℥vi., and diluted hydrochloric acid, ♏vi. to ensure 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. 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. 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. 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, resembles strychnine in most of its characters.

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. 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. The 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 gelatin 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 the feeding of 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 ʒii. to ℥i.; cattle, ℥ss. to ℥ij.; sheep and pigs, ʒss. to ʒii.; dogs, grs. x. to grs. xxx.; administered in infusion or decoction, made with one to 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, about the size of a damson, and containing a single seed. Ripe olives yield 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. Medium qualities, often prepared from long-gathered and fermented fruit, and by steeping in water previous to expression, are brought from Naples. Inferior varieties, got from stale or rotting olives, or by moistening and pressing the residue left during the manufacture of the superior qualities, come from Sicily and Spain.

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 glycerin ($C_3 H_5$, 3 $C_{18} H_{33} O_2$). Olive oil contains about 72 per cent of fluid olein, holding in solution 28 of a mixture of palmitin and stearin. 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 the 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 the 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 linseed, rape, and lard oils. The "black oil" so extensively used empirically throughout England for bruises, strains, and wounds, is usually made with a pint of olive or linseed 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.

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 ὀπὸς (*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 rapeseed. The cake or residue left after the 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. It flowers in June or 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 is mostly of fine quality, and highly prized in the English market, is chiefly collected in the north-western districts of Asia Minor, and exported from Smyrna and Constantinople. It is brought down in bags or baskets covered with poppy leaves and with the chaffy seeds of the rumex. It occurs in round flattened pieces weighing from half a pound to three pounds; 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 contain on an average 10 or 12 per cent of morphine, and are also rich in meconic acid.

EGYPTIAN OPIUM, being generally grown on too moist a soil, 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 5 per cent 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 many thousand pounds weight, at the rate of 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 disposed of by the native cultivator to the opium 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 $3\frac{1}{2}$ 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 (*Pharmaceutical Journal*, vol. xi.)

Persian Opium, cultivated in the central provinces, and brought 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 has been cultivated in France and Germany, and also in Great Britain. In 1818 Dr. Young grew poppies near Edinburgh, and obtained nearly six ounces of excellent opium from a fall of ground, being at the rate of $57\frac{1}{2}$ 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 the time, and the low value of land and labour, the speculation was tolerably lucrative. Unless 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 from 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. When heated they soften, and at high temperatures burn with a strong, peculiar odour. Cold water dissolves about 60 per cent of a good 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 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 of all, opium from which morphine has been already extracted. Such inorganic matters as sand, stones, 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, pectin, wax, albumin, and colouring matters, chiefly derived from the scrapings of the capsules, and constituting about 10 per cent; about 6 or 8 of uncrystallisable sugar; traces of an aromatic volatile oil; 10 to 15 of water, about 7 of ash; and combined with meconic and sulphuric acids, several crystalline alkaloids, 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 alkaloids, 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. 438), washing the precipitate, and drying at a gentle heat. The yield from different specimens of opium varies from 6 to 12 per cent. The highest recorded yield is 21 per cent, obtained from opium grown near Amiens, but nearly the same results have been got from selected specimems of Turkey opium. 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, dissolves in 1000 times its weight of cold water, in 400 of boiling water, in 30 of boiling rectified spirit, in chloroform, oils, alkalies, and weak acids, with which it forms crystallisable and usually soluble salts. With a neutral solution of ferric-chloride it produces a purple-blue solution, which gradually becomes green; with nitric acid, an orange-red solution; with iodic acid, a red-brown liquid containing free iodine. Its actions and uses are identical with those of its salts. (See p. 340.)

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. It is the most certain and active emetic known; ¼ 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, soluble in 100 parts of boiling water, 400 of cold, rather more soluble in glycerin 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 ($C_{20} H_{21} N O_4$) is present to the extent of about 1 per cent, is separable in shining prisms, 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 ($C_{23} H_{25} N O_5$), 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 6 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 have an insipid taste, and are soluble in ether, alcohol, and weak acids, but not in cold water. It is a feeble base, and is distinguished from morphine by having no bitter taste, no reaction on vegetable colouring matter, and no effect on ferric-chloride. It is stated to be devoid of narcotism, but a tonic and antiperiodic, and in 20-grain doses has been used in India as a substitute for quinine in the treatment of intermittent and remittent fevers.

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. 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; 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, has an acid taste and alkaline 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 4 to 8 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. 438) 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 ammonio-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 be 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 a syrup. Redissolve this 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, necessarily exhibits various and diversified actions. It is the type of a narcotic. It acts both on the cerebro-spinal axis and sympathetic system. Full doses cause primary stimulation and secondary depression. According to its dose and the state of the patient, it is stimulant and sedative, or excitant and soporific. 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 mainly depends upon the dose and temperament of the patient. 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 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; and, promoting healthy nutrition, they are anodyne. Fuller doses are narcotic, sedative, antispasmodic, and, in virtue of their paralysing effects, are anodyne. Digestion or absorption, secretion or excretion, is not retarded by stimulant or feebly soporific doses, but is 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; after a brief preliminary excitation, it usually calms and even 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 at the top of 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.

General Actions.—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 any 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 Narcotics,* 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 vasomotor nerves, deranges and depresses the functions of the vagus, and thus develops the characteristic nausea, retching, cramp of respiratory muscles, and distension of the right heart (p. 121).

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. To this fact are referable 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 by 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 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 of the experiment.

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. These 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 irregular, 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. 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, galvanism, and dashing cold water over the head and neck 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 overtaxed heart. But although antagonising some of the actions of opium, neither strychnine nor atropine is available as a safe antidote (Dr. Harley).

No article of the Materia Medica is more frequently and generally prescribed. As a stimulant and restorative it acts almost like food or alcohol. Cutchie horsemen share their opium with their jaded steeds, and increased activity and capability of endurance are observed alike in man and beast. In gastritis, or gastro-enteritis, whether produced from disease or from swallowing acrid poisons, opium is of great value in allaying irritability, pain, and spasm. Obstinate chronic vomiting, depending upon gastric irritation, when occurring either in dogs or pigs, is generally relieved by a few grains of opium given with chloroform, or chloral hydrate. When, in weakly, young, growing animals, food is hurried too rapidly through the digestive canal, opium checks excessive secretion and peristaltic motion, and, conjoined with mineral acids, 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 appears to abate irritability of the vaso-motor nerves, diminishes excessive secretion, and may often be advantageously united with acids, bitters, or vegetable astringents. For such purposes, alike in horses or cattle, the following recipes answer well:—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 linseed meal, or dissolved in ale or gruel, and given twice daily, or as required. An ounce laudanum, thirty drops sulphuric acid, two drachms powdered catechu, with an ounce of ginger, aniseed, or fenugreec, 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. Half 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 to 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 are acting imperfectly.

Antagonising muscular spasm, opium is valuable in intestinal colic, so common amongst improperly and irregularly fed horses. In these cases it 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 muco-enteritis, so fatal amongst the heavier descriptions of hard-worked horses, a dose of opium and calomel is prescribed in the earlier stages, and opium, belladonna, chloral hydrate, and ether in the second stages. In muco-enteritis as well as 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.

Diseases of the respiratory organs, with shallow embarrassed breathing, are unsuitable cases for full doses of opium, which would still further depress respiratory function, and favour death by apnœa. Pleurisy may be treated by larger and more frequently repeated doses than bronchitis or pneumonia. Cough, irritability, and pain about the throat or chest, are usually relieved by opium, conjoined with belladonna. With belladonna and stimulants, opium is very serviceable in the various catarrhal epizootics of horses, popularly recognised as influenza, and long and fatally doctored by antiphlogistics. For such epizootic cases, after a few doses of salines, cough and vascular congestion are effectually removed, the pulse strengthened, and the appetite improved, by half a drachm each of opium and belladonna extract, with an ounce of ether or sweet spirit of nitre administered twice daily in gruel or ale. 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. In tetanus, occurring in young animals from exposure to cold, opium, especially when conjoined with chloral hydrate or conium, is often of signal benefit; whilst in the more serious cases amongst adults, spasms and morbidly acute sensibility are sometimes abated. Both in human and veterinary patients rigidity has 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. In hæmorrhoids, it 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 kidneys, bladder, and rectum. Such injections have not only a beneficial topical effect, but by reflex action they 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 ʒi. to ʒij.; for cattle, ʒij. to ʒiv.; for sheep, grs. x. to grs. lx.; for pigs, grs. x. to grs. xxx.; 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. Its sedative effects are intensified by combination with calomel, aconite, or tartar emetic; its stimulant and antispasmodic actions 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 actions by union with chloral hydrate, hemlock, or henbane; its diaphoretic virtues 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 those 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 of opium, 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 British Pharmacopœia 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 $13\frac{1}{4}$ 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 starch gruel.

MORPHINE HYDROCHLORATE OR MURIATE.—Hydrochlorate of morphia, or morphiæ hydrochloras ($C_{17}H_{19}NO_3$, HCl, $3H_2O$), 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 the ordinary medicinal actions. White sugar is sometimes used for adulteration. The British Pharmacopœia 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, give 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 morphia, or morphiæ acetas ($C_{17} H_{19} NO_3, C_2 H_4 O_2$), 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 the 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 nerves themselves still retain sensibility and conductivity. They are used to antagonise irritability, spasm, and pain.

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, 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 to 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 effect, 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, pallor of the surface, reduction of temperature, diminished peristaltic movements and action of the kidneys, with contraction of the pupil. Atropine in full doses causes delirium, cardiac stimulation, redness of the surface, elevation of temperature, increased peristaltic movements and action of the kidneys, with dilatation of the pupil. 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 the 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 the restlessness and delirium, the rapidity and force of the pulse, the 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; whilst narcotism, so rarely produced by either drug alone, is sometimes developed (*Old Vegetable Narcotics*).

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. Injected hypodermically, they act in smaller quantity, as well as more speedily and certainly than when swallowed; they can be brought nearer to the seat of suffering; and by Messrs. Mavor and Dollar of London, Mr. Fearnley of Leeds, and other practitioners, have been successfully used, especially in neuralgia, acute rheumatism, spasmodic cough, and enteritis in horses; and in these, and other such cases, good effects result from the conjoint use of morphine and atropine.

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 accidulated either with hydrochloric or acetic acid. For hypodermic 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 yields many fragrant plants used in medicine as mild stimulants, stomachics, carminatives, and antispasmodics, and in pharmacy as flavouring aromatics. The most important are mint, lavender, rosemary, marjoram, and thyme, all closely resembling each other in properties, actions, and uses.

The only one requiring special notice is peppermint, an herbaceous plant, growing wild in damp situations, with a smooth annual stem, three to four feet high, and stalked ovate lanceolate smooth leaves. The herb, and especially its leaves, have an agreeable aromatic odour and a warm aromatic taste, followed by an impression of cold; owe their properties to a bitter principle, a little tannin, and still more notably to a colourless or yellow volatile oil, of which the fresh herb yields 0·25 per cent by distillation with water. At 24° the oil deposits crystals of menthol or peppermint camphor (C_{10} H_{18}, H_2 O). In indigestion, flatulence, and griping ♏xx. of the oil are given to horses and cattle, ♏iij. to dogs; but its chief use is for disguising the flavour of unpalatable drugs, and preventing their nauseating. Peppermint water is prepared by distilling the fresh-flowering herb with water and a little rectified spirit, or, according to the British Pharmacopœia, by distilling $1\frac{1}{2}$ fluid dram volatile oil with $1\frac{1}{2}$ 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 climbing plant—the Piper nigrum, of the Nat. Ord. Piperaceæ. They are imported from the Malabar coast, the islands of the Indian Archipelago, and the West Indies. The spike, bearing 20 to 30 berries, is gathered shortly before ripening, dried in the sun, the berries rubbed off, and ground without separating their outer covering, yielding black pepper. To prepare the milder white pepper, the best and soundest ripe berries are steeped in water, and their outer covering carefully separated before they are ground. Long pepper brought from Singapore and Batavia consists of small, closely-attached berries, arranged on cylindrical gray spadices one or two inches long. Cubebs, or Cubeba, are the dried unripe fruit of the Cubeba officinalis cultivated in Java. The berries are stalked and lighter coloured than those of the 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 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, and is resolved by nitric acid into piperic acid (C_{12} H_{10} O_4), and an active oily alkaloid piperine (C_5 H_{11} N).

Jamaica pepper, pimento, or allspice, closely resembles the true peppers; is the dried unripe berry of Eugenia pimenta, a fine 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 3 to 4 per cent of volatile oil, tannic acid, fixed oil, and starch.

Capsicum—the dried ripe fruit of Capsicum fastigiatum and annuum—is also known as Chili pepper, chilies, Guinea or pod pepper, and is 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, and owes its properties to a volatile crystalline alkaloid—capsicine, half a grain of which 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 omnivora, 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 stimulate the nerves of common sensation and of taste, and are stomachic and carminative. 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 a 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, occasionally in colic, and for obviating the disagreeable taste and nausea of various drugs. It is not now given as a sialogogue, nor for the irrational object of increasing the 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 ʒij.; cattle, ʒiij.; sheep and swine, grs. xx. to ʒi.; 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—NAPHTHA.

Petroleum is a somewhat vague term, applied to a class of bitumins usually found in the tertiary strata; probably 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, produced from the distillation of coal in the manufacture of gas. 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 a volatile naphtha, and burns with a dense sooty flame. During the last twenty-five 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 bitumin or pitch, which, in Rangoon tar, reaches four per cent; a crystalline spermaceti-like paraffin, 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, easily separated by distillation, varying in volatility and boiling point, excellent solvents for indiarubber, resins, fats, and sulphur, burning readily like alcohol; and under the various names of paraffin oils, petroleum spirits, benzoline, or naphthas, used for burning in lamps, for singeing horses, etc.

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. Canadian crude naphtha is not so effectual an antiseptic as carbolic acid, wood naphtha, or turpentine. 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, chronic wounds, with thrush, canker, and other diseases of the feet.

PODOPHYLLUM—PODOPHYLLIN.

Dried rhizome of Podophyllum peltatum, from which the resin Podophyllin is extracted by rectified spirit.

Nat. Ord.—Ranunculaceæ. *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. Powder yellowish gray; sweetish in odour; bitterish, sub-acrid, and nauseous in taste (*Brit. Phar.*)

The dried, coarsely powdered root, by 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. Associated with the resin is the amorphous alkaloid beberine, devoid of irritant properties, also present in various plants of the Berbery tribe and in calumba root, an odoriferous principle and saponin (Flückiger).

Actions and Uses.—Podophyllum and its active resin are irritants of the mucous membrane; when swallowed they are cathartics and nauseants. Full doses cause emesis in carnivora. As a purgative it resembles jalap; but for the larger domestic animals it is slow and uncertain; its cholagogue effect, like that of other resinous purgatives, probably depends upon its irritating the duodenum and hurrying onwards any bile lodged there, and which, were it not removed, would undergo reabsorption.

Podophyllum has been used by medical men in America since 1847, and more recently by many British practitioners; 30 to 60 grains act on human patients much in the same way as jalap, but it has the disadvantage of producing unpleasant sensations in the throat, with occasional nausea, vomiting, and depression. Half a grain to a grain of the resin slowly empties the human bowels. It is prescribed in habitual constipation and congested states of the liver, and in smaller doses as an alterative in skin diseases and rheumatism.

The late Dr. F. G. Anstie made, in 1863, a series of experiments with an alcoholic solution, 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 the injection, when vomiting and purging were set up, the frequently-passed dejections became very fluid, freely mixed with mucus, and usually tinged with blood; the breathing was 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 require for the development of these poisonous effects doses fully larger than those which destroyed dogs. From his experiments, Dr. Anstie drew the following conclusions :—" 1. Podophyllin, when injected into the peritoneal cavity of dogs, cats, or rats, has no irritant action upon the serous membrane, unless it remain unabsorbed, lying for some time in contact with it. 2. Podophyllin, when injected into the peritoneal cavity, passes into the blood, and exercises a special influence of an irritant kind upon the mucous membrane of the intestines, usually of the small intestines only. 3. As a secondary result of this irritation, or perhaps as a mere consequence of the squeezing of the gall-bladder by the abdominal muscles in repeated efforts at defecation, bile is occasionally poured out in large quantities; but this is by no means necessary. 4. Neither poisonous doses, nor those which produce what may be called a medicinal effect, appear capable of exciting any inflammatory process in the liver. 5. For all these reasons, it appears pretty certain that podophyllin in the animals above mentioned does not act directly on the liver; and that the catharsis produced is due to increased secretion from the intestine, consequent on the specific irritation of its mucous membrane." (*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 favourable 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, V.S., 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 a gentle purgative action. During the two following days the bitch refused her 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, and gradually removing the mange. In all these cases the pulse was reduced in number and in strength; the secretion of urine 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 whatever. I have repeatedly given healthy horses, prepared by mashed 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 purgative effect. Two days later he again received two drachms, with a drachm of aloes, still without any noticeable action on the bowels. Four hours after the second dose, the pulse, however, was observed to have fallen from 44 to 34 beats per minute. During three days this horse ate nothing but bran; getting tired of this, he had for two days hay and a little corn; for twenty-four hours he was again restricted to bran mashes, and then received two drachms each of podophyllin and aloes, which, even after this careful preparation, only produced slight laxative effects.

To a well-bred hunter, nearly sixteen hands high, under treatment for injury of the psoæ muscles, and fed for twenty-four hours on bran, Mr. Dollar administered two drachms podophyllin in a ball, and two ounces Epsom salt in solution. Scarcely any perceptible action was observed on the bowels; and two days later two drachms podophyllin and one drachm calomel were given, also without purgative effect, but with a reduction, as in the 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 any 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.

From these and other experiments, it is evident that podophyllin is not likely to be serviceable as a purgative for the domestic animals; that it acts very tardily, and only when given in doses so large as to induce nausea. Mr. Dollar's observations show, however, that it is possessed of nauseant and sedative effects, which may 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 such sedative purposes, horses and cattle take ʒi. to ʒij. of podophyllin, united with calomel ʒi., or with an ounce of nitre or of Epsom salts. For dogs, gr. i. to grs. ij. may be conjoined with calomel gr. i., gray powder grs. v. to grs. x., or about the same quantity of ipecacuan.

POTASSIUM AND ITS MEDICINAL COMPOUNDS.

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.

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. The crude potashes, calcined until white, yield pearl ashes. Pearl ashes or potassium carbonate boiled with freshly slaked lime produce by double decomposition liquor potassæ, of which one fluid ounce contains 27 grains potassium hydrate (K HO). 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 gray or white deliquescent, hard, crystalline sticks of caustic potash. Potassium salts 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, 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 (Ringer's *Handbook of Therapeutics*).

Potash salts are constituents of the blood and all the animal textures, but abound especially in the juice of the flesh and in the milk. They are abundantly present in most land plants. Potassium salts, notably the chloride, occur in the Australian salt bush countries, and are stated to be the source of their healthiness, the size of the stock grown on them, and their freedom from parasites. Potassium salts are very soluble. Like other alkalies, the hydrate and carbonates aid the 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. They increase the gastric and other acid secretions; but diminish secretion of the salivary glands, liver, and pancreas. They have a high diffusion power, stimulate oxidation and tissue metamorphosis, exert a solvent power over albuminoids, and thus counteract deposition of exudate. They are excreted from the body mainly by the kidneys, increasing chiefly the watery parts of the urine, and neutralising its acidity.

It simplifies the understanding of the potassium salts to divide them into two groups. 1st, Those which are corrosive, antacid, and antilithic—such as the hydrate and carbonates. 2d, Those which are irritant, cathartic, diuretic, alterative, febrifuge, and refrigerant—such as the sulphate, acetate, tartrate, nitrate, chlorate, and permanganate. A third group might be added, including salts which partake of the actions of their acid, or salt radical constituent—such as potassium sulphuretum, iodide, bromide, and cyanide.

Actions and Uses.—Large doses of potassic hydrate, whether in the solid state 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. Hertwig found 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 a most 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 urethral 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, it must be applied cautiously. Mixed with lime, 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 eighty per cent of potassium carbonate, with twenty per cent of potassium sulphate and chloride, which, being less soluble, are got rid of by dissolving the pearl ashes, with brisk agitation, in an equal weight of water, pouring off the solution, and evaporating it to dryness. 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. Carbonic acid, or carbonic anhydride, being diatomic, unites with two equivalents of the monatomic potassium to form the carbonate $K_2 CO_3$, and with one of potassium and one of hydrogen to form the bicarbonate $KH CO_3$.

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. 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, alterative, and diuretic. As an antacid, preference is given to the milder bicarbonate. Both are useful antidotes for overdoses of acids; and exert antacid and alterative virtues in rheumatism, and also in psoriasis, nettle-rash, and other itching chronic skin complaints. Besides being used internally, a solution is sometimes, with benefit, applied to the 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℥ii. to f℥viij., with belladonna extract, grs. viii. to grs. xvi., followed by potassium bicarbonate, ʒss. to ʒi., 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. At the Cape of Good Hope, a ley made from wood ashes is used successfully as a remedy for scab, either alone or mixed with sulphur. Diluted with 60 to 80 parts of water, the bicarbonate forms a soothing dressing for the earlier weeping stages of eczema rubrum, or red mange, in dogs.

Doses, etc.—Of either carbonate, horses and cattle take ℥ss. to ℥i.; sheep and pigs, ʒss. to ʒi.; 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 sulphide and hypo-sulphite; but as it oxidises and becomes lighter coloured, it contains besides potassium sulphite and sulphate.

Actions and Uses.—In large doses it is a narcotic, irritant poison; in medicinal doses, 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_2SO_4.)

POTASSIUM BISULPHATE. Hydropotassic Sulphate. Bisulphate of Potash. ($KHSO_4$.)

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 distinguished 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. Professor Rutherford found that it has a distinct stimulant effect on the liver, shared by sodium sulphate, but not by magnesium sulphate. Both sulphates are cathartic and diuretic. As cathartics, however, 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. 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 British Pharmacopœia 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 British Pharmacopœia 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 in its actions and uses, but is less powerful, and devoid of local irritant action. Medicinal doses are alterative, deobstruent, and diuretic. No salt exhibits greater rapidity in absorption, in permeating the textures, and in being excreted through the mucous surfaces, but especially 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 quickly got rid of.

Two or three drachms dissolved in water, and given to dogs, caused vomiting, great depression, and death in a few days; one 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 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. For arresting the discharge of chronic bronchial catarrh, and hastening absorption after attacks of lymphangitis in horses, and after other inflammatory complaints, it is conjoined with tonics or stimulants. 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 the removal of lead mercury and other metals from the body, probably causing their re-solution and expulsion in the urine. It is applied externally for the reduction of tumours, and is constantly employed for increasing the solubility of iodine, both in water and alcohol.

Doses, etc.—Horses and cattle take ʒij. to ʒvj.; 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 nerve sedative, depressing cerebral function and reflex excitability. It is excreted mostly unchanged by the kidneys. In human patients it is given to allay cerebral excitement; and in dogs, to check epilepsy, and other convulsive disorders. Like the corresponding iodine salt, it is believed to be deobstruent; and is used in the same, or somewhat larger, doses, occasionally conjoined with chloral and hemlock. Neither the potassium nor ammonium bromides have yet been used for horses or cattle.

POTASSIUM NITRATE. Potassæ Nitras. Nitrate of Potash. Nitre. Saltpetre. (KNO_3.)

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 the oxidation of the ammonia alike of the soil and atmosphere, and also by the direct union of the nitrogen and oxygen of the air under the influence of electricity. From the disintegration of felspar and mica rocks and plant remains, the potassium is eliminated. The 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 $3\frac{1}{2}$ parts of cold water, and one-third of its weight of boiling water; during solution much heat is abstracted; it is insoluble in alcohol. Warmed in a test-tube, with sulphuric acid and copper filings, it evolves ruddy fumes of nitric peroxide; heated to fusion, the melted mass forms, on cooling, the hard, white, fibrous, sal-prunelle. None of its common impurities interfere with its medicinal actions.

Actions and Uses.—Large doses are irritant and cathartic; medicinal doses are diuretic, alterative, antiseptic, febrifuge, and refrigerant; 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.

Nitre has a high diffusion power, it rapidly enters the blood; it renders the venous blood scarlet, counteracts adhesion of the red globules, favours solution of fibrin, oxidises products of tissue metamorphosis, and hastens their removal especially by the kidneys, lowers arterial tension, and neutralises acidity. To one or more of these actions are due its several curative effects. In febrile inflammatory and rheumatic complaints it abates fever, lowers excessive temperature, and removes, by the kidneys, both fluid and solid matters. In the earlier and acute stages it is conjoined with other salines and sedatives; in the second stages, with alteratives, stimulants, and tonics. Along with diuretics, it is prescribed in scantiness and turbidity of the urine, and in swelled legs and dropsical affections. Small, frequently-repeated doses are often valuable in arresting purpura in horses, even in cases in which iron and turpentine have proved ineffectual. Many agriculturists give their horses, whilst on hard food, an ounce of nitre with a mash every Saturday night; the 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 consequently a useful refrigerant in apoplectic seizures and inflammation, especially affecting the joints and feet. Its cooling effect is increased by admixture with sal-ammoniac. Five ounces each of nitre and sal-ammoniac, dissolved in sixteen of water, reduce the temperature from 50° to 10°, or through 40° (Pereira).

Doses, etc.—As a diuretic, horses take ℥ss. to ℥i.; cattle, ℥i. to ℥ij.; sheep, ʒi. to ʒij.; pigs, ʒss. to ʒi.; dogs, grs. x. to grs. xxx. Soap, resin, with other diuretics, and free solution in water, hasten and increase its action 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, two drachms camphor, and one drachm each of ipecacuan and belladonna extract, made into a ball, 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 fever medicine 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 a pill with syrup, or liquorice powder and water. Mr. Mayhew recommends three to eight grains nitre, one to four grains James' powder, and the same quantity of belladonna extract, made into a 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 febrifuge, antiseptic, refrigerant, 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. When swallowed, it is absorbed, is excreted by the salivary and buccal glands, exerting a beneficial action on aphthous or other such eruptions of the mouth. It is in great part got rid of in the urine, mostly unchanged, and without being deprived of its oxygen. Like other salines, it is of service in febrile and inflammatory cases, probably retarding too rapid decomposition of albuminoids, preventing undue multiplication of white corpuscles and bioplasms, and promoting secretion. In fever cases, whether in horses or cattle, it lowers the pulse and temperature, cleans the tongue, restores the appetite, gently stimulates the bowels, and renders their evacuations more natural and less coated with mucus. In inflammatory cases, it is given after aconite or cathartics have abated the more acute symptoms; in zymotic cases it is used either alone or 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, who uses it largely, considers that in such cases its regular use during a week or two wards off attacks of farcy. 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. On account of its general febrifuge action and its healing effect on the irritable aphthous membrane, it is of special value in mouth-and-foot disease.

Doses, etc.—Horses take ʒi. to ʒij.; cattle, ʒij. to ʒiij.; 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.

POTASSIUM PERMANGANATE. Potassæ Permanganas. Condy's Fluid. ($K\ Mn\ O_4$.)

When manganese black oxide is fused with potassium oxide 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, well adapted for external use. They are of no value as internal remedies, for when swallowed they are rapidly decomposed, manganese black oxide being evolved. Whilst thus readily parting with a portion of their large supply of oxygen, they also lose their distinctive colour, which varies from purple to pink according to concentration. The rapidity with which a known quantity of the permanganate solution loses its colour is hence a handy indication of the amount of organic contamination in the water, other fluids, or even in the air experimented with. Permanganates 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. Still, in virtue of this oxidising power, permanganates attack and break up those gases and organic particles on which bad smells depend. Excepting hydrogen peroxide, which is not generally applicable on account of its cost, no deodorisers are so effectual. Portions of sacking wetted with solutions of one part of Condy's Fluid to fifty or sixty of water, should be suspended about the premises to be deodorised, or shallow vessels containing such solutions placed about the building. But, although promptly removing bad smells, they cannot, like the tar acids or sulphurous acid, 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. Being 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, ozæna, 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 NC or H Cy.)

Prussic acid is so called from its 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, a volatile oil, and some other products.

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 water and alcohol, 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 the 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 gray precipitate, speedily becoming blue from absorption of oxygen, and with iron persalts a deep Prussian blue at once. It is tetrabasic, with the formula $K_4 Fe Cy_6$, $3H_2O$. 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 Fd Cy.

For the making of medicinal prussic acid the British Pharmacopœia gives the following directions :—" Dissolve $2\frac{1}{2}$ 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 :—

$$\underset{\text{Potassium ferrocyanide.}}{K_4\,Fe\,Cy_6} + \underset{\text{Sulphuric acid.}}{3\,H_2\,SO_4} = \underset{\text{Iron and Potass. cyanide.}}{K\,Fe\,Cy_3} + \underset{\text{Potassium acid sulphate.}}{3\,KH\,SO_4} + \underset{\text{Hydrocyanic acid.}}{3\,H\,Cy.}$$

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. The 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 grayish-green precipitate is thrown down, which, on the 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, distinguished from the white chloride by its being soluble in ammonia and in hot nitric acid, but insoluble in cold nitric acid, and by its 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, when silver cyanide is produced. If the watch-glass is moistened with potash solution, and any prussic acid is given off, potassium cyanide is formed, detectible 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 amongst plants and animals. Poisonous doses paralyse the cerebro-spinal axis, act most notably on the medulla and respiratory centre, and destroy life by paralysis of respiration. Medicinal doses are sedative, anodyne, and antispasmodic. Used externally, it allays irritability and itching in eczema and other skin complaints.

General Actions.—No poison is more active than anhydrous prussic acid. 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. 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 power of 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. 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. If the animal lives for half an hour, perfect recovery may be expected. Recent observations disprove any special action on the vagus (Dr. Bochin, *Practitioner*, September 1874). Convulsions depend upon the paralysing and deranging action on the spinal cord, and not, as with strychnine, on a stimulant action. Professor Coleman gave an aged horse repeatedly, at intervals of several days, one to three drachms of Scheele's acid, containing about four per cent of anhydrous acid, and noted much excitement, the pulse raised to 100, and in one experiment to 160, laboured breathing and tetanic 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 the 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 caused a long deep expiration and collapse of the lungs (Jones and Bartholow). The poisonous effects are observed in all animals, and by whatever channel it enters the body—whether introduced into the stomach, injected into a vein, placed in the areolar tissues, or in a wound, or taken up from a serous or mucous surface. It is absorbed and diffused with great rapidity in whatever condition it is administered, but is especially active in the state of vapour. Air saturated with it killed one dog in ten seconds, another in five, and a cat in two seconds. 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 mode in which it establishes its effects is unknown. It may act directly on the nerve cells, arresting generation of force, or less directly by checking oxygenation. The blood certainly rapidly becomes black and deficient in oxygen, but whether this precedes or follows, whether it is the cause or effect of the violent disturbance of health, still remains conjectural.

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, venous congestion; 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; the nervous centres are usually congested.

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 and bleeding from the jugular relieve congestion of the lungs, and of the 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 doubts 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 convert 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.

Medicinal Uses.—As a calmative and antispasmodic it 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 a ball 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. Externally it allays the irritation of urticaria and eczema in dogs; and, for such purposes, two drachms of medicinal acid and twenty grains corrosive sublimate are dissolved in a pint of water.

Doses, etc.—Of the Pharmacopœia acid horses and cattle take ♏xx. to fʒi.; sheep and pigs, ♏x. to ♏xx.; dogs, ♏ii. to ♏v., given in water sweetened with simple syrup. As its soothing effects are transient, the 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 a long time. 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.

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 $\frac{1}{10}$th per cent of quassin

($C_{10} H_{12} O_3$), a neutral crystalline principle, soluble in dilute alcohol and chloroform, but scarcely soluble in water or ether.

Actions and Uses.—Quassia is stomachic, bitter, tonic, and anthelmintic. It nearly resembles gentian, calumba, and cinchona. It is prescribed for the several domestic animals in dyspepsia, loss of appetite, and convalescence from debilitating disorders. 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℥ii. to f℥iv.; sheep and pigs, fʒiv.; dogs, fʒj. 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 recently stated to be produced by the Rheum palmatum, var. tanguticum (Royle's *Mat. Med.*) 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 dry it in the sun. Internally it is marbled with grayish-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, three aromatic resins, the golden yellow, odourless, tasteless, feeble crystalline, chrysophanic acid, rheotannic and rheumic 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, and cathartic. 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, as in human patients, act, in dogs and cats, as mild cathartics, stimulate the secretions and movements, especially of the stomach and small intestines, and increase secretion of bile (Professor Rutherford and Vignal). In horses and cattle it has, however, 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 the skin or mucous surfaces it acts as a mild astringent.

Doses, etc.—As a stomachic and tonic, repeated several times a day, horses have ℥i.; cattle, ℥ij.; sheep, ʒi.; dogs and cats, grs. x. to grs. xxx. As a laxative, dogs take ʒi. to ʒiij., 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 astringent effects. 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 flour gruel, with a tablespoonful or two of brandy or sweet spirit of nitre. One-third or one-half this quantity answers for diarrhœa amongst lambs.

SALICYLIC ACID.

This valuable antiseptic can be procured by fusing potassium hydrate with salicin—the crystalline bitter principle extracted from willow bark; but is more commonly obtained by passing dry carbonic anhydride through dry sodium phenol at a temperature over 212°. The resulting 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. Its formula is $H\ C_7\ H_5\ O_3$.

Actions and Uses.—Salicylic acid is a powerful antiseptic, is used in surgery in the same class of cases as boracic, benzoic, and carbolic acids, and is given internally as a febrifuge, notably reducing animal temperature, and acting almost as a specific in rheumatic fever.

Like its analogues, carbolic and phenic acids, it arrests fermentation and putrefaction. A watery solution containing one per cent of the acid, dissolved with the aid of a little borax, preserved effectually blood, pus, and urine. Such strong solutions dry or shrivel mucous surfaces, but, how freely soever used, exert no irritant effect. Being, like boracic acid, devoid of irritant and poisonous actions, and moreover without odour and almost without taste, it is preferable to carbolic acid as an internal antiseptic. Its mode of operation when swallowed has not yet been fully studied. It resembles quinine in its actions; in its medicinal effects it is identical with, but more active than, salicin; it is more than twice as powerful as sodium salicylate, into which salt it is probably converted in the body. It is excreted in the sweat, saliva, and after twenty to thirty hours in still larger amount in the urine, to which it imparts an olive-green hue. Doses of 15 to 20 grains given to men, or one to two drachms to horses, suffering from acute fever, and repeated every hour until six or eight doses are taken, lower the force and frequency of the pulse, reduce temperature one or two degrees, and provoke diaphoresis. It has none of the deliriant or narcotic effects which belong to carbolic acid; although repeated doses relax the bowels, it has no direct irritant action. Salicylic acid or sodium salicylate is now generally accepted as the most rapidly acting and effectual remedy in rheumatic fever in man; it lowers temperature, abates pain, and cuts short attacks in twenty-four to forty-eight hours. In typhus and typhoid fevers in man it reduces the pulse ten to fifteen beats, produces a proportional lowering in the number of the respirations, lowers the temperature two or three degrees, and further exerts a beneficial effect on the mucous membrane, arresting foul defecations (*London Medical Record*, May 15, 1876). In veterinary practice it deserves careful 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, without any curative results, have however given drachm doses twice a day to horses affected by farcy and nasal gleet.

In all descriptions of wounds, and in all animals, it arrests suppuration, putrefaction, and fœtor, lessens pain, and hastens healing. It is especially applicable in serious wounds that through their sloughing stages have been treated with carbolic dressings, and in which both granulation and epithelium growth require to be encouraged simultaneously. This important two-fold service is usually better done by salicylic than by carbolic acid. It abates the itching, discharge, and smell of eczema in horses' heels.

Doses, etc.—Horses and cattle take ʒi. to ʒii., sheep and dogs grs. x. to grs. xv., every hour or two hours, mixed with about an equal weight of sugar, mucilage, or glycerin. Sodium salicylate may be used in double the dose of 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 made with one part of acid mixed in a heated mortar with six or eight of benzoated lard. This may be got in the handy state of a paste by addition of one part of paraffin. Lint, cotton-wool, or jute, soaked in a strong, hot, watery solution, made as above with borax to ensure solubility, absorbs the acid, and may be used as an antiseptic protective in the same manner as the carbolic or boracic lint. Iron salicylate is both antiseptic and astringent, and has been used as a styptic.

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.

The 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, and isomeric with oil of turpentine (C_{10} H_{16}). The brown empyreumatic oil of cade, employed on the Continent as an insecticide, is obtained from the dry distillation of the brown-berried juniper—the Juniperus Oxycedrus.

Actions and Uses.—Savin applied externally is rubefacient and vesicant; moderate doses are stimulant and diuretic, especially stimulate the urino-genital organs, are allied to the turpentines, and in large doses produce gastro-enteritis. Horses, however, take considerable quantities with impunity. Hertwig has given half a pound twice daily for six or eight days, without effect; whilst 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 other two recovered, after suffering much 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 also 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 the 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 up with the food 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. Both the tops and oil are occasionally applied as stimulants for indolent sores and warts, and for keeping up the discharge from blisters and setons.

Doses, etc.—As an anthelmintic, cattle or horses take about f℥iij. or f℥iv.; dogs, ♏iij. to ♏v., dissolved in any fixed oil. For external application, an infusion is made with one part of the 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 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-rot, 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 the 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.—Salts of silver closely resemble those of copper and zinc. Large doses are corrosive and irritant; and produce convulsions and paralysis with death from respiratory arrest. Medicinal doses are tonic, stimulant, and astringent. Applied externally it is caustic, stimulant, and astringent. Rosenstirn, experimenting on the vessels of the mesentery of frogs with weak solutions, found that silver nitrate was incomparably the most powerful astringent; lead acetate followed next in order, requiring 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. Medicinal doses are absorbed as albuminates and peptonates, and, when given for some time, the metal is discovered in the liver and spleen, and also in the structure of the skin, where it produces a black stain; it is chiefly eliminated by the intestines and liver. As a tonic for the dog, it is prescribed in chorea, epilepsy, and other nervous diseases. Half a grain is given several times daily in chronic diarrhœa, dysentery, and cholera in dogs; whilst enemeta of ten to twenty grains to the ounce of distilled water, or of starch gruel, are sometimes also useful.

Its external applications are numerous and important. Applied to irritable, relaxed, abraded skin or mucous surfaces, it constringes dilated vessels, coagulates mucus and albumin, produces a white film of chloride, which gradually deepens in colour owing to the reduction of the silver salt to the metallic state. The solid nitrate or strong solution rubbed into the skin raises blisters. The eschar remaining, after a liberal dressing, gradually cracks and peels off, leaving usually a healthy surface beneath. The solid nitrate, being readily localised in its effects, is for many purposes preferable to fluid caustics, or to the deliquescent caustic potash. It is used to remove fungous growths, warts, and angleberries; to improve indolent sores; to heal callous ulcers. 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 one of the best dressings 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 accidents, but is of little avail in the cloudiness of 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 to arrest inflammation in the early stages of boils, circumscribed erysipelas, and synovitis. A weak solution relieves the pain and hastens the 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 ten to fifteen grains to the ounce, conveniently blown from a spray-producer, is sometimes useful in controlling congestion and irritation of the fauces and throat. Such solutions destroy the parasites of mange, scab, and ringworm, and, as a clyster, have sometimes been used to bring away ascarides from the rectum of horses and dogs. 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 three or four 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 used, sometimes coated with wax to preserve them from the 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 lard. The 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 glycerin ($C_3\ H_8\ O_3$) (p. 319). These fats, when boiled with solutions of potash, soda, or ammonia, are decomposed. The alkali displacing the glycerin 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. 364), 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 glycerin 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 30 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. Glycerin 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 glycerin. 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. As antacids they are less effectual than the alkaline carbonates or bicarbonates, but are occasionally used in poisoning by acids and metallic salts. 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. In grease, mange, scab, and other skin diseases, the diligent use of soap and water is very effectual, both for cure and prevention. Dr. M'Call Anderson's prescription of equal parts of soft soap, oil of cade, and rectified spirit, is useful for eczema and other itching skin disorders. Gently rubbed over slight burns or scalds, soap prevents access of air, and greatly relieves irritation. They are much used for making boluses, liniments, and ointments.

SODIUM AND ITS MEDICINAL COMPOUNDS.

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. Sodium salts 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.

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 are constituents of the blood, bile, and serous fluids, and, used medicinally, they restore any deficiency of soda salts. During their absorption, their continuance in the body, and their elimination, they exert antacid properties, or, in other words, combine with lactic, uric, and other organic acids. They are also antidotes for poisoning by mineral and other acids. They favour endosmosis, and thus promote interchange, oxidation, reconstruction, and excretion. Beneficial effects thus result from their moderate use in febrile attacks, rheumatism, and irritation of the kidneys. Injurious and wasteful effects ensue from their continued abuse (Dr. John Harley). Small doses increase the secretion of gastric juice, and assist the emulsion and digestion of fats. Young calves too exclusively fed on skim milk, and suffering from indigestion with constipation, are often relieved by dissolving three or four drachms of bicarbonate in each meal of milk. Weak solutions are used, especially by Continental veterinarians, as soothing lotions for the irritable weeping stages of eczema, and as injections in leucorrhœa. The carbonate and bicarbonate differ only in the degree of their action, closely resemble the corresponding potassium salts, are less penetrating and irritant, but, containing a higher percentage of alkali, have a greater neutralising power.

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. $Na_2 B_4 O_7, 10H_2 O$.

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 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 glycerin, 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 of anhydrous borax ($Na_2B_4O_7$), 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 and antacid, and is excreted by the kidneys unchanged. It is used externally as a stimulant, detergent, and destroyer of fungi. The powder or strong solution is a useful dressing for the small, round, superficial ulcers of aphtha, occurring especially in calves and lambs, for abating the irritation of skin abrasions, and allaying the itching of eczematous eruptions, especially in dogs, when it is best alternated with zinc oxide. 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 not only purges away bile lodged in the intestines, as do saline and resinous cathartics, but is found by Professor Rutherford directly to increase the secretion of bile, and is therefore a true cholagogue—a property not possessed by the allied magnesian sulphate. It has a solvent action on fibrin; large doses are excreted, mostly unchanged, with increased secretion, chiefly by the intestinal mucous membrane; smaller doses, also in great part unchanged, are given off by the kidneys. Like other saline purgatives, it acts irregularly on horses. Among cattle it is said to be less effectual than Epsom or common salt, and more apt to act on the kidneys. In the dog it acts both as an emetic and purgative. It is applicable to the several purposes of a saline cathartic, and is still occasionally given to cattle.

Doses, etc.—As a purgative, cattle take lb. j. to lb. iss; 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 Hyposulphite. Hyposulphite of Soda.
$Na_2\ H_2\ S_2\ O_4,\ 4\ H_2O.$

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 arrest fermentation, destroy septic germs, 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, often 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, and so thoroughly did it permeate the system, that even moderate doses were found 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 the sulphite, kept fresh for three weeks; whilst 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, whilst 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, however, getting no sulphite, daily became worse, the limb got gangrenous, and in ten days he died of typhus. Very similar results followed the injection into the femoral vein of bullock's blood kept for four months, and offensively putrid. Dogs that had previously received the sulphite had recovered their appetite and were almost well in three days; whilst those managed in the same manner, but not receiving the sulphite, died comatose in five days, suffering from typhoid 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 the previous administration of the sulphite, although at first seeming to suffer most from the injection, 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; whilst, 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, purpura, inveterate skin disorders, tedious cases of strangles, rheumatism, and farcy. In some cases of indigestion they counteract flatulence. 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 Cattle Plague*). Mixed with treacle and placed within the lips, it diminishes irritation, smell, and acrid discharge in foot-and-mouth disease. With potassium chlorate it has been given to young cattle to prevent attacks of congestive fever or black leg, and for this object half-ounce or ounce doses are administered with the ordinary food for three or four days consecutively during every fortnight. Twenty grains given twice daily help to keep the bowels regular, arrest the offensive smell of the secretions, and abate the low fever occurring in distemper in dogs.

Doses, etc.—Horses and cattle have ℥i. to ℥ij.; sheep and pigs, ʒss. to ʒi.; 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 $2\frac{1}{2}$ 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, oily coats of the others, which, although not much superior to their neighbours in weight, were more lively, and of so much better appearance that they brought a somewhat higher price. The cattle receiving salt exhibited throughout much 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 in such prepared food is usually in small amount. During convalescence from acute disease, most animals are especially fond of salt. 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 taste, but probably also serves other useful purposes. It appears to be the natural stimulant of the digestive system; to furnish hydrochloric acid for the gastric juice, and soda salts for the bile; to preserve the fluidity of the blood; and to assist in nutrition, for it always abounds where active reparative or formative changes are taking place. It is excreted by the mucous membranes and kidneys.

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 that sedative action which accompanies 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 flatulence, diarrhœa, vertigo, convulsions, paralysis, and death in eight to twenty-four hours, from the eating of 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 oblongata" (*Veterinarian*, December 1871). Although very suitable as a cathartic for cattle and sheep, they occasionally suffer from overdoses. I have seen dangerous effects produced by several ounces given to young and delicate calves, for which oil is a much 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. 461; and *Veterinarian*, September 1876.)

For vigorous adult cattle and sheep common salt is a very useful purgative, as prompt and powerful as Epsom or Glauber salts, and especially effective when given with Epsom salt. By causing thirst, it induces the animal to drink largely of water or other bland fluids, which, in torpidity of the bowels and constipation among cattle, soften and carry onwards the hard, dry, impacted matters, so apt to accumulate in the first and third stomachs, and resist the action of ordinary purgatives. Among cattle and sheep it is administered to evacuate the bowels in distension of the rumen with food, in fardel-bound, and 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 probably proves serviceable by unloading the stomachs and bowels, freeing the blood of peccant matters, and exciting counter-irritation. It is the best antidote for 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 irregularity of the appetite. Salt regularly given lessens the liability to intestinal worms, and an injection of half an ounce 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 prevents or retards the progress of liver-rot in sheep. It is a common addition to laxative clysters. 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 part of salt is mixed with two parts of pounded ice. Such freezing mixtures require, however, to be used warily; for if applied for many minutes at a time, they are apt dangerously to lower vitality. For preventing and arresting putrefaction, salt is cheap and effectual, and stands on the list of antiseptics next after zinc and iron chlorides and carbolic acid. 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 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. i.; sheep, ℥i. to ℥iii. 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 thus 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 the addition of other purgatives; and in such cases an effectual combination may be 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 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. A more prompt result is obtained by adding to the salt a grain of zinc or copper sulphate; whilst more marked sedative effects are gained by the addition of a grain of tartar emetic.

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, hypochlorate, 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 deodoriser, 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; converts the colloids which are unable to permeate the walls of the capillaries into crystalloids, which readily pass through the capillary walls (Dr. John Harley; Royle's *Mat. Med.*, 6th edition). Hence in febrile cases it favours excretion of imperfectly oxidised matters. It is prescribed in typhoid fever, purpura, and erysipelas 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 and deodoriser for foul sloughing wounds and ulcers, for checking excessive noisome discharges from the skin or mucous surfaces, for controlling eczema and prurigo, and for douching with a spray-producer 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 very 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℥i. to f℥ij.; sheep and pigs, fʒi. to fʒij.; 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 glycerin; but taking up an atom of water separates into palmitic acid ($HC_{16} H_{31} O_2$) and the solid crystalline ethal ($C_{16} H_{34} O$).

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 starch, 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 up 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 conjoined 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 of eczema. Heated with about eight parts of glycerin until it forms a translucent jelly, it is applied with three or four parts of water. 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 $\frac{1}{4}$ inch long and scarcely so wide; 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. In the shelly covering are two acrid, colourless, crystallisable alkaloids, dephinine ($C_{24} H_{35} N O_2$) and staphisaine ($C_{16} H_{23} N O_2$).

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 from beetroot, and in America from the sugar-maple. But that used in this country is chiefly got from the sugar-cane, 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-gray 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 albumin, entangling impurities, is skimmed off; the syrup is cooled in wooden vats, and dried in the sun, yellow dark-brown crystals of raw sugar are formed, and there drains away a variable quantity of brown uncrystallised molasses. The raw brown or muscovado sugar 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 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, it has an amorphous and a crystalline form; its crystals are monoclinic prisms; 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.

Acids, ferments, and prolonged boiling cause cane sugar, and also starch and cellulose, to assimilate a molecule of water and form fruit sugar, fructose, or lævulose, so called on account of its rotating a ray of polarised light to the left, instead of, like cane sugar, to the right ($C_6\ H_{12}\ O_6$). This is the form of uncrystallisable sugar present in ripe fruits, new honey, and germinating seeds. Exposure to air, further action of the acid, the ferment, or the heat, cause the fruit sugar to assume another molecule of water, when it constitutes grape sugar, glucose, or dextrose ($C_6\ H_{12}\ O_6$, H_2O), and regains its crystalline property. This change, from fructose to glucose, gradually occurs in ripe fruits and fresh honey, on which the crystals of grape sugar form. Grape sugar occurs in the blood, in the animal textures, and in urine; is the variety formed from starch, whether in or out of the body; and is yielded by a number of proximate vegetable principles, termed glucosides, including tannin, amygdalin, digitalin, etc., when these are boiled with diluted acid. 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 sulpho-saccharic 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 preparing 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. 371).

Honey or mel, the saccharine secretion deposited in the honeycomb by the hive bee, when first collected, is yellow, translucent, and viscid, but gradually a portion of its uncrystallisable fructose becomes converted into the crystallisable glucose and sucrose. 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, grayish-white, hard, cylindrical masses of rhombic prisms. It is gritty, and 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 and 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 and emollient, 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 sores, 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. 210), and retards the oxidation of ferrous compounds (p. 346). 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 $7\frac{1}{2}$ 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 accelerate 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 nitre are dissolved in a pint of water; a few ounces of the sweet solution are slowly administered every hour or two, or when the 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 lbi.; 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 grayish-yellow soft powder of milk of sulphur or precipitated sulphur, the molecules being much 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 sulphates; with hydrogen producing hydrogen sulphide; with oxygen forming seven acids; and also with chlorine, iodine, and bromine.

Properties.—Sulphur has a yellow colour, a spec. grav. 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 benzol, 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. Sulphur thus occurs in three allotropic states: it is crystalline, as in roll sulphur; amorphous, as in the sublimed and precipitated varieties; 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, amorphous, granular powder, less soluble than the crystalline roll sulphur. 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 the mucous surfaces. Applied externally, sulphur is a stimulant and effectual antiparasitic.

In horses, a pound 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 the 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 gray. 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). Passing through the alimentary canal, sulphur acts as a mechanical irritant; only a small quantity is converted into a soluble sulphide and absorbed; whilst within the body it stimulates the mucous surfaces, is excreted by the skin and mucous membranes in the form of hydro-sulphuric and sulphuric acids, and communicates the disagreeable hydrogen-sulphide odour to all the secretions. Waldinger mentions that even small quantities given repeatedly to sheep impart a disagreeable flavour to the flesh.

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 and skin affections. 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*. Its sudorific effects are scarcely observable in the domesticated animals. Rubbed daily into the skin, it is said to abate the pain of rheumatism. 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 destroy the burrows in which the female acari have deposited their ova, by diligently scrubbing the patient with soft soap and water. The scarf skin being thus 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 first dressing. In intractable mange, besides scrupulous attention to cleanliness and the internal use of arsenic and alkalies, it is desirable to vary the application, using in turn sulphur, tar oil, diluted mercurial ointment, and alkaline washes.

Doses, etc.—As a laxative, horses take ℥iij. to ℥iv.; cattle, ℥iv. to ℥vi.; sheep and pigs, ℥i. to ℥ij.; dogs, ʒvi. 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, and 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 twice daily. For external use almost every practitioner has his own formula. The simple ointment consists of one part of sulphur and four of lard; one-fourth part mercurial ointment is sometimes added. The simple 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. 341). For itch cases and all 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 acid ($H\ NO_3$), 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 acid, after oxidising the sulphurous acid, is reduced to the condition of nitric oxide ($N\ O$), absorbs oxygen from the air, becomes nitric peroxide ($N\ O_2$), 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 ($H\ SO_4$), 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 $13\frac{1}{2}$ 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 $H_2\,O_2\,SO_3$, and the monohydrate $H\,O\,SO_3$ 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.

Impurities.—The specific gravity and the 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.

Concentrated doses in all animals corrode and inflame the surfaces of the mouth and fauces, peel off the mucous membrane, 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 the 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. 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 the relaxed condition of the alimentary mucous membrane. An acid solution on one side, and an alkaline solution on the other side of the moist gastric membrane stimulate osmosis. Of ordinary doses a certain proportion is 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; 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 and skin, exerting on these excreting channels its special 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.

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, when accompanied with weakness and alkaline discharges, a drachm of acid is administered twice daily to horses and cattle, united with an ounce each of laudanum and ginger, and administered in starch gruel or mucilage. In those cases of influenza in horses, with a tendency to œdema or purpura, I have seen much 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. In contagious pleuro-pneumonia amongst cattle, it usually reduces the pulse and temperature, relieves the breathing, and sustains the vital powers. Its success, however, is by no means invariable, nor is the percentage of recoveries greater than when iron sulphate or other tonics have been 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. It often arrests the 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 most 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 the 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 the knife or by ligature. 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 fʒi. to fʒij.; cattle, fʒij. to fʒiv.; sheep, fʒss. to fʒi.; pigs, ♏x. to ♏xx.; dogs, ♏ij. to ♏vi.; repeated several times a day; given diluted, so that it does no topical injury, 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 ($H_2 SO_3$), which is crystallisable, 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. Both the gaseous and liquid forms are used as bleaching agents, especially for woollen and silk goods. Unlike chlorine, which is an oxidiser, it abstracts oxygen, becoming converted 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 generally as antiseptics, disinfectants, and deodorisers.

Sulphurous acid possesses in a concentrated form the same antiseptic properties as the sulphites and hyposulphites (p. 487). Its chemical affinity as a deodoriser enables it to decompose hydrogen-sulphide, and thus remove bad smells; and also accounts for its bleaching properties. 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 and other of the lower forms of life, and thus prevents or stays 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 the putrefaction of the gelatin 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. 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 bedclothes to be exposed to the vapours from the 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. Dr. Dewar and others have, with considerable advantage, used both the solution and the gas in the treatment, as well as in the prevention, of the contagious pleuro-pneumonia of cattle. In this, as in other typhoid cases, it probably neutralises the specific poison, and also modifies dangerous symptoms. In tedious influenza cases, and in purpura and erysipelas in horses, I have seen it do good when used internally, and also as a wash for the tender or broken skin. In such cases it is 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-solution or spirit. 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 filaria in calves and lambs. About two fumigations at intervals of a few days usually effect a cure, which is hastened by a dose of turpentine.

It 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 cold, often arrests the 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 parasites of ringworm; and relieves the itching of eczema 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. 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 effects, 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, fʒss. to fʒi.; dogs, ♏xx. to ♏lx.; given every two hours 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 the solution of the acid is a more effectual antiseptic than either the sulphites or hyposulphites. 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; in irritable or painful wounds a little laudanum is added; in skin irritation admixture of glycerin proves soothing. Baths are readily made by conducting the vapours of burning sulphur into water; and baths or strong solutions are more effectual than fumigation in curing mange and other skin complaints in veterinary patients. 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 (NO_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—

$$\underset{\text{Alcohol.}}{C_2H_5HO} + \underset{\text{Nitric acid.}}{HNO_3} + \underset{\text{Copper.}}{Cu} + \underset{\text{Sulphuric acid.}}{H_2SO_4} = \underset{\text{Copper sulph.}}{CuSO_4} + \underset{\text{Water.}}{2H_2O} + \underset{\text{Nitrous ether.}}{C_2H_5NO_2}$$

In preparing nitrous ether, to prevent tumultuous ebullition, violent succussions, and liability to explosion, sand is placed within the retort or mattrass, 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 British Pharmacopœia 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 a 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, produce delirium and coma, with a variable amount of preliminary excitement. Medicinal doses are stimulant, antispasmodic, diuretic, diaphoretic, and antiseptic. 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, rheumatism, and local congestion. Like alcohol and ether, properly regulated doses lower excessive animal temperature and antagonise pyæmia and most forms of blood-poisoning. It is excreted mainly through the lungs.

Doses, etc.—As a stimulant and antispasmodic, horses take f℥i. to f℥ij.; cattle, f℥i. to f℥iv.; sheep, fʒij. to fʒiv.; pigs, fʒi. to fʒij.; dogs, ♏xv. to fʒi. 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, 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. For influenza and typhoid ailments in horses, two ounces each of sweet spirit of nitre and ammonium acetate solution, with a drachm of belladonna extract, are a good stimulant anodyne draught. In most typhoid cases continuous and permanent effects are produced by combination with 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. Special diuretic effects are secured 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.

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 by the natives of America; and is still grown largely about the great river Orinoco, in the United States, and in many parts of the world. It was unknown in the Old World, at all events in Europe, until after the discoveries of Columbus, and was first introduced into England by Sir Francis Drake in 1586.

The Nicotiana Tabacum, which yields the Virginian and several important 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 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 the strongest, is generally preferred for medicinal purposes. Snuff is prepared by cutting tobacco into small pieces, piling it into heaps, and pouring water over 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 or nicotia ($C_{10}\ H_{14}\ O_2$)—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 phosphoric, malic, and citric acids; constitutes six to seven per cent of the dried leaf; and is soluble in water, alcohol, ether, the fixed and volatile oils. It is an energetic poison, almost as potent as prussic acid. Distilled with water, tobacco yields a tasteless, crystalline, concrete, volatile oil—nicotianin or tobacco camphor.

Actions and Uses.—Tobacco is a topical irritant; it causes emesis and catharsis. Medicinal doses induce motor depression and muscular relaxation; hence its antispasmodic properties. Poisonous doses are irritant, motor depressants, paralysing the motor centres and nerves, and killing by respiratory arrest. It is used as an anthelmintic, and to poison acari, lice, and other skin parasites.

General Actions.—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 that the pulse was lowered three to ten beats per minute, and became irregular and intermittent; whilst a repetition of such doses increased the evacuation both of fæces and urine. Large doses, especially when injected into the veins, accelerated the pulse, increased the action both 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 any 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 prussic acid, hemlock, and Calabar bean, and is a physiological opposite of strychnine. 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—given 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 (*Bartholow, Mat. Med. and Therapeutics*). Howsoever administered, it poisons intestinal worms, and diluted solutions thrown into the rectum readily bring away ascarides lodged there ; but for any such purposes its irritant poisonous properties necessitate its being employed with extreme caution.

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 to cause nausea, fainting, and sometimes death ; but one part to thirty or forty of water may be used with safety. 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 the scab acari, double the amount of tobacco may be cautiously used.

Doses, etc.—The larger quadrupeds take ʒi. 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 preferred to 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.

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. 112), and, as the temperature is further raised, methylic alcohol (p. 398), a series of less soluble hydrocarbons, and volatile oil of tar, 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.

III. The resins—the residue of the distillation of turpentine.

IV. Tar and pitch—got by subjecting the roots and wood to destructive distillation.

I. The Turpentines.

The terebinthinate juices recently exuded from the Coniferæ are fluid, or nearly so; but when exposed to the air they solidify, from their volatile oil being partly given off and partly oxidised. They have a peculiar pungent bitter taste and odour, are scarcely soluble in water, are partially soluble in rectified spirit, but 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, principally imported from the United States, and from Bordeaux, is the produce chiefly of the Pinus palustris or 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 turpentine is also procured. During winter or early spring three 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 each tree. Selection is made of trees 12 to 15 inches in diameter. 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 is got by bleeding or hacking the bark, and conducting the juice into suitable vessels placed at the foot of the tree. The trees continue productive for fifty years (Flückiger and Hanbury). Turpentine is semi-fluid; its consistence varies with the temperature; it gradually solidifies from volatilisation and resinification 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 does not separate its active principles. Rectified spirit and ether dissolve it; eggs and mucilage form with it an emulsion convenient for administration. Of essential oil, the American variety, when recent, yields 14 to 16 per cent. Bordeaux or French turpentine is inferior in aroma to the American, is obtained from Pinus pinaster, but at present is imported in small amount.

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 the 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 the 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 volatile 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 a sixth of its weight of magnesia (*Brit. Phar.*) It contains about 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 Mastich order.

FRANKINCENSE, or Thus Americanum, is the semi-opaque, soft, concrete turpentine scraped from the stems of Pinus palustris, and imported from the American Southern States. A similar concrete turpentine comes from the south of France, under the name of galipot or barras. Turpentine from the Norway spruce fir, when melted in hot water and strained, constitutes Burgundy pitch, which occurs in yellow-brown masses, breaks with a shining conchoidal fracture, and has an empyreumatic turpentine odour and aromatic taste. Spread upon leather it is 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 whatever 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 they are applied as mild stimulants, astringents, and rubefacients, and for making up diuretic and stimulant balls. In the south of France, the resinous vapours of the Coniferæ have been successfully used in the treatment of rheumatism, bronchitis, and phthisis in human patients (*Edinburgh Medical Journal*, February 1864).

Doses, etc.—Horses and cattle take ℥i. to ℥iij.; sheep, ʒi. to ʒiij.; pigs, ʒi. to ʒij.; 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 somewhat, according to its source, is colourless, limpid, very volatile, neutral, with a penetrating odour, and pungent, bitter taste. Its specific gravity is about ·864; it boils about 314°; 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. Exposed to the air, it oxidises and thickens from formation of resin. Its composition is $C_{10}\ H_{16}$. It is isomeric with various essential oils, such as juniper, savin, citron, 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.

Actions and Uses.—Oil of turpentine is a stimulant of the vaso-motor sympathetic system. Poisonous doses are irritant and narcotic. Medicinal doses are stimulant, antispasmodic, 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 and diaphoretic. It is used externally as a counter-irritant, antiseptic, hæmostatic, and antiparasitic. Its actions and uses resemble those of alcohol.

General Actions.—Applied to the skin, it causes heat, redness, vesication, and even ulceration. Swallowed, it is rapidly absorbed, 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 the sympathetic system, increases the action of the heart, and raises blood pressure. Larger doses exhaust the irritability of the sympathetic ganglia; 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, tetanus, 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. It poisons lice, worms, and other entozoa, whether lodged in the bowels, bronchial tubes, or skin. As an antiseptic, although inferior to the members of the alcohol series and the naphthas, it is superior to most other volatile oils; it arrests fermentation and putrefaction, and destroys vibrios and bacteria.

Medicinal Uses.—It is administered to the several domestic animals in many diseases. Amongst horses it is often serviceable in indigestion, flatulence, and overloading of the stomach, and even in some cases of diarrhœa, owing its good results to its stimulant, antiseptic, and invigorating effects on the mucous and muscular coats of the intestine. It is second only to alcohol in sustaining the action of the heart, relieving internal congestion, promoting skin and kidney secretion, and restoring 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 sometimes superior to alcohol, for besides stimulating the heart, it braces dilated, weakened vessels, and exerts hæmostatic and antiseptic properties. As a prompt antispasmodic in colic, it is usually conjoined with aloes or oil, and with laudanum. Its combination of stimulant and antiseptic, diuretic and diaphoretic actions, renders it useful in all animals in rheumatism, in which it is employed alike internally and externally. Its cathartic action is uncertain when given alone, but, in combination with aloes, oils, and salines, it is of service in all veterinary patients in overcoming long-standing and obstinate torpidity of the bowels, and for such cases it is given daily both by the mouth and rectum. 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. When ozonised by exposure to the air, it is an antidote to phosphorus, converting it into an insoluble spermaceti-like substance. It prevents the necrosis of the jaw and other serious disorders so apt to occur in persons working with the ordinary phosphorus (Dr. Letheby). Personne gave phosphorus to five dogs, and all died. To five others, an hour or two after similar lethal doses, he gave turpentine, and only one died. Of five dogs to which he gave turpentine immediately after the 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 a few 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; but these results are produced with fully 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 externally. Frequently repeated doses, conjoined with iron salts, check that form of hæmaturia in cattle popularly known as red-water. A useful antidote for the septicemia and congestion of blackleg amongst young cattle or sheep consists of oil of turpentine dissolved in mucilage, white of egg, or milk, conjoined with potassium chlorate, or sodium sulphite, and given to the survivors every second morning for ten days. 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 bring away intestinal worms, turpentine should be given after the bowels have been emptied by a cathartic, after the patient has had a long fast, and conjoined with a laxative. Large and sometimes reiterated doses are often required to destroy tapeworms; unless the head is expelled the parasite grows again. 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 is, however, safer and more effectual. To dislodge ascarides from the rectum, turpentine enemata are very effectual. For removing the bronchial filariæ 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 perfect 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 ten or twelve doses. Where bronchial filariæ prevail, three or four doses of such vermifuge mixtures, given at intervals of a fortnight throughout July and August, not only ward off attacks of thread and tape worm, but diminish the scouring and mortality so common amongst lambs when first put upon roots. A few drops of a solution made with one of turpentine and eight of milk placed in the mouth kill the filariæ which cause gapes in poultry. A dressing of one part of turpentine and two of bland oil, sprinkled 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 often 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 the turpentine oil is often used. As with other external irritants, a continuous moderate action is more serviceable than a single violent effect. As a stimulant it 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 more vitality in old sores, 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 bland oil or glycerin. A similar mixture destroys lice and other skin vermin. It is often added to stavesacre, tobacco, and other antiparasitic solutions. Held in antipathy by most insects, it enters into the composition of various mixtures used by shepherds to protect their flocks from fly and to kill maggots. Such a dressing is made by mixing in a pint of water or whey three ounces of oil of turpentine, one ounce each of oil of amber and mucilage, and one drachm corrosive sublimate. 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℥i. to f℥ij.; as a diuretic, f℥ss. to f℥j.; as an adjuvant cathartic or anthelmintic, about f℥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 fʒi. to fʒiv.; dogs, ♏xxx. to fʒij. 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 mixed with laudanum and starch gruel. For external purposes it is usually applied with linseed oil, soap, ammonia, or mustard. A stimulating mixture is made with equal quantities of bland oil, soft soap, and oil of turpentine. 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 got by mixing with three ounces of any bland oil an ounce each of oil of turpentine and medicinal ammonia.

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 the 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 fiddlers' 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, volatile oils, and caustic alkalies; unite with fats, wax, and spermaceti; and are largely used in the manufacture of yellow soap. Resin chiefly consists of pinic acid ($H\ C_{20}\ H_{29}\ O_2$), a little sylvic acid, isomeric with pinic acid, and a neutral resin. The Bordeaux resin or galipot 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 stimulant, 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. 445). 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 wood, 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 the distillation of the refuse wood in cast-iron stills, and nearly double the yield of tar is thus obtained. 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: it contains impure pyroligneous acid, including acetic acid, acetone, and methylic alcohol; a series of liquid hydrocarbons sparingly soluble in water, with crystals of the pungent irritating pyrocatechin; that made from hard woods contains creasote. When tar is distilled, oil of tar, oleum picis liquidæ, a red-brown, limpid, impure oil of turpentine, passes over, 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.

Actions and Uses.—Tar is stimulant, diuretic, diaphoretic, expectorant, and vermicide. It often benefits chronic cough in hard-worked horses, and in troublesome eczema in all animals is alternated or conjoined with arsenic. It is not much used internally. Externally, 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, or with 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 glycerin: melt the lard and bees' wax together, stir in the lard, tar, and glycerin, and continue to stir until the mass begins to set. Tar is serviceable in foot-rot in sheep, and has the several advantages of stimulating and deodorising unsound noisome textures, and preventing attacks of flies. Undiluted, it is the best remedy for chronic mallenders, being preferable to carbolic acid (Professor Williams); it dries up grease in horses and other forms of eczema, and checks ringworm in calves. 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. Containing various empyreumatic substances, it is an admirable antiseptic, 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.

Pitch is used in veterinary practice as a mild stimulant in such diseases of the horse's feet as thrush, canker, and sand-crack; in foot-rot in sheep; for giving adhesiveness to plasters; whilst its fumes are occasionally disengaged as a disinfectant by inserting a red-hot poker into an iron pot containing the pitch.

VALERIAN ROOT.

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 the short yellow-white tuberous root stock, with the attached radicles, which are about the thickness of a quill, two or three inches in length, and of a yellow-brown colour. It has a penetrating odour, which becomes stronger and even fœtid by keeping, and a bitter, acrid, camphoraceous taste. It contains 12·5 per cent of resinous extract, 6 of resin, 10 of watery extract, with a little sugar and malic acid, and 1 to 2 of a clear, volatile oil, which yields, when distilled, 25 per cent of valerene ($C_5 H_8$), resembling oil of turpentine, several oxygenated bodies of the constitution of camphor, and about 5 per cent of valerianic acid ($H\ C_5 H_9 O_2$), a colourless, limpid, acrid liquid, with the pungent odour and taste of valerian, sparingly soluble in water, but soluble in alcohol and ether, and obtained artificially by the oxidation of fusel or grain oil, otherwise known as amylic alcohol ($C_5 H_{12} O$) (Royle).

Actions and Uses.—Valerian is an excitant of the cerebro-spinal system, a diffusible stimulant, antispasmodic, nerve tonic, and anthelmintic. It resembles assafœtida, the other gum resins, camphor, and the Sumbul or musk root imported from Russia and India, and produced by an umbelliferous plant. It has little effect on horses or cattle, even in doses of several ounces. 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 imparts feeble vermifuge properties, and is chiefly excreted by the skin and kidneys.

Doses, etc.—If used for horses or cattle, it may be given in quantities of ℥ij. to ℥iv.; for dogs, ʒi. to ʒij.; 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, Sodæ Valerianas or Valerianate of Soda ($Na C_5 H_9 O_2$), is obtained by oxidising fusel oil, by heating 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 crystallises 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 the 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.

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 Europe. The rhizome, or underground stem, occurs in cylindrical pieces, two to four inches in length, an inch in diameter, usually with the radicles attached to their lower surface, whilst on the upper remain the scales of the dried leaf-sheaths. Externally, they are gray or brown and rough; internally, grayish-white and rather fibrous. When dried they have little odour, but a bitter, acrid taste. Veratrum viride, the green or American hellebore, is collected in autumn in Canada and the States. The bitter acrid rhizome is generally met with in slices or small fragments. In common with such allied species as cevadilla or sabadilla, and Colchicum autumnale, white and green hellebores are stated to contain the pale gray, acrid, crystallisable, alkaloid veratrine or veratria

($C_{32}H_{52}N_2O_8$) occurring in combination with sabadillic or cevadic acid. Recent observations however throw some doubt on the presence of veratrine, but have discovered another alkaloid —jervine, in combination with jervic acid, and an amorphous bitter principle, veratramarin (Flückiger).

Actions and Uses.—White hellebore and veratrine are irritants causing sneezing, vomiting, and purging. Poisonous doses besides depress the functions of the spinal cord, cause muscular paralysis, ending in death by asphyxia. Carefully regulated doses are nauseants and sedatives, are occasionally used as counter-irritants, and to kill lice. The green or American hellebore is scarcely so irritant; both resemble colchicum, and are allied to aconite, tobacco, and other vaso-motor depressants.

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, Bradnich, 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. 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 infusion of nut-galls or solution of tannin, may also be given, as they form insoluble compounds with any unabsorbed veratrine.

Some veterinary authorities consider that hellebore " 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, uncertain, and often violent. It was formerly used in rheumatism and to control nervous pain, but has been superseded by aconite. Externally, it is applied for destroying lice, for smearing setons, and as an addition to blisters; but it must be used cautiously, as it is apt to irritate unduly, or get absorbed and produce constitutional effects. Dogs are especially liable to suffer in this way; and liberal dressings of the ointment were observed by Mr. Howard to cause 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).

Doses, etc.—As a sedative horses and cattle take of the powdered rhizome ʒss. to ʒi.; sheep and pigs, grs. xx. to grs. xxx.; dogs, grs. ij. to grs. vi. It is 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 lard, and occasionally applied with tar or sulphur dressings.

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 of the voluntary muscles, especially those of the extremities, and death usually amid convulsions from paralysis of the respiratory muscles.

WATER.

Aqua. Hydrogen Oxide or Monoxide. H_2O.

Two volumes of hydrogen and one of oxygen in the presence of a light or an electric spark unite with explosive force, yielding two volumes of gaseous water or steam. It exists in the solid, liquid, and gaseous forms. The familiar liquid is transparent, neutral, colourless, odourless, and tasteless. A minim weighs ·91 grain: a fluid ounce, 437·5 grains. It is the standard of comparison for specific gravities; 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 such gases 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 $1\frac{1}{2}$ 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 (Royle's *Mat. Med*, 6th ed.) When the saline ingredients exceed one-5000th 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.

Various methods are adopted for the purifying of 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, causes abstraction of carbonic anhydride and subsidence of lime and magnesium carbonates, and also reduces the more permanent hardness caused 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, evacuant, and detergent. Hot water is an auxiliary emetic, cathartic, and diaphoretic; topically it is emollient and anodyne; and at still higher temperatures is an active irritant. Cold water is refrigerant and tonic; it is applied to wounds and burns in the form of the familiar water dressing; and at low temperatures it abstracts heat, and antagonises local congestion and hæmorrhage.

Water is an unfailing constituent of all living tissues, and is essential to the support of animal life. It constitutes a large proportion of every kind of food, rendering it more easily digested and assimilated. It supplies the loss of fluid constantly taking place by the skin, lungs, and kidneys. It promotes tissue metamorphosis and increases excretion. Insufficient and excessive supplies of water 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 in the twenty-four hours 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 the gastric juice. Horses, especially if tired and hungry, should have a few swallows of water, or, better still, a bucket of gruel, before feeding. 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. As with human patients, troublesome thirst is often appeased by faintly acidulating the water with hydrochloric acid, and sometimes rendering it 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; is mainly got rid of by the kidneys, lessening acridity of the urine, and augmenting its watery and solid parts. 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 the 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 the scales which abound, especially in inveterate cases, and the subsequent dressings hence more readily get at and destroy the parasites.

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, they control or prevent congestion or inflammatory action of bruises, strains, and severely contused wounds. Mainly by reflex action, their application externally often soothes internal parts which have been irritated or inflamed. 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. Such soothing vapours, medicated, if need be, by laudanum, belladonna, ether, vinegar, sulphurous acid, or alkaline hypochlorites, are readily evolved from a well-made bran mash, placed in a roomy nose-bag, or by holding the head over a bucketful 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 silk 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 the 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 nearly boiling 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 other such injuries, 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. The cold water treatment is also serviceable in broken knees, open joints, and circumscribed burns and scalds; such wounds should not, however, be directly wetted, but kept scrupulously covered by folds of antiseptic wadding 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 also 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 later 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, 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 interfere with their nutrition. 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 to 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 back and loins " not only exerts a sedative influence on the spinal cord, but also on those nervous centres which preside over the blood-vessels in all parts of the body; it partially paralyses them." It appears to diminish muscular tension, sensibility, and secretion, and hence has been used in tetanus, chorea, epilepsy, cramps, in neuralgic pains, and in inordinate discharges from the bowels or kidneys.

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. 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 subjected to severe muscular exertion, relieve colic and cramps, benefit chronic skin disorders, arrest colds and attacks of weed, promote the 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. Under proper control, they are useful in febrile cases, chorea, and convalescence from acute disease. As curative agents, they should rarely be continued for more than three or four minutes, whilst healthful reaction is encouraged by careful drying, hand-rubbing, clothing, and, if need be, by 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 with tepid, hot, or cold water. Noxious and irritable matters are removed from the skin, circulation is equalised, excessive heat reduced, spasm counteracted. In febrile cases, whether in horses or cattle, the temperature of the water at first should not be less than 80° or 85°; 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 rises again to 103° or 104°; after the first or second sponging, temperate water at 60° or 65° may be used; and antiseptics and stimulants given internally. 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 the sponging or 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, and is produced by bees fed exclusively upon pure 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. This 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, loses colour and odour, 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, fuses at about 145°, and readily unites with fats and resins. Two thirds of its weight consists of myrcin 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 benzol and in ether, saponified by alkalies. It further contains 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 the 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 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 the 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 proportion of wax to the fats or oils is regulated by the required consistence of the ointment. 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.

Zinc Oxide. Zinci Oxidum. Oxide of Zinc. Zn O.

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 precipitates the white sulphide (Zn S), which is insoluble in acetic acid, but soluble in the stronger acids. Ammonia solution throws down 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.

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.

Actions and Uses.—The chloride, nitrate, and iodide are the most soluble, most readily diffused, and hence the most active and corrosive of the zinc salts; the sulphate and acetate are more energetic than the less soluble oxide or carbonate. Salts of zinc enter the blood probably as chlorides, lactates, or albuminates; when given for a long period increase tissue change, and produce a series of symptoms resembling those caused by lead, are 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 those of aluminum, silver, and copper. They are corrosive, irritant, astringent, tonic, and antiseptic. As an astringent tonic, ʒij. to ʒiv. oxide has been prescribed for horses and cattle, grs. v. to grs. x. for dogs. Externally, the oxide in powder is dusted as a desiccant gentle stimulant and astringent over the chafed, irritated, and excoriated skin. Eczema rubrum, and erythema, of which mud fever is a common example, are often benefited by the powder solution or ointment, which, by the Pharmacopœia process, is made by mixing with gentle heat eighty grains zinc oxide and an ounce of benzoated lard.

Zinc Carbonate. Zinci Carbonas. Carbonate of Zinc.

Calamine, the native carbonate, and an important ore of zinc, is grayish 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 ($Zn\ CO_3$, $2Zn\ O$, $3H_2\ O$). 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. $Zn\ SO_4$, $7H_2O$.

Zinc blende, the native sulphide, 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. 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 probably 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 the appetite and caused nausea with diuresis (*Veterinarian,* January 1844). 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, chronic skin diseases, 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, ʒi. to ʒiij.; 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. An ounce each of zinc sulphate and 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 grayish-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. 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. Freely dissolved in water, it is a capital stimulant, astringent, and antiseptic, an effective dressing in most varieties of eczema, alike in horses and dogs, a good application for foot-rot in sheep, a useful wash for destroying ticks and other skin vermin. Mr. Campbell De Morgan uses for human surgical purposes forty grains to an ounce of water, and recommends it especially for fistulous 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. As an antiseptic, zinc chloride is as effectual and cheaper than ferric chloride. It stands next to the tar acids for preserving meat and other organic matters; 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 the permanganates, chlorine, iodine, or sulphurous acid. 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 a nerve tonic, but is seldom used internally. Externally, as a stimulant and astringent, it promotes the 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.

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