VETERINARY MEDICINES

THEIR

ACTIONS AND USES

EDINBURGH: PRINTED BY MURRAY AND GIBB,

FOR

EDMONSTON AND DOUGLAS.

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

CAMBRIDGE . . . . MACMILLAN AND CO.

GLASGOW . . . . . JAMES MACLEHOSE.

VETERINARY MEDICINES

THEIR ACTIONS AND USES

BY

FINLAY DUN

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

FOURTH EDITION

EDINBURGH
EDMONSTON AND DOUGLAS
1874

PREFACE TO THE FOURTH 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. As the work is still a text-book at the Edinburgh and other Veterinary Colleges, and is used both by veterinarians and agriculturists, a fourth edition is now called for.

For this edition almost every article has been re-written, the new chemical nomenclature and notation have been adopted, and fuller details given respecting the actions and uses of most medicines.

As in previous editions, the general actions and uses of veterinary medicines, and the most important forms of pharmaceutic preparation, are treated of in the Introduction. The bulk of the volume is occupied with the consideration of the individual medicines, the points chiefly dwelt upon being their natural history, preparation, properties, and 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.

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of the domestic animals; but such matter being somewhat out of place in a text-book of Materia Medica, has now been superseded by an Index of Diseases, in which, under each disease, are set forth the appropriate remedies, arranged chiefly in the order of their value, or of their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

WESTON PARK, SHIPSTON-ON-STOUR,
December 1873.

VETERINARY MEDICINES:

THEIR

ACTIONS AND USES.

INTRODUCTION.

VETERINARY MATERIA MEDICA, in the extended sense of the term, treats of every agent, material or immaterial, which is used for the cure of disease or injury, or for the preservation of health, among the domesticated animals. The full consideration of so large and diversified a subject would, however, fill several volumes, and the present work is devoted to 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. It is impossible, however, 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, irritating, corroding, 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. Medicines which act thus remotely or indirectly appear to produce their effects in either or both of the two following ways : (*a*) They are absorbed into the circulation, and carried by the blood to remote organs ; or, (*b*) The impression which they produce on the parts with which they are brought in contact is transmitted along the nerves to other parts. This latter mode of operation was formerly called action by sympathy.

(*a*.) 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. Thus dissolved medicines pass, by a process of endosmose, into the capillary veins which ramify on the surface of the stomach and intestines, enter the general circulation by the mesenteric and portal vessels, and are carried to all parts of the body, altering, it may be, the nutritive processes of various organs and tissues, and being at length expelled through some of the excretory channels, as the skin, kidneys, or bowels. 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, such absorption occurred that 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.

(*b.*) The other hypothesis regarding the action of medicines ascribes their effects to the production of some nervous impression on the part to which they are first applied, and its subsequent transmission to remote organs by means of the nervous system. A recent modification of this theory, advanced by Messrs. Morgan and Addison, assumes that the nervous impression is produced, not upon the part with which the medicine is first brought in contact, but on the interior of the blood-vessels after partial absorption. Part of the evidence in support of those hypotheses is derived from the fact that some poisons operate with such extreme rapidity, as to render it doubtful whether there could be time for their being absorbed and making the round of the circulation. Thus anhydrous prussic acid, coniine the alkaloid of hemlock, and aconitine the alkaloid of aconite, when injected into the veins, applied to the cellular tissue, or given by the mouth, produce almost instantaneous effects, and death in a few seconds. The strongest evidence in favour of the theories under consideration consists, however, in the effects of local injuries in producing constitutional disturbance. For example, 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 sometimes induces epilepsy; and a local injury frequently causes fever and disordered action of most of the important organs of the body. In such cases the connection between cause and effect obviously depends on the transmission of nervous impressions only. And if topical causes are thus productive of remote effects, it is surely 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 will 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 dynamical 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, and may perhaps be better understood from the following illustrations: A dose of aloes, or of any other purgative, administered during a simple febrile attack caused by the presence of irritating matters in the intestines, induces, first, its usual physiological effect, namely, purgation; this removes the cause of irritation, or excites the so-called therapeutic action, and is hence succeeded by restoration to health. Again, a diuretic given in a case of simple anasarca, or watery effusion in dependent parts, usually establishes, in virtue of its primary or physiological effect of increasing the secretion of urine, a secondary or therapeutic action, namely, the draining away of the effused fluid, and the consequent cure of the case. With some medicines it is not difficult to trace the cure, first to the therapeutic, and then to the physiological action, and to note each stage distinctly; with many others, however, it appears impossible, even with the utmost care and ingenuity, to discover any properly marked difference between the physiological and therapeutic actions on the one hand, and the therapeutic actions and the cure on the other. Indeed, there appears little use for complicating our ideas of the actions of medicines by regarding them 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 perfectly adequate to account 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 once 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, as has been lucidly remarked by Professor Headland, '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, most deserving of credit, and which together appear sufficient to account for the actions of the majority of medicines, are, 1*st*, the *antipathic*, and 2*d*, the *allopathic* mode of cure.

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, 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.

About seventy years ago another method of cure was propounded by the German physician Hahnemann, who taught that the cure of a disease is effected by small infinitesimal doses of such medicines as would induce, if given to a healthy subject in large quantity, symptoms similar to the disease. This is the doctrine of homœopathy (ὅμοιος, *homoios*, like or similar; and πάθος, *pathos*), the principles of which are enunciated in the aphorism, *similia similibus curantur.* According to this doctrine, 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 develope symptoms similar to the diseases for which they are used. Again, the disciples of Hahnemann treat diseases the most dissimilar in their nature and symptoms by the same remedy. Thus Mr. Haycock, in his *Elements of Homœopathy*, employs arsenic as the appropriate remedy in mange, bronchitis, enteritis, diabetes, strangles, tetanus, rheumatism, ophthalmia, poll-evil, glanders, and thirty other diseases; whilst he prescribes aconite in thirty-two diseases, beginning with papular eruptions, including most affections of the respiratory and digestive organs, and ending with ophthalmia and glanders. An 'accurate similarity' between the symptoms of the disease and those of the remedy is, however, regarded as essential to the success of the homœopathic treatment; but where is the similarity between the effects of arsenic and these forty diseases for which it is prescribed, or between those of aconite and the thirty-two diseases in which it is considered so efficacious? These and many other such instances cannot be established without straining similarities which, to ordinary eyes, are imperceptible, or at best but very remote.

Hahnemann, in his *Organon of Medicine*, translated by Mr. Dudgeon of London, and accepted by English homœopathists as their standard authority, states, that 'the symptoms of each individual case of disease must be the sole indication, the sole guide to direct us in the choice of a curative remedy' (p. 120). Now symptoms, although sometimes requiring special treatment, are but the visible signs and results of derangement and disease; whilst their removal, which is all that is aimed at in homœopathic treatment, does not always insure the removal of the conditions on which they depend. Thus rheumatism, pleurisy, enteritis, worms, and many other disorders, frequently remain unchecked after their symptoms have been relieved. Instead of thus vainly attempting the removal of symptoms, it were therefore more rational at once to remove, as is attempted by allopathists, the morbid condition —the source of the evil. *Causâ sublatâ, tollitur effectus.* No curative system, directing its efforts, as homœopathy does, merely against the symptoms of disease, can ever rest upon a safe or 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 new 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 direct derangement of the functions of the vagus nerve; 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 characterize the diseases themselves' (*Haycock's Elements*, p. 20). No provision, let it be remarked, is here made for cases in which the same symptoms result from different or opposite conditions; and yet we not only find the same symptoms produced by very different diseases, but also by the most opposite remedies. Strychnine and prussic acid, for example, although totally dissimilar in their *modus operandi* and general action, both induce convulsions, and should therefore, according to the tenets of homœopathy, be equally suitable for the cure of 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 carbonate of lime, which, in ordinary doses of several scruples or 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 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 neutralize the effect of all; but if this be the case, homœopathic drugs must always be without effect (which is very probable); for all medicines contain adulterations and impurities which, though small in amount, must of course acquire great potency by the triturations above mentioned.

But homœopathists assert that, in spite of the errors which their opponents discover in the system, it is nevertheless very successful in the cure of disease. In judging, however, of homœopathy as a system of practical medicine, it must ever be regarded as made up of two distinct parts: 1*st*, The original and peculiar part of the system, consisting in the use of medicines selected in accordance with a law embodied in the axiom *similia similibus curantur*, and administered in infinitesimal doses, usually varying from one grain to one-millionth of a grain, and carefully prepared according to certain precise directions; and 2*d*, Attention to diet and regimen,—the only effectual and rational part of homœopathy,—the true source of all its boasted cures,—and that very department of medical treatment which has been insisted upon from the most ancient times by all scientific and successful practitioners, both of human and veterinary medicine. The value of the first part of the treatment, viz. 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. If, in a sufficient number of well-regulated experiments, the former method proves itself superior to the latter, then of course it would be fair to infer that the medicine had some real curative effect. But no such superiority has been observed where impartial observations have been made. In experiments made at the Edinburgh Veterinary College, as to the treatment of pleuro-pneumonia and other diseases according to these two modes of cure, it appeared that those cases which were 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 in homœopathic doses. I say, so long as the doses given were homœopathic; and this, I think, is an important fact; for many of the medicines which are used homœopathically are, in ordinary medicinal doses, capable of producing prompt, and often powerful, effects, and become effectual means of cure in virtue of their physiological properties, but not in virtue of any homœopathic actions.

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 showing more forcibly than before 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.

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 is still, however, so incomplete, that it is difficult to arrange remedial agents in satisfactory groups. From amongst many classifications are subjoined an excellent and comprehensive system by Professor Headland, who includes the articles of the materia medica under the four following heads :

I. Hæmatics, or medicines acting on the blood. They restore some of its wanting or deficient constituents, destroy morbid matters circulating in it, are most valuable in constitutional disorders, are tolerably permanent in their action, and include all true tonics and alteratives. Some, as iron, and many salines, having a resemblance or identity with the constituents of the body, remain, restoring what may be wanting ; others, unnatural or foreign to the body, having acted as 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.

[TABLE.

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

I.—MEDICINES WHICH ACT CHIEFLY AS MECHANICAL AGENTS.

		Examples :
Demulcents.	Protect the tissues from the action of irritants.	Solutions of gum, albumen, and gelatine.
Diluents.	Dilute the fluids.	Water, and mild 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.
Deodorizers.	Disguise or destroy odours.	Bleaching powder, tar acids and dry soda sulphite, Condy's fluid.
Antidotes.	Counteract poisons.	Dilute alkalies for acids. Hydrated sesquioxide of iron for arsenic.
Caustics.	Destroy the animal solids, and decompose the fluids.	Strong acids, metallic salts, as nitrate of silver, butter of antimony.
Acids.	Counteract alkalinity.	Sulphuric, nitric, and hydrochloric acids.
Antacids.	Counteract acidity.	Alkalies, with their carbonates, and alkaline earths.

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, tartarized antimony.
	Errhines.	Irritate the mucous membrane of the nostrils.	Veratrum album, euphorbium.
	Stomachics.	Promote digestion.	Ginger, cardamoms, volatile oils.
	Emetics.	Cause vomiting.	Tartarized antimony, zinc and copper sulphates, common 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 the secretions of the respiratory mucous membrane.	Ipecacuan, balsams, gum-resins.
	Diaphoretics.	Increase the perspiration.	Warm clothing, acetate of ammonia, ethers.
	Diuretics.	Increase the secretion of urine.	Turpentine, resin, nitre.
	Sialogogues.	Increase the salivary secretions.	Mercurials, iodine, pungent-tasted bodies.
Agents which increase general action.	Tonics.	Gradually but permanently improve the appetite and increase the general vigour.	Cinchona, quinine, iron and copper sulphates.
	Stimulants.	Promptly but temporarily increase nervous energy, and thus exalt the action of the heart and the other animal functions.	Ammonia, alcohol, ethers, volatile oils.
Agents which improve state of blood.	Alteratives.	Neutralize or counteract morbid materials or processes in the blood.	Mercury, iodine, arsenic, salines, and alkalies.
Agents which corrugate muscular fibre.	Astringents.	Constrict muscular fibre.	Oak bark, tannin, alum, and many other metallic salts.
Agents which diminish local action.	Emollients.	Soften the tissues.	Poultices, fomentations, moistened spongiopiline.
	Refrigerants.	Lower animal heat.	Cold air, cold water, ice, saline, and etherous matters.
Agents which diminish general action.	Sedatives.	Depress both the circulatory and nervous systems.	Aconite, prussic acid, digitalis.
	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.

Although classifications of the articles of the materia medica are confessedly imperfect, owing to our present defective knowledge of therapeutics, they are nevertheless of much practical utility. On the two previous pages is 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 familiarize 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) sheath and protect the tissues from irritants. Gums, mucilage, sugar, starchy matters, gelatine, albumen, fats, and oils, as well as cotton, thin leaves of gutta-percha, and oiled silk, are familiar examples of this class of remedies. They are chiefly used to take the place of the natural demulcents, as the tears, mucus, or skin, where these are defective or wanting; to defend external sores from the injurious action of the air, or of acrid secretions; and to lubricate the mucous membranes, and protect them from irritating and poisonous matters.

Diluents.

Diluents (*diluo*, I dilute) consist of bland watery fluids which (as the name indicates) dilute the blood and the watery secretions. They include such simple drinks as linseed and hay tea, barley and treacle water, and owe their action to the water which they contain. They are prescribed in febrile attacks, to promote the action of the various secretions ; to help the removal from the body of useless, waste, or poisonous matters ; in irritation of the urinary organs, to dilute the urine, and lessen its pungency ; and in innumerable cases, to facilitate and expedite the action of purgatives, diuretics, and other evacuants. In febrile cases, these diluents are usually prescribed in a tepid state, or 'with the cold air off ;' but they are generally more palatable and refreshing when allowed cold ; and, if only a few mouthfuls 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.

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 substances are so prone, is favoured by moisture, by warmth, and usually by the presence of air or oxygen, but directly depends upon the presence of particular ferments, germs, sporules, or living organisms. Of these, some are of vegetable origin, as the yeast plant ; others, more difficult to isolate or identify, are more allied to animal bodies. 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; lighter than air, they are readily carried through the atmosphere. Charcoal, dry earth, and cotton wool mechanically entangle these floating particles, and hence often retard or prevent putrefaction. Chemical action, such as oxydation or deoxydation, the abstraction of some other essential element of the unstable organism, or the coagulation of its albumen, 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 in the septic germs. But in what manner soever they operate, all true antiseptics destroy those living germs which develope 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,[1] a most instructive series of experiments with antiseptics. He found that cresylic acid and fussel 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 came 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, and turpentine, phosphorus and water, etc. As pointed out by Dr. Angus Smith, the most effectual pre-

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

servers, and those which least interfere with the colour, flavour, and consistence of the meat, are bodies of the alcohol series, namely:

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, would 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 discolouration, 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 were 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. Chloride of lime, in the familiar form of bleaching-powder, destroys ammonia, urea, and uric acid; it hence proves an effectual deodorizer; but its antiseptic power is low, and on account of its decomposing so many nitrogen compounds its addition to refuse matters diminishes their manural value. Hydrogen peroxide and the permanganates are expensive but effectual deodorizers. Carbolic and cresylic acids are the active constituents of the impure brown carbolic acid, of kreasote, of tar oils, and of M'Dougall's disinfecting powder, and 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 manural 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.)

Zinc and iron chlorides, with various other mineral substances, have long been used in surgical practice as antiseptics. For more than a century, pitch and tar, empirically as well as professionally, have been similarly used both in human and veterinary practice. Professor Lister, since 1867, has inaugurated what may be regarded as a new system of antiseptic surgery. Dissolved in boiled linseed oil, glycerine, or water, in the form of solution, putty, or plaster, he has used carbolic acid with most satisfactory results. The carbolic dressings destroy pus germs, kill bacteria, and continuously applied, as they should be, over wounds or raw surfaces, prevent the access of air laden with these ubiquitous germs, which induce faulty and depraved action. In these surgical cases, carbolic acid further acts as a stimulant and astringent, heals extensive wounds often by first intention, destroys bioplasms (Beale), acts as an effectual deodorizer, drys up and preserves dying and dead matter, and thus prevents their exerting their deleterious influence on adjacent living tissues. Under a carbolic dressing abscesses and burcæ are opened with greatly reduced risk of inflammation and suppuration. Knives, probes, and ligatures, before use, are all smeared with carbolic acid, to prevent the possibility of their carrying into the textures of the body any septic germs.

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, as he terms them, bioplasm, 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 glycerine and water: not only were no bad effects produced, but the cow steadily improved and recovered. But even more to the purpose, as showing the efficacy of the administration of antiseptics, are the observations (also made by Mr. Crookes) that cattle in plague-infected buildings, receiving daily an ounce of carbolic acid along with their food, and having carbolic and sulphurous acid fumes frequently liberated in their sheds, did not catch the contagious plague.

Potassium chlorate and permanganate, with other salines, sulphites, sulpho-carbolates, mineral acids, and many so-called alteratives, are now found in many cases of great practical value; and their efficacy is doubtless mainly due, as indicated by Dr. Lionel Beale, 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. They may become available for retarding or absolutely destroying the specific germs of tubercle and cancer, of febrile complaints, of glanders and farcy, of quarter-evil and parturient apoplexy, and other diseases. Even now their employment may be greatly extended in abating acute fevers, lowering elevated temperature, relieving capillary congestion, and removing the fœtor and contagion of the dejecta. Further experiments with antiseptics may very possibly also lead to the discovery of special antidotes for particular forms 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 deodorizers and antiseptics. Strictly speaking, antiseptics prevent decomposition, whilst disinfectants neutralize or destroy noxious matters produced by decomposition or change, whether in dead or living matter. Mr. William Crookes, in his report to the Cattle Plague Commissioners,[1] remarks : 'Disinfection, in the widest sense of the term, includes deodorization, and means the neutralization 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 particularized as the essential causes of contagious disorders ; as, for example, carbonic acid, marsh gas, sulphuretted hydrogen, ammonium sulphide, hydrogen selenide. But these gases have not been found in undue amount in the atmosphere in which patients affected by contagious diseases have been kept ; moreover, when mixed with air, they may usually be breathed in sensible, and sometimes even considerable, quantities without producing such diseases. 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 powers 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 organized body ; and probably resembles the pollen of flowers, or some of the odorous dust given off by plants or animals. It retains its characteristic activity although carried

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

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 developes 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. Baron Liebig and other chemists believe that the organic particles communicate their own motion or activity to the decomposable materials brought into contact with them. Pasteur Beale and other physiologists teach that contagion consists of organized germs possessed of inherent vitality and power of reproduction. These germs are perfectly distinct from microzymes, bacteria, vibrones, or such animalcules, which are 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 of $\frac{1}{100000}$ 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 generally regarded as the natural disinfectant which neutralizes many dangerous organic impurities. Water, like air, is a valuable means of cleansing and disinfecting. It mechanically dilutes noxious matters, and hastens their oxydation. 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, when mixed with M'Dougall's disinfecting powder, should be 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. 'Oxydizing agents will plainly be of great value, as they can readily convert hydrogen into water and carbon into carbonic acid; and these 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 special poisoning effect on 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 typhous patients were, after similar exposure, 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.

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 deodorizing 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 deodorizing, 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 neutralizing 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 degrees. It is recommended to be used for the preservation or disinfection of fresh-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. Lime chloride, in its convenient form of bleaching-powder, has little antiseptic power, but is an effective deodorizer 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, hooves, 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 neutralize 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, it 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 glass spray producer, it volatilizes 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.

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 any 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 stronger 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. Several instances have, during the present summer, come under my notice, where foot-and-mouth disease of a virulent type has been arrested after a portion of the herd had 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. As already remarked, when writing of antiseptics, the disinfectant or antiseptic treatment of contagious and zymotic diseases is of great promise, alike in the way of prevention and of cure. 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.

Deodorizers.

Deodorizers are substances which 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 deodorizers only cloak and overpower instead of neutralizing 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 neutralizers—sulphuretted hydrogen by chlorine; ammoniacal 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 or broken up by such gases as chlorine and sulphurous acid. For destroying the intolerable smell from the cochineal dye-works, no deodorizer 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 deodorizers. 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 deodorizer. 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 iodized solution may be freely distributed by a glass spray producer. Cresylic and carbolic acids are good deodorizers, 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 deodorized. 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 deodorizer, can be employed either for solid or liquid impurities, is volatile, 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 two to five 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 inconsiderable amount, destroys health and life; but in reality it differs from a medicine only in the degree or intensity of its effects. Indeed, it is found that, whilst many valuable medicines, when given injudiciously or in large doses, become active poisons, many poisons, when properly administered, become 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; and 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, is useful in overcoming the sedative effects of poisoning by prussic acid; and opium in lessening the unpleasant consequences of irritants. In all cases of poisoning, it is of importance at once to evacuate the stomach, in order to get rid of any poison still remaining there. This may be 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 clay, lard, or glycerine, frequently helps to prevent the poison coming freely into contact with the walls of the stomach, and thus retards its absorption. Such measures are very serviceable in poisoning either of horses or cattle, and have 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 may be given 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. After poisons have got access to the blood, the judicious administration of purgatives and diuretics is often effectual in expediting their excretion and promoting restoration to health.

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 albumen fibrine and other organic constituents. This chemical action, which is true combustion, destroys the vitality of the part, and 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, nitrate of silver, 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; and others so active as to cause extensive sloughing and purulent discharge. Those possessing the latter action sometimes receive the special title of escharotics (*ἐσχάρα*, *eschara*, an eschar, scar, or scab). The difference between solid and fluid caustics is not great. The effects of the latter are more rapid and powerful, but more difficult to localize. The firing-iron, or actual cautery, when used at any temperature above a full red heat, acts in exactly the same manner as caustics, producing first a chemical action, and then a highly exalted vital action. Besides being used as a caustic, it is also much employed as an external irritant (p. 41).

Caustics are used for many different purposes: for repressing soft, spongy, and exuberant granulations; for removing warts and other sorts of tumours, especially when so deep-seated and vascular that they cannot be safely extirpated by the knife; for altering morbid actions of the skin or of wounds; for exciting adhesive action in the walls of fistulæ; for preventing the effects of poisoned wounds, in which case fluid caustics are often preferable to solid ones, on account of their readily penetrating to all parts of the cavity; for opening abscesses and forming issues; for expediting and completing the destruction of sloughing textures; and for arresting hæmorrhage from accidental or surgical wounds. Caustics employed for the last-mentioned purpose usually receive the special title of *styptics* (*στύφω*, *stüphō*, I constringe; *στυπτικός*, *stüptikos*, astringent). In using them, the blood should be removed by a sponge, and the part lightly pressed, so that the blood-vessels may be more readily seen, and the caustic applied to them with greater precision, and with as little destruction as possible of the surrounding textures.

Acids.

Acids (*ἄκις*, *akis*, a point) are defined by the chemist as substances which are mostly sour to the taste, soluble in water, 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. In large doses and concentrated form they act as chemical corrosives, decomposing the tissues by uniting with their watery, saline, and albuminous parts. They are, therefore, all included under the head of caustics. They are useful antidotes in poisoning by alkalies. When given internally, they should be sufficiently diluted to prevent their exerting any corrosive action. They appear to be absorbed without previous neutralization, as seems evident from their acting so differently from their various salts. With a high diffusion power they rapidly reach the blood, in which they seem to neutralize any excess of alkali—probably of ammonia, which has been found to be unduly abundant in fevers and other such cases. But soon after entering the blood they must pass into the condition of salts, and by this change probably eliminate some weaker acid. According to 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.

Whatever be the explanation of their action, whether it be chemical or vital, the use of acids generally determines certain well-marked results, and especially improvement of the appetite and strength, with a general astringent effect. Hydrochloric and lactic acids exert a special effect in dissolving the albuminous constituents of the food. Where the gastric secretions are faulty, as in some cases of indigestion, acids given medicinally either directly supply the deficient acid, or more probably become absorbed into the blood, where they favour the natural production of lactic acid, which is regarded as the true stomach acid. Possibly, in a somewhat similar manner, they counteract some of those chronic cases of diarrhœa, where the excretions are strongly alkaline, usually from the presence of carbonate of soda. Or, again, they moderate irregular or excessive fermentation, which is so frequently the source of acidity and its concomitant evils; whilst in other cases their efficacy depends upon their astringent or tonic action. Acting as astringents, they counteract hæmorrhage. Of great value in low fevers, they are given every two or three hours, either alone or with gentian, quinine, or ether. 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 oxydized into carbonates, they have a primary acid but secondary alkaline action. In full doses the mineral varieties are excreted, usually imperfectly neutralized, 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 acids and various other substances 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. 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 last are converted into carbonic acid in their passage through the body. As an antacid, ammonia, on account of its volatility, is less permanently effectual than the fixed alkalies. Potash seldom exists, either free or carbonated, in the blood; but is effectual in increasing its alkalinity, by setting at liberty soda and ammonia. Potash and its salts are more active than soda and its corresponding salts. Lime salts, being soothing and constipating, are indicated in diarrhœa; magnesia salts, being laxative, are appropriate where constipation is present. Lithium carbonate, present in Baden-Baden and Bath mineral waters, is prized in human medicine as a solvent of urinary calculi and deposits. The more active antacids, as the alkalies, are in large quantity corrosive, dissolving albuminous matter, and saponifying fat. They are prescribed as antidotes against acids of all kinds, and wherever occurring. Thus they are administered for the purpose of neutralizing either mineral or vegetable acids, which may have been given as poisons; and for removing acidity of the alimentary secretions, with the indigestion and diarrhœa to which such acidity often gives rise.

By Ringer and other authorities, alkalies are stated to stimulate the secretion of gastric juice; but in indigestion cases they are apt to be abused, and given too largely and indiscriminately. Prescribed in 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 fibrine, and promote oxydation; and hence tissue changes. This probably explains the value of alkalies in rheumatic disorders, eczema, and some other skin diseases, as well as in many inflammatory and febrile cases. In large quantities, some of these antacids are proved to pass rapidly out of the system by the bowels; but 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 agree in so far as they induce inflammation of the skin, but differ considerably in the degree and intensity of their action. *Rubefacients* (*ruber*, red ; and *facio*, I make) include substances which slightly inflame and redden the surface of the skin, as alcohol, liniment of ammonia, mustard, and mild preparations of cantharides. Smart friction and moderate heat must also be included in this class. In the lower animals, however, the colour of the skin, and the abundance of the hair, render the reddening action of these agents considerably less obvious than in man. *Vesicants* (*vesica*, a bladder) have a more active and deep-seated effect, causing inflammation of the true skin, with effusion of serum between it and the cuticle. The serous effusion filling these vesicles or blisters consists, according to M. Magueron (quoted by Dr. A. T. Thomson), of about seventy-eight parts of water, eighteen of albumen, usually with a little fibrine, and four of salts. The quantity and rapidity of the effusion vary much according to the substance used, but are especially great in the case of steam and boiling water. After some days the blisters either dry up, or, when the inflammation has been considerable, secrete a muco-purulent fluid, which hardens over the parts, protecting them until the new skin appears. 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 than either rubefacients or vesicants, and actively inflame the deep-seated tissues of the skin, causing a crop of pustules and a purulent discharge. This is the effect of croton oil and tartar emetic, of ointment of the mercury biniodide, 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 very imperfectly on the thick and insensible hides of cattle. On these, alcohol, turpentine, and even cantharides, have but slight effect; and for them the only counter-irritants which are convenient, prompt, and effective, are mustard made up with equal parts of turpentine and ammonia, and scalding hot water, which latter is certainly the most prompt and effectual blister that can be used. In the case of dogs, blisters require to be cautiously applied, as the skin is often so irritable and sensitive that the animals bite and rub the blistered parts, and thus induce sloughing. There is a curious and inexplicable anomaly in regard to the action of turpentine on the skin of the horse. If applied over a considerable surface, it produces such intense itching irritation, that the animal sometimes becomes for a short time quite frantic and unmanageable, which is 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 the latter on account of their being less liable to cause blemishing. The seton consists of a piece of tape or cord, passed by means of a seton needle underneath the skin. To prevent it slipping out, the ends of the tape are tied together or knotted. It is moved daily; and if a severe effect is desired, it is smeared with blistering ointment. Setons act chiefly on the comparatively insensible subcutaneous cellular 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 which is known as roaring, and which so frequently follows these attacks of 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 fibrine 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. Besides being applicable to the same uses as active vesicants, it is employed for many of the purposes of caustics; and when used at a sufficiently elevated temperature, resembles these in abstracting water from the tissues, and in inducing, in the first instance, an active chemical effect. Its beneficial application in cases of diseased joints, ligaments, and tendons, in which it is so often used, depends on its exciting a superficial inflammation, and not, as was once currently believed, on its forming a permanent bandage around the parts. Indeed, though the skin, for a short time after the operation, 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, are known to result, not from the operation, but from the rest which it necessitates. 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 in enlarged joints in delicate young animals.

The uses of rubefacients, vesicants, and suppurants are very analogous. They are applied as topical stimulants to indolent sores and ulcers, and occasionally to inveterate cases of mange, scab, and other scaly skin affections. The substances mentioned as vesicants are best adapted for these purposes. As soon as the earlier acute stage is over, they are in common use in inflammation of the joints and surrounding tissues, and of the eye, lungs, and intestines, with their investing membranes. Inflammation, according to the scientific hypothesis propounded by Professor Lister, depends upon a depraved and debilitated state of the affected parts; and blisters accordingly are of service, not by withdrawing, as was wont to be taught, blood and nervous influence from the inflamed spot, but by attracting to it more blood and healthier nervous influence. By withdrawing from the blood liquor sanguinis, and with it the white corpuscles or their rudiments, they remove organizable materials, and establish this drain without diminishing the amount of the red globules which are so essential for maintaining nervous and vital power. By reflex action blisters sometimes rouse a circumscribed inflamed spot, to rid itself of congestion and disease; they contract and invigorate over-distended capillaries; and substitute higher formative for lower debased action. Mainly in this way are they serviceable, in rousing patients from narcotic poisoning or depression. Most practitioners are familiar with the healthy glow and more equable circulation which follow the application of mustard to the legs of a horse labouring under influenza, typhoid fever, or other such depressing complaints. External irritants, though very serviceable in subacute or chronic inflammation, are useless, and often injurious, in acute inflammation, especially if it be accompanied by much constitutional fever. In the latter case, they either have no effect at all, or only aggravate the inflammation which they are intended to cure. Irritants should be applied near the seat of the disease, 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; but, according to Dr. Anstie, if applied over a posterior branch of the spinal nerve trunk, from which the irritated nerve issues, a reflex effect of the most beneficial character is often produced. 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 very 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. Undue local irritation is abated by fomentation, while 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, glycerine, or sugar of lead lotion.

Errhines.

Errhines (ἐν, *en*, in ; and ῥίν, *rhin*, the nose) are a small and unimportant class of topical irritants, which act on the nasal mucous membrane, causing discharge of nasal mucus, and sometimes sneezing. This latter consists in a forcible expulsion of air through the nostrils, and is a reflex action excited for the purpose of removing any irritant lodged about the nasal passages. Almost all irritant and acrid substances, when directly applied to the Schneiderian mucous membrane, act as errhines ; but those chiefly used 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) are substances which promote digestion. They include most 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 expedite and facilitate the action of purgatives, and to impart an agreeable flavour to many medicines.

Emetics.

Emetics (ἐμετικά, from ἐμέω, *emeō,* I vomit) induce an anti-peristaltic motion of the œsophagus and stomach, and, in severe cases, of the anterior portions of the small intestines, with increased secretion from all these parts. They have no obvious effect on horses; indeed, vomiting only occurs in these animals from extreme distension and spasm of the stomach, from dilatation of the lower part of the gullet, from rupture of the stomach or intestines, or from the effects of aconite and a few other poisons. This insusceptibility to the action of emetics appears to result chiefly from the acute angle at which the œsophagus enters the stomach, from the strong horseshoe-like band of muscular fibres which guards the œsophageal opening, from the smallness of the stomach, and the consequent difficulty of its compression between the diaphragm and the abdominal muscles. The position and length of the velum palati, even supposing the contents of the stomach to get so far in their upward progress, would cause them to pass out by the nostrils, and not by the mouth, as in true vomiting. It might reasonably be presumed, 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. This is probably due to their large, subdivided, and comparatively insensible stomach, and to the lesser irritability of the vagus nerve. The dog and pig, however, can be made to vomit very easily and speedily; indeed, the former often purposely brings on vomition, by eating the *triticum repens* and other emetic grasses, which his instinct readily enables him to discover. In the dog, the act is so natural, and so readily induced, as to be capable of being caused by almost all disagreeably tasted, nauseous, or acrid substances.

The emetics in common use are—mustard, tobacco, ipecacuan, common salt, zinc and copper sulphates, tartarized antimony, and tepid solutions of many salts. These emetics differ somewhat from each other in their effects. Zinc and copper sulphates act with great rapidity, whilst tartarized antimony and tobacco are somewhat more tardy in their action. The first two cause a greatly increased mucous secretion, but have not such a marked sedative effect as the latter. Some emetics, as mustard and most metallic salts, act chiefly in virtue of the local irritation which they produce, and have consequently little effect, unless when placed in contact with the mucous membrane of the stomach. Others, however, as tartar emetic, ipecacuan, and tobacco, appear to owe their effects chiefly to their being absorbed, and operating on the nervous centres connected with the stomach. This is strikingly shown by Majendie's experiment with a pig, whose stomach had been removed, and a bladder substituted, but which, nevertheless, vomited freely when dosed with tartar emetic. All true emetics act with nearly equal certainty by whatever channel they enter the body. When an emetic is given, it first causes nausea, and then, in from two minutes to half an hour, vomiting, which continues for a variable length of time. In the meanwhile, the animal heat is raised, the pulse is somewhat quickened, the respiration disturbed, and, when the straining is excessive, fæces and urine are sometimes passed involuntarily. The matter vomited usually consists of a portion of the emetic and the contents of the stomach, together with mucus, which is secreted in large quantity, and occasionally a small amount of blood, which generally comes from the pharynx. After the vomiting has entirely ceased, the pulse and respiration fall below their natural standard, and hence the value which emetics possess as sedatives. Where the action has been violent or long continued, it is usually succeeded by considerable prostration of strength. The act of vomiting is a good illustration of what is termed a reflex spinal action. In the majority of cases where, for example, a dose of common salt is swallowed, the impression which the medicine makes on the mucous membrane of the stomach is conveyed by the appropriate nerves (the pneumogastric, and occasionally the splanchnic) to the medulla oblongata, whence the influence which produces the several motions, together constituting the act of vomiting, arises, and is distributed by the motor nerves. Tartarized antimony and other emetics which operate by whatever channel they enter the blood, probably either act directly on the medulla oblongata and other nervous centres, which preside over the movements of the stomach ; or, according to Mr. Headland, they owe their effects to the derangement which they produce in the functions of the vagus nerve. Dr. Marshall Hall has shown that the several motions constituting vomition occur as follows : A quick, deep inspiration is taken, the larynx is spasmodically closed, the pyloric orifice of the stomach is also closed, whilst the cardiac is opened ; all the muscles of expiration are called into action, the diaphragm alone remaining a fixed surface, against which the stomach is pressed ; and finally, as the lungs are full, and expiration is prevented by the closure of the larynx, the whole force of the effort is concentrated in emptying the stomach.

Amongst dogs and pigs, emetics are chiefly used for emptying the stomach, in order to expel crude undigested food, poisons, or other foreign bodies ; for clearing away obstructions from the throat or œsophagus ; and for depressing the circulatory and nervous systems. In virtue of this evacuant and sedative effect, they are serviceable in canine practice for mitigating the severity of distemper, for cutting short febrile attacks, and for the antiphlogistic treatment of all sorts of internal inflammation, except that of the alimentary canal. They were formerly sometimes used to cause relaxation of muscular fibre, and thus aid in the reduction of dislocations. But for these purposes chloroform has now entirely superseded all other remedies. Drop doses of ipecacuan or antimonial wine, as now prescribed in human practice, often check obstinate vomiting in dogs, and are given either alone or with nux vomica. For a medium-sized dog a safe and convenient emetic consists of a teaspoonful of common salt, with about half that quantity of mustard, dissolved in a teacupful of tepid water.

Where a prompt and certain effect is desired, two or three grains of zinc sulphate should be given, dissolved in water, rolled up in a piece of meat, or mingled with some other food. Where a more permanent sedative result is sought, two grains of tartar emetic, dissolved in three or four ounces of water, may be given, either alone or with ten grains of ipecacuan.

Ecbolics—Parturients.

Ecbolics (ἐκ, *ek*, out of; and βάλλω, *ballō*, I throw) are medicines which are believed to cause contractions of the uterus, and expulsion of its contents. They are represented by such substances as ergot of rye, savin, rue, cantharides, and gamboge. They have, generally, slight special action on the uterus, but owe their effects mainly to their violently exciting such neighbouring parts as the intestines or kidneys. They cannot produce abortion or hasten the period of parturition, without causing such constitutional irritation as renders their employment dangerous to life. Some of them, especially ergot of rye, are occasionally given during the act of parturition, to increase the uterine contractions, and expedite the expulsion of the fœtus. Even in such cases their utility has been greatly overestimated. Indeed, veterinarians have little occasion for the use of such agents, since, with a little time and patience, parturition in the lower animals is usually effected easily and safely, and without much interference or assistance.

Aphrodisiacs.

Aphrodisiacs (ἀφροδίσια, *aphrodisia*, venery) are substances which have, or are supposed to have, the power of exciting the venereal appetite. They include such articles as phosphorus, cantharides, peppers, and turpentines. On the Continent they still appear to be frequently given to various of 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), augment the intestinal secretions, and quicken and increase the evacuation of fæces. Some of them, like errhines or vesicants, produce topical irritation of the alimentary mucous membrane, succeeded by increased secretion and peristaltic motion. The husks of grain, vegetable fibres, and other indigestible substances, probably act in this way, as also many resinous and comparatively insoluble purgatives previous to their absorption. 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 cause irritation of 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 more than one horse affected by bronchitis die from superpurgation, induced by only three drachms of aloes; and an almost equal degree of 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 ninety square feet. This extensive superficies is covered by a highly vascular mucous membrane, packed full of actively secreting glands, and abundantly supplied with nervous influence. Such an immense extent of intestinal mucous membrane in such a vascular and sensitive state, necessitates great caution in the administration of purgatives to the horse. If possible, the animal should be restricted, for at least a day previous to the exhibition of the dose, to mash diet or green food. The dose should be small, 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. Saline matters in cathartic doses are irregular, and sometimes act with unexpected violence. Senna, colocynth, buckthorn, and various other substances of much value as purgatives for men and dogs, have scarcely any such effect on horses. Purgation may be produced in the horse in from eighteen to twenty-four hours, and sometimes in a shorter period, if the auxiliary treatment above mentioned be adopted, as it invariably should be. A horse should never have purgative medicine when his strength is reduced and his pulse small and weak, or when he is in the advanced stages of inflammatory disease of the air-passages, and never without extreme caution in influenza and other debilitating epizootics.

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, render the action of many purgatives far less certain than in most other animals. For these ruminants saline purgatives are preferable to any others, and their action may always be materially expedited by encouraging the animals to drink 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. In ordinary circumstances, purgation may 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 less bulky 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 acts more slowly and uncertainly, while saline medicines are too 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, about an ounce 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. When employed for the destruction or expulsion of worms, they generally receive the special title of *anthelmintics* or *vermifuges*, and often owe their success simply to their causing such increased peristaltic motion and excessive secretion of fluid, as to unloose the hold which the parasites have on the intestinal walls, and wash them entirely away. The most effectual anthelmintics, however, destroy the worms by poisoning them. Such are turpentine and various volatile oils, quassia and other bitters, areca nut, etc. To remove bots in horses, one-fourth part of an ounce each of aloes and assafœtida are rubbed down 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 for several succeeding 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 recommends (*Veterinarian's Vade Mecum*) two drachms of assafœtida, 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—doses of 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, tincture of the iron chloride, 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.

2d. Purgatives are exhibited in order to diminish the watery parts of the blood. This they effect very rapidly, owing to the large extent of actively secreting intestinal surface on which they operate. Directing large quantities of blood to the intestinal mucous membrane, and robbing it of a great amount of its fluid parts, purgatives are of service in relieving congestion and inflammation of various internal organs, except the intestines themselves. In many cases of inflammation, accompanied by high fever, it is difficult, however, to establish purgation, on account of the fulness of the vascular system; and in such cases much advantage results from combining the purgative with some sedative, as tartar emetic, calomel, or aconite. Purgatives are often effectual in causing the absorption of dropsical effusions; for when the proportion of its watery parts is diminished, the blood endeavours to regain its normal density, by absorbing fluid from whatever source it can be procured.

3*d*. Cathartics not only purge the intestines, but they generally purge the blood as well. By increasing the activity of the intestinal mucous surfaces, they accelerate the separation from the blood of effete matters produced by the disintegration of the tissues, and of morbid matters which may 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 accumulating 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, accelerating the cure of most inflammatory disorders, abating lameness in horses, and favouring the healing of wounds.

4*th*. Most active cathartics exert an indirect action on the liver, cause increased secretion of bile, and hence are termed *cholagogues*. Of these, the most important are calomel and other mercurials, which generally increase the biliary matters of the fæces. Orfila further noticed, that corrosive sublimate given to dogs produced abundant vomiting of biliary matter. Manganese sulphate was found by Gmelin to induce an extraordinary secretion of bile. Rhubarb and aloes are also considered to act upon the liver. Podophyllum, the amorphous resinoid extract of the Podophyllum peltatum or May-apple, is said to act specially on the liver, slowly developes its purgative action, occasionally with some pain and spasm; in small doses proves an alterative; and has been stated to counteract congestion of the liver, spleen, and other internal organs. Cholagogues are prescribed in some cases of jaundice, and where torpidity of the liver is suspected. Quinine and other bitter tonics often, however, prove serviceable in these cases of torpidity; but, as they do not appear materially to increase the secretion of bile, they cannot be considered as true cholagogues; and their beneficial effects depend, according to Professor Headland, on their striking analogy to the biliary matter taurine, and their taking its place in those cases where it is deficient from tardy action of the liver. By reflex action cathartics act, not only upon the liver, but sometimes upon the urinary and genital organs.

Expectorants.

Expectorants (*ex*, out of; and *pectus*, the breast) are substances which increase the natural secretions of the mucous membrane lining the trachea, bronchi, and other parts of the respiratory apparatus. Some of them exercise a topical effect, as chlorine, iodine, ether, tobacco smoke, and the vapour of water; some astringents and emetics exert on the throat and upper part of the digestive tract a stimulant effect, which is propagated by reflex action to the air-passages; whilst others, as ipecacuan, balsams, gum-resins, and antimonials, become absorbed, and, entering the circulation, exercise a special stimulant effect on 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 we have no evidence whatever of expectoration. They are not now used in veterinary practice.

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 of action.

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, it also acts as a pneumatic apparatus, excreting carbonic acid from the system, and probably also absorbing 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 matters, 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 azotized 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 in that way 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 paramount importance of always 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 greatly 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 all 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 diluents in large quantity, to apply smart friction over the surface of the body, and subsequently to keep the animal well covered with horse-cloths, and in an 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, ipecacuan, volatile oils, Dover's powder, and antimonials. These diaphoretic medicines, like other evacuants, become absorbed. Being, however, foreign elements, they do not remain long in the blood; but where the conditions already insisted on are duly attended to, they are attracted towards the skin, and produce there a stimulant effect, and an increased secretion, by which they are carried out of the body.

In connection with this subject, it may be remarked that warm and vapour baths have been used successfully in veterinary practice, and, like diaphoretics, prove beneficial chiefly by augmenting the healthy functions of the skin. The hydropathic method of sweating a patient has also been usefully employed in regular practice. 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. After from one or two hours, according to circumstances, the sheet and rugs should 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 equalizing 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 have been opportunely nipped in the bud by the use of a couple of comfortable horse-rugs, bandages to the legs, and a warm, stimulating, 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 congestions, and is often effectual in diminishing such excessive secretions 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 evacuant and purifying functions of the bowels or kidneys are 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 giving either large quantities of fluid, or certain saline, resinous, or other soluble substances which have a tendency to pass out of the system in the urine. Hard work or bad food, such as heated oats or musty hay, also produce similar effects. Diuretics of every description enter the blood; but not being required there, are speedily directed towards the kidneys as the organs best adapted for their excretion. As is always the case with organs acted on by evacuants, these glands become excited to increased activity, and hence a copious flow of urine, in which the irritant substance—the cause of the action—is carried away. Although diuretics greatly augment the watery parts of the urine, they 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's view of the action of diuretics appears to afford a very satisfactory explanation of this. He 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 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; turpentine, with most resins and many volatile oils; sweet spirit of nitre and most etherous and alcoholic fluids; digitalis and cantharides. When used as diuretics, neutral salts must be given in moderate quantity, for in large doses they act chiefly on the bowels. A very useful diuretic ball for the horse may be 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. A good and simple 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, and by encouraging the animal to drink large quantities of water, thin gruel, or some other bland fluid,—in short, by promoting as much as possible the excretion of the medicine by the kidneys, rather than by the skin or bowels.

In the treatment of disease, diuretics are used chiefly for the following important purposes:—*1st*, To restore the healthy action of the kidneys in diseases in which the secretion of urine is diminished. *2d*, To promote the absorption of dropsical effusions, by removing water from the blood, which, in order to recover its normal density, absorbs the anasarcous or dropsical swelling. *3d*, To promote the elimination of poisonous agents from the blood,—a purpose for which diuretics have been strongly recommended by Orfila and other toxicologists, who find that, in the case of arsenic and other drugs, doses adequate to occasion poisoning may be given with impunity, provided active diuresis be speedily induced. *4th*, To augment the proportion of water in the urine, and so to prevent the deposition of its solid parts in the bladder or other urinary passages. For this purpose, diuretics are frequently used in the human subject, occasionally in dogs, but very seldom either in horses or cattle, as these animals are little subject to gravel. *5th*, To assist in removing inflammation, by exciting counter-irritation; by diminishing the fluid parts of the blood; and also, in a more advanced stage, by carrying away the deleterious matters produced by the inflammation, or accumulated in the system, on account of the general arrestment of secretion.

Sialogogues.

Sialogogues (*σίαλον*, *sialon*, saliva; and *ἀγωγός*, *agōgos*, evoking) increase the salivary and buccal secretions. They act in one of two ways—either producing a local irritant effect, as do ginger, mustard, tobacco, and raddish; or undergoing absorption and exercising a special action on the salivary glands and mucous follicles, as is the mode of operation of mercury, and to a certain extent of salts of gold and antimony, iodine, and almost all nauseants. In works on the materia medica published so lately as 1810, the list of sialogogues sometimes included upwards of a hundred substances; but in the present day remedies of this class are only used empirically.

Tonics.

Tonics (*τόνος*, *tonos*, tone) are agents which increase the general tone and vigour of the system. 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.' Professor Headland considers that tonics act primarily and directly in the blood as restoratives, and certainly some of them appear to supply the blood with natural materials of which it may be temporarily deficient. Thus the different preparations of iron probably owe their virtue as tonics, in part at least, to their providing iron for the hæmatin of the blood-globules; and cod-liver oil and other oleaginous tonics to their supplying the fatty materials necessary for the manufacture of healthy blood. But, although it is impossible in all cases satisfactorily to trace the *modus operandi* of tonics, we do know that they all become absorbed. Many of them 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 properly regulated doses they gradually induce a more healthy state, both of primary and secondary nutrition. Many of them favour oxydation 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 all 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. When given to healthy animals in large and repeated doses, they do not, however, improve health ; but, on the contrary, sometimes cause disorder of the digestive organs, and occasionally (in man and the dog) febrile symptoms. Similar effects sometimes also ensue from their injudicious administration to sick animals. Tonics, although bearing considerable resemblance to calefacients or general stimulants, are distinguished from them by the following well-marked characters. Their action is slowly and gradually induced, but tolerably permanent, and not succeeded by any subsequent depression ; whilst the action of stimulants is speedily, and indeed almost immediately, developed, but proves very temporary, and is succeeded by a state of depression varying in proportion with the previous excitation. In short, tonics give strength, whilst stimulants merely call forth strength previously latent. Tonics also closely resemble astringents, but differ from them in acting more slowly, and possessing no obvious chemical influence, and no effect on animals except when alive.

Tonics are prescribed in indigestion and mal-assimilation, when these depend on debility; in most cases of a chronic and subacute character, when unaccompanied by acute fever; in scrofulous and other exhausting complaints; and during recovery from most debilitating diseases. In the human subject they have also a remarkable power of arresting agues and other periodic diseases, and that sometimes before many doses of the drug have been given, and before the development of any obvious physiological effect. Tonics should be withheld wherever there is active inflammation or acute fever; and they seldom do much good, unless the bowels be in a tolerably regular and normal state. To insure 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, and the mineral acids. The vegetable tonics are gentian, cinchona, quassia, and rhubarb. Alcohol, judiciously employed, proves a useful cardiac tonic, reducing the frequency and increasing the strength of the pulse, besides rousing tardy digestive function. Mineral being generally more active than vegetable tonics, are more extensively prescribed for horses and cattle. Vegetable tonics usually 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 equalizing circulation.

Stimulants, Calefacients, or Excitants.

Stimulants promptly but temporarily increase nervous energy, and thus exalt the action of the heart and the other animal functions. They include alcohol, ethers, volatile oils, turpentines, balsams, gum-resins, phosphorus, and ammonia. They all become absorbed, and may often be detected in the blood, and in various of the secretions and excretions. They usually excite the organs by which they are evacuated from the system, and on this account frequently possess various subordinate actions, some being diaphoretic, others diuretic. Although acting probably through the nervous system, stimulants produce their most prominent effects on the circulation, causing increased fulness and frequency of the pulse, accelerated respiration, and augmented temperature. In properly regulated doses they do not, however, affect the functions of the brain. Those which act with rapidity are termed *diffusible stimulants.* Such are ammonia, alcohol, and ethers. Their effects are, however, evanescent, and can be maintained only by frequently repeated doses.

Unlike tonics or alteratives, stimulants do not gradually counteract or remove disease, but their principal value results from their promptly increasing nervous force. Sustaining the action of the heart and the powers of life, they are of signal service in animals sinking from sudden shock, from loss of blood, or from poisoning by sedatives or narcotics. Increasing especially the action of the heart, equalizing circulation, overcoming tendencies to capillary congestion, and moderating exalted animal heat, they are valuable remedies in influenza, typhoid fever, and most debilitating diseases. They further prove very effectual in removing congestion of the lungs, caused either by exposure to cold or by violent and continued over-exertion, and in controlling those shivering attacks which are so often the precursors of internal disease. Used for these purposes they sometimes receive the special title of *cordials.* The general action of stimulants is often accompanied by special local effects : thus they frequently improve the appetite and promote digestion, or, in other words, act as *stomachics ;* they prevent or remove flatus, or act as *carminatives ;* or they counteract spasm, in which case they are termed *anti-spasmodics.* Alcoholic and etherous substances, volatile oils, ammonia, and other diffusible stimuli, are anti-spasmodic. In virtue of their inherent power, they exalt and control nervous force, and thus overcome that depressed and perverted condition of the nerves or nervous centres on which spasm depends. Stimulants, such as chloroform and ether, when given in large or frequently repeated doses, develope only a brief stage of excitement, presently followed by impaired sensibility and unconsciousness. (See Anæsthetics.) Some stimulants—like nux vomica, with its alkaloid strychnine, and veratrine, the active principle of white hellebore — appear to expend their stimulant action chiefly on the nervous system, without materially increasing the action of the heart, and hence have been sometimes separately classified as *nerve stimulants.*

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 trials 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. Cold air and cold water often act usefully as stimulants.

Active inflammation and acute fever contra-indicate the use of stimulants for horses and dogs; but in many such disorders amongst cattle and sheep, stimulants sensibly used overcome tendencies to congestion, equalize irregularities of temperature, remove irritability, subdue subacute inflammation, and induce a healthier action of the various secretory organs.

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, and 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. Thus quinine promptly cuts short an attack of ague in man. The very few medicines capable of thus producing with certainty special curative results are frequently termed *specifics.* As therapeutics become better understood, the present very limited number of specifics may possibly be increased, and particular blood poisons may in time have their appropriate antidotes.

The treatment of some of these blood diseases is, however, at present uncertain and unsatisfactory ; but those of them which are under medical control are counteracted and annihilated by a large and useful class of medicines, termed alteratives, alterants, or catalytics. As their name indicates, they alter for the better the condition of the system. They include iodine, sulphur, arsenic, salts of mercury, antimony, silver, zinc, copper, and lead, alkalies and saline matters, mineral acids, and carbolic acid. They are mostly of inorganic origin, are soluble in some of the various secretions of the alimentary canal, are absorbed, and exert in the blood or soft solids their special influence, neutralizing or arresting morbid processes. Frequently they alter the chemical character of fluids and solids ; they check waste and disintegration of healthy textures ; they prevent the undue development of bioplasm or degenerate cells ; or they hasten the 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 as they are expelled through the various excretory channels, and more especially through the skin and kidneys, they increase their activity. Alteratives bear some resemblance to tonics and astringents, and, as pointed out below, are still more nearly 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 emulsine of the bitter almonds resolves the amygdaline into prussic acid and other compounds, or ptyaline and pepsine promote 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 neutralize 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 fibrine, one-seventh of its albumen, and one-sixth of its globules. Alkalies dissolve fibrine, 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.

The practical uses of alteratives are numerous and important. They are employed in most febrile and inflammatory attacks. In rheumatism their judicious employment is usually serviceable. In such nervous disorders as epilepsy and chorea, when unattended by nervous lesion, but depending upon a faulty state of the blood, alteratives are extremely useful, and none of them more so than arsenic and metallic salts. Scab, mange, eczema, and other skin diseases, are also benefited by such alteratives as arsenic, sulphur, and iodide of potassium. 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 blood. 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 salammoniac, 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, salammoniac, 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, proves a useful alterative, especially if any 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 must be included amongst alterative remedies.

Astringents.

Astringents (*ad*, to; and *stringo*, I bind) corrugate the softer animal solids and coagulate the fluids. They include 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; and owe their effects chiefly to the tannin they contain. Almost all astringents produce, in the first instance, a chemical action on the parts with which they come in contact. Metallic substances unite with the elements of the tissues, diminishing their bulk and solubility; whilst most vegetable astringents tan them, causing their partial conversion into leather—the tough, insoluble tanno-gelatine of chemists. Thus far astringents have merely a chemical action, which they exert equally on dead and living tissues. When applied to the latter, their chemical constringing effect is, however, speedily succeeded by a vital constringing effect. Albuminous, fibrinous, and gelatinous tissues exposed to this twofold action become lessened in volume, their blood-vessels diminished in calibre, their exhalations and secretions decreased. Their impressions, conveyed by the sensory nerves to adjacent ganglia or to the spinal chord, often produce a beneficial reflex action. Hence cold to the loins will often arrest bleeding from the uterus; ice swallowed checks bleeding from the nose or lungs; astringents applied to the mouth and fauces occasionally relieve atony of the respiratory mucous lining. But astringents have often a still more extended action; most of them, when properly administered, become absorbed, and exercise their characteristic effects, especially on voluntary and involuntary muscular tissues. They act on the unstripped muscular fibres of the arterial and capillary vessels, increasing the strength and firmness of the pulse, and on the same textures in the mucous membranes and glands, decreasing secretion, and often promoting digestion and improving general health. In producing these effects, astringents bear a close resemblance to tonics, and, in practice, may often be substituted for them, or combined with them. The most marked difference between them probably consists in the action of astringents being preceded by, and resulting from, a purely chemical effect. The same substances must, however, be frequently included in both classes.

In veterinary practice astringents are used internally for arresting excessive mucous secretion, especially when depending on defective tone; for counteracting relaxed states of the digestive organs, with the morbid conditions dependent on such relaxation; and for staying hæmorrhage. It is not out of place here to note that Dr. George W. Balfour of Edinburgh has recently recommended the hypodermic injection of ergotine as an effectual mode of arresting bleeding from the human lungs, stomach, and other parts. The external uses of astringents are even more numerous and important. They are applied to counteract relaxation and excessive secretion both of serum and pus; to suppress pale flabby granulations; to hasten the formation of healthy cicatrices; to diminish the volume of protruded organs, in order to faciliate their return, as in cases of protrusion of the rectum or uterus; to coagulate blood, and as styptics to stop the mouths of bleeding vessels; to constringe dilated and paralyzed capillaries, and thus to 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.

Emollients.

Emollients (*mollio*, I soften) are somewhat analogous to demulcents; but, in addition to the various substances already mentioned as belonging to that class, they include poultices, fomentations, moistened lint, and spongio-piline. On account of their warmth and moisture, they soften, swell, and relax the parts to which they are applied; either directly or by reflex action they soothe irritable nerves. In effect they are diametrically opposed to astringent tonics. They are serviceable in the earlier stages of inflammation for effecting resolution; in the more advanced stages for promoting suppuration; and in all stages for relieving the outward symptoms of heat, tension, and pain. Although serviceable for softening and cleansing wounds, they should never be applied to those which are likely to heal by adhesion or first intention.

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. Contracting the vessels of the part to which they are applied, they diminish their supply of blood, and thus retard cell growth and tissue change. They are serviceable for the removal of circumscribed and superficial inflammation, especially in parts of low organization, and where suppurative action is to be repressed. Cold air and cold water are not only the most common but the most convenient refrigerants. The fact, however, that all solid substances, in becoming fluid, absorb heat, suggests the expediency of dissolving in the water, immediately before application, some saline matters, as common salt and nitre, or common salt and ammonium nitrate. 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 it is desirable that the temperature be reduced below the point that can be attained by the ordinary use of cold water frequently renewed, with or without 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 tendons, open joints, 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 to the parts. In the human subject congelation has been successfully used by Dr. Arnott for the cure 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 analogous to what were formerly termed antiphlogistics. They include blood-letting, aconite, prussic acid, tartar emetic, and digitalis. Applied to the mucous surfaces, to the skin, or to wounds, sedative medicines find entrance into the blood, are conveyed by it to the nervous centres and spinal chord, derange and subdue the action of these parts, and consequently depress the functions of most of the vital organs;

especially reducing the force and frequency of the pulse, decreasing the number of the respirations, and often causing nausea and general exhaustion. They are somewhat uncertain in their effects, and particularly apt to be affected by modifying circumstances. They are exactly opposed to stimulants; and although they bear some resemblance to narcotics, they differ from them in causing no preliminary excitation and no direct effect on the intellectual parts of the brain. In excessive doses most of them are dangerous poisons, usually destroying life by syncope or arrestment of the action of the heart; sometimes by paralyzing the respiratory movements. They are chiefly useful in reducing or controlling inordinate or irregular action of the heart, as in febrile attacks and inflammation of the lungs, intestines, and other important organs; and in subduing some spasmodic affections. For the horse the sedatives most to be relied on are ten drops of Fleming's tincture of aconite, or a scruple of calomel and a drachm of opium repeated every two hours, until the pulse becomes more natural, or six or eight doses have been given. For cattle the same medicines in somewhat larger doses are effectual. For dogs and pigs there is a larger choice of reliable sedatives, and any of the following formulæ prove serviceable: Fifteen to twenty grains of Dover's powder; two grains tartar emetic, and five grains of nitre; two grains each of calomel and opium; two drops of tincture of aconite; or one grain of calomel, with a drachm each of Mindererus' spirit and tincture of arnica. Perhaps no remedies are so frequently abused as sedatives. They are often erroneously administered in cases of inflammation long after the acute stage, in which alone they are useful, has passed away; and also very often in cases of weakness and irritability, where the small rapid pulse indicates the necessity of tonics and stimulants, rather than of depletives or sedatives.

Sedatives vary considerably in their special effects, and their applicability for particular purposes. Aconite induces very rapid and general depression, is the most certain and effectual sedative for horses, cattle, and sheep, and possesses a curious local anæsthetic influence, which renders it useful as an anodyne in rheumatism and neuralgia. Hemlock, and its alkaloid conine, induce a series of symptoms allied to those produced by aconite, reduce the action of the heart, allay nervous irritability, and, in large doses, develop swift-spreading paralysis of the motor nerves exactly antagonistic to the stimulating effects of strychnine. The woorara or urari poison of Guiana also destroys life, by inducing general paralysis. The ordeal bean of Old Calabar resembles in many respects hemlock and woorara. In poisonous doses it induces nausea and retching, discharge of saliva and tears, and general muscular paralysis. Its actions and uses have been ably investigated by Dr. Thomas R. Frazer, who finds that full doses cause first contraction, and afterwards dilatation of the smaller blood-vessels; that arterial and venous tension, at first increased, is rapidly diminished; that the pupil alternately dilates and contracts,—although contracted at the time of death, it almost immediately after becomes dilated. Consciousness, the special senses, or volition are little interfered with. It appears to be the physiological opposite of strychnine. It paralyzes the motor tract of the spinal chord, causing death either by arresting the respiratory movements or the action of the heart. The motor nerves, commencing with their peripheral extremities, are paralyzed. The sensory nerves are not affected. Dr. Frazer has found Calabar bean useful in rheumatic fever, bronchitis, delirium tremens, and tetanus. It is further notable on account of its producing, when applied within the eyelids, rapid contraction of the pupil,—an action diametrically opposed to that of belladonna and its alkaloid atropine,—and stated to be of some service in serious inflammation of the eye, by shutting out the undue stimulus of light, by moving the iris, and thus preventing or breaking down adhesions. Like aconite, it will probably be found useful when locally applied for the relief of rheumatic inflammation of joints, and of neuralgic pains. Prussic acid, in large doses, causes convulsions and fatal sinking; and in medicinal doses acts more especially upon the vagus nerve, quieting cough and irritation of the stomach. Creasote somewhat resembles prussic acid in its anodyne uses, but, besides, stimulates the mucous membranes, and thus shows some relationship with turpentine. Antimony, ipecacuan, and digitalis are believed to derange or destroy the functions of the vagus nerve ; in medicinal doses, especially in men and dogs, they produce nausea, with notable depression of the action of the heart, and act, besides, as eliminatives on the organs by which they are excreted from the system,—antimony and ipecacuan proving diaphoretic, and digitalis diuretic. Bromine exerts a special sedative influence on the sympathetic or organic system, as well as on the nerves of common sensation. It 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 chord, 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 fibrine, and to a lesser extent the albumen 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 must be wound some thread, tow, or hair. Although blood-letting is assuredly the best 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 affections 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 are defined by 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 are divided by Professor Headland into inebriants, soporifics, and deleriants; and include such medicines as opium, Indian hemp, belladonna, hyoscyamus, camphor, and tobacco. In large doses they induce depression, preceded by comparatively little excitation, and usually cause death by coma. In small doses, however, they mostly produce very obvious excitement; and those which chiefly exhibit this effect—as opium, Indian hemp, and tobacco—form the connecting links, as it were, between narcotics and such stimulants as alcohol and ether. In these latter, however, the primary stimulation is much greater and of longer continuance than the secondary depression, whilst exactly the reverse obtains in the case of narcotics. Some narcotics, as belladonna and hyoscyamus, closely resemble sedatives, being preceded by but slight excitation, and having little action on the functions of the brain proper.

Among horses and cattle, narcotics require to be given in unusually large doses, and at best act far less certainly and perfectly than in the human subject or the dog. During the preliminary stage of excitation among animals, they appear to exalt chiefly the functions of the spinal chord, causing spasms and convulsions; whilst in the same stage in man they act more particularly on the mental powers, on the special senses, and on volition and sensation. During the succeeding stage of depression, drowsiness and stupor, although noticeable in foals, calves, and other young creatures, are generally less obvious in the lower animals than in man; and death is more apt to occur from apnœa or syncope than from coma.

Narcotics are given to relieve inordinate nervous action. They are specially serviceable in removing the spasms of colic and chorea; in alleviating the irritability of chronic coughs, bronchitis, tetanus, diarrhœa and dysentery, with gastrodynia, and chronic vomiting in dogs; and in blunting the pain of severe wounds, rheumatism, pleurisy, and other acute inflammations. When thus used for the relief of pain, they are usually termed *anodynes;* and when they cause sleep, *hypnotics.* To insure their full effect, they should be given at intervals of one or two hours; their action carefully observed; and, since their effects are apt to diminish with their continued use, they should, when necessary, be administered in gradually augmented doses.

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 closely 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 proposed nitrous oxide as a means of causing insensibility. About 1831 ether was known to have the power of causing insensibility among the lower animals, and relieving asthma in the human subject. It was first used to produce anæsthesia in man in America, on 30th September 1846, by a Mr. Morton, in the extraction of a tooth, and shortly afterwards became general in all kinds of surgical operations. On this side the Atlantic, it was first used in London on the 19th December by a dentist, and on the 21st by the celebrated Liston. In the succeeding February it was first applied in midwifery by the late Sir James Y. Simpson. Before, however, another year had elapsed, that gentleman had discovered another anæsthetic, more potent, safe, and convenient than any hitherto tried—this was chloroform. It had been previously known for some time as a chemical curiosity, and 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 power of producing anæsthesia in man was first discovered on the night of the 4th November 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 all parts of 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. Since the discovery of chloroform, although many other anæsthetics have been tried, none of them have come into general use.

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, the 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 embarrassed or feeble, or the breathing shallow or noisy. Anæsthetics are almost invariably administered by inhalation. By no other channel do they so rapidly and safely gain access to the blood. Even although free from pungency, they require to be breathed mixed with air, usually to the extent of twenty times their volume. When inhaled undiluted, or when the 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 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.

All anæsthetics enter the blood, and have a remarkable power of diffusion; but how they determine their special action is not very easily explained. It has been stated that they add carbon to the blood; that they saturate it with chlorine or some such substance which robs it of oxygen; that they shrivel up the blood corpuscles, preventing the endosmose of oxygen. But in what manner soever produced, a swift-spreading paralysis extends over the several portions of the nervous system; the functions of the cerebrum and cerebellum, at first exalted and deranged, somewhat in the same way as by full doses of alcohol, are presently depressed; and hence result drowsiness, with suspension of special sense and voluntary motive power. The paralysis shortly overtakes the optic thalami and other sensory ganglia and the spinal chord, producing extinction of common sensation, and of the power of involuntary or reflex movement. If the medulla oblongata and sympathetic are also deeply narcotized, as where full and prolonged anæsthesia occurs, the functions of organic life, and especially the actions of the heart and lungs, are arrested.

The mode of dying and the *post mortem* appearances vary somewhat with the rapidity of the poisoning. Where a large amount of chloroform or other anæsthetic has been rapidly inhaled, both heart and lungs appear to be stopped somewhat simultaneously. Where death occurs more slowly, the pulse, according to Dr. Snow's observations, and those of the Paris Commission appointed to inquire into the subject, continues to beat after the respiratory movements cease. Hence the value of artificial respiration in restoring patients from profound anæsthesia. The blood is darker coloured and less coagulable; rigor mortis comes on naturally; the lungs are seldom congested; the right side of the heart is almost invariably overfilled; the left side nearly empty; the brain and nervous centres are seldom congested.

On account of the difficulty of getting the lower animals submissively to inhale them, anæsthetics are not extensively used in veterinary practice. They have, however, been successfully exhibited in all formidable surgical operations. In parturition they afford, as in the human subject, 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, or for obviating the spasms of tetanus, colic, and asthma, a low degree of anæsthesia 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 paralyzed, and sensation entirely removed. The agents generally used are ether, alone or mixed with chloroform, or with alcohol. Dr. B. W. Richardson, on account of its rapidity of action, 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 tumors, probing and excising fistulæ, opening abscesses, reducing herniæ, extracting teeth, and in inserting setons, firing, neurotomy, and other such operations. 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. Pyroxylic or wood spirit, or methyl alcohol ($C\,H_4\,O$), and methyl hydride or marsh gas ($C\,H_4$), are feebly anæsthetic. 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 highly recommended, and much used even in the most formidable surgical operations in man; and requires to be given rapidly, without much admixture of air. Methyl bichloride contains an atom of chlorine less, and an atom of hydrogen more, than chloroform; is represented by the formula $C\,H_2\,Cl_2$; being very volatile, it rapidly produces anæsthesia. Acetone, chemically regarded as methyl acetyl ($C\,H_3$, $C_2\,H_3\,O$), has been tried, but is objectionable on account of its acrid and irritating properties.

The several members of the ethyl series—such as nitric, hydrochloric, acetic, and formic ethers—have been subjected to careful experiment, but none have been found so safe and serviceable as ether ($C_2\,H_5\,O$). Aldehyde ($C_2\,H_4\,O$) readily acts as an anæsthetic, but is somewhat uncertain and irritant. Chloral hydrate ($C_2\,Cl_3\,H\,O$, $H_2\,O$), being at ordinary temperatures in a solid state, cannot be inhaled; but when swallowed, is converted by the alkalies of the blood into chloroform, and hence proves anæsthetic and narcotic.

Amyl hydride, or hydramel ($C_5\,H_{11}\,H$), a derivative of one of the higher alcohols ($C_5\,H_{12}\,O$), is obtained from American petroleum, has the specific gravity ·625, boils at 86° Fahr., and has recently 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 narcotized 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 the human subject amyl hydride has been successfully 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\ H_{11},\ NO\ $) has been found by Dr. Arthur Gamgee, when inhaled, to combine with hæmoglobulia, the oxygen-carrier of the blood, and prevent its giving off oxygen. Rabbits and other animals made to breathe it die with suffocative convulsions. It relaxes undue contractions of the pulmonary and systemic capillaries, and has been prescribed by medical men in asthma, angina pectoris, and cholera. Given internally or by subcutaneous injection, it is said to act better than by inhalation, and to be less apt to interfere with due oxygenation of the blood and tissues.

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, another of the light hydro-carbons derived from coal tar or American petroleum, is also anæsthetic, and is generally used by entomologists to narcotize their specimens. The oily, fragrant Dutch liquid, or ethylene dichloride ($C_2 H_4 Cl_2$), although favourably regarded by Mr. Nunneley, was pronounced nauseating and dangerous by the late Sir James Y. Simpson and Dr. Snow. Amylene ($C_5 H_{10}$), another of the olefines, a volatile diffusible liquid, was highly recommended by the late Dr. Snow; but it has a disagreeable odour, and a marked tendency to paralyze the heart. Nitrous oxide, or laughing gas ($N_2 O$), has recently been successfully used for the less formidable and brief operations of human surgery. It is free from unpleasant smell and taste; it rapidly removes sensation, which is again restored in one or two minutes. 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 exert a general stimulant effect; while those which are still larger act chiefly on the bowels. Small doses of most salts of potassium, sodium, and magnesium are alterative and diuretic, while larger quantities are purgative. Aloes, in small quantity, is tonic, and in large, purgative. Alcohol, opium, and many other substances, afford striking examples of medicines in which a variation in dose produces a difference in the nature of 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. Where uniform and continued effects are required, as with most 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. Lead, mercury, and digitalis, 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 be expected to 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 expedites 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 changes also in physiological action, has been recently discovered and investigated by Professor Crum Brown and Dr. Thomas R. Frazer. 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 paralyzers 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, cultivation, and other circumstances, which will, however, be more conveniently noticed when discussing those medicines which they specially affect. 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 different classes of veterinary patients are very differently affected by many medicines. A few grains of tartar emetic cause almost immediate vomiting in dogs, whereas the same medicine, even when given in doses of several ounces, has scarcely any physiological effect on horses or cattle. Aloes, the most uniform and convenient purgative for horses, is uncertain and irregular in its action on cattle, but purges dogs in doses of about a drachm, or eight times as much as is given to a man. Opium, strychnine, and ether further afford good illustrations of the different effects which the same medicine has on different classes of animals. In the present state of our knowledge, some of these anomalies cannot be very satisfactorily accounted for, but most of them depend on differences of organization and habit; and to a few of these we shall now briefly advert.

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. Vegetable purgatives appear more suitable than mineral ones, 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 and some few other poisons, horses never vomit. Vomition is prevented by the smallness of the stomach; by its distance from the diaphragm and abdominal muscles, and the consequent difficulty with which it can be compressed betwixt the two; by the stout band of muscular fibres which surround its œsophægeal opening; and, according to some authorities, by the inaptitude of the vagus nerve to receive and convey the special irritation. Most substances which act as emetics for men and dogs are supposed to produce a sedative effect 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 only reliable sedative medicine. Sudorifics are less active and useful than in man, and are very apt to act on the kidneys, unless the animal be well clothed. Opium and other narcotics exert less soporific influence on horses, and indeed on all the lower animals, than on man.

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 three first 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 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 somewhat less easily acted on than the corresponding organs in the horse; 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 soever 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 there are some remarkable exceptions to this rule. 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 are 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 sorts of grass, 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, but the practitioner is seldom required to prescribe for these animals.

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 first portions of the small intestine,—parts which afford great facilities for speedy and complete absorption, and are, moreover, very sensitive, and intimately connected, both by vessels and nerves, with all the important organs in 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 tonics and alteratives 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 is very actively absorbent, and 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, and corrosive sublimate, ignorantly or carelessly applied for the cure of skin diseases or such other purposes, 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 other concentrated medicines, when so used, operate with great certainty, and in doses considerably less than those usually swallowed. Subcutaneous injection has now, however, almost 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, 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 pains, such as those 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. Any tolerably concentrated medicines can thus be introduced into the system. With active agents it is unwise, without careful trial, to use 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; one or two ounces 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. No plaster or dressing is required for the minute puncture.

Habit.—The continued use of a medicine alters the degree of its action, and affects especially organic agents. Arsenic is, however, a notable example of an inorganie medieine, of whieh both men and animals beeome wonderfully tolerant by use. Thus arsenic-eaters sometimes use with perfeet impunity twelve or fifteen grains daily,—a quantity suffieient to poison three or four persons unaeeustomed to the poison. A like toleranee is observable amongst horses whieh have been aeeustomed to reeeive arsenic. Opium, and most general stimulants, when administered for some time, gradually lose their effects; while causties and irritants, whieh exereise only a topical aetion, exhibit, on their repeated application, a gradually increasing activity.

Idiosyncrasies, whieh in the human subject render some poisons almost innoeuous, and some simple medicines deadly poisons, are mueh less frequent and notable among the lower animals. Those of most frequent oeeurrenee among veterinary patients, are either an inereased or a diminished suseeptibility to the action of purgatives and diuretics. Most medieines aet with greater eertainty and effect upon well-bred animals, whether amongst horses or dogs, than upon eoarsely-bred mongrels.

Diseases.—The existenee of disease alters the suseeptibility of the system to the action of many medicines. Influenza, low fevers, and most extensive inflammations of mueous or eutaneous surfaces, withstand redueing remedies badly, and require for their sueeessful treatment the early exhibition of large doses of tonies and stimulants. Copious blood-letting and large doses of sedative medieines induee less depression in inflammatory fevers than in health; immense quantities of opium and ehloral hydrate have comparatively slight effeet in tetanus, hydrophobia, or enteritis; while excessive doses, both of purgatives and stimulants, are tolerated in the apopleetie form of puerperal fever among eattle, and in all other eases in whieh there is depression of nervous force.

External Circumstances.—The circumstances in whieh 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 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 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. When the powder is to be finely divided, it must be transferred to smaller mortars, which may be made of wood, marble, or Wedgwood-ware. Those of the latter material are the most convenient, being cheap, easily kept clean, and little affected by acids. They should be kept of several different sizes. To reduce a substance to powder, the most easy and expeditious way is to put only a small quantity of it into the mortar at a time. When a fine state of division is required, the powder is sometimes put through a sieve, and the coarser particles returned to the mortar. The laboratory should always contain sieves of different sizes and degrees of fineness, some of wire-gauze, and others of horse-hair. For light pungent or irritant powders compound sieves are sometimes useful. They are merely common sieves entirely closed in with a lid both above and below. If it can be avoided, medicines, especially the more expensive vegetable preparations, should not be purchased in powder; for in that state they are apt to contain adulterations and impurities, which are, for the most part, unusually 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 usually contain, besides the active ingredients, certain subordinate constituents, termed *excipients*, which are added to give the bolus cohesion and consistence. The most common excipients are linseed meal and water, oil, lard, soap, liquorice powder, treacle, syrup, glycerine, and conserve of roses. In the selection of suitable excipients, the choice is determined by the nature of the active ingredients. The first four excipients 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. In order to keep a mass long 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 the aid of heat is sometimes necessary, as when any of the materials are of a waxy or resinous nature. 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 so prepared 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 up 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 gelatine. 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, may be 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 and the mouth closed.

DRAUGHTS—DRENCHES—DRINKS.

Drenches are usually extempore preparations. They are occasionally given to horses, especially when a speedy effect is desired, as in colic; are frequently prescribed for dogs; and are almost the only form in which physic is ever given to cattle or sheep. In these ruminants, medicines in the solid state act very tardily and imperfectly, for they get mixed up with the immense bulk of food always found in the rumen, and thus remain unabsorbed often for a long time. Some medicines, too, from prolonged contact with this mass of vegetable matter, probably undergo changes which materially interfere with their action. 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 may be 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, which is a more convenient form for conveyance in 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 carefully and slowly given ; and if coughing occurs, the operation should be stopped, and the animal set free for a few minutes.

DECOCTIONS.

Decoctions are prepared by boiling solid substances, usually of vegetable origin, in water. To ensure perfect solution, the medicine is bruised or cut into small pieces, and digested in the fluid for some time ; but excessive heat and prolonged boiling should be carefully guarded against. Any insoluble residue is subsequently separated by filtering the mixture through bibulous or unsized paper, straining it through muslin or calico, or allowing it to settle, and then pouring off the supernatant fluid. When decoctions are to be kept for some time, they should have a little spirit added to them, and be bottled and well corked while hot. Without these precautions, such preparations are very apt to ferment, or otherwise become spoilt. *Examples*—Decoction of barley, of camomile flowers, of aloes, etc.

INFUSIONS.

Infusions do not differ materially from decoctions. They are made by digesting the crude drug either in hot or cold water, and afterwards separating any insoluble parts by decanting, filtering, or straining. The process is often conducted in stoneware 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. With such an apparatus, infusions are easily prepared ; but unless well bottled and corked whilst hot, they seldom keep well. An infusion free from starchy matters, and which therefore keeps better, may usually be got by percolating cold water through the substance packed in an apparatus similar to that used for making tinctures. Various infusions used in human medicine are now concentrated by evaporation, and their keeping properties improved by the addition of alcohol. *Examples*—Infusion of catechu, gentian, aloes, etc.

TINCTURES.

Tinctures are solutions of animal, vegetable, or mineral substances in any spirituous fluid. Alcohol, in some of its various degrees of concentration, pyroxylic spirit, and occasionally ether, are the spirituous fluids generally used. They are prepared 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 for seven days; the solution is poured off; the residue pressed; and the tincture, when filtered, is ready for use. Sometimes the materials, in a state of moderately fine division, are packed in a percolator or cylindrical vessel of glass, earthenware, or metal, the spirit passes gradually through them, displaces and dissolves out their soluble parts, filters through the linen or calico at the lower part of the cylinder, and passes off by the stop-cock, which should be attached to the apparatus. Some tinctures are made by macerating the materials in water for a couple of days, obtaining the remaining active principles by percolation with spirit, and mixing the two solutions. Tinctures are very convenient preparations; they are usually tolerably concentrated, and are well adapted for long keeping. *Examples*—Tinctures of aloes, myrrh, opium, and cantharides.

EXTRACTS.

Extracts are the soft, semi-solid residues left by evaporating decoctions, infusions, tinctures, or the natural expressed juices of plants. What is chiefly necessary in their preparation is, to avoid exposing them to high temperatures, which are very liable to decompose or volatilize their active principles,—accidents which are especially apt to occur with narcotic plants, but which may be entirely prevented by first getting rid of a quantity of the fluid matters by evaporation in vacuo, and then transferring the residue to flat shallow pans, in which it is exposed to currents of air at ordinary temperatures, and continually stirred until it arrives at the desired consistence. Both alcohol and water are used in making the solutions from which extracts are subsequently prepared; and the best solvent in each particular case is that which removes the active principles without acting on the starch, gum, or other matters, which not only uselessly increase the bulk of the preparation, but also render it apt to spoil. When extracts are well made, they keep for a long time without undergoing change, especially if occasionally moistened with a little rectified spirit. *Examples*—Extracts of belladonna, hemlock, digitalis, liquorice, aloes, etc.

MIXTURES.

Mixtures are fluids containing two or more ingredients, either mechanically commingled or chemically combined. They usually are prepared extemporaneously, are drumly and thick, and deposit a sediment on standing. Camphor, chalk, and catechu mixtures are examples of this sort of preparation.

ELECTUARIES.

Electuaries are generally made with sugar or mucilage; are thick, viscid, and of the consistence of treacle; and are chiefly used as vehicles for the administration of insoluble and disagreeably tasted drugs. They are usually regarded as synonymous with conserves and confections, but are rarely used in veterinary practice. *Examples*—Electuaries of catechu, senna, and opium.

SYRUPS.

Syrups are saccharine solutions, of a density varying between 1·300 and 1·400. In preparing them, care must be taken that they are of a proper consistence; for if too thin and weak, they become mouldy, and are apt to ferment; while, if too thick and strong, the sugar crystallizes out. Simple syrup, occasionally employed in veterinary practice, consists of two parts of sugar and one of water. Syrup of poppies and syrup of buckthorn are also occasionally used.

LOTIONS.

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

OINTMENTS.

Ointments are preparations for external use, containing oleaginous or waxy matters, and about the consistence of butter. When lard or oil are the excipients, 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 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 will be found essential articles of the laboratory furniture. They should be of different sorts, some being made of steel, and others of bone, wood, or horn. *Cerates* are ointments containing wax ; and *liniments*, ointments containing oil, and of a mediate consistence between ointments and oils.

PLASTERS.

Plasters consist of waxy and resinous matters spread on calico, linen, leather, or some such substance. They are less useful in veterinary than in human practice ; for in the lower animals they are difficult to apply, and, from the greater power of the panniculus carnosus, are very apt to be displaced.

Where they are desired 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 once much used in all kinds of lameness. Their application is beneficial, partly from their stimulating properties, and partly from their ensuring the patient's being released from work for several weeks.

FOMENTATIONS.

Fomentations are applied for local bathing or stuping. They often consist of water alone; but vinegar, salt, and various other medicinal 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 rug. They 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 as counter-irritants are their being withdrawn before the heat and moisture have time to do much good, and their causing subsequent rapid cooling of the part. 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 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 chord, an increased flow of blood thus follows through the vessels regulated by those parts of the chord, and hence vital activity is augmented. 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. It is important that they be nicely prepared, soft, fresh, and frequently changed. Heat without the moisture may be applied by the agency of hot bricks, salt, or sand, by well-warmed rugs or flannels, or by 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 salammoniac, or of common salt and ammonium nitrate, mixtures of ice and salt, or some such freezing mixture. Cold poultices are especially adapted for sub-acute inflammation, particularly of joints, ligaments, tendons, and feet, and other parts of comparatively low organization. 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 consideration, 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 and irritate the skin, 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 often superseded by fomentations or by antiseptic dressings.

CLYSTERS—GLYSTERS—ENEMA—ENEMATA—INJECTIONS.

Clysters are in frequent use for all the domesticated animals.

Their composition varies, of course, with the purposes for which they are given : thus, in constipation, they usually consist of soap and water, sometimes with oil or turpentine, and occasionally with tobacco smoke ; in diarrhœa, they contain starch-gruel, occasionally with vegetable astringents and opium. No remedies are more safe and effectual for keeping the bowels in good order, whether in health or disease ; and their diligent use, especially in horses, will often safely and effectually fulfil all the purposes of purgative medicine. In tetanus, bronchitis, and other cases in which it is difficult to administer medicine or food in the usual way, they may often be advantageously given in a clyster. About the same dose of medicine may usually be given by the rectum as by the mouth. Clysters frequently prove a convenient channel for exhibiting stimulants in debilitating disorders. Lime water and turpentine 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. Often they allay irritation of the bowels, occasionally overcome intussusception, and, by reflex action, relieve pain of the bowels, kidneys, and uterus. For such purposes they should be used warm, and retained if possible for a short time. When intended to be retained and absorbed, clysters should be limited in quantity, not exceeding two or three pints in the horse. Where intended to produce evacuation of the bowels, their quantity may be doubled 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, or from a caoutchouc ball and tube, 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, ℔.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 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 13 and 26½ 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 legalized 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 pints.

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 0·914 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 pharmacopœias recognise acetic acid under the following varieties of strength and purity: namely, glacial acetic acid, containing 84 per cent. of anhydrous acid; the acetic acid of the shops and of chemistry, containing about 28 per cent. of anhydrous acid; a crude impure pyroligneous acid of somewhat variable strength; a purified pyroligneous acid, nearly corresponding with the commercial acetic acid; and British, French, and distilled vinegars.

ACETIC ACID (acidum aceticum) is usually obtained by the distillation of vinegar or the decomposition of one of the acetates. The British Pharmacopœia directs it to be prepared by heating sodium acetate with sulphuric acid. When rectified it is a mobile, colourless fluid, with a pungent acetous odour and taste, a corrosive action upon organized tissues, and a density varying from 1·063 to 1·066. It boils at 244° Fahr., is combustible, crystallizes at 62°, forming brilliant pearly flat plates, and is hence known as glacial acetic acid. It reddens litmus, gives white fumes with ammonia, dissolves volatile oils, resins, camphor, and vegetable alkaloids, and unites with bases to form the crystallizable and soluble acetates. These salts are distinguished by the acetous odour they emit when heated with sulphuric acid; the peculiar etherial 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. Good commercial glacial acid contains not more than one per cent. of water, and corresponds to 84 per cent. of acetic anhydride ($HC_2 H_3 O_2$). The strong acid usually sold in Scotland contains upwards of 70 per cent. of acetic anhydride ; the ordinary acid of the shops contains from 28 to 30 per cent.

Pyroligneous Acid.—When any of the hard woods, as willow, oak, or beech, are exposed to destructive distillation in capacious iron vessels, there comes over a dark-brown empyreumatic liquid called pyroligneous vinegar. The portions soluble in water contain the acetic acid, methylic alcohol, creasote, and similar substances, to which this impure vinegar owes its value for the curing of meat. When its strength and purity are increased by re-distillation, it constitutes the purified pyroligneous acid of the shops,—a colourless or pale straw-coloured liquid, with a strong acetous taste, sometimes of variable strength ; but, as prepared by the British Pharmacopœia, of the specific gravity 1·144, and containing 28 per cent. of anhydrous acid.

Vinegars.—Vinegar is diluted acetic acid, containing—besides variable proportions of colouring matter — mucilage, alcohol, ethers, sulphuric acid, and calcium sulphate. There are two chief processes by which it may be got—by the destructive distillation of wood, as in the manufacture of pyroligneous acid ; and by the oxidation of alcohol, by exposing it to the air, at a somewhat elevated temperature, and in contact with a ferment. In this latter way most British and continental vinegars are manufactured from various substances containing alcohol ; in this country, from weak spirits, malt liquors, or solutions of sugar ; 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 over a large surface of wood-shavings, at a temperature of from 75° to 80°. After a few days there is formed on the surface of the spirituous solution a gelatinous mould, consisting of the mycoderma aceti, which appears to attract an equivalent of oxygen from the air and supply it to the alcohol ($C_2 H_5 HO$), converting it first into aldehyd ($C_2 H_4 O$) and water ($H_2 O$), and thence, by further absorption of oxygen, into acetic acid ($HC_2 H_3 O_2$). The British vinegars are colourless, or nearly so, have an acid taste and reaction, and when of good quality, a refreshing acetous odour, depending upon traces of acetic ether. The finest are the French champagne or white wine vinegars, distinguished by their etherial acetous odour and high density. Those made from the red wines yield, when treated with ammonia, a purple colour and a purple flaky sediment. Distilled vinegar, prepared by gently heating a good commercial vinegar, rejecting the first and last portions that come over, does not materially differ from the better qualities of French vinegar. It is colourless, entirely dissipated by heat, of an ethero-spirituous odour, of the density 1·005, requires to neutralize it at least 402 grain measures of the volumetric solution of soda, and corresponds to 4·6 per cent. of anhydrous acid (Brit. Phar.). Diluted pyroligneous acid, often sold in the shops under the name of wood-vinegar, consists of one part of pyroligneous acid to three of water, and is very suitable for all veterinary purposes, except for making the spirit of Mindererus.

Impurities.—The most common adulterations of vinegar are water and sulphuric acid. Water is discoverable by its diminishing the density and the power of neutralizing crystallized sodium carbonate. The British vinegars should have the density 1·006 to 1·019; the French, 1·014 to 1·022; and the distilled, 1·005. 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 to vinegar of one 1000th part of sulphuric acid is allowed by the excise laws, in the belief that it prevents spoiling. But the legal proportion is often greatly exceeded. All the sulphuric acid in one fluid ounce of vinegar should be precipitated by ten minims of pharmacopœia solution of calcium chloride. Any traces of copper or lead are detected by their precipitating hydrogen sulphide.

Actions and Uses.—Acetic acid, in a state of concentration, is corrosive and irritant ; when diluted, it is stimulant, tonic, diuretic, astringent, and refrigerant.

Its irritant effects are somewhat less energetic than those of the strong mineral acids ; but it produces death with analogous symptoms, causing in dogs much uneasiness, vomiting and abdominal pain, weakness of the hinder extremities, and exhaustion. An ounce of the strong acid destroyed a medium-sized dog in an hour ; a quarter of an ounce of pyroligneous acid in from five to nine hours ; and four or five ounces of common vinegar in ten or fifteen hours (Christison on Poisons). Among the larger domesticated animals it is much less active, horses taking from six to twelve ounces of the commercial acetic acid, and cattle doses of three or four pounds, without apparent bad effect (Hertwig). Neither acetic acid nor any of its solutions is much used internally. As tonics and stimulants, they have been displaced by the mineral acids, and as diuretics their efficacy is very doubtful. 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 corpulency. This it can only do at the sacrifice of health.

Applied externally, strong acetic acid is a powerful corrosive. Rubbed into the skin, it speedily causes redness, and the eruption of large blisters resembling those produced by boiling water. It is used occasionally as an astringent and styptic.

Dissolving albumen, fibrine, and gelatine, it is of some service in removing warts and such like excrescences, as well as corns in the human subject; whilst, for softening scurf and destroying cryptogamic parasites and acari, it is occasionally used in cases of mallenders and sallenders, ringworm, scab, and mange. In these cases, the 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, produced a vapour which was found by M. Fournié to induce local insensibility in five minutes. Vinegar, along with either hot or cold water, is used in superficial inflammation, strains, and bruises; and occasionally for sponging the skin in febrile disorders. Employed for fumigating stables or cowhouses, it does more harm than good; for it disguises those noxious effluvia which it neither removes nor destroys, and may thus prevent due attention being bestowed on thorough ventilation, and the use of effectual disinfectants. It dissolves the active principles of many medicines, and enters into the composition of such pharmaceutical compounds as 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.—The commercial acetic or purified pyroligneous acids, when used internally, are given diluted with water or any simple fluid, in about the same doses as the common mineral acids, namely, f℥i. to f℥ij. for horses or cattle; ♏x. to ♏.xx for sheep and pigs; and ♏ij. or ♏iij. for dogs.

ACONITE.

Monkshood. Wolfsbane. Aconitum. Tubers and leaves of Aconitum Napellus, A. ferox, and perhaps some other varieties.

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

Botanists have numbered twenty-two species and upwards of a hundred varieties of aconite. 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; annual stems from two to five feet high; deeply divided, dark green leaves; 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 root imported from Germany or cultivated in Britain is brown, conical, rapidly tapering, of an earthy odour, —characters which should distinguish it from the cylindrical, white, pungent, bitter root of horse-radish, for which it has sometimes been 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 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 any irritation or inflammation. This, besides being a test of aconite, also affords an easy and accurate method of judging of the activity of any specimen or preparation of the drug; for it is most observable in those varieties and parts of the plant, and in those preparations which are most potent as medicines and poisons. The root and leaves, when powdered, have a dirty grey 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.* (*See* p. 123.) Pseudo-aconitine, napellin, and other active constituents, have recently been extracted from several of the aconites.

Actions and Uses.—Aconite is a dangerous poison, paralyzing the nervous functions, and acting as a powerful general sedative. Used medicinally, it is sedative, antispasmodic, and anodyne.

It proves poisonous to all animals, from infusory animalcules and earthworms to man himself. Absorption into the blood-vessels appears essential to the development of its constitutional effects, which primarily and chiefly consist in depression of the functions of all parts of the nervous system. It is altogether devoid of irritant properties. When chewed, or otherwise brought into contact with mucous or cutaneous surfaces, it causes a peculiar tingling and numbness, accompanied by no vascular excitement or visible alteration of structure. Full medicinal doses reduce the number and strength of the pulse, and lessen the number of the respirations, probably by deranging the functions of the vagus nerve; whilst they further cause profuse salivation, champing of the jaws, and attempts at swallowing, probably owing to paralysis of the muscles of the fauces. Impaired appetite, and more or less nausea, occasionally remain for one or even two days. Its poisonous action on veterinary patients is well marked. An over-dose, besides the symptoms already mentioned, causes horses to 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. Viborg mentions that a horse, after receiving eight ounces of the root and lower leaves of the 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 that 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 chesnut cab horse, 16 hands high, and useless from a bad quittor, was tied up by the head for ten minutes, to ensure perfect quietude. The pulse was then found to be 56, and the respirations 12. The animal had a good appetite, and regular evacuations. At 10 o'clock he got 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; the respiration was somewhat accelerated, probably owing to the animal's being down; the 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 has 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 quite 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 bronchii, imparting to their frothy mucus a brown colour.

Among carnivorous animals a violent and speedy effect is readily produced by aconite, as is well shown in the two following experiments made at the Veterinary College in October 1852. 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.—An ordinary-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 paralyzed 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 bronchii are full of frothy mucus, which could not be dislodged, owing to the paralysis of the expiratory muscles and glottis; the cavities of the heart are distended with blood; but nothing abnormal is noticed about the digestive organs.

Among ruminating animals the action of aconite, when introduced into the stomach, is less prompt and powerful than in horses or dogs; and Dr. Fleming found that the activity of aconite was sensibly diminished by digesting it with the gastric secretions either of rabbits or calves.[1] When, however, it is injected into the veins, or placed in the areolar tissues, it developes its poisonous effects as readily in ruminants as in other animals, and with the same marked depression of the action of the heart.

In all animals, aconite destroys life by producing paralytic syncope (Headland). But although the action of the heart is first and prominently subdued, the paralysis, which notably involves the muscles of respiration, also contributes to a fatal issue. Given in large amount, it violently deranges and depresses the functions of the vagus nerve, and kills almost instantaneously as if by a sudden shock.

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. Ammonia and other diffusible stimulants with strychnine, being opposed to aconite in their physiological effects, are successfully employed to rouse the failing action of the heart, and the slow and difficult breathing. Congestion of the lungs, which generally hastens death, may be somewhat relieved by moderate bleeding from the jugular.

For all the domestic animals, aconite is a most prompt and effectual sedative. It controls inordinate action of the heart. Ten minutes after a medicinal dose is administered, the number of the pulse-beats is often lowered by one-fourth, their force is also weakened, vascular excitement is thus abated, elevated temperature is reduced, pain is assuaged. No sedative is so

[1] See Dr. Fleming's admirable monograph on the physiological and medicinal properties of *Aconitum Napellus*.

certain and successful in the earlier stages of pneumonia, pleurisy, or bronchitis; of enteritis, peritonitis, or laminitis; of acute rheumatism, weed, or apoplexy: 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 years has advantageously used it in the treatment of contagious pleuro-pneumonia in cattle. In enteritis in horses, Mr. Hill of Wolverhampton has repeatedly found that within five minutes after tincture of aconite 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.) Combined with a purgative, it 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, and is believed to prevent the malady from extending to the heart and its membranes. 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 irregular action of diseased heart. Moiroud and others speak highly of its utility in obstinate dropsies, and Stahl of its value in the removal of worms; but its efficacy in such cases is doubtful. In the first edition of this work, published in 1853, the use of aconite was strongly recommended. It has since found growing favour with veterinarians. But it certainly deserves more extended and general employment, for it is the only prompt and reliable sedative for either horses or cattle: it proves safer, more manageable, and less wasteful of the vital fluids than blood-letting; whilst it is more certain and effectual than calomel and opium, tartar emetic, or digitalis.

From its anæsthetic action on the superficial sensory nerves, aconite is often useful as a local anodyne in neuralgic or rheumatic affections, painful wounds, or swellings of a chronic and non-inflammatory kind; and in such cases it not only allays pain, like opium or belladonna, but also sometimes removes its cause. Like other local anæsthetics, it is more effective in counteracting irritative rather than inflammatory pain. Diluted with ten or fifteen parts of water, and used cautiously, Fleming's tincture sometimes proves useful for relieving the itching and hastening the cure of grease and other eczematous eruptions either 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.

Doses, etc.—Aconite is not employed in the crude state either of root or leaves. The *extract*, unless very carefully prepared from an alcoholic solution, is apt to be of defective or irregular strength. The *tincture*, although the simplest and best preparation, is sometimes sold of uncertain and insufficient strength; and in order to prevent disappointment, should be obtained only from the most reliable sources. Professor Fleming's tincture, still much used in veterinary practice, 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. It is beautifully transparent, of the colour of sherry wine, and the taste is slightly bitter.' The dose of Fleming's tincture for horses is about ♏x.; for cattle, from ♏x. to ♏xx.; for sheep, ♏ij. or ♏iij.; and for dogs, from ♏j. to ♏ij. The Phar. tincture is made by maceration and subsequent percolation of one pint of rectified spirit with two and a half ounces of aconite root in coarse powder, and is about one-fifth of the strength of Fleming's tincture. 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 six or eight doses have been swallowed. Used hypodermically, half the above doses suffice.

Aconitine or Aconitia ($C_{30} H_{47} N O_7$) is obtained from the root of the Aconitum Napellus, and more cheaply from the *A. ferox* and probably other varieties brought 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 ($H_3 C_6 H_3 O_6$), washing and purifying. Aconitine is a transparent, colourless, or pale yellow powder; bitter and sometimes acrid in taste; crystallizable 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; by softening in boiling water; and by developing a violet colour with concentrated phosphoric acid, and a yellow colour passing into violet with sulphuric acid.

Aconitine is one of the most potent of poisons. Dr. Headland, in his valuable work on '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; $\frac{1}{2}$ of a 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; $\frac{1}{10}$th of a grain would probably be sufficient to cause the death of an adult man. 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 three distinct forms—as absolute alcohol, rectified spirit, and proof spirit; 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 these and other processes for the preparation of alcohol, 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 yeast, which breaks it up, probably by a somewhat complicated reaction, into alcohol, carbonic acid, and water, as set forth in the following formula:—

$$\begin{array}{l} \text{1 Equiv. of Grape Sugar} \\ C_6\,H_{12}\,O_6 = \end{array} \left\{ \begin{array}{l} 2\ C_2\,H_5\,HO = \text{Alcohol.} \\ 2\ CO_2 = \text{Carbonic Acid.} \end{array} \right.$$

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 ($C_2\,H_5\,O$) or common ether; ethyl nitrite, ($C_2\,H_5\,NO_2$), the etherous principle of sweet spirit of nitre; ethyl acetate ($C_2\,H_5\,A$), 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 will reach the specific gravity ·825, which, according to the British excise law, 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, has never been frozen, and has a great affinity for water, absorbing it readily from the atmosphere, and mixing with it in all proportions. When oxidized, it forms acetic acid; and when decomposed by acids, produces ethers.

Rectified Spirit (spiritus rectificatus), or spirit of wine, are the terms applied to the spirit containing 84 per cent. by weight of absolute alcohol, to which it bears general resemblance, but has less pungency and volatility, a higher boiling-point, and a specific gravity of ·838.

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 50·8 parts by weight of alcohol, and has the specific gravity ·920.

A mixture of one part of wood naphtha or methylic alcohol and nine of excise alcohol is now sold, free of duty, in quantities of ten gallons and upwards, under the name of methylated spirit. This is an immense boon to pharmaceutical chemists, and many other manufacturers; for the addition of the naphtha, although it prevents the mixture being used for drinking, does not interfere with its value in pharmacy or the arts.

The following alcoholic fluids, so much employed both dietetically and medicinally for man, are occasionally also prescribed for the lower animals:—*Wine*, the fermented juice of the grape, contains from 10 to 25 volumes in the hundred 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; whilst *Hollands*, *Geneva*, or *gin*, a little weaker than these, is 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 quantity of 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 used in its manufacture being roasted. Porter and ales contain between 4 and 7 per cent. of excise alcohol (density ·825).

Impurities.—Excess of water, the most common sophistication of alcoholic fluids, is discoverable by its increasing the specific gravity of the spirit, which may be ascertained either with a hydrometer, or with marked beads. Commercial spirits prepared from malt are apt to be contaminated by an ill-flavoured, pungent volatile oil, called fousel or grain oil, which spoils the finer tinctures and liqueurs, and is detected by the contaminated spirit being blackened by sulphuric acid, or by exposure to the action of silver nitrate and light. To remove this 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 acts locally as an irritant, astringent, sedative, and antiseptic; in poisonous doses it is a narcotic of the inebriant class; medicinally it is a general stimulant, antiseptic, diuretic, and diaphoretic; it is, besides, a readily assimilable article of food.

When a few drops of strong spirit are put into the eye, or a small quantity introduced into the stomach of a dog, or other small animal, topical irritation, with increased vascularity and redness, is first observed; but this soon gives place to diminished vascularity and sensibility, usually corresponding with the previous excitation in continuance and degree. Alcohol has thus a primary irritant, and a secondary sedative effect. Its astringent effects primarily and in part depend on its coagulating albumen, and also, in the case of strong spirit, on its affinity for water. Its antiseptic action, which it shares with most bodies of allied composition, results from its power of destroying those organized germs which excite fermentation and putrefaction. Given internally, alcohol usually produces some of the topical effects just noticed: it speedily becomes absorbed; is detectible in the blood, and most of the secretions; in moderate doses it exerts a general exhilarating and stimulant effect; is utilized in the nutrition of the body, especially of the nervous textures. A considerable proportion seems to be carried in the portal blood to the liver, where its elements are rearranged, probably into bile, sugar, and amyloid matter. In larger doses it induces greater general excitement, disorders the intellectual and volitional functions, and is mostly excreted unchanged, usually within from ten to twenty-four hours after its administration, and mainly by the lungs, skin, and kidneys. Drs. Parkes and Wollowicz' observations on alcohols indicate that in ordinary doses they do not sensibly affect animal temperature; but intoxicating doses in all animals, particularly when unused to them, reduce the temperature. In dogs, for example, two or three drachms of rectified spirit given diluted promptly lower the temperature from half a degree to one degree.

Poisonous doses unmistakeably prove the direct action of alcohol on the nerves and nervous centres, and especially on those parts which lie within the cranium. They induce, first, greatly increased action, and then, after a variable time, deranged and depressed action,—the relative amount and continuance of these two effects differing materially with the dose and concentration of the alcohol. Large quantities of strong spirit rapidly swallowed sometimes produce in dogs rapid depression, coma, and death, within a few minutes, without any appreciable excitement; and several 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 edit. 1872.) Between four and six ounces produced similar symptoms, but did not prove fatal. From one to two ounces destroyed dogs in periods varying between a quarter and half an hour, with similar symptoms, and great inclination to vomit. From one to 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 from six to ten ounces at a time, and gradually becoming less easily affected by it. Alcohol, when injected into the veins or serous cavities, causes speedy death, accompanied by the same symptoms as attend its administration by the mouth. When a large dose of alcohol speedily extinguishes life, the brain, lungs, and liver are found on *post-mortem* examination to be congested with dark grumous blood; an alcoholic odour is exhaled from the bowels and serous cavities; whilst, in less rapidly fatal cases, the stomach and alimentary canal are much reddened, and sometimes, it is said, considerably thickened.

Alcoholic fluids are advantageously employed where nervous power is defective, surface heat irregular or low, the pulse slow and soft, or quick and weak. In many cases of indigestion, in hoven, stomach staggers, and colic, alcoholic stimulants are often used empirically, and are usually convenient, safe, and effectual. They stimulate directly the nerves of the stomach, and further develope reflex effects which help to relieve morbid conditions. In simple congestion of the lungs, caused by over-exertion or exposure, alcohol, conjoined with ammonia, rouses the depressed nervous power to restore the disturbed balance of the circulation, and thus ward off inflammatory attacks. In debilitating diseases, in the second stages of inflammation, in influenza and other febrile disorders, alcohol sustains the action of the heart, counteracts capillary congestion, diminishes undue tissue waste, arresting probably as an antiseptic the downward tendency to the formation of urea and uric acid; whilst, in virtue of its diuretic and diaphoretic actions, it expedites the elimination of toxic materials. Especially when in combination with ammonia, it counteracts the sedative effects of aconite, digitalis, and tobacco. In the larger patients usually in the form of spirits or ale, and for the smaller in the shape of wine, alcohol is very useful in promoting convalescence from all reducing disorders; it improves the appetite and the digestive powers, imparts tone to the weakened heart, supplies small quantities of nutrient matters, and acting probably as an antiseptic, it controls tissue waste, as well as the dangerous degeneration of used-up or morbid materials. It is of importance in most cases to repeat the medicine frequently, in order to maintain the advantage gained by each single dose, and prevent that secondary depression which is otherwise apt to ensue. Spirituous fluids, in their removal from the body by the kidneys and skin, stimulate these secreting organs, causing diuresis, and also, though to a less extent, diaphoresis. In veterinary practice, however, they are not used expressly to induce either of these effects. Given in undue amount, whether in health or disease, alcohol increases abnormally the action of the heart, hinders aeration of blood, impedes general nutrition, retards the excretion of morbid matters, and causes dryness of the skin and mucous surfaces.

Alcohol, in a state of concentration, when applied to the more delicate parts of the skin, acts as a rubefacient, but is seldom used for that purpose among the lower animals. Coagulating albumen, and contracting the capillary vessels, it is occasionally used for arresting bleeding. As a stimulant and refrigerant, it is occasionally applied to bruises, wounds, and strains, being used throughout Scotland in the familiar form of whisky and water; whilst a lotion is also sometimes made with an ounce each of rectified spirit, vinegar, and ammonium chloride dissolved in a pint of water. Spirit beat up with albumen 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 much used in pharmacy, especially for the preparation of tinctures, extracts, and ethers.

Doses, etc.—The dose of rectified spirit for horses is from f℥i. to f℥ij.; for cattle, from f℥ij. to f℥vi.; for sheep, from f℥ss. to f℥j.; for pigs, from fʒij. to fʒvi.; and for dogs, about fʒij. The doses of whisky, brandy, ales, or wine, must be left to the judgment of the practitioner; but in exhausting disorders, spirituous fluids should be given in moderate quantity, but at frequent intervals of one or two hours.

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 rounded woody stems, strong, thick, fleshy, amplexicaul light-green leaves, with sharp serrated edges, and a stout spine projecting at the apex. The bitter purgative juice is contained in cells lying immediately underneath the surface of the epidermis of the leaf, the rest of which is filled with a bland colourless sap. The manner of obtaining the juice differs somewhat in the different countries whence aloes is procured. Sometimes it is allowed to exude spontaneously from incisions made in the leaf, or its flow is hastened by the application of a moderate heat. The aloes thus got is of the finest quality. A somewhat inferior sort is procured by exposing the leaves to pressure, which causes a mixture of the cathartic juice with the mucilaginous sap of the mass of the leaf; while a still lower quality is prepared from leaves that have already yielded most of their purgative juice, by cutting them into small pieces, boiling them with water, and evaporating the decoction.

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

Barbadoes Aloes (*Aloë Barbadensis*) is the variety of aloes most extensively used in veterinary practice. It 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. The preparation of Barbadoes aloes is not confined, as the name might indicate, to the Island of Barbadoes, but is also carried on in Jamaica and most of the West Indian Islands. It is obtained from the leaves by chopping them off near the stem, and placing them in tubs with their cut ends down, when from their longitudinal vessels the juice trickles out, and is concentrated by boiling for four or five hours. By another process, the leaves, in some localities whole, in others chopped in pieces, are placed in bags or baskets, and immersed for about ten minutes in boiling water, which, when fully charged by the repeated immersions of fresh portions of the leaves, is set aside to cool. Whichever process is pursued, the sediment is carefully kept back, the clear fluid poured off, and cautiously evaporated to the required consistence, which is ascertained by taking out a few drops, and observing if they become brittle and concrete on cooling. When sufficiently concentrated, the juice is poured into gourd shells, and the opening closed by a bit of shell let in, and secured in its place by a piece of coarse cloth nailed over it. The gourds, when filled, usually weigh from 60 to 70 lbs.; and fully 2000 of these are annually exported from Barbadoes alone. But aloes is also largely exported from that island in boxes and packages, holding generally about 56 lbs. each; and of these the annual exportation has sometimes been above 2000. 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, gummy, and difficult to pulverize; 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 presence and condition of the aloin. When dissolved in weak spirits, it leaves an abundant flocculent residue.

Hepatic, East Indian, or Bombay 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 not well known. It comes to the London market in tinned 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. It is usually of a brown-red colour, dull, and rather opaque; but in small fragments it is red, sparkling, and tolerably transparent. Its powder is brownish-yellow; its odour less disagreeable than that of either Barbadoes or Cape aloes; its taste, like that of all the varieties, bitter and nauseous. Spirit of the strength of sherry does not fully dissolve in it, but leaves a fleecy residue. Aloes native to India are considered mostly of inferior quality, and are rarely exported. A variety termed *Mocha aloes* is occasionally met with in drug warehouses, is variable and irregular in appearance and quality, and is considered an inferior sort of East Indian aloes.

Socotrine Aloes (*Aloë Socotrina*) is of very fine quality, comes n 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 leaves freshly pulled from the roots, 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 Socotrina 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). From East Indian aloes 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 is of the consistence of thin honey, of a deep orange colour, has 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 spicata*, which has a stem three or four feet high ; long leaves, broad at the base, and gradually narrowing towards the point, marked with white spots, and containing a colourless sap; and campanulate white flowers arranged on a tall spike. 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 $2\frac{1}{4}$d. to $3\frac{1}{2}$d. 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. The better qualities are little inferior either to East Indian or Barbadoes aloes. They have a dark-brown or olive-green resinous appearance, a compact structure, a vitreous dark-green fracture, and a strong and rather disagreeable 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 the 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 sorts; 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.

A knowledge of the more important distinctive characters of the chief varieties of aloes is best obtained by examination of actual specimens, but reference to the following tabular arrangement may occasionally assist the memory :—

	Barbadoes.	Hepatic or East Indian.	Socotrine.	Cape.
Colour,	Liver-brown.	Dark liver-brown.	Garnet-red.	Dark-brown, approaching to black.
Recent Fracture,	Granular, light liver-brown.	Smooth, dark-red.	Smooth and conchoidal, occasionally rough.	Shining olive-green.
Lustre,	Dull earthy, quite lustreless and opaque, even in small fragments.	Waxy. In small fragments slightly translucent.	Full resinous. In small fragments ruby-coloured, and translucent.	Vitreous. In small fragments yellowish-brown, and translucent.
Odour,	Strong, and rather disagreeable.	Agreeable.	Fragrant.	Strong, and disagreeable.
Solubility in alcohol of the strength of sherry,	Leaves a very copious residue.	Leaves a considerable residue.	Almost entirely soluble.	Leaves a very copious residue.
Powder,	Dull olive-yellow.	Yellow, with a red tint.	Golden yellow.	Bright yellow, like gamboge.
Produced by	Aloë vulgaris.	Aloë Socotrina, and probably other species.	Aloë Socotrina.	Aloë spicata, and probably also other species.

Properties.—Aloes is the inspissated concrete juice of the leaves of certain species of *aloë.* In mass it is a solid resinous-looking substance, and is generally rather brittle. Its external surface is duller and darker than a freshly-made fracture. It has an intensely bitter and persistent taste, and a strong and more or less disagreeable odour, which is always much increased when the specimen is breathed on or heated. When held in the hand for some minutes, it softens and becomes adhesive. At a low red heat it becomes partially fused, froths up, chars, and burns. Exposure to temperatures exceeding 150° alter its composition and impair its purgative property. It is almost entirely soluble in boiling water, which, however, deposits, as it cools, a brown substance varying in quantity with the variety of the aloes. Most specimens are entirely soluble in proof spirit, but in weaker solutions of spirit the degree of solubility varies much with the kind and quality of the specimen. The colour of both the watery and alcoholic solutions also varies somewhat in the several commercial varieties ; in general, the solution of Cape aloes has the lightest colour, and that of Barbadoes the darkest. The watery solution, when cold, reddens litmus, is deepened in colour by alkalies, yields an olive-brown coloration with sesquichloride of iron, and a yellow precipitate with acetate of lead.

Composition.—Watery decoctions or infusions, when evaporated, leave about 10 per cent. of aloetin, aloesin, or amorphous aloin, in the form of a brown bitter mass, more soluble in water than spirit. Hot aqueous acidulated solutions yield, as they slowly cool, tufts of yellow prisms of aloin, which constitutes about 30 per cent. of aloes, varies somewhat with the description of aloes from which it is obtained, is the only active principle which has been isolated, and is noticed in more detail at the end of this article. Besides these special constituents, aloes contains resinous matters, a small quantity of albumen, and earthy salts. Recent investigations fail to discover the aloesic and gallic acids which figured in older analyses. (Tilden, in the *Year-Book of Pharmacy for* 1870.)

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 as above given, 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.—Aloes is purgative and tonic: the former action occurs when it is used in considerable doses; the latter when it is given in repeated small doses, insufficient sensibly to increase the action of the bowels.

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 were made into a ball with sixty minims of glycerine, rolled in white tissue paper, and given to a horse, which, in thirty-three minutes after, was killed by dividing the carotid artery. When examination was made an hour later, 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 must, however, be speedily excreted. Insoluble in air, it is not removeable 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 feces fluid, whilst the increased peristaltic motion accelerates their discharge.

As 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. In ordinary circumstances it is, however, a safe and sure purgative for horses. Its effects, except within comparatively small limits, do not increase in proportion to the dose; and, unlike most other cathartics, it is not in large amount an irritant poison. Except in very considerable doses, it does not render the dejections so fluid as saline purgatives, but appears to accelerate in a greater degree the peristaltic motion. Aloes is generally thought specially to increase the secretion of bile, but this has never been very satisfactorily established; indeed, though it usually relieves those symptoms which depend on defective action of the liver, an extra amount of bile has not been found in the feces of animals purged by aloes. 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. It may be produced 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. Thus 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, he observed only diuresis.

The several varieties of aloes differ somewhat in the degree of their action, Barbadoes being the most energetic, Hepatic or East Indian less so, and Cape the weakest. Cape aloes is considered less active than Barbadoes by nearly one-fourth, and is, besides, rather more apt to cause diuresis. Socotrine is regarded by Pereira as having 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 Hepatic 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 effects, 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. 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, or vegetable tonics, and bitters. The irritant effect on the rectum, which is 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 from one to 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 been previously 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, by exposure to a high temperature, 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, probably mainly depend on its vegetable nature, and its consequent resemblance to the ordinary food of the animals; 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.

Aloes is frequently used as a purgative for the dog; but when given alone, 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.

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 ten or twelve drops of Fleming's tincture of aconite. When accompanied with abundant evolution of gas, colic is often successfully overcome by giving with the aloes two ounces of spirit of ammonia, 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 diminish 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 saline cathartics, gamboge, or croton, and given in the fluid form. For dogs, it may be used in the same sort 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 cases of irritation or inflammation of any part of the alimentary canal, and in piles or hemorrhage from the rectum. In bronchitis and other inflammatory affections of the mucous membranes or skin, in inflammation of the kidneys, and in influenza and other typhoid complaints, 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 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 cases of 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 unhealthy granulations, and is an ingredient of the once famous Friars' balsam. (See Benzoin.)

Doses, etc.—The dose of aloes for the adult horse varies from ʒij. to ʒx., according as it is given for a mild laxative or an active cathartic. If used for the foal, the dose, until the animal is several months old, may always be readily ascertained by allowing grs. v. for every week of its age. For cattle, the dose is from ℥i. to ℥ij. ; for sheep, ʒss. to ℥i. ; for dogs, grains xx. to ʒi. ; and for 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 may be 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 glycerine. 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 a fourth of its weight of rectified spirit or oil of turpentine, which is retained by the resinous matter of the aloes, and keeps the mass long soft and moist. Rubbed up with strong sulphuric acid, aloes is oxydized, may be made into balls, and is understood to have somewhat increased activity. Aloetic balls made with lard, oils, or soap, are only suitable for immediate use, and, if kept for any considerable time, become dry and hard. This may, however, be temporarily prevented by adding a little glycerine and a few ounces of potassium carbonate or acetate to every pound of the combination. Fifteen grains each of powdered aloes, jalap, ginger, and soap, made into a pill with a little glycerine, is a good purge for a large dog, and will make two or three doses for smaller animals. 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 of aloes, made with the view of removing a portion of the resin, have nothing to recommend them in preference to the crude drug.

ALOIN.—During the summer of 1850, Messrs. T. & H. Smith, the well-known manufacturing chemists, Duke Street, Edinburgh, discovered, first in Barbadoes aloes, and subsequently in the other varieties, this peculiar crystalline principle (C_{34} H_{36} O_{14} H_2 O). Very recently, Dr. Flückiger obtained from Natal aloes a crystalline substance (C_{25} H_{28} O_{11}) closely allied to aloin, and to which he gives the name Nataloin, to distinguish it from aloin got from Barbadoes and other aloes. Messrs. Smith prepare aloin in the following manner:[1]—Bar-

[1] See Paper on Aloin, by Messrs. T. & H. Smith, in *Monthly Journal of Medical Science*, Feb. 1851.

badoes 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 crystallization. Ultimately it is dissolved in hot rectified spirit, from which the pure aloin crystallizes 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 aloin is odourless ; but 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. Aloin is also dissolved by acetic acid and alkalies, forming with the latter orange-yellow solutions, which deepen in colour by oxidation. Sulphuric ether dissolves it sparingly, and oil of turpentine and chloroform have little effect upon it. Watery solutions rapidly darken in colour by exposure to air and light ; and when heated above 150° Fahr., the aloin is oxidized, 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.

For 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. & H. Smith having liberally supplied me with aloin, I administered drachm doses made up with flour and glycerine to six three-parts-bred carriage horses, four and five years old, 15 to 16 hands high, in good health and condition, and prepared with 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 accompanies 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, 15½ 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 evacuation 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, 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 $1\frac{1}{4}$ lbs. 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 drachm of jalap are added to determine the action on the bowels, 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. & 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.

ALUM. POTASH ALUM. ALUMEN. Aluminium and Potassium Sulphate. $Al_2 K_2 4 SO_4 + 24 H_2 O$.

Alum is found in limited quantity as an efflorescence on the surface of soils and rocks, especially in volcanic districts; and is prepared in large amount from aluminous clay, shale, or schist, which consists of alumina, iron, and sulphur. Near Paisley, where alum is extensively manufactured, the schist lies between the coal and limestone strata. When freely exposed to the action of the air it absorbs oxygen, by which its metallic iron is converted into iron oxide, and its sulphur into sulphuric acid. After the addition of water to dissolve out the iron and aluminium sulphates, the solution is slightly concentrated, and, treated with potassium chloride, double decomposition results; the iron chloride remaining in solution, and the potassium sulphate uniting with the aluminium sulphate. The alum thus formed crystallizes out, and is further purified by repeated solutions and crystallizations. 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.

Properties.—Alum occurs in transparent, colourless, octahedral crystals, or in crystalline masses. It has a sweet, acidulous, astringent taste, acts like an acid on colouring matter, effloresces when exposed to the air, and when heated, fuses, and parts with its water of crystallization. It is soluble in its own weight of water at 212°, and in eighteen times its own weight at 60°. Like other aluminium salts, it is distinguished by its negative action with sulphurreted hydrogen; and its white precipitates of aluminium hydrate with ammonium hydro-sulphide, and with caustic ammonia, insoluble in excess, but soluble in caustic soda. Moistened with cobalt solution, and heated in the blowpipe, alum salts develope a blue colour.

Impurities.—Alum is apt to be contaminated by iron, which is discoverable by the yellow colour which it imparts to the salt, and by the blue precipitate it gives with solution of yellow prussiate of potash. But the presence of iron, though rendering alum unfit for the purposes of the dyer, does not interfere with its medicinal properties.

Actions and Uses.—Alum is irritant, astringent, and sedative. Doses of one or two ounces given to dogs cause vomiting, unaccompanied, however, by any other symptoms. Orfila found that when the œsophagus was tied, so as to prevent vomiting, two ounces occasioned death in five hours, with symptoms of great exhaustion and diminished sensibility. On *post-mortem* examination, inflammation was observed 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 cellular 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. Doses of 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. An overdose of alum may be decomposed and rendered inert by small and repeated doses of sodium carbonate.

In its medicinal actions and uses, alum closely resembles zinc oxide and acetate, but is scarcely so active. Coagulating albumenoids, and acting especially on mucous and abraded skin surfaces, alum exerts a chemical astringent effect, and in powder or strong solution has also 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, vascularity diminished, secretion arrested, and a sedative action established. 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. At one time it was used in diabetes, and is still occasionally prescribed in passive hæmorrhages, in aneurisms and dilatation of the heart, and in slow poisoning by lead. It is much employed externally, as a mild stimulant and astringent, in chronic conjunctivitis, and in many simple injuries of the skin and mucous membranes. On account of its coagulating albumen, it is occasionally used in the treatment of open joints; being mixed with two or three parts of wheat flour, and the mixture dusted over the opening until synovia ceases to flow. It should not be used too freely, either for internal or external purposes; for although it coagulates albumen, the coagulum is re-dissolved by excess of the alum.

Doses, etc.—The dose for horses and cattle is from ʒij. to ʒiv.; for sheep and pigs, from grs. xx. to ʒij.; and for dogs, from grs. x. and grs. xx. It may be given either as a bolus or in solution. The most convenient preparations for external use are the powdered alum or alum flour, a simple watery solution, or an ointment made with one part of alum to three or four of lard. The burnt alum of the Pharmacopœia is little used.

ALUMINIUM CHLORIDE, CHLORIDE OF ALUMINIUM, CHLORALUM ($Al_2 Cl_6$).

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.

Like other metallic chlorides, chloralum is astringent, tonic, and antiseptic. Less irritant and corrosive than the chlorides of the heavier metals, it is convenient for internal use, has been recommended in influenza, typhoid conditions, 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, grs. v. to grs. x. for dogs. It may be used either made into 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, and was one of the substances tested by Dr. Angus Smith in his experiments undertaken for the Cattle Plague Commissioners. For the preservation of night-soil chloralum proved inferior to common salt, carbolic and cresylic acids, and zinc and iron chlorides. As a deodorizer 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 contagion. 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. (NH_4 HO.)

Ammonia is evolved during the putrefaction and destructive distillation of organic matters, and by passing electric sparks through a mixture of hydrogen and nitrogen; but the coal beds are the great source of the commercial article. The ammonium chloride or sal-ammoniac got from gas liquor yields most ammoniacal compounds. To obtain liquid ammonia, one part of sal-ammoniac is triturated with two of dry slaked lime, the mixture transferred to large retorts, gradually increasing heat applied, and the gas evolved conducted into receivers containing water, in which it is freely dissolved.

Properties.—The strong solution of ammonia (liquor ammoniæ fortior) is a colourless, pungent, caustic fluid, consisting of 32·5 per cent. of gaseous ammonia dissolved in water. 'Its specific gravity is 0·891; 52·3 grains by weight require for neutralization 1000 grain measures of the volumetric solution of oxalic acid. One fluid drachm contains 15·83 grains of gaseous ammonia.'—(*Brit. Phar.*) The absence of impurities and adulterations is ensured when the sample, 'diluted with four times its volume of distilled water, does not give precipitates with solution of lime, oxalate of ammonia, hydro-sulphide of ammonium or ammonio-sulphate of copper; and when treated with an excess of nitric acid, is not rendered turbid by nitrate of silver or by chloride of barium.'—(*Brit. Phar.*) Unless kept in closely stoppered bottles, it very soon increases in density from the escape of ammoniacal gas and the absorption of carbonic acid. By a sort of catalytic action it prevents and arrests oxydation, and destroys the lower forms of organized life, thus acting as an antiseptic. It boils at about 100°. It unites with fats and oils, forming soaps and liniments. When heated in a small plain retort, it evolves ammonia (NH_3), a colourless, irritant, irrespirable gas, with the same pungent odour and taste as the solution. 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. of gaseous ammonia.

Actions and Uses.—Ammonia, in a state of concentration, and in considerable doses, is an irritant poison; in medicinal doses it is a general stimulant, antispasmodic, antacid, alterative, antiseptic, diaphoretic, and diuretic; externally it acts as an 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 arrestment 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 rapid reflex action through the sympathetic ganglia, stimulating especially the heart, and the general capillary circulation. As a stomach and general antacid, it is scarcely 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 neutralized by the acid gastric juice. They especially 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 oxydation, 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, and are chiefly exerted on the ganglionic system and the spinal chord. They differ from those of alcohol and ether in not acting so directly on the brain proper, and not producing a primary inebriant and secondary narcotic effect. Dr. B. W. Richardson believed ammonia to be a normal constituent of the blood, and endeavoured to show that its escape causes the coagulation of blood when withdrawn from the body. But the presence of free ammonia in the blood has been disproved by Kühn and Dr. Arthur Gamgee; whilst Professor Lister, in his masterly Croonian Lecture for 1863, demonstrates that 'the coagulation of the blood is in no degree connected with the evolution of ammonia, any more than with the influence of oxygen or of rest.' Applied externally, especially with brisk infriction, it promptly produces redness, vesication, and even sloughing.

Ammonia is of signal benefit in typhoid and debilitating diseases, as in influenza, scarlatina, purpura, chronic bronchitis, and pneumonia; wherever, indeed, the pulse is soft and weak, the extremities cold, the vital powers depressed. It is useful whether when inhaled or when swallowed. It sustains the action of the heart, counteracts congestion, probably neutralizes morbid materials, prevents exudation, sometimes helps to liquefy exudate already poured out, retards oxydation, arrests undue disintegration and waste, and in typhoid fevers may replace the excessive waste of ammonia for which such cases are so notable. It relieves congestion of the lungs brought on by over-exertion or exposure. 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. Dr. Richardson has recently advised its inhalation mixed with the volatile amyl hydride. It is a valuable antidote in poisoning by prussic acid, tobacco, digitalis, and other sedatives. It is successfully used, both internally and externally, in the treatment of snake bites. Diluted solutions, by neutralizing the formic acid, are applied to abate the irritation induced by stings of wasps, and bites of gnats, spiders, and other insects. It is applied externally as a counter-irritant in sore throat and bronchitis, rheumatism, and other chronic affections occurring in the neighbourhood of joints, and for such purposes is especially valuable in cattle practice. 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.—The dose of the strong ammonia, as a diffusible stimulant and antispasmodic, is from f℥ij. to f℥vi. for horses; from f℥ij. to f℥x. for cattle; f℥j. for sheep and pigs; and from ♏v. to ♏xii. for dogs.

The ordinary medicinal solution contains one part of strong ammonia to two of water. Prompt but transient in their action, ammoniacal 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 good stimulant draught, either for horses or cattle, may be made with an ounce each of medi einal ammonia, sweet spirit of nitre, and tincture of gentian. For colic and indigestion in horses, a convenient draught is composed of an ounce of the medicinal ammonia, with four or five drachms of aloes rubbed down in water. Gaseous ammonia, or the strong solution, is sometimes dissolved in rectified spirit, is recognised as spirit of ammonia, and proves a prompt and powerful stimulant and antispasmodic. For external application, ammonia is sometimes used alone, but more frequently along with turpentine or oils. A convenient liniment is made with equal parts of ammonia, oil of turpentine, and linseed oil.

AMMONIUM CARBONATE. Carbonate of Ammonia. Ammoniæ Sesqui-carbonas. Hartshorn Salt. Sal Volatile.

Professor Rose of Berlin has described twelve different ammonium carbonates. The commercial and Phar. carbonate is best prepared by heating together about two parts of finely powdered sal-ammoniac and three parts of chalk. Mutual decomposition occurs, free ammonia and water escape, and the resultant salt is believed generally to consist of two atoms of acid ammonium carbonate ($NH_4\ H\ CO_3$), and one of ammonium carbamate ($NH_4\ NH\ CO_2$) (Dr. Divers and Professor Attfield). It occurs in white, fibrous, translucent cakes, which have a pungent alkaline taste, and a strong ammoniacal odour. It is soluble in four parts of cold water and rather less of tepid water; dissolves sparingly in alcohol; decomposes in boiling water with evolution of ammonia and carbonic acid; sublimes when heated; and when exposed to the air becomes opaque and friable, and covered with a white powder of bicarbonate. It is little liable to adulteration.

Actions and Uses.—The carbonate closely resembles ammonia itself, but is less irritant. It is sufficiently active, however, to produce in small animals the same sort of peculiar irritant poisoning. Thus 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 in the same cases as those in which ammonia itself is serviceable. In influenza, scarlatina, erysipelas, and other typhoid affections, in the second stages of inflammatory complaints, and in convalescence from debilitating diseases, no remedy is of greater value as a general stimulant. For these purposes it is in every-day use for cattle; and in inflammatory attacks in these animals, it may be advantageously given earlier than it generally is, and earlier than is usually advisable in similar cases amongst horses. When mixed with some aromatic oil, as that of bergamot or lavender, and a little aqua ammoniæ, it constitutes the familiar smelling salts.

The dose of the carbonate for horses is from ʒij. to ʒiv.; for cattle, from ʒiij. to ʒvj.; for sheep and pigs, from grs. xv. to grs. lx.; and for dogs, from grs. iij. to grs. viij. It is given either in a bolus with linseed meal, or, better still, dissolved in gruel, which, to prevent driving off the ammonia, must not be used hot. Where a prompt stimulant effect is required, ammonium carbonate is frequently conjoined with some variety of alcohol, with ether, or sweet spirit of nitre; whilst in chronic ailments it is advantageously united with gentian, ginger, oak-bark, or other tonics. The aromatic and fœtid spirits of ammonia of the Phar. are not needed in veterinary practice.

AMMONIUM CHLORIDE. Sal-ammoniac. Chloride of ammonium. Muriate or Hydrochlorate of Ammonia. (NH_4 Cl.)

This salt, from which most of the other ammonium compounds are procured, is chiefly prepared from the ammoniacal liquor of the gasworks, by treating it with diluted hydrochloric acid, or in some manufactories with common salt or impure calcium chloride. The solution, when slowly evaporated, yields brown crystals of chloride, which are 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 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.—In large doses it is an irritant poison, and, like other ammoniacal salts, produces peculiar remote symptoms, which are thought to depend on some special action on the spinal chord. Two ounces given to a horse caused muco-enteritis (Moiroud); two drachms destroyed a little 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). In medicinal doses, like other ammoniacal compounds, it is stimulant, alterative, and diuretic. On account of its stimulating the action of the heart and the secreting organs, and exerting probably some solvent effect on albuminous matters, it proves of service in the second stages of inflammation; and 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; and a good cooling lotion may be made with equal parts of sal-ammoniac and nitre, dissolving the mixture when required for use in sixteen or twenty parts of water. Such a mixture will lower the thermometer from 50° to 10° Fahr. (Pereira).

LIQUOR AMMONIÆ ACETATIS. An aqueous solution of ammonium acetate ($NH_4\ C_2\ H_3\ O_2$). Solution of acetate of ammonia. Mindererus Spirit.

A concentrated solution of the deliquescent 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 thus be made directly by the formula of the Brit. Phar.:—To acetic acid ten fluid ounces gradually add powdered carbonate of ammonia three and a quarter ounces, or a sufficiency until a neutral solution is formed, which is diluted with distilled water two and a half pints. The solution is clear and colourless, 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.

Mindererus spirit resembles the other ammonia salts in its actions and uses; but it is not so active a stimulant as the medicinal solution of ammonia or the carbonate. It is, however, more certain as a diaphoretic and diuretic, and proves a valuable febrifuge. The dose for horses or cattle is from f℥ij. to f℥iv.; and for dogs, from fʒij. to fʒiv. It is usually prescribed in water, spirits, ale, or cold gruel. In febrile or inflammatory attacks, a couple of ounces is often given to horses, in combination with 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 typhoid equine cases. The addition to this febrifuge mixture of half a drachm of extract of belladonna renders it more soothing for coughs 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.

ANISE.

ANISUM. The dried fruit of the Pimpinella Anisum.

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 and Germany. The Spanish seeds are smaller, lighter-coloured, and more esteemed than the German. The anise is a little yellow-brown fruit, about the size of a small oat seed, is covered by minute hairs, encircled with numerous little ridges, 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 a considerable quantity of gummy matter, a little sugar and resin, with various salts, a fixed oil, and also a transparent, nearly colourless, volatile oil, which is the active ingredient of the seed, has a strong anise flavour, and is a mixture of a hydrocarbon isomeric with oil of turpentine, and a stearopten ($C_{10} H_{12} O$), which solidifies about 50°.

Actions and Uses.—Anise is a 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 frequently 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.—The dose of powdered anise for the horse is about ℥i.; for cattle, from ℥i. to ℥ij.; for sheep and swine, from ʒij. to ʒiij.; and for dogs, from grains xx. to grains lv. These doses may be repeated several times a day, are often conjoined with ginger or aromatics, and are conveniently administered in ale or in spirit and water. The oil of anise is too expensive for ordinary use 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.

Caraway, cardamoms, coriander, fennel, and fenugreek, 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 pease, 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 oxide or trioxide (Sb_2O_3) is got 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 greyish white, tasteless, heavy powder, insoluble in water, but soluble in muriatic, 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 (Sb_2O_5) is, however, more conveniently obtained by dissolving the metal in strong nitric acid. The Phar. imitation of the patent James Powder is made by mixing thoroughly one ounce of antimony oxide and two ounces of calcium phosphate.

Actions and Uses.—Antimony oxide is chiefly important on account of its employment in the preparation of tartar emetic, which it closely resembles in its actions and uses.

ANTIMONY SULPHIDES. Sulphurets of Antimony. Antimonii Sulphuretum.

The sulphide, the most valuable and abundant ore of antimony, is popularly known as grey or black antimony. When purified by fusion, it occurs in grey-coloured, metallic, heavy, brittle cakes, devoid of odour and taste, and known as crude antimony. The orange-red sulphurated antimony of the Phar. is got by boiling black antimony with caustic soda, neutralizing the solution with sulphuric acid, and washing the precipitated sulphide (Sb_2S_3), which is mixed with a small but variable amount of oxide (Sb_2O_3). Of the many sulphides at various times used in medicine, the most important are—*Glass of Antimony*, 'an irregular mixture of oxide, with a definite compound of the oxide and sulphuret;' *liver of antimony*, 'a double sulphuret of antimony and potassium;' *Kermes mineral*, a hydrated sulphuret, or, according to Rose, an amorphous sulphuret with sulphantimoniate of soda or potash; *golden sulphuret*, a 'hydrated sulphuret with an admixture of oxide;' *crocus of antimony*, 'a definite compound of one equivalent of oxide and two of sulphuret.' (Christison's Dispensatory.)

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 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 act as emetics for dogs, but are not now used as such.

Antimony Trichloride. Chloride, Terchloride, or Muriate of Antimony. Antimonii Chloridum. Oil or Butter of Antimony. ($SbCl_3$.)

The native sulphide is boiled with four or five times its weight of hydrochloric acid, hydrogen sulphide is evolved, and the chloride remains in solution—a transparent red-brown liquid, with a specific gravity of 1·47. The colour darkens by exposure to the air, and depends upon the iron perchloride derived from the crude antimony salt from which it is generally made. Containing excess of hydrochloric acid, it has an acid reaction, and fumes on exposure to air. Addition of water causes the separation of a white precipitate of oxychloride ($2\ SbCl_3\ 5\ Sb_2O_3$), which if washed yields the oxide. The white crystalline true butter of antimony is got by evaporating and then distilling the commercial solution.

Actions and Uses.—Although less used than formerly, it 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. In these cases many prefer it to other caustics, as more effectual, and at the same time less apt to produce excessive pain and corrosion of neighbouring parts. 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. Tartarized Antimony. Tartar Emetic.

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 ensure 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 :—

$$2\left(\left.\begin{matrix} K \\ SbO \end{matrix}\right\} C_4H_4O_6\right) + H_2O.$$

Properties.—Tartar emetic is sold as a white powder, and in colourless transparent crystals with triangular facets. Slowly evaporated, rhombic octahedrons 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; soluble in weak spirituous fluids, as 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 and 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 volatilizes, 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 deep 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, an emetic, nerve sedative, antiphlogistic expectorant and diaphoretic. It acts very differently on the different domesticated animals. Dogs, pigs, and men are greatly more susceptible of its several effects than horses or cattle, which resist entirely its emetic action, and are brought under its irritant and cathartic effects only by the administration of doses of three or four ounces given in solution. Quantities of from one to eight drachms seldom have much effect on horses, even when given repeatedly. They do not, at least for a considerable time, induce nausea; they improve rather than injure the appetite; they neither augment nor diminish the evacuations, and disturb neither the circulation nor the 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 seven 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.

15th.—10 A.M. Found dead, having taken ten ounces and six drachms of tartar emetic in six days. Mr. Barlow made the following notes of the *post-mortem* examination :—The muscular tissue in every part of the body was unusually flaccid, although the rigor mortis was well established. The right lung, which was the 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 bronchii 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 the ten days from the 16th to the 24th of September 1852; yet she was in no way affected by it: her pulse and respiration were scarcely at all altered; her appetite throughout was voracious; her evacuations natural in appearance and quantity; and her condition considerably improved. She was poisoned by a fluid drachm of Fleming's tincture of aconite. On dissection, not a single morbid appearance 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 Magendie'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 from one to eight drachms may be administered to them in the solid form for days, or even weeks, without producing any very obvious physiological effects; and that doses of several drachms, even when given in the form of solution, in which the medicine is certainly more active, fail to produce any marked depression of the action of the heart, or any diminution in the force and frequency of the respirations.

Cattle, like horses, can take very large doses of tartar emetic without suffering from any of the physiological actions of the drug. 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. By doses proportionate to their size, sheep are acted on much in the same way as cattle. 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.

On dogs the effects of tartar emetic are much the same as on man. Doses varying from six grains to half an ounce are speedily expelled by vomiting, if the animals be left to themselves ; 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 causes 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 from ten to twenty grains cause nausea and vomiting, but act neither very rapidly nor very certainly ; that one drachm in solution, given to a boar nine months old, caused vomiting, dulness, and uneasiness, which continued for three days ; but that two drachms given to a similar animal killed it within twenty-four hours.

Tartar emetic has much the same effect when placed in the cellular tissue, or injected into the veins, as when given by the mouth. It becomes speedily absorbed, is probably converted into an albuminate, and is believed to diminish the plastic elements of the blood (Richardson) ; to exercise a deranging and depressing influence on the vagus nerve, thus inducing vomiting in man and carnivora ; to produce a like sedative effect on the nerves of the heart and lungs, thus explaining the nausea, slower breathing, and increased bronchial secretion which follow its use in these animals (Headland) ; and to develope a pustular eruption of the skin, which, although observed by Lepelletier in man, has not, I think, been noticed in the lower animals. Under its influence carbonic acid and urea in increased amount are eliminated, but whether from increased production or merely from increased excretion has not been determined (Ringer). Tartar emetic has been detected in the blood and in most of the soft tissues, especially in the liver and kidneys, from the latter of which it is chiefly excreted. (Orfila.)

Tartar emetic is still used in veterinary practice, as a sedative and antiphlogistic for horses and cattle. It is prescribed in febrile complaints, pneumonia, pleurisy, bronchitis, and most local inflammations, except those of the alimentary canal. In such cases it is said to be very effectual, especially when the more acute symptoms are partially subdued by bleeding. But many of the more rational and observant veterinary practitioners, both in England and Scotland, have now entirely abandoned the use of tartar emetic for such cases amongst horses and cattle, and rightly consider it perfectly useless. It appears highly improbable that tartar emetic should exert any very active therapeutic effect either in horses or cattle, since in these animals, as already mentioned, it is devoid of marked physiological action. Indeed, the good effects with which it is credited are probably mainly derivable 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 frequently expedites their effects; for it causes vascular relaxation, and thus facilitates their absorption.

Among dogs, cats, and pigs, tartarized antimony is very useful as a nauseating emetic; and is advantageously used in most febrile and inflammatory complaints, relieving engorgement of the stomach and intestines, depressing the action of the heart, and causing copious secretion from most of the mucous surfaces. It does not operate so speedily as mustard or zinc sulphate, but is preferable to these in some febrile cases, since its emetic action is accompanied by greater amount of nausea, and more abundant lung and skin secretions. On account, however, of this tardier action and greater nausea, it is unsuitable for simply emptying the stomach of food or poisons.

Rubbed into the skin, tartar emetic causes much irritation, inflammation, and swelling, with an eruption at first papular, shortly becoming vesicular, and eventually pustular. 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. Unless used with considerable caution, it is apt to induce painful, deep-seated inflammation, sloughing, and blemishing; and is consequently little employed as an external irritant either for horses or dogs. For cattle, however, it is sometimes applied in chest diseases and chronic rheumatism.

Doses, etc.—The usual alterative or sedative dose for horses or cattle is from ʒi. to ʒiv., administered three or four times a day either in bolus or solution. As an emetic for dogs or cats, the dose varies from gr. i. to grs. iv. These doses, if trebled, suffice for the pig. They may be given in a bolus or rolled up in a bit of meat, but are most effectual in solution. The familiar antimonial wine is made by dissolving forty grains tartar emetic in a pint of sherry. In quantities insufficient to produce vomiting, as in doses of one grain or less, it is used in these carnivora as an alterative and antiphlogistic in inflammatory and febrile complaints. For similar purposes in horses and cattle the dose is generally united with several drachms of nitre, two or three scruples of calomel, a few ounces of Epsom salt, or several drachms of aloes,—the last mixture being with some practitioners a favourite purgative in cases of acute febrile complaints. One to two grains, with about the same quantity of calomel or twenty grains of jalap, is often given to dogs to arrest inflammatory complaints. Such a mixture causes vomiting, and subsequently purgation, accompanied by much depression. Tartar emetic is used as an external irritant in the form either of saturated watery solution or ointment. The latter, usually made with one part of tartar emetic and four of lard, is sometimes added to ordinary blistering ointments to increase their activity. A few grains of tartar emetic are also occasionally scattered over Burgundy pitch and other warming plasters.

ARECA-NUT.

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

Nat. Ord.—Palmæ. *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 fatty, fibrous fruit lies the hard, round, red-brown seed, measuring about three-fourths of an inch in diameter. 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 pan so extensively chewed in Eastern countries.

Actions and Uses.—Areca-nut is an effective vermifuge, especially for dogs, and proves destructive alike for 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, suffice for a dog of the size of 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 an 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 even 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 immoveable, will sometimes be speedily and entirely evacuated.

Doses, etc.—For dogs the dose varies from grs. xv. to ʒij.; for horses, from ℥iv. to ℥vi. It is best 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 resin called *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 six drachms of the infusion of the flowers, and noticed quickening of the pulse and diuresis. In the human subject it is stated by Pereira 'to exert a specific influence over the nervous system, causing headache, giddiness, and disturbed sleep.' In infinitesimal doses it was a favourite homœopathic remedy before it was much used in ordinary veterinary practice. It appears to act as an alterative and stimulant, and amongst the lower animals has proved serviceable in rheumatism, the secondary stages of pleurisy, weakness of the loins, and muscular strains. Mr. Dollar, of New Bond Street, London, has found it successful in horses in rheumatism cases which have resisted various other remedies. Drachm doses, repeated twice or thrice daily, afford considerable relief in cases of rheumatic fever in cattle. In the various forms of rheumatic kennel lameness in dogs, and in stiffness produced from over-exertion, it is also usefully employed both externally and internally. Twenty minims of arnica tincture with two drops of Fleming's aconite tincture, given in a few ounces of water, and repeated night and morning, I find effectual in checking obstinate diarrhœa, and straining in lambs. These proportions are suitable for sheep six or eight months old. With sulphuric acid, it is given occasionally in purpura and bleedings from the stomach and lungs.

Externally, arnica is used to allay local irritability, and constitutes one of the most popular of healing and soothing remedies. It is used in strains, bruises, and wounds, and especially in broken knees and sore shoulders. For such purposes an ounce of the tincture may be dissolved in from twelve to twenty ounces of cold water. A still better 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.

Arnica has possibly been overestimated, and the healing properties ascribed to it probably in great part depend on the spirit astringents or other adjuncts with which it is generally used. For painful or irritable wounds the tincture may be used with an equal quantity of chloroform, tincture of belladonna, or laudanum, and the mixture diluted with water according to circumstances. Along with liberal feeding and tonic treatment, a drop of tincture of arnica placed daily within the eyelids is one of the best remedies in those troublesome ulcerations of the cornea which affect weakly dogs recovering from distemper.

Doses, etc.—Horses take from ♏xxx. to f℥i. of the tincture; cattle, double that quantity; dogs, ♏v. to ♏viij. Water, ale, or gruel, are the best menstrua.

ARSENIC.

Arsenicum Album. Arsenious Anhydride. Arsenious Acid. White 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 As). In Cornwall, when the tin ores are roasted, the white arsenic is evolved, accumulates in an impure form in the furnace flues, and is purified by one or two sublimations.

Properties.—When sublimed into conical cast-iron moulds, it occurs in brittle concavo-convex masses, exhibiting on their interior surface minute octahedral crystals, with triangular facets. When the vapour condenses rapidly in a current of air, the arsenic occurs as a heavy white powder. It has a snow-white lustrous appearance, and 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. The density of the transparent variety is 3·73, that of the opaque 3·69. It requires for solution nine times its weight of boiling water, and about 400 times its weight of temperate water. Its solubility is diminished by the presence of organic matter, but increased by the presence of acids and alkalies. Dissolved with alkalies, definite, mostly soluble, poisonous arsenites are produced ($M_3 As O_3$). When the white arsenic or trioxide ($As_2 O_3$) is acted upon by nitric acid, arsenic pentoxide, or arsenic acid, is produced ($H_3 As O_4$), which forms a series of salts, the arsenates of the alkaline metals being soluble, those of the other metals insoluble, none being so active as the corresponding arsenites. In its properties and alliances with other bodies, arsenicum (As) resembles on the one hand phosphorus and nitrogen, and on the other such metals as antimony and bismuth (Roscoe).

Chemical Tests.—The special tests for the detection of arsenic are easy and distinctive.

1*st*, When heated in a common test tube to about 380°, it sublimes unchanged, and condenses 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, condenses low down in the tube, and is amorphous.

2*d*, A mixture of arsenious acid and dry charcoal, or still better, some potassium cyanide and sodium carbonate, is introduced into one of those test 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 volatilizes as a colourless gas with a strong odour of garlic, and condenses in the narrow part of the tube, forming a brilliant steel-grey incrustation. This is dark-coloured and smooth externally, and lighter and more crystalline, rough, and shining internally. When the narrow part of the tube is cut out, put into a common test tube, and heated, the arsenicum regains the oxygen which it previously lost, and a crust of white arsenic in the characteristic octahedral crystals forms in the cool part of the tube.

3*d*, When this white crust is boiled with a little water acidulated with hydrochloric acid, or when white 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 ($Ag_3 As O_5$). (*c*) Cupric ammonio-sulphate (prepared in a similar manner to the silver ammonio-nitrate) gives an apple-green precipitate of copper arsenite ($Cu_2 H As O_3$), 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 peculiar crystals of white arsenic, and afterwards reducing them to the metallic state.

When arsenic, in any form of combiuation, 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 with potassium cyanide and sodium carbonate, or with a mixture of charcoal and sodium carbonate, when metallic arsenicum volatilizes, oxidizes, 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 bluish flame, whilst a piece of glass or porcelain held over the flame soon becomes encrusted, either with metallic arsenic or trioxide, 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.

Actions and Uses.—Arsenious acid is an irritant poison ; is administered as an alterative, tonic, and antiseptic ; and is applied externally as a stimulant, caustic, and destroyer of parasites.

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 excretory 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.[1] Beissenhirz gave a horse one, four, three, two, and eight drachms, on different successive days; but death occurred on the ninth day after the last dose.[2] Hertwig gave it to eight different horses, first in doses of a scruple, but gradually increasing the quantity 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 in some of the cases the condition improved.[3] 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 that dose by a scruple 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 seven ounces, 380 grains, or very 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.[4]

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.[5] These very different effects depend in part on variable degrees of suscepti-

[1] *Recueil de Médicine Vétérinaire*, Oct. 1825. Quoted by Moiroud, p. 466.
[2] Pereira's *Elements of Materia Medica*, third edition, vol. i. p. 606.
[3] *Praktische Arzneimittellehre für Thieraerzte*, Berlin 1847, p. 656.
[4] *Veterinarian* for 1843, p. 347. [5] *Ibid.* pp. 349–351.

bility in the subjects experimented on; 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 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 always should be when used 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.[1]

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 was 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, 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.

It requires somewhat larger quantities of arsenic 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.[2] Hertwig, quoting from a report of the French Academy, mentions that from five to ten grains given to sound sheep produced the usual symptoms of poisoning; that a second dose of from 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

[1] *Veterinarian* for 1843, pp. 350–1.
[2] *Ibid.* p. 345.

been eaten by dogs with impunity.[1] A chronic form of arsenical poisoning, with symptoms of indigestion, thirst, gradual sinking, and chronic diseases of the joints and bones, is sometimes met with among 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. 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 have found that doses varying from a quarter of a grain to a grain, given twice daily, and continued during periods varying from eight to fourteen days, caused in these small animals gradually diminished appetite and vomiting. From the sixth to the tenth day, diarrhœa, lowered temperature, rapid emaciation, and painful cough ensued, and death occurred in from twenty to thirty days. Quantities of from 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

[1] *Veterinarian* for 1843, p. 345.

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.

The *post-mortem* appearances of poisoning by arsenic are very similar in all animals, but 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 disorganized by patches of inflammation and extravasation of blood, which extend into the duodenum, and are also observable in the colon and cœcum. 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 cases of arsenical poisoning, the first object is to get rid of any poison still remaining unabsorbed, 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 the precipitation of two to three ounces of iron sesquichloride solution with one ounce of the crystals of sodium carbonate; these quantities freshly prepared suffice to neutralize ten grains of arsensic, converting it into the insoluble iron arsenate ($Fe_3 As O_4$). 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 as mechanical antidotes, enveloping the particles of the poison, and protecting the coats of the stomach from its action; but to be of use, such antidotes must be given before, along with, or immediately after, the poison. Oils, lard, glycerine, mucilage, and milk exercise 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.

Arsenic has no restorative action like iron or quinine, exerts no immediate neurotic effect like aconite or strychnine, but it counteracts certain blood disorders probably in virtue of its antiseptic properties. In antagonizing blood diseases it resembles mercury. It is administered as an alterative tonic, antiperiodic, and antiseptic. 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 to be conjoined with mercury and iodine.[1] I find it useful amongst horses in relieving chronic irritable cough, especially when remaining after attacks of influenza and sore throat. In such cases, with an ounce of Fowler's solution, is advantageously united an ounce of potassium chlorate, and a drachm of belladonna extract, made into a draught with water or gruel. It is also of value in abating asthmatic symptoms, chronic cough, and irritable conditions of the stomach, sometimes occurring in dogs after distemper. Few remedies are more effectual in obstinate cases of farcy. Lessening excretion of urea and carbonic acid, arsenic is believed to diminish tissue metamorphosis. Partly on this account, more notably perhaps from its antiseptic powers, it appears to have some influence in warding off splenic apoplexy and congestive fever in cattle. In properly regulated doses, it may be safely enough 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, or the urine scanty or high coloured.

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 the general vigour, probably by retarding tissue changes. 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 be effectual in maintaining condition, and imparting strength and endurance. Indeed, 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 years, it is withdrawn, they fall off in appearance, and for several 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

[1] *The Principles and Practice of Veterinary Surgery*, by Professor Williams, Edinburgh Veterinary College.

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 applied as a paste, made with starch or lard, is applied to eradicate warts, and 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 more 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, and appears to be more effectual for the destruction of ticks, and other vermin infesting the wool, than the solutions of tobacco, spirit of tar, and other substances sometimes employed. It is safer and more effectual than the mercurial baths or ointments sometimes recommended; and is still used more extensively than M'Dougall's non-poisonous dipping mixture, which has lately been deservedly rising 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 may be 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 the 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 from ten to twenty gallons of boiling water, and cold water 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 kept from 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 correspondent in Lincolnshire 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 50 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 the 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 patches of mortification 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. 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 certain 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, we 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 which was stated to have also taken place amongst the poultry.

It is a popular error to suppose that sheep, pigs, or other animals, will 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 pigs and poultry die from getting access to yards where recently dipped sheep have been confined; and I some years ago knew of two colts which were poisoned by eating a few vetches which were 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.—The dose of arsenic for horses and cattle is from grs. v. to grs. x.; for sheep, from gr. j. to grs. ij.; and for dogs, from 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 more. When it causes any physiological action, such 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:—'Take of white arsenic in powder, and carbonate of potash, of each eighty grains; compound tincture of lavender, five fluid drachms; and distilled water a sufficiency. Place the arsenious acid and the carbonate of potash in a flask with ten ounces of the water, and apply heat until a clear solution is obtained. Allow this to cool. Then add the compound tincture of lavender, and as much distilled water as will make the bulk one pint.' (*Brit. Phar.*) Every ounce of Fowler's solution contains four grains of arsenic. Where a solution is inconvenient for external use, an ointment made with six grains to an ounce of lard may be applied. It cannot, however, be too often repeated, that all arsenical preparations, whether for internal or external purposes, must be used with great circumspection.

ASSAFŒTIDA.

A gum obtained by incision from the living root of Narthex Assafœtida. In Affghanistan and the Punjaub. *Brit. Phar.*

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

The *Narthex Assafœtida* has a long black perennial root, large pœony-like annual leaves, and a tall, fleshy, flowering stem, terminating in a cluster of flowers. The plant, all parts of which emit a penetrating fœtid odour, grows luxuriantly in Persia and India, and several fine specimens may be seen in the Edinburgh Botanic Garden. When the plants are four years old, the leaves and stem are removed, and some time after, 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, and in two or three weeks has another slice removed; and after a like interval, a third slice is cut, when the plant, after yielding, according to its size, from half a pound to two pounds of juice, is entirely exhausted. The yellow-brown tears first collected are usually agglutinated into irregular lumps, which have externally a red-brown colour, and within a white waxy surface, which, however, becomes gradually yellow or red-brown from exposure to the air. Assafœtida has a disagreeable, penetrating odour of garlic, and an intensely bitter, acrid taste. It is pulverized with difficulty, forms an emulsion with water, is dissolved in rectified spirit, and also in potash and ammonia. Besides water and impurities, it contains 50 to 70 per cent. of resin; 25 to 30 of gums; about 10 of saline matters; 3 to 5 of volatile oil; containing amyl sulphide ($C_6 H_{10} S$), and with the resin constituting the active part of the plant.

Actions and Uses.—Assafœtida is a mild diffusible stimulant, carminative, and vermifuge. It is speedily absorbed, and by its disagreeable odour soon renders its presence appreciable in the breath, perspiration, matter of abscesses, and even in the muscles. Hertwig, however, could not recognise it in the milk or urine of cows or horses getting five ounces daily. It acts very mildly both on horses and cattle; and is little used, except occasionally in cases of colic, in chronic cough, and in chorea in dogs. Like other substances containing odorous volatile oils, it is, however, a vermifuge; and for this purpose may be given either by the mouth or rectum. The two gum-resins, ammoniac and galbanum, are closely analogous to assafœtida, but scarcely so active. They are occasionally used for the same purposes, and as constituents of charges and plasters.

Doses, etc.—The dose of assafœtida for horses is from ʒij. to ʒiv.; for cattle, about ℥ij.; for sheep, ʒi.; and for dogs, grs. x. to grs. xx. As its stimulant effects are very transient, it requires to be given repeatedly, and is most conveniently administered in a watery or alcoholic solution of ammonia. It is often conjoined with camphor and ammonium carbonate. It is sometimes added to alcoholic and etherial preparations intended for veterinary patients, to prevent their being otherwise appropriated.

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 membraneous 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; in a steam-heated pan, is kept stirred 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 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. 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 sorts of food, are quite 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 are employed in the formation of 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. 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. When ground to meal, it is used for making poultices and infusions. Good barley meal contains 68 per cent. of starch, 14 gluten and albumen, 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, must be got rid of, and adds 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 *Brit. Phar.*, readily putrefying when moist, but when dry remaining for a long time unchanged. It contains water, alcohol, carbonic, acetic, and mucic acids, potash and lime with a mucilaginous saccharine extract; and owes its fermenting, self-multiplying powers to the round or oval 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. It is sometimes employed for making antiseptic and deodorizing poultices, which may be prepared with two parts of bran or linseed meal, and one part each of yeast and of boiling water.

BELLADONNA.

Deadly Nightshade. Fresh leaves and attached branches of Atropa Belladonna, carefully dried and gathered from wild and cultivated British plants when the fruit has begun to form. *Brit. Phar.*

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

Belladonna grows in most parts of the country, especially about old walls, edges of plantations, and ruinous shady places; but so great is the demand for its preparations, that the plant is now largely cultivated at Hitchin and elsewhere, and the cultivated are found as active as the wild specimens. It has a straight, round, hairy, annual stem, several feet in height;

large, smooth, ovate, acuminated leaves, which are supported on short leaf stalks, are of a sombre-green colour, and a faint bitter taste ; dark-purple, bell-shaped flowers ; a brownish-black berried fruit, with a mawkish taste ; and a fleshy, branching, perennial root. The plant has greatest activity towards the end of June 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 to use it at once for the making of 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. Besides water, lignin, gum, gummy extractive matter, starch, albumen, and colouring matters, belladonna contains a colourless crystalline poisonous alkaloid called *atropine*, of which further notice will be found at the close of this article.

Actions and Uses.—Belladonna, in large doses, is a narcotic poison of the deleriant order. Unlike opium, it has very slight soporific effects. It is a direct and powerful stimulant of the sympathetic nervous system, and is used therapeutically as a tonic and stimulant of the heart arteries and capillaries, as a general anodyne, as a controller of spasm, especially of the hollow viscera, and as a diuretic. Even in very minute doses, and by whatever channel it enters the body, it causes dilatation of the pupil.

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. On the other hand, Hertwig experimented on upwards of twenty horses, and observed tolerably decided effects. He gave the dry pulverized herb in quantities varying from four to six ounces, 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, expansion 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. In some of the cases there was much abdominal pain ; in others, imperfect power of moving the hinder extremities ; and in others, a fatal termination in from thirty to fifty hours after the exhibition of the first dose. In most of the cases the symptoms gradually retrograded, and after thirty-six or forty-eight hours the animals were perfectly well. From 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 cardial and cerebral excitement are the prominent results of full doses in the horse.[1] Hertwig considers that belladonna is rather more active in cattle than horses ; and records that doses of the root varying from two to four ounces caused in cows violent symptoms lasting forty-eight hours, and that larger doses were dangerous. In dogs, from thirty to fifty grains of the dried herb or root caused, in from 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. After some time the animals became rather drowsy. In from 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

[1] *The Old Vegetable Neurotics.* By John Harley, M.D. London : Macmillan & Co. 1869.

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.)

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, in which over-doses cause the arteries of the web 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 neutralizes the atropine. Calabar bean is antagonistic in many other particulars, as well as in its action on the iris. Ammonia cautiously swallowed and inhaled sustains the flagging breathing and circulation; opium in small amount quiets nervousness and restlessness; diuretics expedite the expulsion of the poison.

Belladonna is a direct stimulant of the sympathetic nervous system. It hence increases the number and force of the heart's beats. It gives tone to dilated and congested capillaries. In the web of the frog's foot it has been seen to contract the ramifications of the arteries often to less than three-fourths of their former calibre, inducing such increased movements of the red globules, that about twice the former quantity of blood passed along them. (Meuriot and Harley.) It does not act directly upon the cerebro-spinal axis like opium, or upon the motor centres like hemlock. It has no paralyzing effect upon the vagus. It resembles alcohol and ether in its anæsthetic action on the sensory ganglia. Although less effectual than chloroform, or even than opium, in blunting natural sensation, it is sometimes superior to either in removing neuralgic pains. This anodyne action results partly from its direct effect upon nerve tissue, which, according to Dr. Harley, it hyperoxydizes, and partly from its better regulation of capillary circulation. It exerts no notable effect upon the lungs or skin. The dryness and congestion which it produces on the mouth, tongue, and fauces, are local phenomena which do not extend to the glands or system generally.

In influenza, scarlatina, and purpura amongst horses, in sore throat, bronchitis, and pneumonia in all classes of patients, in convalescence from many debilitating disorders, no remedy more certainly imparts tone and firmness to the weakened heart, braces up lax capillaries, or soothes excitability of the sympathetic nervous system. In such cases it is often administered with alcohol, ether, ammonia, or camphor. 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 introduced hypodermically, and is often advantageously conjoined with opium, which intensifies and prolongs its effects. 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. Used in conjunction with active purgatives and perfect quiet, belladonna often abates the continued exhausting spasm of tetanus. In hydrophobia, epilepsy, and chorea, it is given without much success. In medicinal doses it is excreted unchanged and apparently undiminished in amount by the kidneys, as has been shown by testing the effects which the urine produces on the iris. During its elimination, it developes 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. Hence its value in nephritis, cystitis, and various irritable conditions of the urinary organs. In diarrhœa and dysentery it is sometimes of service, especially when conjoined with antacids, antiseptics, or astringents. With purgatives it is combined in torpidity of the bowels depending upon want of tone. In these and other cases it owes its value to its general anodyne effect, and to its power of contracting those longitudinal fibres of the hollow viscera which are known to be 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 of course its active principle atropine, contract the iris, and do so by whatever channel they are introduced into the body. The effect is accompanied by increased sufferance of light and other stimuli; is apparent within an hour after the use of the medicine, but often in a shorter time; is developed most rapidly, and with least impairment of vision, by applying the preparation round the eyelids; and continues often for an hour or two, especially when the drug has been swallowed. By some physiologists these effects are ascribed to temporary paralysis of the third nerve supplying the iris. Belladonna, however, has little direct action on the brain, does not interfere with the functions of other spinal nerves; and it is more consistent to believe, with Dr. Harley, that its characteristic stimulant effect upon the sympathetic gradually overpowers the influence of the third nerve: the circular fibres of the iris are accordingly weakened, the radiating fibres contract, and the pupil necessarily expands. These effects of belladonna and atropine are directly antagonistic to those of the Calabar bean, which closes the pupil, and are of practical utility in preventing or breaking up adhesions between the iris and lens in iritis; in expanding the pupil, and thus facilitating the discovery and examination of cataracts, and in the performance of operations on the eye. Tone is also imparted to the dilated congested vessels, and the usual anodyne action of belladonna is also exerted.

Doses, etc.—The dose of the dried powdered leaves for horses and cattle is about ℥ij.; for dogs, from grs. v. to x. The plant is, however, seldom used in this crude state, but is made into extract or tincture. The extract is apt to vary in strength, and from exposure to elevated temperature is sometimes perfectly useless. An active well-keeping preparation may, however, be made by the following *Brit. Phar.* process:—'Take of the fresh leaves and young branches of belladonna, 112 lbs. Bruise in a stone mortar, and press out the juice; heat it gradually to 130°, and separate the green colouring matter by a calico filter. Heat the strained liquor to 200°, to coagulate the albumen, and again filter. Evaporate the filtrate by a water bath to the consistence of a thin syrup; then add to it the green colouring matter previously separated, and, stirring the whole together assiduously, continue the evaporation at a temperature not exceeding 140°, until the extract is of a suitable consistence for forming pills.' 100 lbs. of trimmed leaves and young branches yield nearly 7 lbs. of good extract. The dose of extract for horses is grs. ℈ss. to ℈j.; for cattle, ℈j. to ʒij.; for sheep, grs. x. to grs. xx.; for dogs, grs. j. to iij. The tincture is conveniently made by digestion and subsequent percolation of one ounce of belladonna with a pint of proof spirit. For external application, a tincture is made from the powdered root, and camphor is sometimes used; whilst Mr. Squire has introduced a soothing liniment styled chloroform of belladonna, made by mixing about one-seventh part of chloroform with a strong tincture.

Atropine or atropia ($C_{17}H_{23}NO_3$) concentrates the whole activity of belladonna, is uniform and certain in its composition, and, but for its expense, is preferable even to a well-made extract. It occurs in the plant in combination with malic acid. To prepare it, macerate the root in spirit; further exhaust the residue in a displacement apparatus; from this tincture, containing the atropine bimalate, precipitate the alkaloid by lime; filter; add diluted sulphuric acid so as to get the readily decomposable atropine in the condition of the more stable sulphate. With various precautions evaporate and purify. Two pounds of root should yield forty grains of alkaloid. When pure, atropine is in colourless, silky crystals, devoid of odour, with a nauseous bitter taste, volatile, sparingly soluble in water, soluble in one and a half parts of cold alcohol, and manifests 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 in concentrated form possesses all the poisonous and medicinal properties of belladonna. It has more than one hundred times the activity of the best extract. The action of atropine on horses and dogs was in 1867 carefully investigated by Dr. John Harley and Messrs. F. & 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 from 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; no notable effects upon the secretions. 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 caused entire dilatation of 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 as formerly 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 intercostales and pannuscorium 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 of atropine 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.

These experiments demonstrate the physiological action of atropine, and prove it to be a direct stimulant of the sympathetic nervous system. Like belladonna, it is therefore prescribed as a heart tonic and stimulant, as an excitant of capillary circulation, as a general anodyne, and also as a diuretic. Its concentrated form specially adapts it for subcutaneous injection. In enteritis, tetanus, 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. i. to grs. ij.; for sheep, about gr. $\frac{1}{10}$; for dogs, gr. $\frac{1}{30}$ to $\frac{1}{20}$. One-tenth of these quantities suffice when the medicine is used subcutaneously. Conjoined with morphia, its effects are increased and prolonged, and are often favourably exerted in enteritis in horses.

BENZOIN.

Benzoinum. Concrete balsamic exudation of Styrax Benzoin. Gum Benjamin.

Nat. Ord.—Styraceæ. *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 after it annually yields about 3 lbs. of resin. Incisions are made through the bark, when the juice exudes, concreting in tears, which are subsequently made into larger masses. These are red-brown externally, and yellowish-white within, are brittle and easily pulverized, slightly heavier than water, of a sweet resinous taste, and an agreeable balsamic odour, which is 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 amigdaloid 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 12 to 15 of benzoic acid ($HC_7 H_5 O_2$),—an acrid crystalline substance, prepared by subliming benzoin, or boiling it with lime and then decomposing the calcium benzoate.

Actions and Uses.—Benzoin belongs to a class of mild stimulants, 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, all kinds of pectoral complaints, and consumption; but is now seldom used internally. Externally, it is occasionally applied to contusions and 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 in a closed vessel with occasional agitation, then filter, and add sufficient rectified spirit if required to make one pint.'—*Brit. Phar.* Ten grains of benzoin mixed with the ounce of lard constitute the well-keeping benzoated lard used in general for making ointments.

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 most parts of this country. The berries, the only official part, are black, globular, about the size of peas, and contain an acrid, bitter, nauseous juice, which is at first green, but soon becomes red from the production of acetic acid. Besides colouring matters, acetic and malic acids, it contains a bitter glucoside acid, believed to be identical with the complex active principle of Alexandrian senna, and termed cathartic acid ($C_{180}\,K_{192}\,H_4\,SO_{82}$, Groves). The syrup, the only official form, is thus prepared: —'Take of the fresh juice of buckthorn-berries, four pints; ginger sliced, and pimento bruised, of each three-quarters of an ounce; refined sugar, five pounds, or a sufficiency; rectified spirit, six fluid ounces. Evaporate the juice to two pints and a half, add the ginger and pimento, digest at a gentle heat for four hours, and strain. When cold, add the spirit; let the mixture stand for two days; then decant off the clear liquor, and in this dissolve the sugar with a gentle heat, so as to make the specific gravity 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 from f℥i. to f℥ij., for cats from fʒiv. to f℥i. Tolerably prompt and certain effects are obtained by combining with an ounce of the syrup two or three drachms of confection of senna, 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.

CALCIUM AND ITS MEDICINAL COMPOUNDS.

CALCIUM OXIDE. Lime. Quicklime. Calx. CaO.

When limestone or marble, or any form of calcium carbonate ($Ca\,CO_3$), is burned, its carbonic acid (CO_2) is driven off, and the metallic oxide (CaO) or quicklime is left. It occurs in greyish-white, irregular masses, has an astringent, alkaline, caustic taste, and a great affinity for water. It combines with about half its weight of water, giving off much heat, and forming the hydroxide or slaked lime (CaO, H_2O). Lime is soluble in 730 parts of cold, and 1300 of boiling, water. 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, which, when saturated, contains in every pint, at the temperature of 60°, 11½ grains of lime. 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 detectible in solution, by their yielding no precipitate with hydrogen sulphide or ammonium hydro-sulphide, but an immediate and abundant white precipitate with oxalic acid. This calcium oxalate is insoluble in acetic, but soluble in hydrochloric and nitric acids.

Actions and Uses.—Lime is irritant, corrosive, desiccant, and antacid.

Lime is a natural constituent of the animal textures, in which it probably occurs mainly in combination with phosphoric acid. Being present in most articles of food, extra supplies are seldom required. When given medicinally, it is taken up slowly and only in small amount. Its effects are chiefly local. Lime, especially when unslaked, and in contact with the mucous and abraded skin surfaces, attracts water, and also destroys the soft tissues, thus exerting irritant and corrosive properties. Orfila mentions that a drachm and a half 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, but differs from them in diminishing rather than increasing secretion. In this respect it is somewhat analogous to preparations of zinc and aluminum; but its desiccant action is mechanical, and unaccompanied by any true astringency. Slaked lime and lime-water are used as antacids in indigestion, hoven, and diarrhœa, especially among cattle. About one-fourth or even one-sixth of lime-water given with their milk will often prevent indigestion, flatulence, and diarrhœa amongst young calves, probably by counteracting undue acidity, and the coagulation of the milk in large solid lumps. 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 glycerine, it checks the discharge and abates the itching of eczema, but for such cases zinc preparations are usually more effectual. Lime-water, mixed with an equal quantity of linseed oil, is used in the treatment of scalds and burns under the name of Carron oil, so called from the extensive ironworks of that name in Stirlingshire. In such cases, however, the approved 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 it is used for cleansing and deodorizing foul stables, cow-houses, and piggeries.

Doses, etc.—The dose of quicklime for horses or cattle is ʒi. to ʒij.; for sheep, grs. xx. to grs. xxx.; and for dogs, grs. v. to grs. xx. The dose of lime-water for the larger patients is f℥iv. to f℥v.; and for the smaller, from fʒij. to f℥i. It may be given alone, or with glycerine, oil, or milk. Two ounces each of lime-water and gentian infusion, with three or four drops of aconite tincture, make a good mixture, when repeated twice or thrice daily, for checking 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 up an ounce of slaked lime with five ounces of white sugar, transferring the mixture to a bottle containing a pint of water, shaking and separating the clear solution with a syphon. It is given diluted according to convenience.

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

Calcium carbonate occurs in the several forms of calcareous spar, limestone, marble, and chalk. The last, the only variety of much medical importance, abounds in the south of England in beds mixed with silica, alumina, and iron oxide. These impurities are removed by triturating it with a little water, agitating it 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 has a dull white earthy appearance, is tasteless, adheres to the tongue owing to its porosity and its affinity for water, effervesces with acids, in powder is amorphous. It requires for solution about 1600 times its own weight of water, and its solubility is increased by the presence of carbonic acid.

Actions and Uses.—Chalk is the cheapest and most convenient of antacids; and is much used amongst all the domesticated animals in the treatment of indigestion, chronic diarrhœa, and dysentery. In such cases it proves effectual by neutralizing the acid matters which cause or keep up the complaint, by absorbing irritant substances, and by protecting the intestinal surfaces. It is a good antidote for oxalic and the mineral acids. In a dry and finely divided state, it is used as a desiccant for external wounds, absorbing their irritating discharges, and protecting them from the action of the air.

Doses, etc.—The dose for horses is from ℥i. to ℥ij.; for cattle,

℥ij. to ℥iv.; for sheep, ʒij. to ʒiv.; for pigs, ʒi. to ʒij.; and 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, so as to prevent its accumulation in the intestines. It is frequently conjoined with catechu and other vegetable astringents; with ginger and other carminatives, as in indigestion and diarrhœa; and with opium or belladonna, where there is much 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 a bottle of sound ale; for sheep, similar combinations may be used in about one-fourth of the doses mentioned; for dogs, a convenient pill may be made with chalk and ginger, of each grs. x., with opium, grs. ij., and aromatic confection, q.s. A somewhat similar draught 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. $Ca\,H_4\,2\,PO_4$.

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.—In a slightly different form ($Ca_3\,2\,PO_4$) it 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. 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 doubtless owe 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, may be conveniently given mixed with the food, and in combination with an iron salt.

CALCIUM CHLORATA. Calx Chlorata. Chlorinated Lime. Chloride of Lime. Bleaching Powder. A mixture of Calcium Hypochlorite ($Ca\,2ClO$) and Calcium Chloride ($CaCl_2$).

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 piles 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 from thirty to forty per cent. of it, and has become the familiar bleaching powder.

Properties.—It is a soft, greyish-white powder, with a feeble odour of chlorine, or rather of hypochlorous acid, and an astringent, 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 contain 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 deodorizer, and also as a disinfectant.

When it is applied to any mucous surface, either in powder or strong solution, its irritant, stimulant, and astringent properties show themselves, and depend partly on the free lime it contains, and partly on the chlorine it so readily evolves. Hertwig has given it in variable quantity to all the domesticated animals; to horses and cattle in doses of from one ounce to two pounds; to sheep and goats in from one to eight drachms; and to dogs in from half a drachm to four drachms. The smaller quantities produced scarcely any effect; the larger 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, hasten tissue changes, and diminish the amount of fibrine in the blood (Headland).

Mr. Youatt recommended bleaching powder as a remedy 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. Two drachms each of bleaching powder and belladonna extract, with ten drops of aconite tincture, repeated two or three times daily, sometimes abate the fever and spasms of acute dysentery in cattle. One-third of the quantity may be used for sheep. The deobstruent effects of bleaching powder have not been sufficiently proved. 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 deodorizer for unhealthy ulcers, gangrenous wounds, fistulæ, thrush, canker, and grease; it is one of the approved remedies for mange and various other skin diseases; and, in diluted solutions, it has been recommended for checking conjunctival ophthalmia, and other circumscribed and superficial inflammations. It is a feeble antiseptic, much 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 deodorizer, and also a disinfectant. These useful properties depend upon its readily yielding chlorine gas. Chlorinated lime, either in powder or solution, is spread about cow-houses and animal dwellings where contagious or epizootic diseases prevail; cloths kept saturated with a strong solution are suspended about the infected premises; solutions varying from one to ten per cent. are employed for disinfecting hides, flesh, or excreta of diseased animals. Cheap and effectual as a deodorizer, the only disadvantages of bleaching powder for these purposes are its sickly smell, which appears to be disliked both by horses and cattle; its gradual conversion into calcium chloride, which, having a great affinity for water, leaves the floors, walls, and other objects to which the deodorizer has been applied, in an unsatisfactorily moist state; whilst its decomposing of 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 from ʒi. to ʒij.; cattle, from ʒij. to ʒiv.; sheep, about ʒi.; dogs, from grs. ii. to grs. v. It may be given either in a bolus, or with cold gruel, mucilage, or milk.

CAMPHOR.

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

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

The Camphor Laurel is a tall, handsome evergreen, cultivated in Japan and China, and in many European conservatories. Its wood and leaves evolve a camphoraceous odour when bruised. 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 melting, mixing with lime, and re-subliming.

Properties.—Camphor occurs in concavo-convex masses, which derive their form from the vessels into 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 has a density about 986. When exposed to the air, it slowly evaporates; when 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. It dissolves readily in ethers, acids, and oils, in about its own weight of alcohol, in eight times its weight of milk, and in 1000 times its weight of water. It is the oxide of a hydrocarbon terebene ($C_{10}\ H_{16}$), present in chamomile, cardamoms, cloves, and other such oil-yielding plants. The liquid volatile oil ($C_{20}\ H_{32}\ O$), which in oxydizing and concreting leaves ordinary laurel camphor, is a rare commercial article known as camphor oil.

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 and friability, its high density, and its alliaceous odour. The colourless mobile volatile oil, of which it chiefly consists, is known as liquid camphor or camphene, and is isomeric with oil of turpentine ($C_{10}\ H_{18}$). Artificial camphor is got by the action of hydrochloric acid on oil of turpentine.

Actions and Uses.—Camphor, in excessive doses, is an irritant and narcotic poison; in medicinal doses it is stimulant, anodyne, antispasmodic, diaphoretic, and slightly diuretic; it is used externally as a stimulant and anodyne.

It is somewhat irregular in its poisonous action. In coarse powder, it acts chiefly topically, causing irritation and inflammation of the alimentary canal; but when finely powdered, or in solution, it is absorbed, stimulating, deranging, and by and by depressing the nervous centres, inducing exhilaration, giddiness, delirium, convulsions, and stupor. 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. In dogs there is also imperfect power of controlling the movements of the limbs; and when the doses amount to three or four drachms, insensibility and death ensue. The vapour of camphor is stated to destroy fleas, bugs, moths, and spiders. All parts of the bodies of animals poisoned by camphor evolve a strong odour of the drug. Doses in the solid form produce inflammation, and sometimes spots of ulceration, throughout the stomach and intestines. Given in solution, it leaves, besides vascularity of the alimentary mucous surface, injection of the membranes of the brain, irritation of the pelvic viscera, and the heart filled with florid blood, indicating death from syncope.

In medicinal doses, camphor exercises a stimulant action, accompanied or succeeded by an anodyne effect. Allaying nervous irritability, it is used in chronic cough, diarrhœa, especially in young animals. spasmodic diseases, and typhoid fevers. In many such cases it is especially useful when conjoined with opium, belladonna, or stimulants. A drachm each of camphor and extract of belladonna, dissolved in one or two ounces of sweet spirit of nitre, and given in a pint of water or cold gruel, is a good formula in cases of bronchial irritation of horses and cattle, and may be repeated several times a day. Five grains each of camphor and belladonna extract, with ♏xx. of arnica tincture, in a few ounces of water, often 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. In typhoid cases, either in horses or cattle, a convenient combination consists of two drachms of camphor, a drachm of iron chloride tincture, and an ounce of ether. In influenza and other exhausting disorders, an effectual stimulating and soothing draught for horses is made with two drachms each of camphor and ammonia carbonate and an ounce of ether, given in ale or cold gruel. Camphor appears to be excreted chiefly by the mucous membranes and skin, and in smaller amount by the kidneys; and like other stimulants, it exalts the activity of the excreting organs. Diuresis occurs only after large and repeated doses. Other properties have been ascribed to camphor, some of them on insufficient grounds. It has been thought to possess the power of repelling the secretion of milk in women and animals that carried fragments of it about with them; has been lauded as an anthelmintic; and has even been considered capable of arresting the propagation of contagious diseases. 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 man.

Doses, etc.—The dose for horses is ʒj. to ʒij.; for cattle, ʒij. to ʒiv.; for sheep and pigs, from grs. xx. to grs. xxx.; and for dogs, from grs. iij. to grs. x. Required for anodyne, and not of irritant effects, it is best made into an emulsion with eggs, or dissolved in milk or oil. For external use, it may be conveniently 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 in large numbers 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 then 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 from six to ten lines in length, and from 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 wing coverings, called *elytræ*, of a golden green colour, and so indestructible that they have been recognised by Orfila in the human stomach nine months after interment. The body, especially along its under surface, is covered with greyish-white hairs; the head is large; the antennæ or horns are black and thread-like. The insect is said to live from eight to ten days. It 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 various fatty and other animal matters, and the acrid, fusible, volatile crystalline *cantharidin.* This active irritant is confined to the soft parts of the body of the insect, abounding particularly in the female sexual organs, and constituting about four or five parts to the thousand. It also occurs in most other vesicant insects. It is slowly deposited, when an alcoholic solution of cantharides is concentrated; when pure, it is insoluble in water, but soluble in alcohol, acetic acid, ether, chloroform, and oils. It appears to be a solid volatile oil, with the composition $C_5\ H_6\ O_2$.

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.—Cantharides, when given internally, is an irritant, general stimulant, and diuretic; and when applied externally, a rubefacient and vesicant.

Swallowed in large doses, it acts on all animals as a powerful poison, causing intense gastro-enteritis, inflammation of the urinary organs, and sometimes coma, convulsions, and death. According to Orfila, cantharides not only causes violent inflammation of any part with which it comes in contact, but in excessive doses also exercises a notable influence on the nervous system, and especially on the spinal chord. He 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 cases of poisoning by cantharides, the *post-mortem* appearances are congestion and inflammation of the alimentary canal and urinary apparatus, 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 an excessive dose, or has caused undue irritation of the urinary organs from being freely absorbed from the surface of the skin, mucilaginous fluids should be given in large quantity, both by the mouth and rectum; sodium bicarbonate or other alkalies should be administered; and tepid fomentations applied to any recently blistered surfaces. When the irritation and pain are serious and persistent, blood-letting, followed by opiates and alkalies, may be necessary; and in the horse, fresh sheepskins may be laid over the loins.

The acrid principle of the cantharides, unless when in very large doses, appears to be dissolved by the alkaline matters it meets with in the intestines, and thus enters the blood. Whilst combined with the alkali, it is in great part deprived of its irritant properties, which are, however, recovered as it passes through the kidneys, where excess of acid probably neutralizes 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.) In small and repeated doses, cantharides is a stimulating tonic; but unless used with caution, it is apt to produce diuresis, and undue irritation of the urino-genital organs. When given for some time continuously, little vesicles usually appear on the skin, owing probably to small quantities of cantharidin being thus excreted. It is popularly believed to possess the power of stimulating the sexual appetites; but this action only shows itself where it is given in excessive doses. It is occasionally used internally in impaired action of the digestive and urinary organs. In man it is sometimes useful in relieving dropsies, and arresting chronic mucous discharges.

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 vesicant. It causes first irritation, pain, and swelling, with some redness; and by and by 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 a 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 of the skin, the hair is removed, and does not readily grow again. This most commonly results from the excessive strength of the preparation, from its containing corrosive mineral substances, or from the injudicious application of blisters 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 sometimes 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 an unusual amount of serous effusion, but seldom, when used judiciously, produces any untoward results; and it 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.

No vesicant is more extensively employed than cantharides. Acting beneficially, probably by a sort of reflex action, and by determining to the inflamed parts a more healthy and abundant supply of blood and nervous influence, it is applied as a counter-irritant among the different domesticated animals, to combat inflammation of many internal organs. In rheumatism, pleurodynia, and pleurisy, and less notably in bronchitis and pneumonia, it proves serviceable. 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 several weeks, benefits some cases of chronic paralysis; and either dissipates or removes tardy abscesses, such as those occasionally met with in strangles. As stimulants and vesicants, cantharidine blisters are largely used in irritation and inflammation of joints, bursæ, ligaments, tendons, cartilages, and bones; and in such cases probably act beneficially by inducing an increased vitality, and determining reparative instead of destructive inflammation. In small quantity, they promote adhesion of old unhealthy wounds and fistulæ; stimulate weak and callous ulcers; remove scurfiness and thickening of the skin, as in mallenders, ringworm, and sometimes in inveterate mange; and stimulate the growth of hair. Cantharides blisters must not be applied to any part in a state of highly exalted vascularity and sensibility, as during active inflammation, or where there is tendency to erysipelas. They are usually most serviceable in subacute and chronic cases. 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, forbid their use where these parts are in a morbidly irritable state.

Doses, etc.—The dose of cantharides for horses is grs. iv. to grs. xx.; for cattle, grs. x. to grs. xx.; for sheep and swine, grs. ij. to grs. viij.; and for dogs, gr. ½ to grs. ij. These doses are repeated once or twice a day; are usually given with aromatics and bitters, in the form of bolus or tincture; and their 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, may be made of any strength. Those used in human medicine are too weak for most veterinary purposes. One part of coarsely powdered flies, macerated for seven days with fifteen or twenty ounces of proof spirit, forms a useful tincture of medium strength. Some practitioners augment the activity of such preparations by the addition of a small quantity of euphorbium, liquor ammoniæ, or oil of turpentine. The cantharides tinctures in common use act more speedily than the ointments, but their effects are less powerful and of shorter duration. Though they produce 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 flies in acetic acid, is often used in human medicine, and is equally applicable to veterinary practice. One part of powdered cantharides to ten or twelve of commercial pyroligneous acid forms a prompt and powerful 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 active principles of the fly. Many of these contain a great number of ingredients, but the simplest are usually the best. A useful ointment of medium strength consists of one part of powdered cantharides to six of hog's lard, palm oil, resinous ointment, or such other excipient. 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 three 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 of the integuments, and permanent blemishing. In cattle practice, counter-irritation is generally produced with boiling water or mustard; 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 eight ounces of lard. In preparing cantharidine ointments, the oleaginous and resinous substances are melted together over a slow fire, or, better still, over a water bath, the powdered cantharides and any other ingredients stirred in, the heat, which should not exceed 200°, continued for ten or fifteen minutes, and the mass stirred until cool. The ointment (*unguentum cantharidis*) of the *Brit. Phar.* is thus directed to be made: 'Take of cantharides and yellow wax of each one ounce; olive oil, six fluid ounces. Infuse the cantharides in the oil in a covered vessel for twelve hours, then place the vessel in boiling water for fifteen minutes, strain through muslin with strong pressure, add the product to the wax previously melted, and stir constantly whilst the mixture cools.' To 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 liquified 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 was discovered by Runge in 1843, and is 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 glycerine, oils, alcohol, ether, and acetic acid. It coagulates albumen. With sulphuric acid, it unites to form sulpho-carbolic acid, which produces a series of definite stable soluble crystallizable 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.

It is distinguished by its odour. An aqueous solution, even if containing one 1000th part, when treated with a drop or two of iron perchloride, 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, sometimes substituted for impure carbolic acid, is distinguished from it by boiling 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 crystallizable, developes 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, and also in its physiological effects.

Actions and Uses.—Carbolic acid is a narcotic-irritant poison, and is used medicinally as a stimulant, anodyne, astringent, rubefacient, antiseptic, and disinfectant.

A strong solution acts as a topical irritant, coagulating albumen, and leaving a white, dry, roughened surface from which the shrivelled epidermal scales subsequently peel off. When swallowed, besides exerting this local action, it readily undergoes absorption, and produces inebrient effects analogous to those of alcohol, to which it bears close relationship. 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, stertorous breathing, convulsions, and death in ten minutes. (*Veterinarian* for September and November 1872.) Three or four drops placed under the wings of sparrows caused excitement, suffering, and death in half an hour; toads, earth-worms, beetles, and fleas were promptly poisoned (Lamaire); two drachms repeatedly given by Mr. Romanes of Leith to a donkey had, however, no very notable effect. Poisonous doses caused dogs and other animals to reel and fall as when intoxicated; they cough, froth at mouth, and are paralyzed, the fore extremities being usually first affected; there is more or less anæsthesia and unconsciousness; convulsions precede death. Poisoning is counteracted by neutralizing any unabsorbed acid by liberal doses of white of egg or albumen, giving full doses of linseed and castor oil mixed; evacuating the stomach of carnivora; getting the patient to inhale steam; giving small doses of ammonia and camphor, and hastening elimination through the skin and kidneys. The *post-mortem* appearances are: whitening of the mouth and fauces, and sometimes also of the stomach; a smoky creasote odour pervading the body; the internal organs are congested, 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 corpuscules are unchanged. (*The Antiseptic System*, by Dr. Arthur E. Sansom. H. Sillman, London, 1871.)

Being readily absorbed, carbolic acid produces its effects whether it is swallowed, injected into the rectum, inhaled, applied to wounds, or even placed on the unbroken cutaneous surface. Used as a dressing in human surgery, it has sometimes caused nausea, vomiting, giddiness, and the secretion of high-coloured urine, smelling of smoke. Strong carbolic dressings too freely applied, within a few minutes, frequently cause in dogs excitement, blowing, unsteadiness of gait, convulsions, and occasionally fatal coma. Even in the slighter cases, dulness, trembling, and disinclination for food often continue for several days. Scabby sheep too freely dressed usually suffer from congested and inflamed lungs, occasionally linger for weeks, and even then die. 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. In tolerably concentrated solution, it coagulates albumen and acts as an astringent, and, like other alcohols, proves anodyne and locally anæsthetic.

The great value and manifold applications of carbolic acid depend upon its antiseptic power. It arrests as well as prevents fermentation, but for this purpose requires a larger amount than of corrosive sublimate or sulphuric acid; yeast treated with it fails to exert its familiar effects upon sweet-wort; 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 organized 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 albumen 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. With the exception of its analogues, cresylic acid and fousel oil, no known antiseptics equal carbolic acid in preserving albuminous substances from decomposition. These effects do not result from oxydation or deoxydation, from the coagulation of albumen, or from any chemical action, but from a special power of destroying germs. This septic effect is exerted in all the lower forms of organized life, whether of vegetable or animal origin. Not only does carbolic acid check or 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. 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 disorganize 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 serviceable as a disinfectant.

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 glycerine; 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 proves valuable. It deserves further trial in allaying the fever and pain of weed. By Mr. Priestman and others, it has been used with considerable success 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. A wound, whether made by accident or by the surgeon's knife, when freely irrigated with the carbolic solution, and kept covered with lint and other appliances well soaked with the antiseptic, heals rapidly without untoward results. Those germs with which all ordinary air is loaded are prevented reaching the raw surfaces, and there exciting irritation, with its concomitants of undue exudation, degeneration, and suppuration. Blood and exudate from serious wounds saturated with carbolic acid, and protected from irritating aerial particles, have no tendency to putrefy or develope those acrid foul discharges which frequently characterize 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 occasionally wetted with carbolic solution and covered in by the carbolized dressings, will frequently be mummified and cease to cause irritation. In this way fistulæ of the poll, withers, and lateral cartilages, carefully attended to and protected from air, may sometimes be radically cured without operation. The cells of cancer, melanosis, and other malignant diseases, are also destroyed by the antiseptic.

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 is not 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,—immediately over the wound should be laid six or eight folds of coarse muslin imbued with a mixture of one part of crystallized carbolic acid, four parts of resin, and sixteen parts of 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 Macintosh 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 carbolized 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 crystallized carbolic acid and three of shellac, incorporated with soft cloth. When, after one or more days, the dressings require renewal, it is most essential to the success of the antiseptic treatment, that, with a spray producer or other such device, the raw surfaces so soon as exposed shall be kept wetted, and surrounded by a carbolized atmosphere, until again enveloped in their protecting dressings. To prevent the introduction of irritating germs, sponges, 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 than the above 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. Overreaches, troublesome ulcers, and quittors, after being douched or injected with the watery solution, are covered with a few folds of carbolized lint or oakum, and when painful or irritable enveloped in a large bran poultice, also saturated with acid, and left undisturbed for at least a day. A five per cent. solution usually answers well in foot-rot amongst sheep; but where in chronic cases reparative power is deficient, it may be usefully alternated with turpentine and oil; or where granulations are redundant, 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, glycerine, 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 purigo, 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. 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 abscesses. Caution must, however, be had in using carbolic acid whether by inhalation or injection, or as an external dressing : for it is liable, as above mentioned, to become absorbed ; and if in considerable amount, developes its narcotic irritant properties. Especial care must be taken in applying even weak solutions to the skin of dogs. A considerable 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.*)

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 neutralize 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 neutralizing 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 earth and applied to vine borders, it prevents the odium. 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.—The dose of carbolic acid for horses and cattle varies from ♏xv. to ♏xl.; for sheep and pigs, from ♏v. to ♏viii.; for dogs, from ♏i. to ♏ii. The crystallized form melted should be used. Occasionally it is made into a bolus with meal; but it is more readily absorbed, more regular in its effects, and less likely to develope its local irritant action when given dissolved either in water or glycerine. One part by weight of acid rubbed in a mortar with four of glycerine forms a convenient compound readily miscible with water or other solvents. An ointment is made by rubbing in a mortar grains xvi. 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.

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 acid. When slowly crystallized, 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, crystalline, soluble, almost odourless, usually colourless, stable sulpho-carbolates are obtained, 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.

CASCARILLA BARK.

Cascarillæ Cortex. The Bark of Croton Eleuteria.

Nat. Ord.—Euphorbiaceæ. *Sex. Syst.*—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, it contains 15 per cent. of a bitter resin, 18 of a bitter gummy extract, 1·6 of a pungent volatile oil, recently separated into two distinct oils. The oil and bitter matters are the active principles, and are soluble in spirit, and also, though less readily, in water.

Actions and Uses.—Cascarilla is an aromatic and bitter tonic. It resembles cinchona in its general effects, but is considerably less active. It is occasionally used for the several domesticated animals in indigestion, diarrhœa, typhoid affections, and convalescence from exhausting diseases. But for such cases, especially amongst horses and cattle, there are many more efficacious remedies.

Doses, etc.—The dose for horses is ʒij. to ʒiv.; for cattle, ℥i.; for sheep and swine, ʒi. to ʒij.; and for dogs, grs. x. to grs. xl. It is given in the form of 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. Syst.*—Monœcia Monadelphia.

The castor oil plant, or Palma Christi, generally considered to be Jonah's gourd, is indigenous in 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 still more southern latitudes, as in India, Central Africa, and various parts of North and South America, it becomes a large tree.

The official part of the tree 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 are of a yellow-white colour, and mottled with red-brown spots. The investing coat, which forms about 24 per cent. of the whole seed, consists chiefly of lignin. The nucleus, comprising nearly 70 per cent. of the seed, contains 46 per cent. of a fixed oil—the castor oil—associated with 21 per cent. of albumen, 2·4 of gum, and, according to some, a small quantity of an acrid purgative principle, which remains after the expression of the oil. The seeds further contain about 8 per cent. of moisture.

Besides being manufactured in London, castor oil is largely imported from the East Indies and America, and in small quantities from the West Indies and Australia. Various modes of extraction and purification are adopted. In London the seeds are crushed in a screw or hydraulic press, the oil purified by rest, filtration, and bleaching. In the East Indies mucilage and albumen are got rid of by heating the expressed oil with boiling water, and straining it through flannel. In America, the seeds, carefully cleansed, are exposed to gentle heat, in order that the oil may be more readily expressed; the crude oil is freed from mucilage and albumen by boiling with water until perfectly transparent when cool; 25 per cent. of best oil is thus got 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 the agency of alcohol 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 darker than some other sorts; 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, only 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 injured, and acrid acids are developed.

Castor oil, when fresh and well prepared, is viscid, almost colourless, and of an unpleasant 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. Below 32°, it becomes dense and opalescent, and deposits a small quantity of margarin. Continued exposure to the air renders it thick and rancid; in a thin layer it thickens, and after a time entirely dries up. Castor oil and alcohol exert a mutually solvent action on each other; it is soluble in two parts of rectified spirit and in ether, but not in water; is easily miscible with other oils; saponifies with alkalies; and, with one-twentieth of its weight of hyponitrous acid, is converted in about seven hours into a yellow substance termed palmine. Castor oil is stated to consist of glycerine, the sweet basic principle present in all oils and fats, united with ricinic, ricinic-margaritic, and ricino-stearic acids. (Pereira.) Professor Attfield describes it as a ricinoleate of glyceryl ($C_3 H_5$, $3C_{18} H_{33} O_3$), or ricinoleine, a slightly oxydized oleine. Soubeiran, many years ago, found in castor oil a soft resinous oil, to which he ascribed its purgative properties; but his researches have not been verified. Belonging to the same natural family as croton, and having similar properties, it might naturally be expected that, like croton, it should contain an active, acrid, volatile acid; but as yet no such substance has been found in castor oil.

Impurities.—Castor oil is adulterated with croton oil to increase its activity, with lard and suet oils to reduce its cost. The inferior sorts are distinguished by their dark colour, and disagreeable acrid taste and odour, which may, however, be in great part removed by the addition of water with equal parts of calcined magnesia and coarse animal charcoal, and agitating the mixture at intervals during two or three days. The dark colour may also be got rid of by exposure to sun-light, and filtration through animal charcoal. Pure castor oil is said to be entirely dissolved in its own weight of alcohol, and in two of rectified spirit. (*Brit. Phar.*)

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. The leaves, usually in the form of decoction, are said to be 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 in its action. It causes increased activity of the bowels, but without the frequent and watery discharges induced by some cathartics. Its action seems to depend rather on its increasing the peristaltic motion, than the secretions of the intestines. It may usually be observed in oily-looking 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 taken in the usual way. 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 seems 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 taste and oleaginous form, and in most cases may be obviated by giving the oil with mucilage, a little spirit, or some aromatic, and making sure of its being free of all rancidity.

In properly regulated doses, castor oil produces purgation without irritation or griping, and hence 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 in other cases where more drastic purgatives might induce undue irritation. Its anthelmintic effects have sometimes been over-estimated, are in reality very slight, and are 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 Madras, 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 might be 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 up 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; whilst, to increase its efficiency, it is combined with small quantities of oil of turpentine or of croton.

CATECHU.

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

Three different plants yield the catechus of commerce and medicine: the Uncaria Gambir, a stout, climbing shrub, belonging to the natural family Rubiaceæ, inhabiting the islands of the Indian Archipelago, and yielding the pale catechu gambir or terra japonica, the only variety now recognised by the Pharmacopœia; the Acacia Catechu, an East Indian tree, fifteen to twenty feet high, yielding the black or brown catechus; and the Areca Catechu, or betel nut tree, a tall, beautiful palm, with a fibrous fruit, containing the astringent seed or betel nut (p. 170). 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, 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 without odour, soluble in alcohol and ether, imperfectly soluble in cold water, almost entirely dissolved by boiling water, with which it forms a red-brown solution, which, on cooling, becomes turbid from the deposition of the minutely crystalline catechine, or catechuic acid, which, with tannic acid, are its active principles, and together constitute from 36 to 40 per cent. of the catechu. Good samples are sweet, and free from bitterness and grittiness.

Black or brown catechu (catechu nigrum), or cutch, is imported chiefly from Pegu, in masses weighing about a hundredweight, and made up of layers of small pieces of two to four ounces, enveloped in glanmes or husks of rice. 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 catechine.

Actions and Uses.—Catechu is astringent. Like other tannin-containing substances, it combines with the gelatine and albumen of the tissues, lessens their calibre, and renders them insoluble and capable of resisting putrefaction. Hence its value in the preparation of tanno-gelatine or leather. Catechu being less astringent than oak-bark or galls, is more suitable for internal administration. It is given to all the domesticated animals in excessive mucous discharges, especially from the alimentary canal. It such cases it is often advantageously combined with aromatics, to remove flatulence; with opium, to relieve irritability; and with chalk, magnesia, or an alkali, to counteract acidity. A convenient formula for diarrhœa may be 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, three for a cow, and eight or nine for a calf or sheep. For these ruminants the dose is conveniently given suspended in a little starch gruel. Catechu is occasionally used as an application for sluggish sores and ulcerations, for excoriations on the udder of cattle, and for all the ordinary purposes of a vegetable astringent. Catechu nearly resembles, but is more powerful than kino, the inspissated juice of an East Indian tree, the Pterocarpus Marsupium; and than rhatany, the dried root of a Peruvian shrub, the Krameria triandria.

Doses, etc.—The dose of catechu for horses is from ʒi. to ℨiij.; for cattle, from ʒij. to ʒvi.; for sheep and swine, from ℨi. to ʒij.; and for dogs, from grs. iv. to grs. xx. These doses may be administered three or four times a day, with a sufficiency of mucilage or gruel to cover their astringent taste. An infusion may be readily prepared for veterinary purposes, by pouring boiling water over any convenient quantity of coarsely powdered catechu, allowing the mixture to stand by the fire for an hour, and straining. Flavouring ingredients may be added if required. A good tincture is made by the following process of the Phar.:—'Take of catechu, in coarse powder, two ounces and a half; cinnamon bark bruised, one ounce; proof spirit, one pint; macerate for seven days in a closed vessel, with occasional agitation; strain, press, filter, and add sufficient proof spirit to make one pint.' For external purposes, the powder or infusion, and occasionally 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 an active volatile oil, which, when first distilled, is of a beautiful blue colour, gradually becomes yellow, and contains a hydrocarbon (C_{10} H_{16}) isomeric with oil of turpentine, present in cardamom, caraway, and other aromatics, and associated with it an oxidized portion (C_{10} H_{16} O_2). (Attfield.)

Actions and Uses.—Chamomile flowers are stomachic, carminative, and mildly tonic. They are occasionally given as a domestic remedy to horses and cattle in doses of one to two ounces; to calves, sheep, and swine, in doses of a drachm; and are sometimes used in the form of fomentations and poultices; as external applications they are, however, 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 some of the harder woods into heaps, covering them with turf and sand, and leaving a few apertures for the admission of air. The pile is then ignited; after the flame has risen through the whole mass, the openings are closed, and the combustion proceeds slowly without access of air. The moisture of the wood, its oxygen, hydrogen, and nitrogen, are dissipated, leaving carbon and mineral matters. 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. (Berthier.)

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 with about ten times its weight of calcium phosphate and carbonate (Graham), which exist in a state of very fine division, separate the particles of the charcoal from each other, and greatly enhance its value as an agent 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 containing a large proportion of phosphates.

Actions and Uses.—Insoluble both in water and acids, charcoal has no physiological effects; and its few medicinal actions are dependent chiefly on its desiccant, antiseptic, and deodorizing properties. In chronic diarrhœa and dysentery, especially in cattle, it is occasionally used to counteract flatulence and lessen the fœtor and acrimony of the fæces. Although once much used as an anthelmintic, it is now superseded by more certain and potent remedies. As an antidote for arsenic, nux vomica, aconite, and some other poisons, it acts mechanically by enveloping their solid particles. Like other insoluble powders it is only effectual, however, when given promptly, and in cases where the poison has been in moderate amount, and in the solid form. In virtue of its absorbing and deodorizing properties, charcoal is occasionally applied to unhealthy wounds and ulcers, especially when accompanied by irritating and offensive discharges. It is either sprinkled directly over the unhealthy surface, or mingled with simple poultices. In pharmacy and other arts it is much used for decolorizing and purifying organic solutions. So great is its absorbing power, that one volume of good boxwood charcoal will take up 90 volumes of ammoniacal gas. It precipitates the colouring matter of urine with the urea and uric acid, but not the sugar of diabetic urine. The charcoal used in sugar refining and other such processes, when exposed to a high temperature, has the entangled organic particles contained in its pores effectually destroyed, and is again as serviceable as at first. Sprinkled over meat or game, or in barrels of water intended for long keeping, it retards putrefaction. Although a deodorizer and feeble antiseptic, it is not however volatile, and hence cannot reach or destroy floating germs of contagion.

Doses, etc.—The dose of charcoal for the horse varies from ʒiv. to ℥i. ; for cattle, it is about ℥i. ; for sheep and pigs, from ʒi. to ʒiij. ; and for dogs, from grs. x. to grs. lx. It is usually given suspended in gruel or any other mucilaginous fluid. Its absorbing powers may be materially increased by raising it to a low red heat shortly before it is used.

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 pungent liquid chloral ($C_2\ HCl_3\ O$), purified by distillation with sulphuric acid and mixed with water, becomes the solid hydrate ($C_2\ HCl_3\ O,\ H_2\ O$), which occurs either in colourless needle-like crystals, or when evaporated in vacuo, in solid plates. When pure, it is transparent, aromatic, bitter, and astringent, permanent in air, melts at about 133°, and boils at 204°. It is soluble in water, alcohol, ether, petroleum, and oil of turpentine. When impure, it is yellow and cloudy, pungent, irritating, and caustic, and is imperfectly dissolved, or forms oily drops with water.

Actions and Uses.—Chloral hydrate is a narcotic poison, destroying life much in the same way that chloroform does. Used medicinally, it is an anodyne and anæsthetic. Dr. W. B. Richardson has made with it an extended series of experiments on the lower animals ; fishes and pigeons were narcotized by 1½ to 2 grains, mice by one-third of a grain, rabbits weighing 85 ounces by 30 grains ; 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. Chloral hydrate is readily absorbed and quickly diffuses itself throughout all parts of the body. By the alkalies of the blood it is converted into chloroform, which produces its generally soothing effects. Carried to the brain and nervous centres it allays irritability, and hence proves useful in counteracting the spasms of chorea and epilepsy; temporarily it relieves those of tetanus and hydrophobia; and when given in time, holds in check the tetanic seizures of strychnine and prussic acid. Mr. Robert Littler, Long Clauson, gives it with benefit in the outset of these cases of parturient apoplexy in cows, in which there is intense excitement of the nervous system and violent cramp of the muscles of the hind extremities. Asthma in dogs, violent paroxysmal coughing and colic pains in horses, are generally benefited by a few doses. 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. In small and frequently repeated doses it has been given with advantage in inflammation of the bowels in horses, with the result of allaying pain, moderating the elevated temperature, and hastening convalescence.

Chloral hydrate resembles opium in its anodyne properties, but it does not diminish the action either of the bowels or kidneys, nor does its frequent use render the patient less susceptible to its effects. In its power of relaxing spasm it resembles amyl nitrite, which Dr. Brunton has recently shown to relax the whole arterial system, probably by partially paralyzing the sympathetic ganglia and motor nerves. (Ringer's *Handbook of Therapeutics.*) Its solid form prevents chloral hydrate being inhaled like an ordinary anæsthetic; but when swallowed, chloroform, as already stated, is produced, exerting many of its familiar soothing and pain-assauging influences. As an external local anæsthetic, it is less effectual than chloroform or ether. Bromal hydrate is much less soothing than chloral hydrate; the bromine, indeed, asserts its irritating action, and, according to Dr. Dougall's experiments, induces restlessness, difficult breathing, imperfect sleep, and, in fatal doses, convulsions.

Doses, etc.—For horses and cattle the dose of chloral hydrate is from ʒiv. to ℥i.; for sheep and pigs, from ʒi. to ʒiij.; for dogs, from grs. x. to grs. xxx. The doses may be repeated every two hours, or even oftener. It is greatly more effectual when given after the animal has been fasted for three or four hours. A convenient form of administration is with two or three ounces of syrup. Injected hypodermically, about half the dose given by the mouth appears to suffice, and there is apparently no risk of producing the erysipelatous inflammation which has sometimes followed its injection in the human subject. Employed in this way, good effects have followed in cases of bronchitis and enteritis in horses; whilst considerable alleviation of the symptoms have also occurred in a few cases of pleuro-pneumonia in cattle in which it has been tried. The narcotic paralyzing effects of an overdose of chloral hydrate are combated by the free use of ammonia and alcohol. Its nearest physiological opposite is strychnine.

CHLORINE.

Chlorine is prepared by heating sulphuric acid with common salt and manganese black oxide. For fumigating the Millbank Penitentiary, Dr. 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 only a 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 potash alum.

Chlorine is a yellow-green gas, with a peculiar suffocating odour, an astringent taste, a density of 35·5; it is soluble in less than half its volume of water at 60°. For eighty years it has been used as a bleaching agent. Applied to the skin, it causes redness and eruption, and produces similar effects on the alimentary canal when swallowed in solution. It is so irritating, that it can only be respired in a state of dilution. Its irritant effects are, however, considerably diminished by the force of habit, and are relieved by inhaling ether or the vapour of warm water, ammonia, or alcohol. Small amounts freely diluted are recommended in human practice in chronic cough, bronchitis, and phthisis, and also in poisoning by prussic acid and sulphuretted hydrogen. In contagious pleuro-pneumonia in cattle, cautious inhalation usually relieves cough and difficult breathing.

Chlorine is much used as a deodorizer, antiseptic, and disinfectant. Fresh meat bottled with the gas was found by Dr. Angus Smith to be bleached externally, but red within, and unchanged at the end of twenty-eight days. Its bleaching, deodorizing, and most other properties depend upon its affinity for hydrogen. Aided by sunlight it also decomposes water. The hydrochloric acid thus formed, and the nascent oxygen, both exert considerable power in altering the composition of organic matters. In like manner they doubtless also attack and decompose any septic germs with which they come into contact. Hence chlorine ranks as a disinfectant. Dr. Angus Smith states (Third Report, p. 184), 'that good accounts of cattle plague prevention by it have been heard of.' 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 deodorizer, it is inferior as a disinfectant either to sulphurous or the tar acids. It has the practical disadvantages of being somewhat trouble-some 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, as it intensifies the action of the chlorine; the walls and wood-work 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, nearly 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 wood spirit, bleaching powder, and water, and washing the crude product to free it of deleterious matters.

The *Brit. Phar.* gives the following explicit directions for making and purifying:—'Take of chlorinated lime, ten pounds; rectified spirit, thirty fluid ounces; slaked lime, a sufficiency; water, three gallons; sulphuric acid, a sufficiency; chloride of calcium in small fragments, two ounces; distilled water, nine fluid ounces. Place the water and the spirit in a capacious still, and raise the mixture to the temperature of 100°. Add the chlorinated lime and five pounds of the slaked lime, mixing thoroughly. Connect the still with a condensing worm encompassed with cold water, and terminating in a narrow-necked receiver, and apply heat so as to cause distillation, taking care to withdraw the fire the moment that the process is well established. When the distilled product measures fifty ounces, the receiver is to be withdrawn. Pour its contents into a gallon bottle half filled with water, mix well by shaking, and set at rest for a few minutes, when the mixture will separate into two strata of different densities. Let the lower stratum, which constitutes crude chloroform, be washed by agitating it in a bottle with three ounces of the distilled water. Allow the chloroform to subside, withdraw the water, and repeat the washing with the rest of the distilled water, in successive quantities of three ounces at a time. Agitate the washed chloroform for five minutes in a bottle with an equal volume of sulphuric acid, allow the mixture to settle, and transfer the upper stratum of liquid to a flask containing the chloride of calcium mixed with half an ounce of slaked lime, which should be perfectly dry. Mix well by agitation. After the lapse of an hour connect the flask with a Liebig's condenser, and distil over the pure chloroform by means of a water bath. Preserve the product in a cool place, in a bottle furnished with an accurately ground stopper. 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 of manufacture the chief changes which occur are the evolution of oxygen and chlorine from the chlorinated lime; the reduction of alcohol into aldehyd; the subsequent formation of hydrochloric acid and chloral; and finally, the production of the chloroform, with the by-products of calcium formiate and chloride, and water. The repeated agitation with water washes away saline acid and various organic impurities; shaking with sulphuric acid, which must be scrupulously free from nitric acid, chars and removes the last traces of organic oils; the admixture with calcium hydroxide, and chloride, gets rid of acid and water.

Properties.— Chloroform is a transparent, colourless, oily-looking, mobile fluid, with a density of 1·47, a sweet taste, and a fragrant etherial and apple-like odour. At ordinary temperatures it volatilizes 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 1-2000th part, a pint only holding sixty minims in solution. It readily dissolves volatile oils, wax, resins, and alkaloids.

Chloroform ($C\ H\ Cl_3$) is generally regarded as the chloride of the trivalent radical methyl ($C\ H$); marsh gas is the hydride of the series ($C\ H\ \ H$); methylic, or wood spirit, is the corresponding hydrate or alcohol ($C\ H_3\ H\ O$). But the series contains still other anæsthetics, namely, methyl chloride ($C\ H_3\ Cl$)—a gas soluble in ether, and the mixture, although rather unstable, approved as an anæsthetic by Dr. W. B. Richardson ; methyl bichloride ($C\ H_2\ Cl_2$)—a colourless volatile fluid, with a specific gravity 1·344, and combining most of the properties of chloroform and ether ; methyl acetyl, or acetone ($C\ H_3\ C_2\ H_3\ O$), which conjoins irritant with feeble anæsthetic properties ; and iodoform ($C\ H\ I_3$), irritant, irrespirable, but producing when swallowed intoxication with tetanic convulsions.

Impurities.—Chloroform carelessly prepared or imperfectly purified occasionally contains volatile organic oils, which are apt to induce nausea and headache in those who inhale it. Specimens containing such impurities 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 lower specific gravity and lose bulk when shaken with water. The presence of water, besides affecting the gravity, causes cloudiness at temperatures approaching 32°. Traces of sulphuric acid are discovered by the usual barium test, and chlorine and hydrochloric acid by silver nitrate. In judging of the purity of chloroform, it is chiefly necessary to note its odour when evaporated, its behaviour when agitated with sulphuric acid, its reaction on litmus, and its specific gravity, which is invariably lowered by the presence of adulterations.

Actions and Uses.—Chloroform is a narcotic poison. It is used medicinally as a stimulant, antispasmodic, anodyne, and anæsthetic; applied externally, it is rubefacient, refrigerant, anodyne, and locally anæsthetic.

The poisonous narcotic effect of chloroform is very analogous to that of alcohol, ether, and other inebriants, and is readily caused by large doses introduced into the stomach, or rapidly inhaled without sufficient admixture of air. Possessing a high diffusive power, the volatile chloroform rapidly enters the blood. The physical or chemical changes it produces there are, however, at present unknown. Dr. Harley believes it lessens oxydation, and diminishes evolution of carbonic acid. Its effects, according to the late Dr. Snow, are readily observed so soon as the blood takes up 1-56th part of the amount it is capable of dissolving. It acts directly on the nervous centres, first perverting and then gradually extinguishing their several functions. An ordinary anæsthetic dose affects these centres in tolerably regular order; involving first those presiding over special sense and volition; next those of common sensation and motion; and, lastly, where the influence is unduly prolonged, those which regulate the respiratory and circulatory movements. The symptoms which occur as the agent successively involves these several parts, have been already fully noticed under the head of Anæsthetics. It may be sufficient here to mention that there is at 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, which may usually be produced within five minutes, is that required for the performance of serious operations, and may with caution be safely enough 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 movements. With such warnings artificial respiration must instantly be resorted to, great care being used to prevent any rough handling, which might entirely paralyze the weakened heart. Cold water should be thrown over the head and neck; windows or doors opened to secure a current of fresh air; the tongue drawn forward, lest it interfere with inspiration; and, where thought desirable, the trachea opened. 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. In chloroform poisoning, life is destroyed mainly by paralysis of the action of the heart. This view is supported by Dr. Harley's observation, that the hearts of frogs cease to beat sooner in chloroform than in watery vapour; and are paralyzed by chloroform even after vagus sympathetic and spinal chord are severed. Dr. W. B. Richardson (*Lecture on Anæsthetics*) thus summarizes his views of death by chloroform :—'In the first stage of administration, the effect of the vapour is upon the peripheral nervous surface and the cerebral centres. In both there is excitation, and very early the cerebral centres lose their natural condition, becoming suspended in function. Following immediately upon this, the chord, the sympathetic system, and the true nervous system of the heart become excited. Thirdly, the nervous excitation generally ceases, and there follows calmness, or even depression of action; and if the administration be continued, the medulla fails, the sympathetic fails, the cardiac nervous centres fail. This, then, is the natural order of death of each part—brain, chord, sympathetic centres, cardiac centres.'

No very notable *post-mortem* appearances are observable. 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 known 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. A less amount is required than of ether; its effects, although sufficiently quick, are not so alarmingly rapid as those of methyl bichloride, which anæsthizes 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. It cannot, however, be used so conveniently or safely in the lower animals as in man. In horses, its anæsthetic action is often preceded by considerable excitement; and if, to prevent this, it be given rapidly and in large amount, it occasionally proves fatal. These untoward results are even still more 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.

The uses of chloroform are not as yet so extensive 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 possible 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 has also occasionally removed strangulation of the bowels in horses. Although its inhalation has been recommended in cases of tetanus, and relief is obtained so long as the anæsthesia continues, the spasms speedily return with all 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 pain, 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 it is probably entitled to more extended use as a means of relieving the pain of serious internal diseases, especially when 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 cases of pleuro-pneumonia. It frequently, however, arrests epileptic fits and chorea in dogs.

When swallowed, it proves a useful antispasmodic in all animals in cases of colic, asthma, and troublesome cough. Such coughs occasionally occur in horses after epizootic sore throat, and are greatly benefited by diluted chloroform or chloric ether, which may be 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 ensure a 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 is, however, more rapid and effectual. It 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, it is a ready, cleanly, but somewhat expensive way of removing lice and fleas. Its high diffusive 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 anæthesia. Two or three ounces will generally be effectual in horses or cattle, one to two ounces for sheep and pigs, one to two drachms for dogs. The exhibition 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 ensure 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 action 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, the condition of the pupil, and the reflex sensibility of the conjunctiva, must be carefully watched. If an undue effect be produced, the inhalation must be immediately stopped, fresh air allowed to flow in currents about the face, 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 from f℈i. to f℈ij.; for sheep and swine, from ♏xx. to ♏xl.; and for dogs, from ♏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, sometimes 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 etherial 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, f℈ij. to f℈vi.; and for dogs, f℈i. to f℈ij.

Chlorodyne, so familiar as an anodyne in human medicine, appears to be made from different formulæ, and contains chloroform, chloric ether, ether, morphine muriate, capsicum, peppermint water, prussic acid, and usually Indian hemp. (*Year-Book of Pharmacy for* 1870.)

CINCHONA.

Bark of different species of Cinchona.

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

The natural history of the cinchonas has been admirably elucidated by Dr. Weddell (*Histoire Naturelle des Quinquinas*, Fol., Paris 1849), who describes nineteen species; eight only are valued for yielding the active principles of the bark; four only receive mention in the *Brit. Phar.* The cinchonaceæ are evergreen trees, or tall shrubs, with fine foliage, and beautiful fragrant flowers. They abound on the slopes and valleys of the Andes; extend in a comparatively narrow zone 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 from four to ten thousand feet above the sea-level. The bark is collected during the dry season from May to November, and is stripped from the trees usually after they have been felled, but occasionally whilst they are standing, when the exüdate which next season covers the wood is 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 packed in chests or in serones, which are formed of hides or coarse cloth, and contain from 70 to 150 pounds of the bark. It is exported from Bolivia and other places along the coast of Peru, whence its vernacular name of Peruvian bark. 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 forty to fifty different sorts of bark met with in commerce, for convenience of description, are divided into pale, yellow, and red barks.

The PALE CINCHONAS are usually in thin fibrous rolls or quills, and are mostly stripped from branches or young trees. Their powder is light coloured, astringent rather than bitter, and contains cinchonine in larger proportion than quinine. Crown or Loxa bark, the produce of the *C. Condaminea*, occurs in quills from six to fifteen inches long, and about the size of the finger, and is invested with a grey or tawny epidermis, which is always entire, marked with longitudinal furrows and transverse cracks, and covered with lichens. The inner surface of the bark is orange or cinnamon-brown; and its yellow-red powder is lighter than that of either the red or yellow barks. The *grey* or *silver bark* is another fine variety of the pale cinchonas.

The YELLOW CINCHONAS (Cinchonæ flavæ) include a great variety of barks; the most highly-prized receives the specific title of *yellow cinchona* or *C. regia*, and yields from three to three and a half per cent. of crystallized quinine sulphate. It occurs in quills, more commonly in flat pieces, which are most esteemed, and are usually eight to fifteen inches long, one to three broad, and two to five lines thick. The brown, rough-fissured epidermis is usually removed before importation. The pieces often 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 yellow-orange; the odour aromatic; the taste bitter, without astringency. Dr. Weddell has shown that the best yellow bark is obtained from the *C. Calisaya*, a tall tree, 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.

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 usually occur in flat pieces, twelve to fifteen inches long, varying in length and thickness; made up of liber cortical substance and epidermis; are red, rough, and wrinkled externally; are fibrous red-brown internally; have a feeble, agreeable odour, and a bitter, slightly astringent taste. They yield from two to four and even five per cent. of quinine and cinchonine, the former in larger proportion.

The C. lancifolia is recognised by the *Brit. Phar.* as a source of quinine sulphate, is known as Coquetta or Bogotta bark, but is rather variable in appearance and quality. For mixing with the superior varieties of pale yellow and red barks, various inferior sorts are collected. Such are the ash, rusty, and the various kinds of Carthagena bark. The best tests of the value of any specimen are its general appearance, fracture, colour, odour, taste, and percentage of alkaloids.

Properties.—The several cinchona barks have certain common characters. They occur either in quills or flat pieces, have an aromatic odour and bitter taste, astringent especially in the lowest qualities. Their colour varies through the shades of yellow to red, and is deepened by exposure to moisture. They are soluble in cold and hot water, and in alcohol of all densities; but their best solvents are proof spirit and diluted acids. When solutions are exposed to a high or prolonged heat, the colouring matter unites with the alkaloids, forming insoluble compounds, and on this account decoctions and extracts are ineligible preparations. The special alkaloids, in combination chiefly with kinic acid, and in a slightly soluble form, occur in the liber. By digesting the bark with hydrochloric acid they are dissolved, and from such solution are precipitated by an alkali. Cinchona bark contains the following constituents:—

Quinine or quina ($C_{20}\ H_{24}\ N_2\ O_2\ 3H_2\ O$) is found most abundantly in the yellow barks, which yield from two to three per cent. When a solution of the disulphate, its most common salt (see p. 262), is treated with ammonia solution, the alkaloid is precipitated as an amorphous white powder. By slow evaporation of a concentrated solution, it may also be got in delicate, needle-like crystals. It has an intensely bitter taste, requires for solution about four hundred parts of cold water, but is more soluble in alcohol, ether, and diluted acids. It forms colourless, bitter, crystallizable, rather insoluble salts, remarkable, like the alkaloid, for their tonic and antiperiodic properties. Unlike the two other alkaloids of cinchona, they have the character of left-handed polarization. Acidulated solutions, treated first with chlorine water and then with liquor ammoniæ, acquire a green colour.

Quinidine, amorphous or β quinine, has the same formula as quinine, but its crystals are anhydrous. It is found in most barks, is less bitter and even less soluble in water, but, unlike quinine, is not soluble in ether; its sulphate, however, is more soluble.

Cinchonine or cinchonia ($C_{20}\ H_{24}\ N_2\ O$) is present to the amount of nearly two per cent., chiefly in the pale barks, and may be extracted by the quinine sulphate process (p. 262). Its colourless, four-sided prisms have a feebly-bitter taste, and are scarcely soluble in water, alcohol, or ether—a test which distinguishes it from quinine. Another distinctive feature is the absence of green coloration when treated with chlorine and ammonia. Its actions and uses are identical with those of quinine and quinidine, but it is less powerful probably by one-third.

Kinic or quinic acid ($C_7\ H_{12}\ O_6$) occurs in combination with the alkaloids, and with earthy bases; from its aqueous solution it crystallizes in transparent large rhombic prisms; is sour to the taste, decomposes when heated, and comports itself in many respects like acetic acid. Kinovic acid, or kinova, probably a modified condition of the kinic acid, is white, amorphous, soluble in alcohol and ether, but scarcely in water, and possessed of bitter and tonic properties.

Cinchonic, yellow and red, are uncrystallizable, insipid, colouring matters, partially soluble in water, readily soluble in alcohol and dilute acids, and forming, when heated with the alkaloids, insoluble and nearly inert compounds—two of which, quinicine and cinchonicine, have been especially examined. The tannic or cincho-tannic acid present in bark is less astringent than that of galls, readily absorbs oxygen, and, with iron persalts, gives a green colour or precipitate. Cinchona further contains a volatile oil, resin, starch, gum, lignin, and lime salts.

Actions and Uses.—Cinchona bark, in large doses, is slightly irritant; and, in medical doses, antiseptic, tonic, antiperiodic, and astringent.

Large quantities, in the state of powder, cause irritation of the alimentary mucous membrane, increased force and frequency of the pulse, and, in the dog, vomiting. In rabbits, thirty grains caused debility, and sixty grains death (Christison). An ounce and a half of a strong decoction injected into the jugular vein of a dog, caused, after the lapse of about fifteen minutes, vomiting, violent palpitations, and spasms; and the injection of half an ounce more produced tetanus and death. Persons working constantly amongst bark suffer from itching and eruptions of the skin. Dr. Angelo Monteverdi, of Cremona, recently investigating the subject, concludes that bark and its alkaloids act first upon the sympathetic and then upon the spinal nerves, and thus develope contraction of these mucular fibres supplied by the sympathetic to the alimentary canal, the urino-genital organs, and the blood-vessels. Dr. Headland, on the other hand, thinks that they act upon the blood rather than the nerves; that quinine resembles and may supply in the blood one of its newly-discovered crystalline constituents; or that it may evolve taurine, to which it bears some chemical analogy, and thus stimulate the functions of the liver, which is generally at fault in those cases which are benefited by cinchona (*Action of Medicines.* Fourth Edition). But an explanation of the efficacy of bark and its alkaloids is probably not so far to seek. They are remarkable antiseptics. 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 low organisms.

These antiseptic properties of cinchona and its alkaloids appear reasonably to account for their well-observed power of staying febrile and even inflammatory processes, diminishing tissue waste, lowering exalted temperature, lessening the formation of urea and uric acid. Their readiness to destroy malarial and other toxic germs may also explain their remarkable power of arresting those diseases in which the symptoms recur at regular intervals, such as ague in man, some febrile and nervous attacks in horses, and chorea in dogs. This antiperiodic action has not hitherto been observed except in cinchona and its alkaloids, arsenic, and salts of bebeerine. The eucalyptus globulus, or blue gum tree, of which the leaves and other parts are much used in Austria as a febrifuge, yields crystalline salts resembling quinine in appearance and action. The astringent effects of the crude cinchona bark depend upon the tannic acid and allied bodies it contains. The alkaloids are excreted unchanged mostly in the urine, occasionally in the perspiration and fæces, sometimes for several days after their administration has ceased.

Cinchona is prescribed in all animals in cases of impaired appetite and weak digestion. It increases slightly the secretion of saliva, gastric juice, and intestinal mucus; checks any tendency to undue fermentation, and in irritability of the bowels often imparts tone. Along with gentian, hydrochloric acid, and a little spirit, I often use it for young calves that have suffered from diarrhœa. It is prescribed in other inordinate mucous discharges depending on defective tone; in passive hemorrhages; typhoid affections; 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 or certain cure. 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 of the remedy should be given several hours before the seizure is anticipated. It is contra-indicated in acute inflammatory fever, and where the bowels are irregular and constipated. It is occasionally used externally as an astringent and antiseptic.

Doses, etc.—The doses of cinchona bark for horses are ʒij. to ʒiv.; for cattle, from ℥i. to ℥ij.; for sheep and pigs, ʒi. to ʒiv.; for dogs, grs. xx. to ʒi.; repeated twice or thrice a day 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 a bolus, and is often conjoined with camphor, gentian, ginger, spirits, or ethers. The infusion is made by digesting for some hours, or boiling for ten minutes in a covered vessel one part of powder, and ten or twelve parts of water, and then straining. The tincture is conveniently prepared by the *Brit. Phar.* process :—'Take of yellow bark in moderately fine powder, four ounces; proof spirit, one pint. Macerate the bark for forty-eight hours in fifteen fluid ounces of the spirit, in a closed vessel, agitating occasionally; then transfer to a percolator, and when the fluid ceases to pass, continue the percolation with the remaining five ounces of spirit. Afterwards subject the contents of the percolator to pressure, filter the product, mix the liquids, and add sufficient proof spirit to make one pint.'

QUININE SULPHATE or DISULPHATE (Quinæ Sulphas) possesses in a concentrated form all the properties of cinchona bark, and is the quinine salt most generally used. As it is procured from the manufacturing chemist, minute details regarding its preparation are unnecessary. The proportion yielded by different barks varies from one to four per cent. The yellow bark is usually preferred. Reduced to coarse powder, it is treated with hydrochloric acid, the alkaloids thus dissolved are thrown down by solution of soda, washed repeatedly with water to remove saline and other impurities, re-dissolved by very diluted sulphuric acid, filtered, evaporated, and crystallized, leaving in solution any other alkaloids present. The salt contains two atoms of quinine, one of sulphuric acid, and seven of water of crystallization ($2\ C_{20}\ H_{24}\ N_2\ O_2,\ H_2\ SO_4,\ 7\ H_2\ O$).

Properties.—Quinine disulphate occurs in fine, silky, colourless, odourless crystals, which adhere together in little tufts, and have an intensely bitter taste. Exposed to the air it effloresces, giving off three-fourths of its water of crystallization. It is soluble in 740 parts of cold water, and about 30 of boiling water; a few drops of sulphuric acid convert it into the neutral sulphate, which is freely soluble. Its acidulated watery solution has a faint blue tint, exhibits on its surface a peculiar fluorescence—a characteristic test—and noticeable even when it is diluted with a thousand times its weight of water. With alkalies and alkaline carbonates it yields white precipitates of quinine. When a faintly acidulous solution is treated first with chlorine water, and then with liquor ammoniæ, a green-coloured solution is produced, from which a green precipitate shortly separates. A drop of chlorine water, a few drops of concentrated solution of potassium ferrocyanide, followed as in the previous case by the liquor ammoniæ, produces a bright red colour, passing after some time into green.

Impurities.—Sulphate of quinine is liable to various adulterations. The most common are calcium sulphate, which with other earthy impurities is detectable by incineration; sugar, discoverable by the sweetness of the residuum left on evaporating the solution; 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. Cinchonine or quinodine are detected by throwing down the alkaloids from solution by liquor ammoniæ, and then 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.

QUINIDINE, quinidia, amorphous quininæ, β quinine, having a soluble sulphate, remains in the mother liquor, from which the quinine disulphate is crystallized, and may be precipitated by an alkali, re-dissolved in alcohol, and crystallized. Quinidine is also produced when salts of quinine are exposed to strong light, or are treated with excess of acid, and its large amount in some specimens of bark appears to be owing to careless drying and undue exposure to sun-light. It occurs in anhydrous, colourless, hard, transparent prisms, is not so bitter as quinine; but although freely soluble in boiling spirit and twelve parts of cold alcohol, it requires for solution 2,580 parts of temperate water. In an impure state it is sometimes met with as a yellow, brittle, uncrystallizable substance—a mixture of all the alkaloids and various colouring matters. Although scarcely so powerful, it is identical in its action with quinine, and being considerably cheaper, deserves the attention of veterinarians.

Actions and Uses.—Quinine disulphate, quinidine, and cinchonine differ only slightly in the degree of their action, and are applied to the same uses. They differ from the crude bark mainly in their concentration, and their being devoid of astringency. Quinine sulphate is beyond all comparison the most powerful and certain of vegetable tonics, and is an active antiseptic and antiperiodic. Its expense alone precludes its more extensive use in veterinary practice. It is suitable for all animals in loss of appetite, and weak digestion depending on debility; in convalescence from acute complaints; in chronic exhausting diseases. It is prescribed in horses in strangles, influenza, purpura, and typhoid fever. No tonic is better adapted for badly-nourished dogs, especially when suffering from distemper; it allays irritation, counteracts perverted and inordinate nervous action; given along with port wine or ether, it prevents untoward complications, and expedites recovery. Similar treatment also answers well in chorea. Quinine given with cathartics, is believed to increase their activity; but its actions in combination have as yet been imperfectly studied.

Doses, etc.—The dose of quinine disulphate for horses is from grs. x. to grs. xx.; for cattle, from grs. xx. to grs. xl.; for sheep and pigs, grs. v. to grs. x.; and for dogs and cats, from gr. i.

to grs. v. Quinidine, if good, is used in the same doses; cinchonine, in quantities one-third greater. These doses should be repeated thrice a day; and when the medicine is given as a tonic, it should be persevered with for some days, and occasionally alternated with other remedies of the same class.

It may be given in the form of pill, which is conveniently administered to the dog in a spoonful of thick gruel or a bit of meat. The solution in water, acidulated with a few drops of sulphuric acid, is often used, and 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. Quinine sulphate has been used endermically. A small blister is applied, the vesicles formed are laid open, the medicine in powder scattered over the exposed surface of the true skin, whence it is readily absorbed, and produces its effects in the same manner as if given in the usual way. Two-grain doses, dissolved in ether, repeated daily or as required, have been used with benefit by Mr. Thomas A. Dollar, in sciatica in the horse.

COD-LIVER OIL.

Morrhuæ Oleum. Oleum Jecoris Aselli.

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 into casks. The chief supplies come from Newfoundland. Good samples have a pale yellow colour, and an oily, fishy taste, which, however, becomes less obvious to those long accustomed to take it. The dark colour and nauseous flavour of indifferent specimens result from exposure to high temperatures, or from the oil being extracted from stale putrid livers. Its specific gravity is ·923; it is soluble in ether, and in about forty parts of cold alcohol, and about half that amount of hot alcohol. It consists of 80 per cent. of oleine and 15 per cent. of margarine, a bile material called gaduin, other biliary matters, acetic and nitric acids, and occasional traces of phosphorus, iodine, bromine. A drop of sulphuric acid, added to a few drops of cod-liver oil in a porcelain cup, developes a violet colour which passes to yellow or brown red, depends upon the presence of bile acids, 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, it causes, when given in large doses, derangement of the bowels and purgation; but in small and repeated doses, it is saponified and assimilated, becomes a source of heat and of force, nourishes the nervous and other vitally-endowed organs, increases the intercellular fat, and usually adds 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 oil.

As a nutrient tonic, cod-liver oil, in the human subject, 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 resulting from weakness. It may be advantageously given to dogs and cats in various scrofulous disorders, protracted cases of distemper, inveterate skin diseases, 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 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 ʒi. The doses may be repeated twice a day, and persevered with, if required, for weeks. To remove disagreeable flavour, and prevent nausea, it may be 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. *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 the month of 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 official part of the plant, is usually taken up in June or July, when plump, rich in starch, and about a year old; but Sir Robert Christison considers that, although more shrivelled and watery, it probably continues equally active throughout the succeeding winter and spring. The bulbs are stripped of their brown integument, sliced transversely, and dried at a temperature not exceeding 150°. The slices are greyish-white, dry and firm, with a bitter acrid taste. They yield their active principles to spirits and vinegar, the latter forming their cheapest and handiest solvent. The bulbs contain water, starch, lignin, gum, and a bitter, crystallizable, poisonous alkaloid called Colchicine present also in other parts of the plant. 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 crystallizable, and rather less acrid and irritating.

Actions and Uses.—Colchicum in large doses is an irritant poison ; and in medicinal doses, cathartic, diuretic, emetic, and sedative.

The powdered corm, or any active preparation, causes irritation of 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 was affected with patches of inflammation and erosion. M. Barry, in the *Recueil de Médécine Vétérinaire* for December 1862, records the case of a cow and heifer at 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 pure 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 more active than in horses or cattle. Two drachms of the dried bulb caused in dogs vomiting, diarrhœa, diuresis, 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, 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 also speak favourably of it in constitutional ophthalmia.

Doses, etc.—The dose of the powdered corm or seeds is, for horses, ʒss. to ʒj.; for cattle, ʒj. to ʒij.; for sheep, grs. x. to grs. xxv.; for dogs and pigs, grs. ij. to grs. viij. The powder, mixed with small doses of nitre, is commonly used, 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 in North America, crystallized in octahedrons or cubes, having a specific gravity of 8·9, 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 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 official salts, the sulphate, iodide, and acetate. It is dyad or bivalent, and forms two series of salts, the cupric containing one, the cuprous two atoms of copper. The cupric salts, when hydrated, have a green or blue colour. In acidulated solution copper is distinguished by the following tests :—Hydrogen sulphide and ammonium hydrosulphide give black precipitates of copper sulphide ($Cu\,S$) ; potash or soda, a greenish-blue precipitate of cupric hydrate ($Cu\,2\,HO$), insoluble in excess, but blackened by heat; ammonia, a similar precipitate, which redissolves on further addition of the precipitant, forming a deep blue liquid ($Cu\,SO_4, 2NH_3$); and potassium ferrocyanide, a chocolate-brown precipitate of copper ferrocyanide ($Cu_2\,Fe\,Cy_6$). 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.

Salts of copper closely resemble each other in their actions, being irritant and caustic in large doses, astringent and tonic in medicinal doses. They are analogous to compounds of silver and zinc. Copper, however, so long as it remains metallic, is devoid both of poisonous and medicinal effect. Drouard 'gave as much as an ounce of finely divided copper to dogs of different ages and sizes, but none of them experienced any inconvenience therefrom.' (Pereira.) As with other metals, however, copper acquires activity when either oxidized or converted into a salt. Animals depastured 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 which doubtless depend to some extent on the ingestion of small quantities of copper, but still more upon the arsenic which these smelting furnaces evolve in considerable amount. (See p. 179.) Injurious effects, such as have frequently taken place in the human subject, have also occurred in the lower animals, especially in the pig and dog, 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. Acidulous and fatty matters are most apt to become thus contaminated, and especially if kept long in contact with copper, which is at the same time 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 three times its weight of 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 oxidized into sulphates; at the red heat used, the iron sulphate is decomposed, and the copper sulphate crystallized 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 triclinic prisms, has a specific gravity of 2·2, and a strong styptic metallic taste. Exposed to the air it effloresces, and becomes covered with a greenish-white powder of the carbonate. It is insoluble in alcohol, but is soluble in about two parts of boiling and four of temperate water. The ordinary blue vitriol, when exposed to a temperature of 400°, loses its water of crystallization, 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 of copper sulphate cause irritation of the alimentary canal. Its continued ingestion induces colic, deranged digestion, and chronic nervous disorders, analogous to those caused by lead; medicinal doses are tonic and astringent; in virtue of its irritant action, it is an emetic for the dog. Externally it is used as a stimulant, astringent and caustic; and it is, besides, an effective antiseptic.

Hertwig mentions that large doses (as above, twelve drachms for horses and cattle, one drachm for sheep or swine, and half a drachm for dogs) cause indigestion, impaired appetite; in carnivora, vomiting, diarrhœa, inflammation of the stomach and intestines, and usually death. Drouard found that six grains of the sulphate, introduced into the stomach of a dog, killed it in half an hour, but left no appearance of inflammation. Mitscherlich further found that two drachms caused speedy death, but left no apparent inflammation, and no abnormal condition except 'blueness of the villous coat of the stomach, mingled with brownness, the apparent effect of chemical action.' (Christison on Poisons.) The same observer also mentions, that 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. In poisoning by copper salts the appropriate remedies are white of egg, milk, and other albuminous substances, to form an insoluble innocuous albuminate, iron filings to attract and fix the copper, or potassium ferrocyanide to produce an insoluble harmless salt. The sulphate and other salts of copper, whether administered in poisonous or medicinal doses, become absorbed, and have been detected by Professor Orfila and others in the blood and most of the internal organs, probably exist there as albuminates, and are eliminated both in the urine and fæces.

Copper sulphate is much used as an astringent and tonic in cases of atony and general feebleness, and especially amongst cattle, in which milder tonics sometimes appear of comparatively little use. In dysentery, glanders, and farcy, it arrests abnormal secretion from the bowels, improves the appetite, increases the general vigour, and even where it does not cure it often retards a fatal result; conjoined or alternated with spirituous or ammoniacal stimulants, it is serviceable in purpura, typhoid fever, and other reducing complaints; and like other active tonics, is useful during recovery from exhausting disease. A convenient formula consists of a drachm each of copper sulphate, nitre, and gentian, made into a ball with meal and water. Where the bowels are much relaxed, as in dysentery, a drachm of opium proves an excellent addition. Powdered and given in a ball, repeated for several consecutive mornings, and administered fasting, it is a useful general vermifuge for the horse. As a tonic and antispasmodic, it is serviceable for dogs affected with epilepsy and chorea. Applied externally, it is milder than silver nitrate; weak solutions often beneficially stimulate the mucous or abraded skin surfaces, forming with their albuminous secretions a protecting pellicle, under which healing goes on satisfactorily. It is a useful stimulant and astringent in chronic ophthalmia, in morbid conditions of the Schneiderian and other mucous membranes, scurfy affections of the skin, and superficial hemorrhage from minute vessels; and as a caustic 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 the 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 the dose for horses is from ʒi. to ʒij.; for cattle, ʒij. to ʒiv.; for sheep, grs. xx. to grs. xxx.; for pigs, grs. v. to grs. x.; and for dogs, gr. i. to grs. iij. These doses, repeated twice or thrice a day, are administered either in bolus or dissolved in some mucilaginous solution. As an emetic for the dog, the dose is from grs. viij. to grs. xv., dissolved in water; for pigs, about double that amount. For external purposes, either powder or solution is used. Mixed with equal weights of gunpowder and hog's lard, it makes an effective popular ointment for foot-rot in sheep.

COPPER AMMONIO-SULPHATE. Cuprum Ammoniatum. Cupric Ammonio-Sulphate. $Cu\ SO_4\ 2\ NH_3$.

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 may be prepared in a hydrated state by adding ammonia to a solution of copper sulphate until the precipitate first thrown down is nearly re-dissolved; and in this condition it is used as a test for arsenic. The dried salt has an azure-blue colour, a metallic coppery taste, and a powerful ammoniacal odour. Unless carefully protected from the air, it speedily loses ammonia.

Actions and Uses.—Its actions and uses are closely analogous to those of the sulphate, and it may be used in the same doses. Two or three drachms destroy dogs with intestinal irritation, and symptoms of nervous derangement. Two or four drachms are administered with benefit 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 tonic in chorea and other nervous affections. In veterinary practice, however, it has not been used sufficiently long or extensively to justify an accurate estimate of its value as compared with the sulphate.

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. It 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 chiefly 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. $Cu_2 O_1 2C_2 H_3 O_2$.

Chemists describe five several 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, and 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 on the copper plates, is scraped off, dissolved, and crystallized.

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 or impurity undissolved.

Actions and Uses.—Verdigris, like other copper salts, is an irritant poison, producing also nervous derangement; medicinally it is emetic, tonic, astringent, and antiseptic. Drouard exhibited twelve grains to a strong dog while fasting, and observed that it 'caused aversion to food, efforts to vomit, diarrhœa, listlessness, and death in twenty-two hours.' In some cases, paralysis of the hinder extremities was also observable, but in none was the stomach much inflamed. The neutral acetate ($Cu\ 2C_2\ H_3\ O_2$) appears more active; for Orfila found that from twelve to fifteen grains given to dogs, produced, besides the symptoms above mentioned, 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 days, convulsions and death. The irritant properties of verdigris render it a prompt and effectual emetic for dogs and other carnivora; but its use is not to be commended, as it is liable to become absorbed, and act as a poison. It is employed both internally and externally for the same purposes as the sulphate, and in the same doses. For external application it is used in the several forms of powder, solution, and ointment, the last conveniently 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 or oil.

CREASOTE.

Creasotum. Kreasote. Creasol. $C_8 H_{10} O_2$.

Creasote is one of the products of the distillation of wood tar; is present in wood-smoke, in pyroligneous acid, in the tar of coal and of peat; and confers on these substances their well-known antiseptic properties. It is usually obtained from wood-tar by a tedious and complex process, followed only on the large scale. A somewhat simpler process has been recently proposed—namely, distilling tar into a barrel half filled with water, removing the watery fluid which floats on the surface, 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 is said to contain from 20 to 25 per cent. of creasote. (Gregory.)

Properties.—Creasote is a mobile, oily, neutral fluid, 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 is not very soluble in water, but readily dissolves in alcohol, ether, glacial acetic acid, and volatile oils. Coagulating albumen, it whitens and corrodes the skin and other animal tissues, and forms with them insoluble compounds, which resist putrefaction.

Impurities.—Creasote, when pure, possesses the following characters:—'Specific gravity, 1071. A slip of deal dipped into it, and afterwards into hydrochloric acid, and then allowed to dry in the air, 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 are sometimes mixed with or substituted for wood creasote. From carbolic acid it is distinguished by its remaining fluid at low temperatures, by its drying up at 212°, whilst carbolic acid boils only at 370°, by its being unaffected when shaken with collodion, which produces a jelly with coal tar oils, or impure carbolic acid. Wood creasote is distinguished from that extracted from coal by its lesser solubility, one part requiring for solution 129 parts of water, by its insolubility in potash solution, and by its alcoholic solution, giving with iron perchloride solution a green colour, whilst the alcoholic coal tar solution similarly treated is turned brown. (Professor Attfield.)

Actions and Uses.—Creasote is a narcotico-irritant poison; it is given internally as an anodyne, antiseptic, sedative, and astringent, and is used externally as a caustic, stimulant, astringent, styptic, insecticide, and antiseptic. Its actions and uses closely resemble those of carbolic acid; its irritant, inebriant, and antiseptic properties ally it to alcohol; its stimulating the mucous surfaces and causing diuresis connect it with turpentine; its anodyne effects, especially on the stomach, associate it with prussic acid.

Doses of three drachms given to horses caused merely slight and temporary feverishness, and imparted to the breath a creasote odour (Hertwig). Dr. J. R. Cormack, whose *Treatise on Creasote* (*Harveian Prize Dissertation for* 1836) still remains the best authority on the subject, observed that, when given to dogs in doses of about thirty drops, it caused uneasiness, copious salivation, vertigo, twitching of the external muscles, 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. In all cases the heart and lungs were much engorged with blood, and the heart, even when examined immediately after death, proved very insensible to the action of stimuli. This paralysis of the heart is especially observable when poisonous doses are injected into the veins. The stomach and intestines are slightly inflamed, particularly when the animals have survived for some hours. Creasote, whether in poisonous or medicinal doses, becomes rapidly absorbed, and appears to act especially on that part of the nervous system presiding over the action of the heart. It seems to pass from the body by almost all the excreting channels. In order to arrest its poisonous action, the stomach should be evacuated, ammonia and other diffusible stimuli administered to rouse the sinking action of the heart, mustard applied to the chest; whilst still further, to relieve congestion of the lungs and of the right side of the heart, a little blood may be drawn from the jugular vein.

On account of its physiological action on the heart, creasote has been occasionally administered as a sedative. Several years ago it was used at the Edinburgh Veterinary College in many cases of pleuro-pneumonia among cattle. in doses varying from twenty to eighty drops, dissolved in oil or acetic acid; but although of considerable temporary advantage in allaying irritability, the proportion of cases cured was not greater than was obtained by the use of other remedies. A few drops inhaled with steam prove soothing in bronchitis and chronic lung complaints, especially when accompanied by excessive and fœtid discharges. 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 often, however, greatly benefited by giving daily a drachm of creasote, with thirty minims of sulphuric acid, made into a ball with linseed meal. With chalk, catechu mixture, or a little laudanum and some aromatics, it is useful in checking diarrhœa, especially in dogs. A similar formula answers well in dysentery in all animals, and besides being given by the mouth, may also be used as an enema. It has been recommended in that form of diabetes insipidus common in horses, but usually does harm rather than good.

In men and dogs it is a valuable remedy for allaying pain and irritability of the stomach and chronic vomiting—in this respect bearing some resemblance to prussic acid. It is applied externally as a caustic and stimulant for ulcers, caries, scrofulous tumours, fistulæ, canker, thrush, and foot-rot. It proves a serviceable dressing in erythema, chronic eczema, prurigo, and psoriasis; and in such itching or scaly skin diseases, like carbolic acid, tar, and pitch, it is advantageously used both internally and externally. It is efficacious in destroying vermin infesting the skin; indeed, in the treatment of mange and scab, no remedy is more efficacious. Gerlach in such cases advises an ounce of creasote, dissolved in fifteen ounces of spirit and forty of water. Like other astringents, it is occasionally used as a styptic, and in diluted solution for the cure of superficial and circumscribed inflammation, such as that of the conjunctiva. In the human subject it is a valuable anodyne in cases of toothache depending on caries, and when cautiously used often affords speedy and lasting relief, probably by uniting with the albuminoid matter in the hollow of the tooth, and thus protecting the nervous pulp from the action of air and other irritants. As an antiseptic, it stands next in order after cresylic and carbolic acids and fousel oil, 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 deodorizer.

Doses, etc.—The usual dose for horses is ♏xx. to ♏xl.; for cattle, fʒss. to fʒij.; sheep, ♏x. to ♏xx.; pigs, ♏v. to ♏x.; dogs, from ♏i. to ♏iij. It is best given in a mass with syrup, or in solution made with mucilage, acetic acid, oils, or alcohol. For external purposes it is applied with a camel's hair brush, undiluted as a caustic; more commonly it is used in solution, in spirit, acetic acid, oil, or water; 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 used for sore throat.

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 (*Veterinary Record*, 1846) that the plumæ and testæ are less active than the cotyledons. The oleaginous seed kernel contains about fifty per cent. of a fixed oil, which, when separated by expression and purified by straining, constitutes the official 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 nearly insoluble in pure cold alcohol, but completely soluble in boiling alcohol, sulphuric ether, and the fixed and volatile oils. It is usually stated to contain glyceryl crotonate ($C_3 H_5 3C_4 H_5 O_2$). Geuther, however, fails to find the crotonic acid, but separates acetic, butyric, valerianic, and higher members of the oleic series, together with another special constituent, tiglic acid ($H_2 C_5 H_7 O_2$). (Attfield.) 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 are not liable to sophistication. They should be plump and well-shaped, not dry or shrivelled.

The oil is sometimes 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, most commonly with castor oil.

Actions and Uses.—Croton is an irritant poison; it is used internally as an active cathartic, and externally as a counter-irritant.

Forty seeds destroy a horse in seven hours, with all the symptoms of gastro-enteritis; half that quantity also 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. Orfila gave a dog three drachms, which killed him in three hours, but one drachm also caused fatal effects; and even much smaller doses, as ten or twelve grains, induced violent purgation, gastro-enteritis, and death in from four to seven hours if the œsophagus is tied to prevent the expulsion 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 underneath the cellular tissue, 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 valuable, operating with certainty when many other purgatives are ineffectual, and being rarely attended with undue irritation or other bad 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. Whenever croton comes in contact with the alimentary mucous membrane, it induces topical irritation; when it mixes with the biliary and pancreatic juices, these alkaline fluids intensify its effects, and reduce it, like other fats and fixed oils, 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 in the same way as other purgatives.

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 of much value 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. Croton is contra-indicated in young and delicate subjects, in all debilitating complaints, and wherever any portion of the alimentary canal is in an unusually 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 over a considerable surface, 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 used amongst cattle, in which it is less apt either to purge or to blemish. It is chiefly applied in pneumonia, pleurisy, chronic glandular enlargements, and tedious rheumatic lameness, in which I have frequently 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, from fifteen to twenty seeds for cattle, about 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 from ♏xviij. to ♏xxv. ; for cattle, fʒss. to fʒij. ; for sheep and swine, ♏viij. to ♏x. ; and for the dog, ♏i. to ♏iv. 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. Though sometimes 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 a few scruples of calomel, a pound of salts, or a pint of linseed oil ; and few purgative mixtures are more effectual. Some practitioners, in using croton, drop it in an undiluted state on the tongue ; but, except in extreme cases, this is not advisable, as the particles are 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 *Phar.* It is a herbaceous biennial plant, with numerous drooping, purple-spotted flowers, an erect stem several feet high, and large alternate ovate lanceolate rugose leaves, with crenate edges, and covered with down, especially on their lower surfaces. The leaves, the official part of the plant, are gathered late in June or in July, before the small round grey-brown seeds begin to ripen, and when about two-thirds of the flowers are expanded. The leaves of the second year's growth are generally more active than those of the first. They are best dried in baskets in darkness over stoves, and are then of a dull-green colour, with little smell, and a nauseous, bitter taste. They should be used when fresh ; twelve months' keeping greatly diminishes their activity. Examination of their botanical characters will detect admixture of leaves of other plants. The several parts of the plant owe their activity to the presence of fully one per cent. of digitalin. (See p. 291.)

Actions and Uses.—Digitalis in poisonous doses irritates and deranges the digestive organs, excites disorders, and arrests the action of the heart. In medicinal doses it is a heart tonic and stimulant, and sometimes also acts as a diuretic.

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 from 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, blunting of the special senses, contraction of the pupils, difficulty of breathing, languor, and, after about twelve or sixteen hours, death. (Hertwig.) Doses of 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 were 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 were 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 nauseating and irritant action on the digestive organs, as well as some of its effects on the heart:—

In February 1856, powdered digitalis was given to three horses in good health, and receiving daily 12 lbs. of hay, 5 lbs. of oats, and 5½ lbs. of bran. On the 20th, they each received a drachm of the powder at 12 noon, and another drachm at 6 P.M.; on the 21st and 22d, one drachm at 6 A.M., at 12 noon, and 6 P.M.; and on the 23d, a drachm at 6 A.M.—in all, nine doses of a drachm each in three days.

No. 1. Brown Mare, 3 years old:

Feb. 20.	12 noon, pulse	38, respirations	8.
21.	. .	34, . .	6.
22.	. .	28, . .	7.
23.	. .	28, . .	7

On the evening of the 22d she became dull, and refused her feed. 23d, 10 A.M.—Still dull, without appetite, pupil contracted, passing wind, with small quantities of fluid fæces. 4.30 P.M.—Pulse 32, more distinct than at noon, pupil considerably contracted, rather less dulness. On the 25th, two days after the medicine was withdrawn, the mare was eating, and perfectly well again.

No. 2. Bay Gelding, 3 years old :

Feb. 20.	12 noon, pulse 36,	respirations	7.
21.	. . 36,	. .	8.
22.	. . 30,	. .	6.
23.	. . 32,	. .	6.

23d, 12 noon—Pulse, both yesterday and to-day, slightly irregular ; no appetite, very dull and stupid, with the pupil somewhat contracted. 4.30 P.M.—Pulse 34, tolerably firm, but unequal ; eating a little, and scarcely so dull. No more digitalis being given, the animal recovered its appetite, and by the 26th was well again.

No. 3. Brown Mare, 3 years old :

Feb. 20.	12 noon, pulse 38,	respirations	8.
21.	. . 33,	. .	7.
22.	. . 34,	. .	$7\frac{1}{2}$.
23.	. . 120,	. .	20.

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 extremities 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 bronchii. 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. They are excreted chiefly by the kidneys. Excessive doses produce in all animals embarrassment, irregularity, and arrest of the action of the heart; the pulse-beats are not necessarily diminished in number; the rhythm is little altered; the contractions are strengthened, not weakened; the ventricles, especially the left ventricle, are rigidly contracted and pale. Dr. J. M. Fothergill, in experiments on birds, fishes, and frogs, found that they caused firm contraction of the ventricles, resembling in this respect upas antiar, hellebore, belladonna, and caffein, and directly opposed to aconite and Calabar bean, which cause dilatation of the ventricle. Their effects are believed to depend, not upon any special action in the pneumogastric, but upon stimulation of the cardiac ganglia. (Fothergill and Ringer.) With this knowledge of the physiological action of digitalis, we can understand how poisonous doses powerfully stimulate the heart, throwing it into fatal tetanic spasms; how smaller, but still excessive, doses, by 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.

It is therefore as a cardiac tonic and stimulant that digitalis is rationally prescribed. When the heart is enfeebled, as in horses 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 thus renders the irregular and weakened circulation more natural and steady. Regulating such faulty circulation, it usually secondarily relieves any difficulty of breathing or dropsical effusions which may have resulted from the imperfect action of the heart. In such cases, digitalis is usefully conjoined with potassium chlorate, alcoholic, etherous, or ammoniacal stimulants, or alternated with 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 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 the 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, or the aconite and digitalis may be given together. 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 other remedies, it helps to sustain the action of the heart in typhoid fever in horses, and, as in man, it also reduces excessive temperature. Quieting and regulating the action of the heart, it has been recommended in hemorrhages, 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 frequently advised the omission of the calomel. Digitalis is uncertain as a diuretic, and owes its notable power of relieving many cases of dropsy to its regulating the action of the heart, rather than to any special effect upon the kidneys. Diuresis is, however, determined when digitalis is given with suitable doses of saline matters, and such a combination is often very useful in anasarca, ascites, and œdema. Applied locally, it is stated to produce contraction of the small arteries (Dr. Fothergill).

The chief indications for the rational 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. Its cumulative property, and its requiring to be used sometimes for several weeks continuously, indicate that small, carefully-regulated doses should be prescribed. The effects of overdoses are combated by emetics or the stomach-pump, by diluents, oleaginous purgatives, mustard to the sides, small doses of ammonia and alcohol, and perhaps by tannin-containing solutions which render any free digitalin insoluble.

Doses, etc.—The dose of powdered digitalis leaves for horses is grs. x. to grs. xxx. ; for cattle, ʒss. to ʒj. ; for sheep, grs. viij. to grs. xv. ; for pigs, grs. ij. to grs. x. ; for dogs, gr. i. to grs. iv. Small frequently-repeated doses at intervals of two or three hours answer best. Nausea or irritability of the digestive organs, coldness of the extremities, unwonted fulness or force 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 overheated or kept over twelve months, are prescribed, made into a bolus, or dissolved in hot water or spirit. The *Brit. Phar.* orders the infusion to be made by digesting for an hour thirty grains of dried leaves with ten fluid ounces of distilled water ;

the tincture, by macerating and subsequent percolation of two and a half ounces of dried leaves with one pint of proof spirit. Digitalis is given conjoined with aloes, salines, aconite, belladonna, stomachics, chloroform, and stimulants, and is often alternated with iron salts. Half-drachm doses, dissolved in a pint of coloured water with two drachms of nitre, constitute the ordinary cough and fever draught used by many veterinarians in London and elsewhere. Stonehenge advises, as a diuretic and febrifuge for a medium-sized dog—digitalis, grs. ss.; nitre, grs. v.; ginger, grs. iij., made into a bolus with liquorice powder and syrup, or with linseed flour and water.

DIGITALIN, or digitalinum ($C_{27} H_{45} O_{15}$), is directed by the *Brit. Phar.* to be prepared from an alcoholic extract, from which it is taken up by diluted acetic acid, precipitated by tannic acid, washed and digested with animal charcoal, isolated by removing the tannic acid, and purified again by animal charcoal, by solution in alcohol, and washing in ether. Throughout the process, the temperature is never allowed to exceed 160°. One hundred parts of dried leaves yield about 1·25 of digitalin.

French chemists have recently obtained the active principle in distinct crystals. Made by the *Phar.* process, it occurs 'in porous mammillated masses or small scales, white, inodorous, and intensely bitter, readily soluble in spirit, but almost insoluble in water and in pure ether; it 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.*) Sulphuric acid blackens and dissolves it, leaving a black-brown solution, which in a few days passes through various hues until it is crimson; water added developes a bright green colour. (Pereira.)

Digitalin is about one hundred times more active than the dried herb. Poisonous doses cause considerable gastric irritation, throw the heart into violent and disorderly contractions, and shortly arrest its movements; animal temperature is redueed. Repeated medieinal doses regulate and quiet irritable enfeebled heart aetion, and sometimes reduee by one-fourth, and even by one-half, the number of beats. It is best preserved in granules.

ERGOT OF RYE.

Ergota. Spurred or Horned Rye. Seeale eornutum. Ergot. The sclerotium (eompaet myeelium or spawn) of Claviceps purpurea (Tulasne), produced within the paleæ of the Common Rye. Seeale Cereale. (*Brit. Phar.*)

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

Ergot attaeks not only rye but the other graminaeeæ, the eyperaeeæ, and palms. The earliest symptoms occur about the time of blooming, when the young rye seed and its appendages are covered with white powdery-looking spores and delieate filaments of a fungus—the Clavieeps purpurea. The aborted embryo aequires a mildewed appearance; when it enlarges and protrudes from the husk, it is invested with the eompaeted fungus spawn, has a dark purple colour, and eonstitutes the ergot. In the propagation of ergot, it is believed that the spores eome into aetual eontaet with the fruetifying organs of the plant. Some authorities state that the spores, even if seattered on the ground where the rye is growing, suffice to produee the disease, whilst it has also been reported to oeeur when rye in bloom is deprived of its anthers. Close, damp weather and undrained soils greatly favour the development of ergot, as of other fungous diseases of plants. The injury done to the rye erop by ergot varies mueh; sometimes only a few grains in eaeh head are diseased, sometimes scarcely one is altogether sound; the average number affeeted is from five to ten. Ergot is brought ehiefly from Germany, Franee, and Ameriea, and about thirty ewt. are imported annually. (Pereira.)

Properties.—Ergot of rye has a eylindrieal shape, is eurved, resembling a eoek's spur; 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; and has at its apex a pale grey excrescence, very fragile, easily rubbed off, and believed to be the shrivelled remains of the flowering appendages of the aborted seed. It is usually covered by the grey, powdery fungus, is dark violet-coloured externally, and greyish-yellow within. Its odour is dull and musty; its taste, at first sweet, becomes bitter and slightly acrid. When dry it is inflammable, hard, and brittle; when moist, or long exposed to the air, it is soft, darker in colour, and covered with acari, which eat the interior of the seed. Its internal structure is made up of cells, many of which are oleaginous. Infused with boiling water, it forms a claret-coloured solution, retaining the odour, taste, and physiological actions of ergot. Besides about 26 per cent. of altered starch, and sixteen of mucilage and gluten, ergot contains 35 per cent. of a fixed oil, which probably holds in solution several principles; 1·25 of ergotin, a brown, resinoid, nitrogenous acid, with which is associated secalin, a noisome volatile alkaloid. But the chemistry of ergot still requires examination. The *Brit. Phar.*, perhaps with insufficient reason, sets aside the oil, and adopts a liquid extract, from which the oil has been carefully removed.

Impurities.—Ergot, although not very liable to adulteration, is apt to be of inferior quality from long keeping, especially when in powder, and from the attacks of acari. It should not be kept for more than two years, 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 its deterioration.

Actions and Uses.—Ergot is a topical irritant. In large doses it causes nausea, colic, and diarrhœa, with perverted nervous action and narcotism. Its continued use impairs the appetite, induces wasting, weakness, serous, and sometimes bloody discharges from the mucous surfaces, œdema and gangrene of the ears, tail, and even of the limbs. Therapeutically, it is occasionally given for the purpose of exciting uterine contractions, and arresting hemorrhage from the uterus and other parts. Applied locally, it also acts as a styptic.

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 of 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.) Brown Sequard believes that ergot contracts blood-vessels, which would indicate that, like belladonna, it acts mainly upon the sympathetic system of nerves. Death appears to result from enfeebled action of the heart.

Dr. Samuel Wright, experimenting very carefully and repeatedly with ergot (*Edinburgh Medical and Surgical Journal*, vols. lii. liii. and liv.), found that, when given for several weeks, it caused in dogs and rabbits nausea, impaired appetite, a weak, irregular pulse, soon becoming intermittent, diarrhœa, excessive fœtor of the secretions and excretions, paralysis, particularly of the hinder extremities, enlargement of the liver, contraction of the spleen, formation of tubercles both in the lungs and mesentery, impairment of all the senses, wasting, and general debility. Gangrene of the extremities is not, however, produced so readily as in man. A dog, which got from two to three ounces daily, survived for seven weeks, when it had consumed in all fifty-six ounces of dry ergot. All animals to which it was given —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 by 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.

Concerning the power of ergot to induce contractions of the uterus and expulsion of its contents, there is still much difference of opinion. Amongst the lower animals, it has certainly no power of producing abortion. It has been given in large and repeated doses to cows, bitches, cats, swine, and rabbits in all stages of pregnancy, but without causing abortion. Dr. Wright's experiments on this subject are very conclusive. He 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 ruminating animals, 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 ones were born of good size and well nourished. These experiments, and others attended with similar results, certainly justify the conclusion that, amongst the lower animals, ergot, whether given by the mouth or rectum, in single large doses or for some time continuously, has no tendency to expel the contents of the uterus at any period of gestation. Where it is given for a long period, its usual physiological effects are produced, and the general health of the mother so deteriorated as to cause the death of some or all of the fœtuses, but no special action on the uterus is observable.

Even when the natural period of parturition has arrived, and when labour has actually commenced, ergot is often given to the lower animals with little if any effect. I have given it to cows and bitches, in which the process of parturition was protracted, without observing any increase in the force or frequency of the labour pains. The same has been observed by

Dr. Wright, even though in some of his experiments on bitches he gave doses two or three times as great as those usually prescribed. He also laid open the abdominal parietes at various intervals after the administration of full doses, without observing any uterine contractions. In fact, ergot has no more action on the uterus of the lower animals than any other substance which causes intestinal irritation. Any effect it occasionally has in accelerating parturition appears to be owing, not to any special action on the uterus, but to the local irritation, tenesmus, and vomiting, which commonly succeed its administration. Those who place reliance on it as a parturient, recommend it when the throes are languid, and occurring at long intervals; when the animal has been in labour for some time, and when the os uteri is considerably dilated; but disapprove of it 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. Some practitioners prescribe an infusion for bringing away the placenta; but ergot, as already stated, having no effect in expelling the fœtus, it can have none in expelling the fœtal membranes, which may, however, be very readily removed by the hand. Indeed, so far from expelling the contents of the uterus, it has recently been successfully prescribed internally, as well as applied locally, to ward off threatened abortion. (*British Medical Journal*, Sept. 1872.) As a styptic it is serviceable, whether used internally or externally. It usually checks uterine hæmorrhage, whether occurring during pregnancy or after parturition.

Doses, etc.—The usual dose of ergot, as a parturient or as a styptic, for the mare or cow, is from ℥ss. to ℥i.; and for sheep, swine, and bitches, about ʒi. These doses are repeated at intervals of half an hour or an hour, and are usually given in the state of watery infusion, tincture, or liquid extract. The oil of ergot, although rejected by the *Brit. Phar.*, is still occasionally used in the human subject in cases of lingering parturition, and also externally as a styptic and an anodyne in rheumatism and toothache. Ergotin in five-grain doses, dissolved in ten minims of distilled water, has recently been used hypodermically by

Dr. George W. Balfour, of Edinburgh, for arresting hæmorrhage from the lungs, stomach, and uterus.

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. ($C_2 H_5 O$, or $C_4 H_{10} O$.) *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 *Brit. Phar.* gives the following detailed instructions :—'Take of rectified spirit fifty fluid ounces, sulphuric acid ten fluid ounces, calcium chloride ten fluid ounces, slaked lime half an ounce, distilled water thirteen fluid ounces. Mix the sulphuric acid and twelve ounces of spirit in a glass matrass capable of containing at least two pints, and, without allowing the mixture to cool, connect the matrass by means of a bent glass tube with 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 through a tube into the matrass in a continuous stream, and in such quantity as to equal the volume of the fluid which distils over. For this purpose use a tube furnished with a stop-cock to regulate the supply, connecting one end of the tube with a vessel containing the spirit, raised above the level of the matrass, and passing the other end through a cork fitted into the matrass. When the whole of the spirit has been added, and forty-two fluid ounces have distilled over, the process may be stopped. Dissolve the chloride of calcium in the water, add the lime, and agitate the mixture in a bottle with the impure ether. Leave the mixture at rest for ten minutes, pour off the light supernatant fluid, and distil it with a gentle heat until a glass bead of specific gravity ·735 placed in the receiver begins to float. The ether and spirit retained by the chloride of calcium, and by the residue of each distillation, 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°, hydrogen ethyl sulphate, or sulphovinic acid and water, are produced, thus (Roscoe) :—

Alcohol and Sulphuric Acid yield Water and Hydrogen Ethyl Sulphate.

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

The hydrogen ethyl sulphate further acts upon alcohol; ethyl takes the place of hydrogen; the ether produced distils over, and sulphuric acid remains behind, ready again to repeat the process of breaking up the alcohol.

Alcohol and Hydrogen Ethyl Sulphate yield Ether and Sulphuric Acid.

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

From the crude ether which first distils over, alcohol, water, sulphurous acid, and ethereal oils are removed, as directed by the *Phar.* process, by agitation with calcium chloride and slaked lime, and redistillation. The commercial ether thus obtained has the specific gravity ·735, the boiling point 105°, but contains about eight per cent. of alcohol, which may be removed by shaking with half its bulk of water, and redistilling from pure dry calcium chloride and caustic lime. Pure ether, with a specific gravity not exceeding ·720, is thus obtained.

Properties. — Ether is a mobile, colourless, neutral fluid, having a peculiar ethereal odour, and a warm, pungent taste. It is exceedingly volatile, vaporizes without residue, and from its rapid evaporation, speedily reduces the temperature of any part to which it is applied. Even the commercial ether boils at 105°, and freezes at —24°. As it is exceedingly inflammable, and forms explosive mixtures with air, much care should be used in approaching it with a light. It is miscible with alcohol in all proportions, and soluble in about ten parts of water. 'Fifty measures agitated with an equal volume of water are reduced to forty-five by an absorption of ten per cent.'—

Brit. Phar. It readily dissolves volatile oils, balsams, resins, and such alkaloids as morphine and strychnine.

Impurities.—When badly prepared or long kept it becomes acid. The presence of alcohol or water increases the density and causes a diminution, exceeding five or six per cent., when the impure article is agitated with dry calcium chloride and quicklime. Ether containing oil of wine when evaporated from the back of the hand evolves a peculiar odour, which the practised sense readily distinguishes from that of pure ether. Gently distilled with water, the ethereal oil remains floating on the surface. Perfectly pure ether, when poured upon white blotting paper laid on the warm hand, should evaporate rapidly, leaving neither moisture nor unpleasant odour.

Actions and Uses.—Ether in poisonous doses is an inebriant narcotic; medicinally it is stimulant, antispasmodic, anæsthetic, diaphoretic, and diuretic; used externally it is refrigerant, anodyne, anæsthetic, and antiseptic.

Like other spirituous and etherous substances, it is rapidly absorbed, acts on the brain, cerebro-spinal axis, and other nervous centres, producing, according to the dose and mode of administration, either great excitement or great depression. It rapidly impregnates with its odour and taste the flesh and other secretions, and appears to be excreted particularly 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. Its narcotic effects are developed when considerable doses are given to dogs or other small animals, and the preliminary stage of excitement, which is sometimes attended by convulsions, is generally very brief. Thus, when Orfila gave a dog four drachms, securing the œsophagus to prevent vomiting, he observed in about ten minutes 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 found after death to be red and much congested. (Christison on Poisons.) Among the lower animals, the anæsthetic effects of ether are tolerably easily induced, and are seldom attended by evil consequences. A two-year-old thoroughbred filly, experimented on by Mr. Barron, of Newmarket, was fully etherized 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.)

Anæsthesia, however, in veterinary practice 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 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, soon causes local blanching and anæsthesia. An ounce of ether thus applied will in about three minutes anæsthize a horse's limb sufficiently for the painless performance of neurotomy. Applied with infriction, it causes redness and even vesication.

Ether closely resembles chloroform. As an anæsthetic it requires, however, to be inhaled in larger quantity, and usually for a longer time. It developes rather more preliminary excitement, exerts on the heart a tonic effect, does not weaken it like chloroform, and in large doses destroys life by paralyzing the muscles of respiration. Six times more volatile than chloroform, its effects are more transient. Ether is more diffusible and active as a stimulant than sweet spirit of nitre or acetic ether, neither of which are anæsthetic. From alcohol it is chiefly distinguished by the rapidity and transiency of its stimulant effects, and by its anæsthetic properties. Compared with ammonia, it stimulates more notably on the brain and cerebro-spinal axis, has distinct narcotic and anæsthetic properties, but has no antacid virtues.

As a prompt and powerful diffusible stimulant, ether often combats violent and dangerous symptoms. 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 almost any of the forms of influenza, ether proves serviceable; it gives tone to the enfeebled heart, it equalizes irregular circulation, promotes imperfect action of the skin and kidneys, and even helps to relieve cough. In such cases it is often usefully conjoined with alcohol, ammonia, gentian, or potassium chlorate. Overcoming nervous derangement or torpidity, it speedily 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 typhoid fevers, and in convalescence from exhausting diseases, ether is of much service. Amongst cattle and sheep it may be given even earlier, and more freely than in 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 in a state of considerable dilution 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 vascular excitement, inflammatory fever, or sthenic inflammation.

As an anæsthetic it is used in the same cases as chloroform. Its effects are most conveniently developed by pouring the fluid 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 generally suffices to develope the requisite effect in horses or cattle; pure ether is necessary, as any watery contamination gets frozen and blocks the tube of the instrument. It is thus used for opening abscesses and fistulæ, removing tumours, for neurotomy, tenotomy, firing, and occasionally for castration. For such purposes it requires, however, to be used 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 a good but expensive refrigerant for sprains and bruises, and is occasionally employed for the reduction of herniæ. It is sometimes used as a solvent for oils, resins, balsams, crystalline organic bodies, and gun-cotton. Like other substances of the alcohol series, it is an antiseptic, and preserves meat fresh and almost unchanged for twenty-eight days.

Doses, etc.—As a stimulant, the dose for horses is from f℥i. to f℥ij.; for cattle, from f℥ij. to f℥iij.; for sheep and pigs, fʒij. to fʒiv.; and for dogs, fʒss. to fʒi. As an anæsthetic, the larger animals take from f℥iij. to f℥vi.; the lesser, from fʒiv. to f℥i. As a stimulant, it is usually given with water or diluted spirit, is sometimes sweetened with sugar or treacle, or flavoured with aromatics, and is always administered cold to prevent the ether being volatilized. On account of its transient effects, it often requires to be repeated every hour; and as its effects diminish with use when it is given for some time continuously, the doses need to be increased. Its stimulant effects are augmented by combination with alcohol and ammonia; its antispasmodic and anodyne effects by giving it with opium and belladonna.

Spirit of ether, the spiritus ætheris of the *Phar.*, is made by mixing one volume of ether with two of rectified spirit. Collodion is prepared by mixing one ounce of gun-cotton with thirty-six fluid ounces of ether and twelve ounces of rectified spirit. The solution, preserved in well-corked bottles, is clear, colourless, inflammable, and evolves a strong odour of ether. It was several years ago introduced as a substitute for sticking-plaster. Applied with a fine brush over the skin, the ether evaporates, leaving a delicate film of cotton, which, by repeated applications of the solution, at intervals of a few minutes, becomes sufficient to protect wounds from the air, or other causes of irritation. A styptic antiseptic protective is made by agitating together until mixed collodion 100 parts, carbolic acid 10 parts, tannic and benzoic acids each 5 parts, and applying it as described. 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 officinarum, and probably other species of Euphorbia. Imported from Western Africa. (Pereira.)

Nat. Ord.—Euphorbiaceæ. *Sex. Syst.*—Dodecandria Trigynia.

The natural family Euphorbiaceæ includes both the croton and castor oil shrubs. The cactus-like plants yielding the medicinal euphorbium grow in the kingdom of Morocco, and in the region skirting the Atlas range. When incisions are made into the cortical part of 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 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 grey, and insoluble in water; but its 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 from 40 to 60 per cent. of resin, which is its active ingredient; and from 14 to 19 per cent. of wax, a little caoutchouc, and various salts. Containing no gum, it ought not to be styled a gum resin.

Actions and Uses.—Euphorbium is a violent irritant. Introduced into the stomach or areolar tissues, rubbed into the skin, inhaled into the nostrils, or applied to any other mucous membrane, it speedily causes violent and often 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 about twenty-six hours. Inflammation of the intestines, with 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 many blistering applications, 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.—Filicaceæ. *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 pennate leaves reach to the height of three feet. 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, somewhat astringent, nauseous taste. Besides the usual constituents of plants, it contains about four per cent. of resin, two per cent. of a fixed oil, with a lesser amount of a volatile oil, which is its active ingredient. The root should be collected in summer, 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 other ferns for those of the male shield fern, in great part explain the depreciatory accounts sometimes given of its efficacy. Panna, the root of a South African fern (Aspidium athamanticum), although sometimes recommended, has no advantage over the filix mas.

Actions, Uses, and Doses.—In large doses it acts as an irritant, is slightly laxative, and as a vermicide is given especially for the destruction of tape-worm. Kuchenmeister states that it poisons bothriocephalus even more readily than tæniæ. It is said to kill tape-worm 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 develope another worm. The powdered root is used in doses of a pound for horses and cattle, ℥iij. to ℥v. for sheep, and ʒii. for dogs and cats. (Gamgee's *Vet. Vade Mecum.*) But the powder is inconveniently bulky, and less certain than the fluid extract or oil, which is the only official form retained by the *Brit. Phar.*, and is thus directed to be made:—'Take of male fern in coarse powder two pounds; ether, four pints, or a sufficiency; mix the fern root with two pints of the ether; pack the male fern closely in a percolator; and pass the ether slowly through it until it passes colourless. Let the ether evaporate on a vapour bath, or recover it by distillation, and preserve the oily extract.' The dose of this oily extract for horses or cattle is fʒi. to fʒij.; for sheep, ♏xxv.; for dogs or cats, ♏v. to ♏xx. It is best given in a little oil or gruel, when the bowels have been emptied by a purgative and several hours' fasting, and, if requisite, may be followed after a few hours 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.—Amentaceæ. *Sex. Syst.*—Monœcia Polyandria.

Galls, or gall-nuts, are found on the young branches and shoots of a shrubby species of oak, and are caused by a small insect, which punctures the bark and deposits its ova. Irritation follows, the punctures become surrounded by woody matter, and within this globular abode the insect passes through the various stages of its growth, until about the month of 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 East Indian from Bombay are scarcely so sightly. 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; are of a bluish-grey colour externally, and yellow within. In their interior is a hollow, in which the insect may generally be found. Sometimes, however, the central hollow is empty, from the death of the insect, or from its escape in a perfect form, when the small hole may be found, through which the creature has liberated itself. These are known as white galls. They have a smoother, duller appearance, a lower density, lighter colour, and less astringency than the ordinary or blue galls. Galls are easily reduced to a yellow-grey powder devoid of odour, but having a powerful astringent taste. They yield their properties to water and proof spirit, forming with the latter a dark red tincture. Iron persalts, added to a watery solution, slowly precipitate the dark blue or black iron tannate, the basis of writing ink. An aqueous solution of gelatin throws down a grey flocculent precipitate of tanno-gelatin—the essential principle of leather. These reactions, as well as the other important properties of galls, depend on the presence of from thirty to sixty-five per cent. of tannin or tannic acid, with which is associated about ten of fibre, eleven of moisture, five of gum, sugar, and starch, four of gallic, ellagic, and luteo-gallic acids; together with extractive matter, chlorophyll, volatile oil, albumen, and salts. (Guibour.)

Actions and Uses.—Galls are powerfully astringent, occupying, as regards activity, a mediate place between tannic acid and oak-bark. They are prescribed to brace up weakly and relaxed membranes, to dry up chronic mucous discharges, to relieve passive hemorrhages, and to combat poisoning by tartar emetic and vegetable alkaloids. In relaxed sore throat, they may be repeated three or four times daily with ether, and made into a draught with mucilage or cold linseed gruel. They are further used in prolapsus of the uterus and rectum, for piles in dogs, and for the several purposes of topical astringents and styptics.

Doses, etc.—The dose of powdered galls for the horse is from ʒiv. to ʒvi.; for cattle, ℥i. or ℥ij.; for sheep and swine, from ʒss. to ʒi.; for dogs, grs. v. to grs. x.; for cats, from gr. i. to grs. iij. Various forms of administration are adopted. The simple powder is made into a bolus, with the ordinary excipients, or dissolved in warm water or proof spirit. A tincture, much used as a chemical test, diluted and sweetened as required for internal administration, is made with two and a half ounces of 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 strengths, 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, and many vegetable astringents owe their characteristic properties. Powdered galls, softened by remaining for two days in a damp place, are mixed with ether, the pasty mixture pressed 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 rectified spirit; very sparingly soluble in ether. The aqueous solution precipitates solution of gelatin yellowish-white, and the iron persalts of a bluish-black, colour. It leaves no residue when burned with free access of air.'—*Brit. Phar.* Tannic acid is precipitated by, and hence is incompatible with, the alkalies and their carbonates, with tartar emetic and many metallic salts, the mineral acids, and the vegetable alkaloids. 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. It is hence termed a glucoside.

Actions and Uses.—Tannic acid is the most powerful of vegetable astringents. It differs only in degree of concentration from galls and oak bark. Combining with the albuminoid constituents on the mucous or broken skin surfaces, it forms a protecting covering from air or acrid discharges, and further braces up relaxed or irritable capillary vessels. In irritable, noisome conditions of the membrane of the nostrils or mouth, as a dressing for weakly sores, as an occasional application for eczema, it proves serviceable, especially in the form of glycerine of tannin. Given internally, it exerts a topical astringent effect, diminishes intestinal secretions, whether healthy or morbid, and is hence prescribed in chronic diarrhœa and dysentery. Even after absorption its characteristic effects are still developed in staying inordinate secretion and bleeding, and it is excreted in the urine, converted into gallic and pyrogallic acids. Drachm doses repeated every second hour, and given in gruel alone, or with ♏xx. of creasote, sometimes arrest red-water in cattle. Coagulating the albumen and gelatin of their structures, it is believed to curl up and destroy tape and other worms infesting the intestines.

Doses, etc.—Horses take grs. xx. to grs. xl.; cattle, ʒi. to ʒii.; sheep and pigs, grs. xv. to grs. xxx.; dogs, from grs. ij. to grs. xx. It is used either in the form of pill, infusion, or tincture. A drachm each of tannin and opium, with two ounces of lard, makes an excellent ointment for piles in dogs. Glycerine of tannin, a convenient form for keeping or prescribing tannic acid, is prepared by rubbing together in a mortar one part of the acid with four of glycerine, and furthering complete solution by the aid of gentle heat. It is used in aqueous or spirituous solution, in draught, clyster, or spray, with starch, gruel, opium, or carbolic acid.

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 gallic acid and glucose thus:

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

The *Brit. Phar.* states it to be 'crystalline in acicular prisms, or silky needles, sometimes nearly white, but generally of a pale, fawn colour. It requires about 100 parts of cold water for its solution, but dissolves in three parts of boiling water; soluble also in rectified spirit.' Its aqueous solution gives a blue-black precipitate with an iron persalt. From tannic acid it is distinguished by not precipitating solutions of gelatin, and by strong boiling 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, becoming brown as it absorbs oxygen. (Attfield.)

The actions, uses, and doses of gallic acid are the same as those of tannic acid; from three to six grains, with about half that amount of opium, forms a useful pill for dogs suffering from chronic diarrhœa or dysentery. Not combining with gelatin or albumen, gallic acid is not, however, such a powerful topical astringent as tannic acid; but by admixture with solutions of gum or grape sugar, it acquires astringency, probably owing to its reconversion into tannic acid.

GAMBOGE.

Cambogia. Camboge. A gum-resin obtained from Garcinia morella. 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 bark, or by breaking the leaves and branchlets, when the yellow milky juice exuding is collected in leaves of the tree, in cocoa-nut shells, or in bamboo canes, is transferred into flat earthen vessels, and dried in the sun. It occurs in cylindrical pieces or rolls, one to three inches in diameter, and in cakes. It has a yellow colour, breaks easily with a smooth conchoidal glistening red-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, contains from 20 to 25 per cent. of soluble gum, and from 70 to 75 per cent. of an active orange-yellow resin, gambogic acid (C_{20} H_{23} O_4), 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 its activity only to croton and elaterium. Moiroud gave horses from 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.

Although uncertain and almost unsafe when given alone, its purgative effect on ruminants is safe, speedy, and regular, when it is given in combination with other purgatives. In indigestion, fardel bound, parturient apoplexy, and other such disorders of cattle, few formulæ prove more prompt and effective than an ounce of gamboge given with a half or three-quarters of a pound each of common and Epsom salts. Although neither is particularly certain when used by itself, an ounce each of gamboge and aloes, rubbed down together and given in solution, proves an effectual purge for ordinary cattle cases. Gamboge is too drastic and irregular to be safely given either to horses or dogs.

Doses, etc.—For cattle, the dose is ℥ss. to ℥j.; for sheep, grs. xx. to grs. xxx. It should be 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.

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 Acipenser, prepared and cut into shreds; chondrin is the gelatinous matter extracted from cartilage. Gelatin, when dried, is hard and tough; varies in colour according to its purity; forms, when dissolved in a limited quantity of hot water, a viscid tremulous mass; and is precipitated even from a diluted watery solution 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. Like peptones, it has, however, a valuable power of economizing albumen. According to C. Voits' recent observations, it appears to be readily decomposable within the body, and is itself broken up, conserving the more valuable albumen. Hence its dietetic value in men, dogs, and even in horses, recovering from exhausting diseases, and in which the breaking up and excretion of albuminoids is great. This conservation of albumen is enhanced when gelatin, as soup or in any other convenient form, is given along with fats or carbohydrates. 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. For this latter purpose, 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 up, the immediate application of such plasters is sometimes useful in keeping the parts in position, and preventing the annoyance of flies; a dependent opening must, however, in all cases, be left for the egress of matter. Glue plasters are also often effectual in reducing and retaining umbilical hernia both in calves and foals; and in these, as in all other cases, the chief requisites for applying them securely 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 be thoroughly dry: the admixture with the glue of one-third or one-half of pitch increases greatly adhesiveness. 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 root, and an annual herbaceous stem, which rises three or four feet in height, and bears numerous 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 official. 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, varying in length from a few inches to a foot or more, and in thickness from half an inch to one or two inches. These pieces are marked by transverse annular wrinkles and longitudinal furrows. Externally, the root is yellowish-brown, and internally, brownish-yellow; its texture is tough and spongy. (Pereira, 1872.) 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, it is brittle and easily pulverized. The powder is yellow, with a shade of brown, and readily yields its bitterness to water, alcohol, and ether. Gentian root consists of 'a volatile, odorous, and butyraceous oily matter; a bitter crystalline body, consisting of an acid (gentisic acid) and a bitter principle (gentianite), with gum, sugar, pectin, wax, caoutchouc, a yellow colouring matter, and woody fibre.' (Pereira, 1872.) Its composition still requires investigation; its active principle has not yet been isolated.

The admixture of the root of the Gentianæ lutea with that of other Gentianæ is frequent, but is of little importance, since all are possessed of similar properties. With the gentian are also occasionally mixed roots of a different and sometimes poisonous action, such as monkshood, belladonna, and white hellebore, which may, however, be distinguished by the absence of the pure bitter taste and bright yellow colour so characteristic of true gentian. The gentian powder, especially that met with abroad, is stated to be occasionally adulterated with yellow ochre, which may be easily detected by heating the suspected specimen with a little sulphuric acid, filtering and testing for iron.

Actions and Uses.—Gentian is a pure and simple bitter, prescribed as a stomachic and tonic. It is the best of all bitters. It resembles in its actions quassia, calumba, and chiretta; has been considered little inferior to cinchona as a tonic, is devoid of astringency. Narcotic properties have been ascribed to it; but no such effects follow its administration to veterinary patients. Horses have received from four to twenty-four ounces, and dogs from two to four ounces, repeated during several days, without evincing the slightest symptoms of narcotism.

For all classes of patients, gentian is given to improve the appetite and general tone. Amongst horses no combination is more effectual in febrile catarrhal attacks than an ounce of powdered gentian, two drachms nitre, two ounces Epsom salt, dissolved in a pint of water, linseed tea, or ale, and repeated night and morning. In most inflammatory complaints this prescription also proves serviceable, especially after the more acute stage is passed. Where the bowels are constipated or irregular, or the febrile symptoms insufficiently subdued, one or two drachms of aloes may be advantageously united with the gentian and nitre. Where a more decided tonic effect is desired, iron or copper sulphate may be alternated with the gentian and salts. The early use of an ounce of gentian with an ounce or two 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, bronchitis, and other such complaints. Such a combination hastens recovery from all exhausting disorders, and has an almost magical effect in restoring horses that are jaded, overworked, or suffering from loss of appetite or slight cold. Gentian is sometimes useful in simple indigestion, especially in young animals; and in such cases 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. From its bitterness and laxative tendency, gentian is sometimes effectual in expelling intestinal worms. Its supposed utility in jaundice is probably mainly owing to the laxatives with which it is usually combined. Amongst cattle the above formulæ are, in similar circumstances, as serviceable as for horses, and only require to be given in somewhat larger doses. For sheep, gentian is a most useful stomachic and bitter tonic, and when given along with salt appears to arrest for a time the progress of rot. Next after quinine it stands as the best vegetable tonic for dogs laid up with, or recovering from, reducing disorders. Like other tonics, gentian is contra-indicated in irritation of the intestines, and in the earlier stages of acute inflammatory diseases. In the form of an infusion, it is occasionally applied externally as a mild stimulant and antiseptic.

Doses, etc.—The dose for the horse is from ℥ss. to ℥i.; for cattle, from ℥i. to ℥ij.; for sheep, ʒi. to ʒiij.; for pigs, ʒss. to ʒi.; and for dogs, from grs. v. to xx. These doses may be repeated twice or thrice a day. The carefully-prepared *Phar.* extract infusions and tinctures, flavoured with bitter orange-peel and aromatics, are little required in veterinary practice. The powdered gentian is either prescribed as a bolus made up with treacle, glycerine, and meal, or as an infusion made by digestion 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 in conjunction with ginger, cardamoms, antacids, alcohol, or ethers, and even with mineral tonics.

GINGER.

Zingiber. The scraped and dried rhizome, or underground stem, of Zingiber officinale, from plants cultivated in the West Indies and other countries. (*Brit. Phar.*)

Nat. Ord.—Zingiberaceæ. *Sex. Syst.*—Monandria Monogynia.

The Zingiber officinale, grown in many warm climates, 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 washed, usually scraped, to remove the dark-brown wrinkled epidermis, and dried in the sun.

Properties.—Several sorts are recognised in the trade :—The Jamaica in large plump pieces or races, pale, stripped of epidermis, producing a light-coloured powder, and of superior quality ; Malabar, Tellycherry, or Cochin China, a little darker, but usually good ; Bengal and African, or Sierra Leone, imported both coated and uncoated, many samples of which are cheap and excellent ; Barbadoes, in short thick races, retaining its brown corrugated epidermis. These unstripped descriptions are sometimes termed black gingers. The several varieties are met with in irregular lobed knotted pieces or races, from two to four inches in length, with a marbled soft resinous texture, a strong, agreeable aromatic odour, a warm, pungent taste, and dissolving in water and alcohol. To imitate the finer Jamaica ginger, inferior varieties are exposed to sun-light, to sulphurous acid, or to calcium chloride; but such bleaching or white-washing cannot impart the soft resinous structure, short mealy fracture, aromatic odour, and hot taste which distinguish good specimens. Ginger contains pale yellow volatile oil, of the composition of hydrous oil of turpentine, 1·5; aromatic, acrid, soft resin, 3·5; extractive matter, 11; starch, 19; gum, bassorin, and mucilage, 46; woody fibre, 8; and water, 11. (Bucholz.)

Actions and Uses.—Ginger is slightly irritant, stomachic, carminative, and mildly tonic. 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 often prescribed with tonics and stimulants; conjoined with purgatives, it diminishes their tendency to nauseate and excite griping, while it also somewhat expedites their action. To fulfil these purposes, it is used for all domesticated animals, and especially for cattle and sheep.

Doses, etc.—The dose of ginger for the horse is ʒiv. to ℥i.; for cattle, from ℥i. to ℥iij.; for sheep, ʒi. to ʒij.; for pigs, ʒss. to ʒi.; for dogs, grs. x. to grs. xxx. It is made into a bolus with any suitable excipient, or dissolved in hot water, the solution being either given alone or sweetened with treacle or sugar. The tincture, although rather expensive for general veterinary practice, is highly spoken of by Mr. Morton, who recommends it to be made with two ounces of ginger to the pint of proof spirit. A much better tincture, less liable to become turbid and unsightly, is made with two and a half ounces of coarsely-powdered ginger to a pint of rectified spirit, macerating, percolating, and then mixing the two solutions. (*Brit. Phar.*)

GLYCERIN.

Glycerinum. Glyceryl hydrate. Glyceric alcohol. A sweet principle, obtained from fats and fixed oils, and containing a small percentage of water. (*Brit. Phar.*)

Glycerin was first discovered, in 1789, by Scheele as a product in the manufacture of lead plaster; it occurs in small amount in the fermentation of sugar; it is the hydrate of the basylous principle of most 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 trivalent, unites with the three atoms of water previously held by the caustic soda, thus :—

$$\begin{array}{lcl} \text{Caustic soda} + \text{Vegetable oil} & = & \text{Hard soap} + \text{Glycerin.} \\ 3\,Na, HO + C_3H_5, 3\,C_{18}H_{33}O_2 & = & 3\,Na, C_{18}H_{33}O_2 + C_3H_5, 3\,HO. \end{array}$$

Mr. G. F. Wilson, of Price's Patent Candle Company, discovered the following simple and convenient process for getting glycerin in a state of purity. 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 distils 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 1·25, and contains 94 per cent. of anhydrous glycerin. It is viscid and colourless, odorous, 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 common arsenic.

Actions and Uses.—Glycerin is demulcent, emollient, feebly antiseptic, and a convenient solvent for alkaloids, tannic and gallic acids.

Glycerin possesses some of the nutrient properties of cod-liver oil and other fatty matters, and has occasionally been given to delicate dogs in doses of two or three drachms, repeated twice or thrice daily. Excluding air and moisture from abraded or irritable surfaces, it proves a capital demulcent and emollient for cracked heels, mud fever, blistered or burnt surfaces—indeed, wherever the skin is irritable, dry, rough, or scurfy. It is employed alone; but for tender or abraded textures is better diluted with water, or spirit and water, or used as glycerin of starch made by mixing, with the aid of heat, one ounce of starch with eight fluid 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. Glycerin is of pharmaceutic value as a solvent for tannic and gallic acids, and for alkaloids; it is advised as a good vehicle for their hypodermic injection; it is a useful addition for preserving boluses and masses soft and sound; and is 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. (*Brit. Phar.*)

Nat. Ord.—Leguminosæ. *Sex. Syst.*—Monodelphia Polyandria.

Gum is largely present in many plants, but for commercial and medicinal purposes is chiefly got from various species of Acacia. These are stunted, withered-looking trees, usually of medium size, with a grey bark, oblong linear leaflets arranged along either side of the stalk, and a moniliform fruit resembling the laburnum. They abound in dry, warm climates, especially in Nubia and the valley of the Upper Nile, and are most prolific when old and stunted, and during dry, hot seasons. In 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 of both hot and cold water, insoluble in alcohol, ether, and oils, and decomposed by mineral acids; heated with nitric acid, it is converted into oxalic acid. Gum consists of arabin or gummic acid, which is associated with calcium or potassium, and has the formula $H_2\ C_{12}\ H_{18}\ O_{10}$, $H_2\ O$. (Attfield.)

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 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 is derived from shrubs or small trees belonging to the genus Astragalus, is collected in Asia Minor, mostly exported from Smyrna; occurs in thin, semi-transparent lamellæ or plates of a white-grey or yellow colour, and marked with concentric ridges; and is tasteless, odourless, and very tough. Cold water swells it into a jelly, which is tinged violet by tincture of iodine; boiling water readily dissolves it, forming a dense mucilage. Associated with the soluble arabin, tragacanth contains a large amount of the less soluble bassorin ($H_2\ C_{12}\ H_{18}\ O_{10}$), which, gelatine-like, swells up, but is not dissolved either by hot or cold water. Unlike arabin, it is soluble in alcohol.

British gum or dextrin ($C_6\ H_{10}\ O_6$) is made by heating starch with a little sulphuric acid, by exposing it to a temperature of 320°, or by acting upon it by diastase or other such ferment. Heated with nitric acid, it yields mucic acid.

Actions and Uses.—Gums, although the least nutritive of the carbo-hydrogens, are tolerable effectual demulcents; dissolved in water, they are sometimes serviceable in diarrhœa, whether caused by purgatives, poisons, or other irritants; are used as injections in inflammation of the bowels, kidneys, and bladder; and afford mechanical investment for injured or inflamed parts, protecting them from the action of irritants. For veterinary purposes, they are, however, usually superseded by linseed or starch gruels. For the making of emulsions, electuaries, and boluses, gums have the disadvantage of speedily drying and hardening.

Does, etc.—The dose of gum for horses and cattle is from ℥i. to ℥ij.; for foals, calves, and sheep, from ʒiv. to ℥i.; and for dogs, from grs. xv. to grs. xl. It is given in the form of mucilage, 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.*) Used where there is much irritation, mucilage is advantageously conjoined with opium or belladonna; where there is atony, with oak bark, catechu, or chalk.

HELLEBORE.

Helleborus. Black hellebore rhizome. Dried underground stem and root of Helleborus niger.

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

The Helleborus niger, Christmas rose, or bear's foot, is indigenous to many parts of continental Europe, and is often cultivated in this country. It is a herbaceous plant, from one to two feet high, with numerous digitated, dirty-green leaves, flowers which appear in January and February, and a perennial, black, scaly rhizome or root-stock, several inches long and about 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 are often mixed with those of the niger, and are very similar in action. Hellebore is believed to contain an acrid oil and a neutral crystalline principle (Pereira).

Actions and Uses.—Black hellebore is an acrid irritant, scarcely so active as veratrum album or white hellebore. It is occasionally used as an anthelmintic and external irritant. Full doses produce in all animals gastro-enteritis. Two drachms, swallowed by a medium-sized dog, killed him in a few hours, and much 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 from forty to fifty hours; from one to three drachms induce similar effects among sheep and goats. (Hertwig.) In carefully-regulated doses, it is purgative and anthelmintic, and an emetic for carnivora; but on account of its violence it is now scarcely ever prescribed in regular practice. Externally it is still occasionally employed as an irritant for promoting discharges, and a constituent of blistering ointments. But 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, destroys 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 ripe fruit of Conium maculatum. (*Brit. Phar.*)

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

Hemlock grows wild in all parts of this country. 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 the plant is usually collected for use, the root is large, white, and fusiform; the flowering stem from two to five feet high, round, hollow, jointed, smooth, and thickly 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, less apt than the leaf to lose its energy by keeping; but according to Dr. J. Harley's experiments, when ripe and dry, as ordered by the *Brit. Phar.*, it is almost inert. The green, nearly ripe fruit yields, however, an active juice or extract: 9 lbs. of such fruit produce an ounce of conine.

The leaves, the chief officinal part of the plant, should be gathered when the fruit begins to form, rapidly dried in stoves at a temperature of about 120°, and preserved in tins, bottles, or jars, excluded from light. They rapidly spoil by keeping. They readily communicate their properties 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 the inertness of many preparations of hemlock is owing. The leaves, when strongly heated, produce a powerfully narcotic empyreumatic oil, similar to that got by the same method from hyoscyamus. Hemlock contains an acrid volatile oil, to which it owes its odour, and a volatile oleaginous alkaloid called *conine conia*, or cicutine ($C_8 H_{15} N$). From its special acid, the coniic, it is liberated by distilling the fresh juice or an alcoholic extract with diluted caustic potash. It is transparent, oily, lighter than water, colourless, but soon becoming brown when exposed to air and light. It has an intense odour of mice, a peculiar acrid taste, is sparingly soluble in water, but readily dissolved by alcohol, ether, and dilute acids. It coagulates albumen. Nitric acid dropped on conine produces a blood red colour; sulphuric acid, a purple red passing to olive green. Along with conine has recently been found methyl-conine. The odour, taste, colour, and form of the leaf readily distinguish it from other leaves with which it is sometimes mixed. Triturating with diluted caustic potash solution, and noting the intensity of the mousy odour developed, affords a ready estimate of the odorous volatile oil, but not of the alkaloid. 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 in poisonous doses paralyse the motor nerves; the peripheries are affected before the trunk; the voluntary muscles lose their contractile power, the muscles of respiration are shortly involved, and death occurs from asphyxia. In medicinal doses they relieve muscular irritability, and are nerve tonics, anodynes, and antispasmodics. Hemlock was the State poison of the Athenians, the death potion of Socrates.

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 an extra effort 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.*) The fitting antidotes are cold water to the head, ammonia to the nostrils, stimulating enemata, with the cautious exhibition of stimulants.

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. Neither in medicinal nor in poisonous doses is the brain proper or spinal chord directly affected; there is no narcotism; no action on the sensory or afferent nerves; no effect on circulation, secretion, or excretion. Applied directly to the nerves, it exerts no topical irritation, but appears to destroy their conducting power. On the unbroken skin it exerts no effect; on wounds large quantities irritate, whilst small quantities soothe and ease pain. No perceptible effect occurs when it is added to recently-drawn blood. 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; but the general paralysis which the bean induces depends, according to Dr. Fraser, on its destroying the reflex power of the spinal chord. It is allied to prussic acid, which, however, developes its paralysing effects through the brain, chord, and motor centres of organic life. Hemlock and conine, in many of their symptoms, are opposed to nux vomica and strychnine. The former cause muscular paralysis, the latter muscular spasm; but the former, as pointed out, paralyse directly the motor nerves, the latter tetanize by irritation of the chord. Guttman, by experiments on frogs, has further proved that they are not mutually antagonistic or available as antidotes the one for the other.

The curative effects of hemlock on the lower animals have been imperfectly studied. It has, however, no sedative, alterative, deobstruent, or diuretic effects, such as are sometimes ascribed to it. From its physiological action it is evident that its special value is for the soothing of motor irritability, whether direct or reflex. It is serviceable in many cases of convulsions, especially amongst young animals, and in epilepsy and chorea, particularly where depending on motor excitability. It deserves more extended trial in tetanus. In spasmodic cough, such as sometimes follows epizootic sore throat in horses, hemlock and belladonna in full doses prove an almost unfailing specific. In irritable conditions of the respiratory organs in man, hemlock vapour, made by adding a tincture of conine to hot water, is recommended. It abates the pain of some cases of rheumatism and neuralgia, for which it is used both externally and internally, and is also beneficial in specific ophthalmia in horses. Internally and 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 also 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 almost inert. (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, 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 from ten to sixteen fluid ounces; for sheep and pigs, from half an ounce to three ounces; for dogs, from one to four drachms. The medicine should be repeated twice daily, and be persisted with and given in quantity sufficient to paralyse voluntary motor power. Combined with opium, belladonna, or hyoscyamus, hemlock prolongs and intensifies their effects. Few more soothing or effectual pain-relieving mixtures can be devised than opium, chloral hydrate, and hemlock. Of the tincture, the dose generally prescribed is two or three fluid ounces for horses or cattle, two or three drachms for dogs; of the extract, one or two drachms for the larger animals, one to five grains for the lesser. But so faulty are most tinctures and extracts, that these small doses are inadequate 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.*) The differences which occur in the accounts of the action of conine are explained by the recent experiments of Professor Crum-Brown and Dr. Frazer, who have shown that commercial conine often contains methyl conine, which acts on the chord as well as on the motor nerves, sometimes causing muscular twitchings, and, where in considerable amount, convulsions. 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.—Solanaceæ. *Sex. Syst.*—Pentandria Monogynia.

Henbane grows wild in most parts of this country, and is also cultivated at Mitcham, Hitchin, and elsewhere. The leaves are the principal officinal part, are of a yellow-brown colour, rough, hairy, and clammy, with a fœtid narcotic odour, and a nauseous, bitter taste. The small, round, yellow-grey seeds sometimes used resemble the leaves in taste and odour, but are difficult to collect in quantity. The root is white, contains much starch, and resembles the parsnip, for which it has occasionally been mistaken. There are two varieties, an annual and a biennial; the latter, alone recognised by the *Phar.*, 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. One hundred pounds of the fresh herb, when dried, weigh fourteen pounds.

Henbane owes its activity to a crystaline alkaloid closely resembling atropine (p. 198), and termed hyoscyamine or hyoscyamia ($C_{18}\ H_{23}\ N_2\ O_3$, or according to other authorities, $C_{15}\ H_{23}\ N\ O_3$).

Actions and Uses.—In poisonous doses hyoscyamus is an inebriant narcotic, and in medicinal doses a cardiac-sedative, anodyne, and antispasmodic.

In general action it resembles belladonna, stramonium, and the other solanaceæ. It exerts its effects mainly on the sympathetic system, but is less stimulant than belladonna, has a more decided secondary sedative effect on the heart, and in excessive doses also involves the cerebrum and motor centres. (Dr. John Harley; *Old Vegetable Neurotics.*) It has less preliminary stimulant action than opium, does not so notably 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. In the inebriant action of large doses it is analogous to alcohol and turpentine. It has less effect on cattle and sheep 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 heart beats, but no symptoms of acute poisoning. Small doses at once lower the action of the heart. 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.)

Hyoscyamus is occasionally prescribed to quiet the excited tumultuous action of the heart. Frequently it will reduce the pulse of the horse from 60 to 40 beats per minute. It deserves further trial in cases of tetanus. Its anodyne properties recommend it in rheumatism and neuralgia. Given internally, as well as by injection, it sometimes stays spasms of the uterus or bladder. As a calmative, antispasmodic, and substitute for opium, Mr. Mayhew prescribes it for dogs suffering from distemper, giving the tincture f℥ss, with ether fʒi, mixed 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 want of care in collecting the plants, from their being too long kept before being used, or from exposure to high temperatures, many preparations of henbane are almost inert. The officinal preparations are the succus or juice extracted at a temperature not exceeding 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; and the extract made by the cautious evaporation of the expressed juice. f℥jss. succus corresponds with about f℥iij. tincture, fʒj. extract, or grain j. hyoscyamine. These are suitable doses for horses or cattle; sheep and pigs take about one-eighth, dogs one-twelfth, of these doses. In full medicinal doses, the effects are usually developed in an hour, and are intensified and prolonged by combination of the hyoscyamus with opium. It is also occasionally given conjoined with belladonna, camphor, and chloral hydrate.

HYOSCYAMINE is usually prepared from the extract; 1 lb. fruit yields grains xx. of the soluble crystalline hyoscyamine sulphate. Its efficacy is destroyed by elevated temperatures or caustic alkalies. (Garrod.) Like atropine and daturine, hyoscyamine acts on the sympathetic nerve system; retards capillary circulation; in large doses causes vascular paralysis; increases the number but diminishes the strength of the pulsations; quickens respiration; small doses accelerate, large doses diminish, the movements of the intestines; small doses augment, large doses lower, temperature; results are not modified by cutting the pneumogastric nerve; excretion takes place wholly by the kidneys. (Dr. T. R. Frazer.)

IODINE.

Iodum. A non-metallic element, obtained principally from the ashes of sea-weeds. (*Brit. Phar.*)

Iodine is chiefly found in sea-water, and thence is stored up in the textures of sea-plants and animals. Most of what is used in this country is prepared in Glasgow from kelp—the semi-vitrified ashes of various sea-weeds—by breaking it into small pieces and dissolving it in water, when sodium chloride, carbonate, and sulphate, with potassium chloride, crystallize 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 volatilizes, and is received in a series of spherical glass condensers. 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, which is afterwards decomposed by sulphuric acid and manganese binoxide. By a more recent patent process, the dry sea-weed is at once economically subjected to distillation in iron retorts, and iodine as well as other products obtained.

Properties.—Iodine usually occurs in black or blue-black laminar crystals of a metallic lustre. Its specific gravity is 4·95. It has an acrid, disagreeable taste, and a pungent, unpleasant odour, resembling that of chlorine or sea-water. Applied to the skin, it produces a yellow stain, readily removed by alkaline solutions. At ordinary temperatures it slowly evaporates; at 239° it melts; at 392° it boils, volatilizing entirely in distinctive, violet-coloured, heavy, irritating, antiseptic vapours. 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 is univalent; its combining weight is 127; its formula I, or according to some authorities I_2. It readily unites with bases, and forms many compounds used in medicine. 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 which it leaves on the fingers when touched, by the violet-coloured vapour it evolves when heated, and by the blue compound which it forms with a cold solution of starch.

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, frequently present, sometimes in the proportion of fifteen or twenty per cent., is discovered in minute drops adhering to the iodine scales: such a sample, if rolled in bibulous paper, moistens it; shaken in a dry phial, it adheres to the sides. The purity tests of the *Brit. Phar.* 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 discoloration, 1000 grain-measures of the volumetric solution of sodium hyposulphite.'

Actions and Uses.—Iodine in large doses is irritant and corrosive. In medicinal doses it is a stimulant of secreting glands and vessels, alterative, deobstruent, and in the horse especially has a specific power of arresting thirst and excessive secretion of urine. Given for a long period, it produces a debilitated, depraved state termed iodism. Externally it is used as a rubefacient, counter-irritant, and deobstruent. It is a feeble antiseptic, but an effectual deodorizer and disinfectant.

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 death in from two to seven days, producing numerous yellow spots and little ulcers in the stomach, and a peculiar rose-tint of the liver. (Cogswell.) Hertwig found that such doses killed every dog to which they were given. Horses and cattle are less susceptible than dogs, both of the local irritant and general constitutional effects of iodine. This probably results from the less sensitive structure of their alimentary canal and the presence of large quantities of starchy food, 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-coloured evacuations and increasing emaciation. Professor Dick repeatedly gave horses iodine in 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. Quantities of several ounces have also been given to cattle with the same negative results. But the slight effects observed in these and in Professor Dick's cases, while they certainly depend in great part on the natural insusceptibility of horses and cattle to the poisonous action of iodine, are also partly owing to the iodine having been given in the solid form, and hence being slowly, and perhaps only partially, dissolved and absorbed. It is no uncommon thing to find boluses of iodine—and, indeed, of many other substances—in the intestines of horses, almost in the same condition in which they were administered several days or weeks before,—a strong argument in favour of giving medicine in as soluble a condition as possible. In medicinal doses, and in a properly soluble form, iodine usually produces marked effects even in horses and cattle; it imparts new activity to the digestive and assimilative processes, improves the appetite, abates thirst, increases the nasal mucus and saliva, as well as the biliary and pancreatic fluids. Various morbid processes are checked, excessive thirst and inordinate secretion of urine are arrested, and glandular enlargements absorbed. The condition of iodism produced by the administration of the drug for a considerable period 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, and inaptitude for exertion. In the human subject, wasting of the testicles and mammæ have been observed; and in the bull, atrophy of the testicles, with loss of sexual desire. (Morton.) But among the lower animals iodism is of exceedingly rare occurrence, and even in man it is now scarcely ever seen. Where it has occurred, it is arrested by withholding the medicine; exhibiting starch, so as to convert any unabsorbed iodine into the innocuous starch iodide; and then giving mineral tonics, bitters, and nutritive diet.

Iodine produces its constitutional 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; it may be detected in many of the secretions and excretions, 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 immediately formed. Iodine leaves the body chiefly in the urine. Its *modus operandi* is still obscure. Its good effects appear mainly to depend upon its stimulating the secreting glands and vessels, and hence improving the condition of the blood and textures. Professor Headland says that it exerts a catalytic action; Dr. Billing believed that it contracts capillary vessels; Professor Pereira taught that it liquefies the blood. It is closely allied to chlorine and bromine, not only in chemical but in physiological 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. Like mercury, lead, and digitalis, iodine has been thought to be cumulative. But this is extremely doubtful; for it has been given to man in small doses for many months together, and even for more than a year, without any deleterious consequences being observed; whilst its effects, unlike those of mercury and other undoubted cumulatives, cease whenever its administration is discontinued. The potassium and sodium iodides retain the chief properties of iodine, only differing from it in 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.

Iodine is employed, sometimes rationally, often empirically. In inflammatory affections, it is unsuitable so long as acute inflammation and fever continue; but when these are subdued, it is prescribed as an alterative and resolvent. It aids the removal of such effusions as hydrothorax and ascites, of recent exudations on mucous membranes, and of enlargements of glands. Its success in reducing chronic glandular enlargements is well illustrated in its curative effect in diseased thyroid gland—a complaint occasionally met with in the human subject, and known as goître, or Derbyshire neck. It is serviceable amongst the lower animals in chronic enlargements of the liver and udder, and also in rheumatism, especially of a chronic nature, and amongst cattle. It is given with occasional benefit in disease of the mesenteric glands, pulmonary consumption, and other scrofulous affections. But in no veterinary cases is iodine of more decided and unfailing advantage, than in that variety of diabetes insipidus or polyuria which affects the horse. In this disease, from 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 alteratives or tonics are 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, diluted with steam, or dissolved in the volatile amyl hydride in the proportion of twenty grains of iodine to an ounce, it often soothes irritable conditions of the respiratory surfaces, braces relaxed membranes, and abates hoose in calves. In chorea and epilepsy in dogs, iodine is of little value. On doubtful authority it has been stated to antagonize poisoning by mercury, strychnine, and veratrine.

Iodine is much used externally. Applied to mucous surfaces or to the skin, especially where it is thin and tender, it causes superficial inflammation. As a stimulant and resolvent, it is used in swellings of joints, bursal enlargements, strains of tendons, thickening of the periosteum, scrofulous and other tumours, and indurations of the udder. Applied in sore throat, it frequently relieves coughing and dyspnœa; whilst in pleurisy it occasionally helps to arrest the formation of exudate, and hasten the removal of what may have been outpoured. In solution it is sometimes injected into cysts and cavities, from which their contents have been withdrawn to promote adhesion. It proves useful in such skin eruptions as eczema, psoriasis, and lupus, as also in scab, mange, and ringworm. In many of these skin cases, it is advantageously mixed with sulphur or mercurial preparations, or alternated with them. For the cure of indolent ulcers, an ingenious mode of application has been advised. The raw surface is 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 deodorizing unhealthy and malignant wounds, Dr. B. W. Richardson's elegant solution of iodine in amyl hydride has recently been used. Iodine deserves further trial in fistulous wounds, in which it often abates irritation and suppuration. Although an expensive, it is an effective deodorizer and disinfectant, decomposing noisome organic compounds by uniting chiefly with their hydrogen, and also exerting a specific destructive effect on germs. Iodine is contraindicated 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.—The dose of iodine for the horse is from grs. xx. to ʒi.; for cattle, from ʒss. to ʒiss.; for sheep, grs. xv. to grs. xl.; for pigs, grs. x. to grs. xx.; for dogs, from grs. iij. to grs. viij. Such doses should be repeated once or twice daily; should be given some considerable time after eating, so as to prevent as much as possible their conversion into the mild, insoluble starch iodide; may be continued for a week or ten days, withheld for a day or two, and, if necessary, again administered as before. Much larger doses are often given with impunity, but usually without increased curative result. Iodine is generally given to horses and dogs in boluses made up with any convenient excipient. Handy although this form undoubtedly is, it is less certain than a good fluid preparation, such as is obtained by shaking equal weights of iodine and potassium iodide in six or eight parts of water. The potassium iodide does not interfere with or alter the action of the iodine, but ensures its perfect solution and full action. The 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 solution is usually suitable. For injection into wounds, five grains each of iodine and potassium iodide to a pint of water usually suffice. An ointment is employed, made usually with one part of iodine and eight of lard. When freshly prepared and applied with smart friction, this acts well enough. But, by keeping, the iodine is apt to separate and volatilize; whilst, unless indefatigably rubbed in, it is only very partially absorbed. These disadvantages are obviated by using one part each of iodine and potassium iodide to eight of lard or of oil. Half an ounce of iodine, an ounce of tar, and four ounces lard or oil, make a useful mange dressing. For many skin diseases sulphur iodide proves serviceable. It is prepared by mixing, in a wedgwood-ware mortar, four ounces of iodine with one of sublimed sulphur, and gently heating the mixture until liquefaction occurs. The red-brown liquid, as it cools, becomes a greyish-black crystalline mass, insoluble in water, but soluble in glycerine and fatty matters, 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.—Rubiaceæ. *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 is of greater medicinal value than the tough, white, internal woody matter. The powder is greyish-yellow, has an acrid bitter taste, a faint nauseous odour, and communicates its properties to hot water, alcohol, and weak acid solutions. The notable constituents are an odorous volatile oil; an astringent acid termed ipecacuanhic or cephaëlic, and, in combination with it, about one per eent. of a colourless, uncrystallizable, slightly bitter irritant alkaloid ealled emetine or emetia ($C_{30} H_{44} N_2 O_8$). It is present also in the striated and undulated ipecacuans, neither of whieh are, however, reeognised by the *Phar.* With most reagents it comports itself like morphine, from whieh, however, it is distinguished by salts of iron produeing no ehange of colour.

Actions and Uses.—Ipeeaeuan is irritant, emetie, and slightly cathartic. Its diaphoretic and expeetorant virtues are less notable in the lower animals than in man. On account of its emetie action, it is sedative.

Braey Clark considered that three ounces would kill a horse. Full doses cause, in earnivora, considerable gastric irritation. Properly regulated doses are mildly emetic for dogs, eats, and pigs, act more slowly and gently than zine or eopper sulphates, and produee less seeondary nausea and depression than tartarized antimony. In emetie and expeetorant effeets it resembles squill. Failing to produee a full emetie effeet, it usually acts as a laxative. Small and repeated doses, espeeially when eombined with opium, augment the seeretions of the skin and pulmonary mucous membrane; but these results, as already indieated, are produeed with more diffieulty in veterinary than in human patients.

As an emetic, it is given to dogs, eats, and pigs, to relieve derangements of the digestive organs by evaeuating undigested food or irritant matters; and to arrest febrile and inflammatory complaints, espeeially of the eyes, brain, or air-passages. Delafond and other Freneh veterinarians consider that it gently opens the bowels and allays irritation, and aceordingly prescribe it in diarrhœa in eattle, in doses of half a draehm to a drachm, given in gruel or any simple drink. Following Dr. Ringer's reeommendation in the human subject, drop doses of ipecaeuan wine, given at half-hourly intervals, often arrest vomiting in weakly dogs; and for such purposes is sometimes advantageously conjoined with nux vomica. In mueous eatarrh and sore throat amongst horses, where the patient is feverish, the appetite indifferent, and the respiratory membrane dry and congested, Mr. Thomas A. Dollar, of New Bond Street, sometimes gives a drachm of powdered ipecacuan with an ounce of the solution of ammonia acetate in a pint of water, repeating the dose several times daily.

Doses, etc.—As an emetic, dogs take of the powder from 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, as a diaphoretic and anodyne, the celebrated Dover's powder, or the pharmaceutical imitation of it, made by triturating together one part each of ipecacuan and opium, and eight parts of potash sulphate. Of this, horses and cattle take ʒi. to ʒiij. ; sheep, grs. xxx. to ʒi. ; dogs, grs. x. to grs. xv. ; cats, grs. ii. to grs. v. These doses may be 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 is prepared by macerating an ounce of bruised root with a pint of sherry. 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. (Magendie.)

IRON AND ITS MEDICINAL COMPOUNDS.

IRON. Ferrum. Ferrum redactum. Pulvis ferri. Fe.

Iron is a lustrous, whitish-grey metal, tenaceous, malleable, ductile, readily welded at a low red heat, and with a specific gravity of 7·84. It occurs native in the condition of oxide carbonate and sulphide. To extract the metal, the ore is first roasted, which reduces the iron 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 cast-iron. In the manufacture of wrought-iron, the carbon and silicon of the cast-iron are burned out in the puddling furnace. Steel is made by heating wrought-iron in contact with charcoal, of which it takes up one or two per cent.

With other elements and radicals, iron unites in two proportions : it forms the lower proto or ferrous salts, in which it is bivalent and magnetic; and the higher per or ferric salts, in which it is trivalent 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 sulphide ($Fe\ S$); with caustic alkalies, white or grey precipitates of hydrated oxide ($Fe\ H_2\ O_2$); with potassium ferrocyanide, a light-blue precipitate, gradually becoming darker by oxidation ($K_2\ Fe\ Fcy$); with potassium ferridcyanide, a precipitate dark-blue from the first.

The ferric salts are mostly brown or red, and in solution have, with hydrochloric acid, a negative reaction; with hydrogen sulphide, give a white precipitate of sulphur; with ammonium hydrosulphide, the black ferrous sulphide ($Fe\ S$); with caustic alkalies, a brown-red precipitate of ferric hydrate ($Fe_2\ H_6\ O_6$); with potassium ferrocyanide, a deep-blue precipitate of Prussian blue at once goes down ($Fe_4\ 3\ Fe\ Cy_6$); with potassium ferridcyanide, no precipitate, but a green or olive decoloration; with solution of galls, 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 upwards of three thousand years. It is occasionally given in the form of filings or pulvis ferri, as an antidote in poisoning by soluble salts of mercury and copper. In this finely-divided state the metal becomes oxydized and dissolved by the alimentary fluids. Iron salts are astringent, styptic, stimulant, irritant, and tonic. In contact with the unbroken skin they have little effect; on mucous, or skin-abraded surfaces, the soluble preparations combine with albumen and exert their familiar astringent effects. When swallowed, they supply as food iron to the blood and tissues; exert, probably, some not-well-ascertained action on the formation and nutrition of the blood discs; impart a deeper hue to many of the secretions; induce a general astringent and tonic effect; and, reduced in great part to the condition of the black sulphide, are eliminated mostly through the bile in the feces. As external stimulants, astringents, styptics, and antiseptics, the ferrous sulphate and ferric chloride are chiefly used. In the gastric fluids the metal, in a finely-divided state, and the insoluble compounds, are dissolved. The ferrous salts are converted in the stomach and duodenum into the corresponding ferric, which are generally more soluble and active. The inorganic are more powerful than the organic compounds. In Pereira's and other works on human materia medica, upwards of forty iron salts are enumerated; but as they only differ 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 used in treating squamous and herpetic skin diseases, in about the same doses as arsenic, and is also applied externally as an ointment. Citrate of iron and quinine, conjoining the tonic properties of its components, is occasionally prescribed in dog practice, in pill or solution, in doses of four to ten grains.

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 greyish-green, has a chalybeate inky taste, and dissolves with brisk effervescence in hydrochloric acid. Exposed to the air, it rapidly absorbs oxygen, gives off carbonic 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 grey lumps, has a sweet, very feeble chalybeate taste, and should contain at least thirty-seven per cent. of carbonate. (*Brit. Phar.*)

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 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. 147). 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 and silica. Water is freely added, and the solution evaporated, when the iron sulphate crystallizes 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 absorb oxygen, becoming opaque, and covered with a brown coating of oxysulphate. Specimens containing an excess of sulphuric acid undergo this oxidation less rapidly. It has an intensely inky metallic taste; is insoluble in rectified spirit, but soluble in three-fourths of its weight of boiling water and twice its weight of cold water. Heated, it fuses, readily parts with six atoms of water of crystallization, retaining, however, the seventh more tenaciously. Its distinguishing tests are the same as those of other ferrous salts, and are detailed above (p. 342).

Actions and Uses.—Given internally, it is irritant, astringent, restorative, and tonic; used externally, it is stimulant, astringent, styptic, and antiseptic. 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 effusion of a thick layer of tough mucus; whilst the same quantity applied to a wound, proved fatal in twelve hours. (Christison on *Poisons.*) These irritant effects depend upon the soluble sulphate combining with the albuminous tissues and subsequently developing vital reaction. They 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 many rapidly-growing weakly subjects, in scrofulous cases, during recovery from debilitating disease, the blood globules are sometimes notably deficient; they have been found reduced to half their normal amount. Iron salts cause their gradual increase, and hence often impart to all the 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. In addition to its restorative or nutrient powers, like metallic salts and various vegetable tonics, iron sulphate, doubtless, also exerts chemical astringent and vital invigorating effects, whilst it has further marked antiseptic properties. To such influences are probably due the diminution in the size and increased firmness of the spleen, mentioned by Weinhold as the common effect of the continued exhibition of the salt to dogs (Pereira's *Elements*, 3d Edit.). Iron sulphate is the cheapest and most convenient of iron preparations, 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.

Iron sulphate is beneficially administered to all veterinary patients in anæmia, and the various disorders connected with it; 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 hemorrhages; in indigestion and diarrhœa depending upon local atony or general weakness; in antagonizing enlargements of the spleen and liver (Cruveillier); in chorea, and occasionally in epilepsy; and in convalescence from most acute debilitating diseases. In farcy, nasal gleet, and chronic relaxed conditions of the mucous membranes, it is sometimes prescribed for horses, in two drachm doses, conjoined with six grains of arsenic, and made into a bolus with Canada balsam. As there is, however, some risk of the insoluble iron arsenite being produced, the formula is improved by substituting the copper for the iron sulphate. On account mainly of its chemical action, full doses of the powder or strong solution shrivel and destroy various intestinal worms, and, further, impart a healthier condition of the bowels unfavourable to the development of parasites. Although itself devoid of purgative action, it increases the activity of most cathartics with which it is combined. It is applied externally as 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 contraindicated where there is fever, active inflammation, or irritability of the bowels. During early convalescence from inflammatory complaints, milder tonics are often preferable.

Doses, etc.—The dose for the horse is from ʒi. to ʒiij.; for cattle, from ʒij. to ʒiv.; for sheep, grs. xx. to grs. xxx.; for pigs, grs. x. to grs. xx.; and for dogs, from grs. v. to grs. x. These doses may be made into a bolus with linseed meal and treacle, dissolved in water, or mixed with soft food, and repeated three or four times a day. They are often conjoined with other medicines. Thus, in want of tone and torpidity of the bowels in horses, a drachm is given daily with one or two drachms of aloes. Such a combination is also often serviceable in removing worms. 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 bottle of ale or gruel prove a valuable tonic for cattle. The quantities mentioned make three doses for sheep, and eight or ten for dogs. Thirty grains, with a drachm each of common salt and nitre, is 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, besides preventing derangement of the digestive organs, 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 the salt. The dark colour and disagreeable odour which the feces 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.

When iodine, iron wire, and distilled water are gradually heated together, combination occurs; and the solution, filtered and evaporated, yields a green crystalline salt, with a tinge of brown, inodorous, with a styptic metallic taste, and soluble in about its own weight of water and alcohol. The solid iodide contains about 18 per cent. of water of crystallization, 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; or still more effectually by boiling the freshly-prepared solution in syrup.

Actions and Uses.—It is irritant, astringent, alterative, and tonic. Poisonous doses produce the effects of iron rather than of iodine. Thus, Dr. Cogswell found that three drachms given to a dog caused 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 occasionally prescribed in human and also in canine practice.

IRON, RED, PER OR SESQUI-OXIDE. Ferric Oxide. Ferrugo. Rust of Iron. $Fe_2\ O_3$.

IRON PEROXIDE MOIST. Ferri peroxidum. Humidum Ferric hydrate. $Fe_2\ 6\ HO$.

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 hydrate form, by boiling a solution of ferrous sulphate with a few drops of nitric acid, and as much sulphuric acid as it already contains; decomposing this solution of ferric sulphate ($Fe_2\ 3\ SO_4$) by an alkali,—the *Brit. Phar.* orders solution of soda,—and washing the soft red-brown magma thrown down. This pasty mass is the best antidote for arsenic, but requires to be used freshly prepared, as it gradually loses its efficacy by keeping. Dried on a plate over hot water, the oxyhydrate ($Fe_2\ O_2\ 2\ HO$) remains; heated to redness, there is left about 12 per cent. of the red-brown, tasteless ferric oxide ($Fe_2\ O_3$).

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 ($Fe_3\ 2\ AS\ O_4$). In the human subject, doses of a table-spoonful are given every five or ten minutes. Professor Douglas Maclagan says that 12, and Devergie that 32, parts of the hydrate are sufficient to neutralize 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 *Phar.*, the Liquor Ferri Perchloridi Fortior, is orange-brown, odourless, inky-tasted, has a specific gravity of 1·438, 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 strong watery solution with three of rectified spirit. This tincture has a red-brown colour, an etherial odour, acid chalybeate taste, and a specific gravity of 0·992.

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 also 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 from want of tone, where intestinal worms have been troublesome, 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. Externally it is used as a caustic, astringent, styptic, and stimulant. Injected into the rectum, in the proportion of two drachms of the medicinal solution to a pint of water, it destroys ascarides, breaking up and coagulating their albuminous textures. French surgeons have used it with some success in reducing erectile and aneurismal tumours, a few drops injected into the sac causing coagulation of 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.

Doses, etc. — Of the weaker watery, or spirituous, solutions, horses and cattle take f℥i. to f℥iij.; 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.

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; purple-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 of a hard, compact structure, 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 starchy and mucilaginous matters without the cathartic, resinous principle, which, however, is readily soluble in rectified spirit.

Along with the ordinary plant constituents, jalap contains about 18 per cent. of an active cathartic resin, which is separated by evaporation of the tincture, differs from ordinary resin in being insoluble in oil of turpentine, and consists of two distinct resins, jalapin ($C_{31}\ H_{50}\ O_{16}$), and convolvulin ($C_{34}\ H_{56}\ O_{16}$). The former is soft, brown, greasy, and soluble in ether; the latter colourless, odourless, tasteless, insoluble in ether, and remarkable for the production of a beautiful crimson colour when moistened with sulphuric acid. (Gregory.) Jalap of good quality is dark-coloured, dry, heavy, compact in structure, with an acrid, bitter taste, and not worm-eaten. The elongated, lighter, paler, wrinkled tubercles of the Tampico jalap, and of several other plants, are frequently substituted for those of the officinal jalap, but are deficient in resin and cathartic action.

Actions and Uses.—Jalap is irritant, cathartic, and feebly vermifuge. Two drachms caused the death of a small dog, when the œsophagus was tied to prevent the drug being vomited. A large quantity rubbed into the skin, or applied to any mucous membrane, excites inflammation. Its cathartic action is very 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 giving half a pound without purging; equally large quantities are without perceptible effect on cattle; one to two drachms proves a mild purge for sheep and pigs. It is prescribed for dogs for all the ordinary purposes of a gentle purgative; and, though not very speedy, is safe and tolerably certain. It is believed to operate chiefly on the small intestines, increasing both their secretions and their peristaltic motion. In its action it resembles scammony; it is more active than senna, less irritant than gamboge, but for the larger quadrupeds is neither so certain nor so effective as aloes.

Doses, etc.—Dogs take ʒi. to ʒij.; cats, ʒss.; pigs, ʒi. to ʒiv. It is best given in combination with calomel. Dogs are effectively physicked by half a drachm to a drachm of jalap, with two or three grains of calomel, made into a bolus with linseed-meal and water, or 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 dark 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. They are chiefly brought from the shores of the Mediterranean and the Baltic. All parts of the tree have similar properties, and yield, when distilled with water, about one per cent. of a transparent colourless oil ($C_{10} H_{16}$); isomeric with oil of turpentine yielding, in contact with water, a white, crystalline, hydrous substance ($C_{10} H_{16} H_2 O$), (Attfield), and concentrating the characteristics of the plant. 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 resemble other substances containing volatile oils, such as anise, caraway, and coriander, the balsams of Canada, Copaiba, and Peru; they are analogous to, but less active than, the turpentines. In horses and cattle, two ounces of the berries act only on the digestive organs; but three or four ounces induce diuresis, and also slight diaphoresis. The action of the heart, however, is not affected. 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 from ℥i. to ℥iij.; sheep, from ʒij. to ʒiv.; dogs, from grs. xx. to grs. xl. These doses are repeated several times a day; are usually given coarsely powdered and mixed with fodder; and are readily eaten by most animals, especially by sheep. A decoction, made either from the fruit or tops, is occasionally used internally, and also 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 from galena, the sulphide (Pb S.). It has a bluish-grey colour, and a peculiar odour when rubbed; is malleable, readily cut or scratched, and has the specific gravity 11·35. Exposed to the air it oxidizes, loses its metallic lustre, and becomes dull and opaque. It fuses at 612°. In ordinary water, with access of air, a hydrated oxycarbonate is gradually formed. Lead is sometimes quadrivalent, but most of its medicinal compounds are bivalent.

Actions, etc.—Lead, in the metallic state, 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 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 oxidized, dissolved, and exert its characteristic effects. The soluble compounds, as the nitrate and acetates, are corrosive and irritant, but not nearly so powerful as corresponding zinc or copper salts. The insoluble, as the oxides and carbonates, have scarcely any irritant action. All lead compounds, when given in repeated doses for some considerable time, induce a peculiar state called plumbism. In the end of 1851, Mr. Shenton, an intelligent veterinary surgeon practising in Derbyshire, had eleven fatal cases of this disease 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.[1] The symptoms of lead poisoning among the lower animals are analogous to those observed in man. They usually continue, in more or less aggravated form, for several weeks or even months. The lead retained in the system impairs the digestive functions and

[1] See Professor George Wilson's excellent paper on cases of Lead Poisoning, in the *Monthly Journal of Medical Science* for May 1852.

deteriorates the blood. The appetite becomes capricious, is sometimes entirely gone, at other times is morbidly increased. The gums and teeth are of a grey or blue colour. Constipation and colic are not so invariable as in the human subject. Cramp is not confined to the muscles of the bowels or extremities, but probably also affects the blood-vessels; the blood contains an excess of urates; nutrition is interfered with, strength and condition fail; the disordered or depressed state of the nervous system determines paralysis, especially of motor power, occasionally epilepsy or apoplexy. Indeed, these diseases occasionally simulate lead poisoning so exactly as to have been mistaken for it by various practitioners. In a letter received from Mr. Shenton, he thus describes the conditions which came under his observation:—'There was a rough staring coat, a tucked-up appearance of the abdomen, and a slightly accelerated pulse; in fact, symptoms of febrile excitement, which usually, however, passed away in about a week. About this time large quantities of grey-coloured matter were discharged from the nostrils, and saliva from the mouth; but at no time was there any enlargement of the sub-maxillary, lymphatic, or salivary glands. Neither was there constipation of the bowels, which appears to be nearly always present in lead poisoning in man. Fits and partial paralysis came on at intervals; and when the animals got down, they often struggled, for a long time ineffectually, to get up again. The breathing up till this period was pretty tranquil, but now became so difficult and laboured, that the patients appeared in danger of suffocation. The pulse was in no case above sixty or seventy; and I ascribed the difficulty of respiration to a paralysed state of the respiratory apparatus. The animals did not live more than two or three days after these symptoms appeared. The post-mortem appearances varied but little. The lungs and trachea were inflamed; the lungs engorged with large quantities of black blood; the trachea and bronchi filled with frothy spume. In all cases but two, the villous part of the stomach presented isolated patches of increased vascularity; and in all cases the intestines, and especially the large ones, were inflamed. The blind pouch of the cæcum was nearly gangrenous. There was nothing remarkable about the liver, spleen, or kidneys, except that they were of a singularly blue appearance. The brain and spinal cord were not examined.' It may further be observed, that in dogs destroyed in about three weeks by lead poisoning, the muscular system was flaccid, pale, and bloodless. (Schwepfer.)

Mr. Cartwright of Whitchurch, Salop, records, in the *Edinburgh Veterinary Review* for August 1863, three cases of milch cows poisoned by eating sheet lead which had been used for lining tea-chests, had been carelessly thrown on the manure heap, and thence been spread on the clover fields. Besides failure of the milk and the appetite, grinding of the teeth, and dulness, several curious symptoms are mentioned. The head was rested against the wall 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. 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.' The best process for preparing for analysis the different organs and parts to be examined, in cases of lead poisoning, is that which Professor Wilson followed in the chemical investigation of Messrs.

Shenton and Mayor's cases, above referred to. The organs are digested in aqua regia, over a slow fire, until the 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, dried, and dissolved in dilute hydrochloric acid. This solution will usually be sufficiently pure to exhibit, with appropriate reagents, the characteristic reactions of lead and its compounds. It should give, with hydrogen sulphide and ammonium hydrosulphide, a black precipitate ($Pb\ SO_4$); a white precipitate, with sulphuric acid and soluble sulphates; 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 usually gets contaminated by conveyance through leaden pipes, or standing in leaden cisterns. The conjoined action of air and moisture is apt to produce, on the surface of the metal, 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 nitrates, chlorides, carbonic acid, and nitrogenous matters. Hard waters, abounding in carbonates, sulphates, 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 the 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, appear liable to set up galvanic action, and thus dissolve the metallic lead. 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.

There are two chemical antidotes for lead poisoning,—the unsavoury hydrogen sulphide, which converts it into the insoluble black sulphide, and sulphuric acid, which converts it into the insoluble white sulphate. Potassium iodide, besides producing an insoluble salt, also expedites the elimination of the poison by the kidneys. These antidotes should be given dissolved in such diluents as milk, mucilage, or egg; the bowels must 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.

Melted lead exposed to a current of air oxidizes, forming a yellow, semi-crystalline powder called massicot. This, when fused at a red heat, acquires a foliaceous or scaly structure, a red or yellow-red colour, and is known as litharge ($Pb\ O$). At higher temperatures litharge is further oxidized, and produces red lead or minium ($Pb\ O_2$, $2\ Pb\ O$). Nitric acid breaks up this complex oxide, leaving undissolved the puce-coloured dioxide ($Pb\ O_2$). White lead, so extensively used in the arts, is a mixture of carbonate and hydrate ($2\ Pb\ CO_3$, $Pb\ H_2\ O_2$), 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 in large quantities are irritant and astringent; in frequently-repeated doses, they exert the usual constitutional effects of lead compounds; they exhibit cumulative properties, and are occasionally used externally as astringents. Most coloured vegetable fluids shaken with litharge are decolourized.

Lead Oleate. Lead Plaster. Emplastrum Lithargi vel Plumbi.

The common sticking or diachylon plaster is thus directed to be prepared: 'Take of litharge in fine powder, four pounds; olive oil, one gallon; water, three pints and a half. Boil all the ingredients together gently by the heat of a steam bath, and keep them simmering for four or five hours, stirring constantly until the product acquires a proper consistence for a plaster, and adding more water during the process if necessary.' (*Brit. Phar.*) In this process the fatty matter 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. 318). 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 a mild stimulant, and is useful for uniting incised wounds, and protecting them from the action of the air. It is generally used spread on linen or calico, when the strapping, besides affording increased protection, gives wounds healthful pressure and support. Such plasters are rendered more adhesive, and consequently better adapted for most veterinary purposes, by adding three or four ounces of pitch or resin to every pound of the lead plaster.

Lead Iodide. Plumbi Iodidum. $Pb\ I_2$.

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.—In physiological action it resembles the other salts of lead; is believed to act specially on the spleen; 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 or DIACETATE. Plumbi subacetas. Lead oxy-acetate. Goulard's Extract. $Pb_2\ O,\ 2\ C_2\ H_3\ O_2$.

Of the several 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 diluted pyroligneous 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. Water at 60° dissolves somewhat less than its own weight. In solution it has a remarkable power of uniting with different proportions of the oxide, forming subsalts. Two of these sub or diacetates are present in the familiar Goulard's Extract. An officinal liquor, plumbi subacetatis, in imitation of Goulard, is prepared with 'acetate of lead, five ounces; oxide of lead, in powder, three and a half ounces; water, a pint or a sufficiency. Boil the acetate of lead and oxide of lead with the water for half an hour, constantly stirring; then filter, and, when the liquid is cold, add to it more distilled water, until the product measure twenty fluid ounces. Keep the clear solution in stoppered bottles.' (*Brit. Phar.*) It is colourless, transparent, alkaline, has a sweet astringent taste, and becomes turbid on exposure. From 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 its watery solution, and by its producing an opaque white jelly when mixed with gum Acacia 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. Frequently repeated doses develope the special symptoms of plumbism (p. 354). Medicinal doses are astringent, antiseptic, and anodyne; whilst they also check the escape of albuminous matters in the urine, in which they are mainly excreted. Externally they are astringent, styptic, and anodyne. On skin-abraded or mucous surfaces they combine with albumen, leaving a protecting covering. Accompanying this union with albumen, there is diminished calibre of capillary vessels, and an anodyne 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 in external applications, on account of their not drying up or crystallizing.

Hertwig exhibited sugar of lead to horses in doses of a pound, 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. Its effects on cattle are even more energetic. Prinz observed, that doses of half an ounce daily, continued 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, and 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. Doses of half an ounce, administered to dogs, and retained in the stomach by tying 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 the chemical action the coat of the stomach is found grey, and 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.

Lead acetate is administered to check hemorrhages and profuse discharges. In purpura in horses and red water in cattle it is often very effectual, doubtless on account of its powerful astringency and its staying undue excretion of albumen in the urine. In diarrhœa and dysentery it dries up excessive secretion, and quiets undue vermicular movements. Half-drachm doses each of sugar of lead and opium, given daily, arrest the dangerous diarrhœa which attacks badly-managed calves and young cattle in autumn and early winter. Scouring lambs are equally benefited by five or six grains each of the lead acetate and opium. In many of these cases, besides being given by the mouth, it is also added to starch injections. Its twofold action as an astringent and anodyne recommends it in cases of superficial inflammation; in burns, bruises, and irritable over-secreting sores; in strained inflamed tendons and joints; in eczema, nettle-rash, and weeping, itching skin diseases. 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. These doses are given in bolus or solution, repeated two or three times 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 affected by spasms. 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 *Phar.* Goulard's extract, diluted to suit convenience, is also much used. Diluted with four parts of linseed or olive oil, it is recommended as a cooling application for blistered or contused surfaces. (Morton.)

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 ground constitutes linseed meal.

To utilize the fibrous stem, the plant is steeped in water, which, in the improved process, is used hot; starchy and cellular matters are got rid of by scutching; the fibres are hackled aud carded, the shorter coarser portions forming tow, the finer, when bleached, are made into linen, which is scraped down to form the familiar surgeon's lint. Both lint and tow are used for protecting wounds from external irritants; and, when saturated with hot or cold water, they prove cleanly substitutes for poultices. 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 a line 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. The external envelope consists chiefly of starch, gum, and wax. The internal nucleus, with albumen and gum, contains about 38 per cent. of a fixed oil. Ground and pressed without the aid of heat, the seeds 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- or oilcake.

Linseed oil, carefully prepared from tolerably sound seed, has a pale yellow colour, a mild but nauseous taste, and a specific gravity of about 930. Exposed to the air it speedily becomes rancid; but a thin stratum quickly dries up, forming a hard transparent varnish, and 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 about forty parts of cold alcohol, and in about one and a half of ether. Like other fixed oils, it is glyceryl oleate, with a little palmitate and stearate; boiled with alkaline solutions, it forms soaps; mixed with an equal quantity of lime water, it forms carron oil, once much used for scalds and burns. It is sometimes adulterated with rapeseed oil; but is more commonly of inferior quality from rancidity, preparation at continued high temperatures, or the presence of impurities.

Actions and Uses.—Linseed and linseed cakes are valuable feeding stuffs; they are digestible, palatable, and nutritive. As producers of fat, such oleaginous bodies 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 healthy repair and growth of every tissue; their combustion developes heat and force. In moderate amount they favour the digestion alike of starchy and nitrogenous food, with which they may be 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 favours economically 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 everyday use as a mucilaginous demulcent in irritable conditions of the throat, alimentary canal, kidneys, and bladder; in poisoning with irritants and corrosives; and as a convenient vehicle for the administration of nauseous or acrid medicines. Ground linseed makes good poultices, especially when mixed with an equal quantity of bran and oatmeal; but the bruised linseed or oil-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 causing laxative effects. It increases rather than diminishes the quantity of ordinary food consumed. As an adjuvant feeding stuff, I have found it inferior to linseed cake, beans, or oats.

Linseed oil given 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 lubricating and emollient properties, linseed oil often relieves choking in cattle; injected into the rectum or bladder, it allays irritation of these organs. As a soothing dressing, it is applied to hard, dry, irritable surfaces. From its drying properties, it is less suitable than olive oil or lard for making ointments or liniments.

Doses, etc.—As a cathartic, horses take Oss. to Oj.; cattle, Oi. to Oij.; sheep and pigs, from f℥vj. to f℥viij.; dogs, from f℥i. to f℥ij.; cats, fʒi. It is 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 best on dry, light, sandy soils. The best qualities are grown in England, or imported from Spain and Italy. The plants vary from two to four feet in height, and have large, irregular yellow-green leaves; papilionaceous white 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 a resinous oil, to which it owes its sub-acrid taste, and a sweet, yellow, uncrystallizable sugar, termed glycyrrhizin. 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, especially in irritation of the pulmonary mucous membrane in man; is employed 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 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—the *magnesia levis* of the *Phar.*—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 hydrosulphide. Like other salts of the alkaline earths, they produce with potassium carbonate a white precipitate of carbonates, which, unlike the carbonate of calcium or 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. In antacid characters it resembles potash and 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, but is a gentle laxative for dogs and cats, and is occasionally prescribed with calomel, jalap, or buckthorn. It is sometimes ordered for foals and calves troubled with acidity and flatulence, but in such cases acids usually answer better. It is an antidote for poisoning by acids. It removes arsenic from solution, and 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, from ʒii. to ℥i.; dogs and cats, ʒss. to ʒi. It is conveniently given suspended in milk or gruel, and conjoined with carminatives.

MAGNESIUM CARBONATE. Magnesia alba. $3\ Mg\ CO_3,\ Mg\ O,\ 2\ HO,\ 4\ H_2O$.

When sodium carbonate is mixed with bittern or with a solution of magnesium sulphate, double decomposition ensues, and the precipitated magnesium carbonate, with a little magnesium hydrate, is collected, washed, and dried. The solutions, tolerably concentrated and mixed without heat, yield a heavy, when 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 the 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.

In action and uses the carbonates are analogous to the oxide; may be used in double the quantity either as antacids or laxatives; but in contact with the acid gastric juice, are apt to evolve much gas, and thus cause distension and discomfort.

MAGNESIUM SULPHATE. Magnesiæ Sulphas. Epsom Salt. $Mg\ SO_4,\ 7\ H_2O$.

This important magnesian salt is found in various rocks, soils, and mineral waters. From its presence in the mineral streams of Epsom, it derives its vernacular name.

Preparation.—It is generally prepared from magnesian limestone, or dolomite, which is a double calcium and magnesian carbonate; or from bittern, the oily-looking liquid left when sea-water is concentrated for the separation of common salt. Prepared from the first of these sources, the magnesian limestone 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 all the lime into calcium chloride, which is separated in solution, leaving the insoluble magnesia, which is then treated with sulphuric acid, and the magnesium sulphate thus produced crystallized out. Bittern, when concentrated, yields an abundant crop of crystals of magnesium sulphate, and still larger quantities are obtainable by first adding some sulphuric acid to convert the chloride and other salts into the 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, needle-like crystals; but by slow crystallization it may be got in large transparent rhombic prisms. It has a cooling, saline, nauseously bitter taste; is insoluble in alcohol, but soluble in its own weight of temperate water, and in three-fourths of its weight of boiling water. When heated, it fuses in its water of crystallization; but, as the temperature is raised, the water volatilizes, and a colourless glass remains. 'In solution, it gives copious white precipitates, with chloride of barium (sulphate), and with a mixed solution of ammonia, chloride of ammonium, and phosphate of soda (ammonio-phosphate of magnesia). Its aqueous solution at ordinary temperatures is not precipitated by oxalate of ammonia (showing the absence of lime), nor should it give a brown precipitate with chlorinated lime or soda (testifying the absence of iron and manganese).'—*Brit. Phar.* It resembles zinc sulphate, from which, however, it may be 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, and febrifuge. It closely resembles common and Glauber salts, and is more purgative than potassium bitartrate or sodium phosphate. It has a low diffusive power, passes tardily through animal membranes, and in full doses retards absorption of fluid from the stomach and intestines, which become over-distended, and are shortly purged of their contents (Buckheim and Ringer). Like other salines, it proves a tardy and uncertain cathartic for horses, acts on the kidneys as much as on the bowels, but in repeated doses of two or three ounces proves a valuable alterative and febrifuge. Among dogs its purgative effect is slow and irregular, and often accompanied by nausea and vomiting. For cattle and sheep, however, it is a most convenient and effectual cathartic, equalled only by common salt in rapidity and fulness of action. Full doses usually take effect on cattle in twelve or fifteen hours, and cause very fluid evacuations. Purgation is its most prominent effect, but it also augments the secretions of the kidneys and skin, especially when prescribed in moderate, frequently repeated doses. 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 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 so soon as the more acute symptoms are subdued, is used once or twice daily, but should be altogether withheld, or diminished in amount, whenever the bowels become unduly relaxed, or where flatulence or spasm follows its use. It seems to act more certainly and regularly when given in solution rather than in bolus. It is often conjoined with nitre and camphor; or in convalescence from acute disorders, with powdered gentian and ether. Epsom salt is one of the best antidotes in 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.—The cathartic dose for adult cattle is lbj. to lbij.; for average-sized calves, of two to three months, ℥iij. or ℥iv.; for sheep and pigs, from ℥iv. to ℥vi.; for 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 acting as febrifuges and alteratives. Epsom salt is best given dissolved in ten or fifteen parts of water. To conceal its nauseously bitter taste, it may be administered with treacle, or with sulphuric acid, in the proportion of fifteen or twenty drops to every ounce of salt. To expedite its purgative action, and prevent nausea and griping, some carminative is also often added, such as a drachm of ginger to the ounce of salt. Where prompt and full purgation is desired in cattle or sheep, a mixture of equal weights of Epsom and common salt is preferable to either given alone; an equal weight 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 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.

Althææ Radix. Dried Root of Althæa officinalis.

Nat. Ord.—Malvaceæ. *Sex. Syst.*—Monadelphia Polyandria.

The plants of the natural family Malvaceæ are rich in mucilage, and most of them yield tenacious fibres, from which cordage is obtained. The seeds of the several species, Gossypium, are surrounded by delicate, flattened, twisted hairs, which constitute raw cotton. The marsh mallow grows both in this country and on the Continent, generally in the neighbourhood of rivers and salt marshes. The flowers, stem, and leaves yield mucilage, but in lesser proportion than the root, which is sold in light-coloured, fibrous, cylindrical pieces, several inches long, and about an inch in circumference. It has a sweet, mucilaginous taste, and readily yields to hot water about twenty per cent. of mucilage, with starch and uncrystallizable sugar.

Actions and Uses.—Marsh mallow root is employed both internally and externally for the various purposes of a demulcent and emollient, nearly resembles linseed, and is used chiefly in the form of drench and poultice, 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 synonyme hydrargyrum ; to its mobility and metallic lustre such appellations as aqua argentum, aqua metallica, and quicksilver. Although occasionally found in metallic globules, its most important source is the sulphide or cinnabar, chiefly obtained from Idria in Carniola, and Almaden in Spain, from Peru, California, and latterly from China and Japan. When the ore is roasted or heated with iron or lime, sulphur is got rid of, and mercury distils over, and is exported in cylindrical wrought-iron bottles, holding from 60 to 112 lbs.

Mercury is easily distinguished by its mobility, liquidity, and silvery-white lustre. It is tasteless and odourless ; freezes at —40, forming octahedral crystals ; and boils at 662°, forming a dense colourless gas. Its specific gravity at 60° is 13·6, its atomic weight 200. It is bivalent, forming, like copper, two series of salts, the lower or mercurous, the higher or mercuric. Thus the mercurous chloride calomel ($Hg\,Cl$) contains exactly half the amount of metal as the corresponding mercuric chloride corrosive sublimate ($Hg\,Cl_2$). When pure, its globules roll readily over a sheet of white paper without losing their spherical shape or leaving a stain. Triturated with fatty or saccharine substances, as in the preparation of mercurial ointments and liniments, the metal loses its fluidity and globular structure, is reduced to the condition of a dark grey powder, whilst a small portion is oxidized.

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 test-tube with dry sodium carbonate, they undergo decomposition, their metallic portion volatilizing, 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-grey stain, easily removable by heat. (*d*) In solution, hydrochloric acid produces a white precipitate if a mercurous salt is present. 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 gives a black sulphide, insoluble in nitric acid. There are numerous confirmatory tests. (*f*) Alkalies and lime-water with mercurous salts yield grey or black precipitates of the lower oxide; with mercuric salts, the yellow, red, or higher oxide. (*g*) Potassium iodide added to mercurous solutions gives the green unstable mercurous iodide; added to mercuric solutions, it gives the red or scarlet mercuric iodide, which is soluble in excess either of the mercury or potassium salt.

Actions and Uses.—Mercury, so long as it remains uncombined, like other metals, is devoid of physiological action. It has been given to the human subject in doses of several pounds, for the purpose of removing obstruction of the bowels, and exerts only a mechanical effect. In a state of fine division it is readily oxidized or dissolved, and thus acquires active properties. In this way mercurial vapours, in themselves innocuous, speedily become powerfully poisonous, as is well illustrated by the following case:—'In 1810, the *Triumph* man-of-war and *Phipps* schooner received on board several tons of quicksilver, saved from the wreck of a vessel near Cadiz. In consequence of 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, vol. i., p. 813.) 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 kept in the adjacent reservoirs, contaminated by the waste products of the furnaces, lose their red spots and become sickly.

Mercurial compounds are of much interest both as medicines and poisons. They have a wide range of action. 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; in full or frequent doses they disintegrate the blood and soft solids; they are excreted by the mucous and glandular surfaces. The nitrates and higher chloride, better known as corrosive sublimate, are powerfully irritant and corrosive. The soluble compounds are cathartic, and for this purpose calomel, grey powder, and blue pill are in common use. Mercury salts, in some particulars, resemble those of antimony, which, however, develope their action mainly through the nervous system, and exert their chief effects on the skin and mucous surfaces. Antagonizing blood disorders, they are analogous to arsenic, which has, however, antiseptic rather than destructive effects on the soft solids. Inducing specific blood-poisoning, they are somewhat like iodine, which has, however, a more limited range of action, and chiefly stimulates secreting glands and vessels.

Mercurials produce a specific condition called mercurialism, of which the symptoms are tolerably uniform in all animals. Secretion and excretion become 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 and bile; the kidneys and skin are unusually active; the mouth becomes tender, the gums red and swollen, the breath fœtid; the pulse usually somewhat accelerated. There is impaired appetite, with nausea, gradual loss of condition, and general weakness. During the continuance of this peculiar condition, the blood forms a soft friable clot, loses in man one-third of its fibrine, one-seventh of its albumen, one-sixth of its globules, and is loaded with a fœtid oil. Mercury remains a long time in the body. It has been detected in the urine of man four weeks after its administration ceased. (Schneider.) Globules of it have been found years after its use in the cancellous structure of the bones. It is excreted by the mucous membrane of the intestines, and in lesser amount in the bile and urine. 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. During the action of mercury, various curative actions are developed. Anasarcous swellings are removed; glandular enlargements or indurations diminished; acute inflammation is mitigated or subdued; whilst exudation of lymph is checked. Such beneficial effects are stated to be especially observable in inflammation of membraneous tissue, as in pleurisy, rheumatism, liver complaint, and ophthalmia, and where the administration of mercurials has been preceded by blood-letting. Mercurialism may be produced in any of the lower animals, but with most difficulty in horses, which, like other animals, manifest, however, very various degrees of susceptibility to it. 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. It occasionally follows the exhibition of one large dose, when it is apt to be violent and difficult to control. It is induced most certainly and safely by small and repeated doses of calomel, or any of the milder mercurials, and its production is expedited by using the medicine both externally and internally, and by employing blood-letting, nauseating medicine, or other means which diminish vascular tension and favour absorption. 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 expedited by sulphurous fumigation or baths, and small doses of opium. Dr. Schneider's observations indicate that potassium iodide, although generally recommended for the purpose, has little, if any, influence in expediting the removal of mercury from the system.

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 *Phar.* directs the addition of one-sixteenth part of suet, 'are kept in the fluid state by a temperature of about 100°, and are driven round with rapidity in a circular trough by two spherical iron balls, which are propelled by means of a steam-engine; and in this way extinction is accomplished in the course of twelve hours.' (Christison's Dispensatory.) The process is facilitated by adding to the materials a sixteenth part of old ointment. The quality and purity of mercurial ointment may be conveniently judged of by comparing its colour, which is bluish-grey, with that of a specimen of known purity; estimating its specific gravity, which, according to Pereira, should be 1·78; observing, with a magnifying lens of four powers, whether the metallic globules are extinguished; or removing the fatty matters by ether, when the residue should be half the weight of the ointment first taken. For most purposes this ointment is too strong, and may be conveniently diluted with two or three parts of hog's lard or soft soap. Good mercurial ointment contains about one-fifth of its mercury in the more active state of oxide, and during application, with infriction and exposure to the air, oxidation is doubtless increased.

Actions and Uses.—Mercurial ointment, when merely laid on the surface of the skin, acts very slightly; when applied with smart friction, it induces irritation and vesication. It is used in the several domesticated animals as a stimulant dressing 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 ointments. It requires 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. This tendency to become absorbed is, however, sometimes useful, and the ointment is applied over a considerable surface, to aid in producing the constitutional effects of mercury given internally. Even when used alone, two ounces of the stronger mercurial ointment of the shops, rubbed daily into the skin of a horse, will salivate 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, mixed with shaking, constitute the liniment of the *Brit. Phar.* 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 morphia, made by heating oleic acid to about 300° with from five to twenty per cent. of mercury red oxide. A grain of morphia 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. Mr. Marshall further urges its use in relieving pain and checking morbid action in pleurisy, pneumonia, and pericarditis.

Mercurial Plaster. Emplastrum Hydrargyri.

The *Pharmacopœia* gives the following directions for preparing mercurial plaster :—'Take of mercury three ounces; olive oil, one fluid drachm; sublimed sulphur, eight grains; lead plaster, six ounces. Heat the oil and add the sulphur to it gradually, stirring until they unite; with this mixture triturate the mercury until globules are no longer visible; then add the lead-plaster, previously liquefied, and mix the whole 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. Mercury with Chalk. Grey Powder.

These mixtures are made by triturating together an ounce by weight of mercury with two ounces of chalk or magnesia until globules disappear, and the mixture acquires a uniform grey colour. Grey powder should be free from grittiness, insoluble in water, its chalk soluble in hydrochloric acid, leaving the mercury in a finely-divided state. Both preparations are laxative and antacid, but the grey powder only is official. I frequently give it with good effect to young calves suffering from indigestion and diarrhœa, in doses of ten or fifteen grains, repeated several times a day, usually united with a drachm of ginger, and administered either in spirits and water, linseed oil, or a little gruel. As an alterative for dogs, five to ten grains are prescribed. In the earlier stages of distemper, Mr. Mayhew recommends from grs. v. to grs. xv. of grey powder, conjoined with from 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 from 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, makes 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, grey, or lower oxide is prepared by decomposing calomel (Hg Cl) with a solution of an alkali or an alkaline earth. It is a heavy black powder, devoid of taste or odour, insoluble in water and alkalies, but soluble in nitric and acetic acids. It is unstable, and readily decomposes on exposure to light. It is less active than the higher or red oxide; and is chiefly used, as a stimulant for unhealthy sores and ulcers, in the form of the black wash—the lotio hydrargyri nigra of the *Phar.*—made by mixing thirty grains calomel with ten fluid ounces lime water.

MERCURY RED OXIDE. Hydrargyri Oxidum Rubrum. Mercuric oxide. Hg O.

The red, yellow, or higher oxide, also known as red precipitate, is prepared by decomposing corrosive sublimate with lime water, or by heating mercuric nitrate ($Hg\ 2NO_3$) 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. The lotio hydrargyri flava of the *Phar.* 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 is used externally for indolent ulcers, luxuriant granulations, unhealthy eruptions, and chronic tumours, being applied in the several forms of powder, lotion, or ointment.

MERCURY SULPHIDE. Hydrargyri Sulphuretum. Hg S.

Cinnabar, a red-brown substance found in Carniola and Spain, is a native sulphide, and 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 mixture of sulphide and 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 Subsulphas Flavus. Turbith or Turpeth Mineral.

The four sulphates possess little veterinary interest. The insoluble yellow oxysulphate or turpeth mineral ($Hg_3\ O_2\ SO_4$) 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 was formerly prescribed for glanders and farcy; on account of its actively irritant properties, it is an errhine; but for these and other purposes it is now superseded by safer and more certain remedies.

MERCURY CHLORIDE. Mercury Sub or Lower Chloride. Hydrargyri Subchloridum. Mercurous Chloride. Calomel. $Hg\,Cl$.

Calomel is found native in Carniola and Spain, but in too small amount to be of commercial value. It is obtained either by decomposing a solution of the nitrate with a hot solution of common salt, or by subliming a mixture of the lower sulphate and common salt. The latter process is now usually preferred, and is thus carried out by the instructions of the *Brit. Phar.*: 'Take of sulphate of mercury ten ounces; mercury, seven ounces; chloride of sodium, dried, five ounces; boiling distilled water, a sufficiency. Moisten the sulphate of mercury with some of the water, and rub it and the mercury together until globules are no longer visible; add the 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 following reactions occur: Triturating metallic mercury with the sulphate, a subsulphate is produced; when this is heated with sodium chloride, mutual decomposition occurs, calomel is sublimed, sodium sulphate remains. 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 volatilizes, but at lower temperatures it becomes yellow, regaining, however, its original appearance when allowed to cool. Its specific gravity is nearly 7·2.

Impurities.—Admixture of corrosive sublimate, although occasionally dreaded, rarely occurs. The minutest trace is readily dissolved out by agitation with cold water, and testing with hydrogen-sulphide, caustic potash, or lime water. Sal-ammoniac, occasionally present, is discoverable by its taste; whilst common inorganic impurities are left behind when the suspected specimen is volatilized by heat.

Actions and Uses.—Calomel is irritant, stimulant, sedative, catalytic, alterative, and antiphlogistic; in large or repeated doses it causes mercurialism; it is an emetic for dogs and pigs. Passing out of the body, it stimulates the various excreting organs, and proves cathartic, cholagogue, diuretic, diaphoretic, and sialogogue. Applied externally, it is stimulant and astringent.

Calomel is less irritant than corrosive sublimate or the nitrates. Its irritant and 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 these animals, in from twenty-four to thirty-six hours, and in dogs in less time, occasional colic and copious excretion of feces, which contained considerable quantities of bile, and were greyish-green in cattle, but black in dogs. Such doses, especially if repeated daily for three or four days, further induce thin and stinking evacuations, 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 about 85. By the eighth day the 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 feces or urine. By the twelfth day, these symptoms became more aggravated; the pulse softer and less frequent, indicating the sedative action which renders calomel useful for many curative purposes; and the strength much reduced. On the fourteenth day the administration of the calomel was suspended, but death occurred in two days afterwards. The animal had received fourteen drachms in fourteen days. On *post-mortem* examination, the teeth were found loose, the mucous membrane of the mouth and air-passages blanched, while that of the stomach and intestines was softened, easily torn, and in many places thickly covered with mucus and epithelium. The liver was rather friable, but the kidneys, spleen, and lungs were healthy. Three or four grains given night and morning salivated large dogs in a week, and killed them in nine days; the only notable appearances were inflammation of the large intestines, and of the sympathetic ganglia of the abdomen. Hertwig considers that dogs and swine, on account of their often getting rid of the medicine by vomiting, are less easily affected than the other domesticated animals; and that horses are less susceptible than cattle.

Preceding the production either of its 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. According to some authorities, it undergoes partial conversion into the higher chloride, corrosive sublimate; but Dr. G. Oettinger, after careful investigation, declares that the chlorides in the canal are insufficient to effect such a change.—*Monthly Journal of Medical Science*, 1851, p. 88.

Provokingly conflicting accounts are given regarding the action of calomel on the liver. The Committee of the British Medical Association found that when calomel, or blue pill, was given to dogs, the amount of the bile secreted fell to nearly one-half of the normal amount; and in the second period of the experiment, more bile was secreted on those days in which the mercury was suspended than on those in which it was given. So long as neither purgation nor prostration is produced, the effects are negative. Professor John Hughes Bennett, secretary of the Edinburgh Committee appointed to investigate the subject, states 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. Professor Bennett adds that dysentery and purgation from any cause lessen the amount of bile and the proportion of its solid constituents. Deductions from these experiments made upon dogs must, however, be accepted with caution. The fistulous opening, the severance of nerves and vessels, may alter greatly the liver-functions, and vitiate results. From evidence carefully collected, as well as from actual experiment, Dr. Thomas R. Fraser considers that calomel does increase the flow of bile into the intestines, and that such increased bile formation results from direct or indirect action upon the liver, or from removal of abnormal conditions which interfere with the secreting functions.

Few remedies have been applied to so many and diversified uses. It is employed in most animals in reducing and controlling acute inflammation, especially when affecting the serous membranes, as in pleurisy, common and puerperal peritonitis, laminitis, iritis, and rheumatism. It is probably serviceable in altering the condition of the fibrin, albumen, and red corpuscles of the faulty blood, in rousing the activity of most of the secreting organs, and in promoting excretion of morbid products. Professor Headland states that it acts as a catalytic, hæmatic, and eliminative. In acute febrile and inflammatory cases it is frequently prescribed after blood-letting or a few doses of aconite, is given at intervals of one or two hours, and is usually combined with opium or some other agent which retards its excretion. In enteritis, whether in horses or cattle, the late Mr. Barlow was wont to use half-drachm doses of calomel, united with an ounce of laudanum, in a pint of gruel, and repeated every hour until four or five doses are taken, or until relief, nausea, or collapse occur. Two or three such doses usually answer well in the outset of gastric fever in horses. In cases of metritis and peritonitis affecting cows three or four days after calving, a good sedative combination consists of half a drachm calomel, two ounces laudanum, one pound castor oil, mixed with hot water and treacle, and repeated every two or three hours. Rheumatism, alike in horses and cattle, is often 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 very useful in indigestion, acidity, bilious diarrhœa, in correcting pale, noisome, clayey feces, as well as in surfeit, nettle-rash, and various old-standing skin disorders. Jaundice, and other chronic affections of the liver, accompanied by impaired action, are frequently relieved by small repeated doses, conjoined with rubbing of the ointment into the right side, and persisted with until the earlier symptoms of mercurialism present themselves. Two or three grains 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 croton; 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 is often also induced its alterative, stimulant, and antiphlogistic actions. Its purgative properties render it anthelmintic. 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, 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.

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. Such doses are given three or four times a day, or oftener, and along with an equal weight of opium or belladonna extract, to prevent their passing off too rapidly by the bowels. As a cathartic, calomel is never used alone; and 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 from 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; calomel is the lower or mercurous chloride ($Hg_4\ Cl$), and an insoluble, comparatively mild, and much used medicine. By using, whether in speaking or writing, the vernacular names of these two chlorides, all risk of mistake is effectually guarded against.

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, 16 of sodium chloride, with one of manganese black oxide added, to liberate a little chlorine and thus prevent the formation of calomel.

Properties.—It occurs either as a dense white powder of broken prismatic crystals, or in heavy, white, semi-transparent, brittle, crystalline masses. It has no odour, but an acrid, disagreeable, metallic taste. It has a specific gravity of 5·2. When heated, it fuses, and afterwards rises unchanged as an exceedingly acrid poisonous gas. It is very soluble both in alcohol and ether, and dissolves in three parts of boiling water and eighteen of cold water. It has an acid reaction on colouring matter, and forms flaky precipitates with albumen and fibrin. Its tests have been detailed (p. 375). It is not subject to intentional adulteration. When pure, it is free from colour and moisture, leaves no residue when heated, is entirely soluble in water, and still more so in alcohol and ether.

Actions and Uses.—It is an irritant and corrosive poison; is occasionally prescribed as an alterative, antiseptic, antiphlogistic, and diaphoretic; repeated doses cause mercurialism. Externally, it is used as a stimulant, astringent, caustic, and as an antiseptic and parasiticide.

Full doses induce in carnivora vomiting, and in all animals uneasiness, colicky pains, tenderness of the abdomen, evacuation of bloody feces, a small, wiry, and accelerated pulse, short and difficult breathing, nausea and prostration of strength, with occasional convulsions—in short, all the symptoms of gastro-enteritis. Seven or eight grains destroyed dogs in seven, twelve, or 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 borne 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. *Post-mortem* examination of cases of poisoning by corrosive sublimate discover the stomach and lower intestines disorganized by the chemical action of the poison, and also inflamed and ulcerated, except where death has occurred before the establishment of vital reaction; the kidneys and other urinary organs unusually vascular; the lungs spotted with effused blood; the heart occasionally inflamed, and filled with blood, thus indicating a state of paralysis which probably depends on nervous derangement or depression. (Moiroud.) 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 do not beat so long as when in water. (Dr. Harley.) Placed underneath the skin, or injected into the veins, the poison, in about the same quantities, produces the same symptoms and appearances as when swallowed.

The best antidote is albumen, which forms an insoluble and inert mercury albuminate, and is, besides, useful as a demulcent. It is conveniently given in the form of white of egg. One egg is said to suffice 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.

Its irritant and corrosive properties necessitate its being given warily, in small doses, and hence it seldom produces mercurialism. For horses, it has been prescribed 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. Doses of half or even of a quarter of a grain, repeated every two hours, are sometimes useful in arresting the slimy, bloody, reducing discharges of dysentery in cattle. Conjoined with opium, hemlock, and salines, it is sometimes useful 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 fistula and foot-rot in sheep. Its notable power of coagulating albumen has led to its use in open joints; but synovia-coagulating matters, 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 carbolic acid 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 also destroys the fungus of ringworm. Four or five grains, rolled up 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 may 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. For such cases ammoniated mercury is also sometimes employed. It is an opaque, white, rather insoluble powder, made by mixing solutions of corrosive sublimate and ammonia, and washing and drying the precipitate. ($N\,H_2\,Hg\,Cl.$) It is used as an ointment, which the *Phar.* directs to be made by mixing thoroughly sixty-two grains of ammoniated mercury with one ounce of simple ointment. To relieve the itching of skin diseases, 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 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 has considerable activity as an irritant, a scruple destroying 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 vermilion-coloured, heavy, inodorous, crystalline powder, with a disagreeable metallic taste. It is insoluble in water, sparingly soluble in alcohol, but soluble in ether, acids, solution of potassium iodide, and most saline fluids. By direction of the *Brit. Phar.*, 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. In its actions the red iodide resembles other mercurials; it is almost 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. For condensing and reducing splints, spavins, ring bones, and other bony deposits, it is a most effectual application. It is, however, too powerful to be used, as fly blisters often are, immediately after firing; and when thus employed, it is apt to cause sloughing and blemishing. One or two dressings of red ointment 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 farcy cases resist its timeous employment, conjoined with the administration, night and morning, of half a drachm copper sulphate and ten grains arsenic, made into a bolus with Canada balsam and meal. Mercury red iodide ointment is also used to reduce chronic enlargements and indurations of strained tendons, bursæ, and joints, and as an irritant dressing in sore throat, chronic cough, and even sometimes in roaring. A strong ointment is frequently rubbed into the rheumatic joints of cattle. The *Brit. Phar.* orders the ointment to be made by thoroughly mixing sixteen grains red iodide with an ounce of lard; but for most veterinary purposes this ointment is not sufficiently strong, and a more effective preparation is made by mixing one part of red iodide with eight of lard.

MERCURY NITRATE. Mercuric Nitrate. Hg $2 NO_3$.

MERCURY NITRATE OINTMENT. Hydrargyri Nitratis Unguentum. Citrine Ointment.

When mercury is dissolved in diluted nitric acid, there is produced the liquor hydrargyri nitratis acidus of the *Phar.*,—a colourless, strongly acid solution, sometimes used abroad as a powerful caustic, and with 12 or 15 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, & Co., chemists, Edinburgh, first discovered the secret of preparing well-keeping citrine ointment, and his instructions are embodied in the *Phar.* directions: 'Take mercury, four ounces; nitric acid, twelve ounces (density 1380 to 1390); olive oil, thirty-two ounces; lard, fifteen ounces. Dissolve the mercury in the nitric acid, with the aid of gentle heat; melt the lard in the 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 cool.' 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. The London ointment, containing less acid to lard and oil, does not keep well. Mild ointments, made by diluting the strong citrine ointment with lard, are only fit for immediate use, as they rapidly oxidize 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, or much exposed to light, it speedily, however, becomes of a greyish-green colour, hard, brittle, and easily pulverized. This reduction of portions of the nitrate to the metallic state is prevented by preparing the ointment with excess of nitric acid, which fully oxidizes the lard. 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 various 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; easily absorbed, if applied over an extensive surface, it induces the usual specific effects of mercury.

MURIATIC OR HYDROCHLORIC ACID.

Acidum Hydrochloricum. Spirit of Salt. Hydrochloric Acid Gas (H Cl) dissolved in water, and forming 31·8 per cent. by weight of the solution. (*Brit. Phar.*)

Hydrochloric acid, in an impure state, is a by-product in the manufacture of sodium carbonate from common salt. The medicinal article is prepared, by order of the *Phar.*, by distilling together 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 specific gravity 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 measures 26½ fluid ounces. It has the specific gravity 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, with traces occasionally of arsenic.

Actions and Uses.—In large doses it is irritant and corrosive; in medicinal doses, astringent, antiseptic, tonic, and an antidote for poisoning by alkalies; externally, it is used as a stimulant, astringent, antiseptic, and caustic.

Concentrated solutions have a strong affinity for the water bases, and even for the albuminoids of the tissues, and hence are irritant and corrosive poisons, inducing gastro-enteritis when swallowed. The fitting antidotes are alkaline bicarbonates, calcium, and magnesian carbonates, milk, white of egg, and other demulcents.

It resembles the other mineral acids and acetic acid; but, having somewhat less affinity for water, it is not so destructive to the tissues as sulphuric or phosphoric acids. Acid secretions are checked, alkaline secretions increased, by the administration of acids. It is thus in part that acid drinks, promoting salivary secretion, abate thirst. They are specially effectual for this purpose when given with gentian or other bitters, which resemble acids in stimulating the salivary secretions. 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, and in relaxed chronic sore throat besides exerts a beneficial astringent and antiseptic effect. These topical benefits, by reflex action, are doubtless also extended to other portions of the digestive and respiratory membrane. Where the acid treatment of indigestion is required, 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 indigestion and acidity depending upon undue secretion of gastric juice, or the irregular or excessive formation of acetic, lactic, or buytric 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 that have been troubled with worms. As it passes through the digestive canal it becomes neutralized, but probably sets free biliary and other acids. (Ringer.) It has a high diffusion power, exerts in all animals general tonic and astringent effects, and is advantageously prescribed, especially in convalescence from 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 utilized for plant food.

Doses, etc.—Medicinal hydrochloric acid is given to horses in doses varying from f℥ss. to f℥ij.; for cattle, f℥ij. to f℥iv.; for sheep and pigs, ♏xv. to ♏xx.; for dogs, ♏iij. to ♏x. It is usually prescribed with about forty or fifty times its bulk of water; often along with bitters or ferric chloride.

MUSTARD.

Sinapis. The seeds of the Sinapis nigra and Sinapis alba, reduced to powder, mixed. (*Brit. Phar.*)

Nat. Ord.—Cruciferæ. *Sex. Syst.*—Tetradynamia Siliquosa.

The Sinapes are annuals about 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 chilly 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.*)

Commercial mustard contains, as indicated, starch and various aromatics. In solution made with warm water and cooled, the starch is detected by adding iodine, when the characteristic blue starch iodide is produced. These admixtures greatly diminish the potency of the unmixed black mustard-flour as a counter-irritant. Inorganic impurities, occasionally present, are detected by their remaining after burning.

Mustard seeds contain a reddish-yellow fixed oil, similar to that of rape, usually obtained from the dressings or siftings, and constituting about 28 per cent. of the seeds. The black mustard also contains potassium myronate, a neutral, colourless, crystalline salt; and an albuminous ferment, usually called myrosin, allied to the emulsin of bitter almonds. In contact with this ferment, the complex potassium myronate is broken up, producing the acrid, colourless, volatile oil of mustard, which is the sulpho-cyanate of the univalent radical allyl (C_3 H_5), thus:—

Potassium myronate.	Potassium acid sulphite.	Oil of mustard.	Glucose.	Water.

$$K_2C_{20}H_{38}N_2S_4O_{19} = 2(KHSO_3) + 2C_3H_5CNS + 2C_6H_{12}O_6 + H_2O.$$

White mustard differs from black in containing no potassium myronate; but it has a special glucoside, sinalbin, which, with the aqueous extract, yields some acrid essential oil. (Attfield.)

Actions and Uses.—Unbruised mustard-seeds have little effect when swallowed, probably because they are only partially and gradually digested. The flour, however, acts in large doses as an irritant; in medicinal doses as a stomachic and carminative. 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 up in a week. Occasionally, however, from its 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 rather less permanent; 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 deep-seated parts, and hence produce sloughing; unlike cantharides, it has no tendency to act upon the kidneys. It is almost as prompt in its effects, 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 colds, sore throat, bronchitis, pneumonia, and pleurisy, mustard, properly applied, seldom fails to lessen pain and relieve difficult breathing. It is most effectual when rubbed in over a considerable area, after about fiteen 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: hence its suitability where the urinary organs are irritable. Neither mustard, nor indeed any blisters, can be directly applied to parts extensively or deeply inflamed without great risk of disorganization and sloughing.

Doses, etc.—As a stomachic, carminative, and mild stimulant, mustard is occasionally prescribed for horses, in doses of ʒiv. to ʒvi.; for cattle, ℥ss. to ℥j.; for sheep and pigs, ʒi. to ʒij.; for 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 oil. 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 moistened mustard spread upon paper and dried; or of poultices, ordered by the

Brit. Phar. to be made with equal parts of mustard and linseed-meal, well stirred with four parts of boiling water. In the lower animals, the freshly-made paste is usually applied directly to the skin, with smart continued friction; after fifteen or twenty minutes it is washed off with tepid water, and may be again applied, if required, three or four times 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 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, in chests containing from two to four cwt. It is believed to be one of those substances which the Israelites used for frankincense. It exudes spontaneously from cracks in the trunk or branches of a shrubby tree, and also from perforations and bruises; is at first of an oily consistence, and a yellow-white colour, but gradually becomes solid like gum, and of a brown-red tint. 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 an acrid bitter taste, and an agreeable aromatic odour. When heated, it softens, froths up, and after a while takes fire, but burns with difficulty. It is nearly insoluble in water, but readily dissolves in rectified spirit. It consists of 50 per cent. of soluble gum, probably arabin; 10 of insoluble gum, probably bassorin; 2·5 of volatile oil; and 25 of two varieties of resin. (Attfield and Pereira.)

Impurities.—Inferior varieties are often mixed with the better qualities. They are coarse, opaque, hard, resinous, very dark coloured, and devoid, or nearly so, of the characteristic aromatic odour and peculiar balsamic taste. Indian bdellium, or false myrrh, common in second-rate specimens, is deficient in 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 feeble tonic and stimulant; externally, it is a gentle stimulant and astringent. It appears to act chiefly on the digestive organs, improves the appetite, and arrests excessive mucous secretion, bearing in this respect some resemblance to copaiva. It differs from the turpentines and balsams in possessing tonic properties, and from the fœtid gum resins in being less stimulant and antispasmodic. It is occasionally prescribed in indigestion, in chronic catarrh and other mucous discharges; but its principal veterinary use is as a stimulant for indolent wounds.

Doses, etc.—Horses and cattle take ʒij.; sheep and pigs, ʒss. to ʒi.; dogs, grs. x. to grs. xx. These doses are repeated several times daily, in bolus, decoction, or tincture, alone, with other tonics, or with aloes, as in the form of the compound tincture of aloes and myrrh, which is thus prepared:—Take of myrrh and aloes, in coarse powder, of each an ounce; methylated or rectified spirit, fourteen fluid ounces; water, six ounces. Macerate the myrrh and aloes in the spirit and 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 93 per cent. of real nitric acid ($H\ NO_3$), has the specific gravity 1·52, but is inconveniently unstable, and gives off nitrous fumes. The strongest acid of the *Phar.* contains 60 per cent. of real acid, has the specific gravity 1·42, is a definite hydrate ($2H\ NO_3$, $3H_2\ O$), 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 too great for most purposes, and the *Phar.* recognises a diluted acid, containing 17½ per cent. of real acid, and with a specific gravity 1·101. Nitro-hydrochloric acid, or aqua regia, used as a solvent for gold, and distinguished by its odour of chlorine, in its diluted *Phar.* form, is prepared by mixing three fluid ounces of nitric acid, four of hydrochloric acid, and twenty-five of distilled water.

Properties.—Strong nitric acid is colourless; emits pungent, corrosive, suffocating fumes; has an intensely sour taste; oxidizes, 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. The characteristic tests are—morphine hydrochlorate causes an orange-red solution; copper, zinc, and some other metals deoxidize 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 colouration when into a cold solution in a test-tube a few crystals of ferrous sulphate are dropped, the tube gently shaken, and eight or ten drops of strong sulphuric acid added.

Impurities.—The specific gravity and colour are the simplest tests of purity. The specific gravity indicates the proportion of water contained; the colour the presence of nitrous acid. Any trace of sulphuric acid is precipitated from a diluted solution by barium chloride; while hydrochloric acid is precipitated by silver nitrate.

Actions and Uses.—According to quantity and degree of concentration, nitric acid is irritant, caustic, astringent, tonic, or refrigerant; it is also lithonlytic, antiseptic, and disinfectant.

It nearly resembles the other mineral acids. Readily absorbing water, and parting with oxygen, strong solutions corrode any living textures with which they come in contact. In a gaseous state, both nitric and nitrous acids are dangerously corrosive, although they do not always prove immediately fatal. Strong solutions cause gastro-enteritis; leave yellow or brown marks about the mouth and fauces; but in the stomach and intestines, this discolouration 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 some weeks. As with other irritant poisons, it is less active and fatal in cattle than in horses and dogs, owing to the stomachs of ruminants being constantly filled with food, and the alimentary mucous 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.

Diluted solutions prove refrigerant, abate thirst, promote salivary secretion, exert stimulant and antiseptic effects on relaxed or ulcerated conditions of the mouth or throat. For stomach derangements, where the gastric secretions are unduly acid and there is liability to fermentation, it is sometimes prescribed, but is scarcely so suitable as hydrochloric acid. It is a useful tonic and astringent in chronic diarrhœa and dysentery, especially in cattle and sheep; in chronic enlargement of the liver; in typhoid fever in horses; and also, alternated with arsenic, in inveterate mange, eczema, and farcy. As a caustic, it 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 stimulates and deodorizes unhealthy wounds, such as caries, foul, and foot-rot, arrests spreading sloughing sores, and lessens undue secretion. Excessive sweating in horses during exertion or sickness is usually checked by sponging the skin several times daily with a very diluted solution, which is also often serviceable in abating the itching of nettle-rash. 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 neutralize and preserve from decomposition unduly alkaline urine; but although such conditions are not uncommon in 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 corroding organic and metallic substances, and producing very irritant effects if incautiously breathed.

Doses, etc.—The diluted medicinal acid is given to horses or cattle in f℥i. to f℥ij., to sheep and pigs in ♏x. to ♏xx., to dogs in ♏ij. to ♏x. It should be given 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 with 'a pound of olive oil, four ounces of axunge, and five drachms and a-half, by measure, of nitric acid. Melt the axunge and oil together in a glass vessel; when the mixture is nearly concrete, add the acid, and stir briskly with a glass rod till the whole solidifies.' (*Dub. Phar.*) A paste made with sulphur and lard is also in use for extirpating warts, destroying acari, and stimulating the skin in scab and mange.

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, and in many islands of the Indian Archipelago. It is a moderate-sized tree, with crooked stem, irregular branches, tough, white wood, known in commerce as snake-wood; white 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, several round, flat, grey-coloured seeds, about an inch in diameter, and covered with short satiny hairs. These seeds, the nuces vomicæ, have a little umbilicus on their concave ventral surface, and, amidst the horny grey albumen towards the margin, lies the white embryo, with two heart-shaped, thin cotyledons. So tough and horny are the seeds, that, in order to powder them, they require to be steamed, sliced, and ground in a coffee-mill. The powder dissolves in water and spirit, has a dirty green-grey colour, an intensely pure bitter taste, and produces an orange-red colour when moistened with nitric acid. Besides ordinary vegetable constituents, nux vomica contains various colouring matters, lactic acid, a soluble crystallizable acid (the strychnic or igasuric), and three poisonous alkaloids —strychnine, brucine, and igasurine. These are present in all parts of the tree, but especially in the seeds and bark. Their properties and uses will be noticed below.

Actions and Uses.—Nux vomica, in large doses, produces fatal tetanic convulsions; in medicinal doses, it is a tonic and stimulant of motor nerves. It is also a slight topical irritant.

It is a powerful exciter of the spinal cord, especially of its motor tract. It dilates the vessels, increases the blood supply, and stimulates the functions of the cord. (Dr. Harley.) It is also stated to lessen absorption of oxygen and production of carbonic acid. It has 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, given 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-ounce doses in about thirty minutes; but goats, curiously enough, are much less susceptible. Hertwig gave a goat 440 grains in eleven days, without observing 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, which gradually become more frequent and severe, and from their involving the glottis, diaphragm, and muscles of respiration, cause 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, intermittent, and rapidly fatal. The *post mortem* appearances vary somewhat with the severity and duration of the case, and usually include general venous congestion, engorgement of the lungs, right side of the heart, membranes of the brain, and spinal cord; when the patient has survived for some hours, softening of the cerebellum and spinal cord, and occasionally redness and inflammation of the intestines. 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 tetanized muscles quickly undergo firm *rigor mortis*.

There are no reliable chemical antidotes for poisoning by nux vomica or strychnine. Any unabsorbed poison should at once be removed by emetics or the stomach-pump. Charcoal, potassium bromide, solutions of tannin, and tincture of iodine have some slight effect in neutralizing any unabsorbed poison. Calabar bean, injection of curare, chloral hydrate, tobacco and nicotine, with hemlock and conine, produce opposite physiological effects, and hence weaken and ward off the convulsions of nux and of strychnine. Drs. Crum Brown and T. R. Fraser have recently discovered that the ethyl and methyl compounds of strychnine are antagonistic to strychnine; they paralyse the extremities of the motor nerves, induce general paralysis, and hence are effectual antidotes. 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.)

Nux vomica is useful in all animals in chronic motor paralysis. 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 was 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; the 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 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 produce 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 and inflammation continue.

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 should be 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 conveniently given in bolus. The extract, six or eight 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, however, prepared hitherto from nux vomica, which contains one part in 200. The following are the chief steps in the somewhat tedious *Phar.* 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 crystallizes out, leaving brucine in solution. Commercial strychnine usually contains some brucine and igasurine; but by washing repeatedly with diluted spirit, boiling with rectified spirit, and crystallizing, a pure alkaloid is obtained.

Strychnine occurs 'in right-square octahedrons or prisms, colourless and inodorous; sparingly soluble in water, but communicating to it its intensely bitter taste; soluble in boiling rectified spirit, in ether, and in chloroform, but not in absolute alcohol or in ether. Not coloured by nitric acid; leaves no ash when burned with free access of air.'—*Brit. Phar.* One grain requires, for solution, fifteen ounces of cold water. It forms crystalline, colourless, and 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 strong 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, oxidize and colour strychnine in the same manner. The tetanic spasms produced in frogs and other small animals by very minute doses prove a valuable corroborative test.

Actions and Uses.—Strychnine concentrates the active properties of nux vomica. Poisonous doses violently stimulate the spinal cord, producing tetanic convulsions. Carefully regulated medicinal doses are stimulants and tonics of motor nerves. It closely resembles brucine and igasurine, and also thebaine, papavarine, and other of the opium alkaloids.

One-sixth of a grain, in solution, destroys a dog in two minutes, and sometimes even in shorter time; one-eighth of a grain in twelve minutes. (Christison.) Half a grain killed an English terrier in twenty-four minutes; three grains killed a greyhound in an hour and a half; whilst one grain killed 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 intermit occasionally, but recur again and again with increased force, until death is produced, either from exhaustion, or 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.

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 at 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 hinder 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 above mentioned as occurring in poisoning by nux vomica. In dogs destroyed at the 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. (See Dr. S. Macadam's valuable paper in the *Pharmaceutical Journal* for August and September 1856.) The antidotes are the same as for nux vomica.

Strychnine, like nux vomica, is slightly irritant; like other bitters, it 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,[1] strangles, influenza,

[1] The following case, illustrative both of the poisonous and medicinal action of strychnine, came under my observation in November 1853 :—A four-year-old gelding, suffering from a severe attack of staggers, lost the power of moving his hinder extremities. He could not be moved, turned,

or rheumatism, when 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,

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 back without difficulty. The strychnine was withheld for four days, and the patient became decidedly worse, and walked very unsteadily. The medicine was again prescribed, but, from an unfortunate mistake, was given in doses of five grains, repeated twice a day. After three such doses, violent spasms supervened, affecting especially the head and neck, and becoming particularly severe when the animal was touched or disturbed. Clysters and stimulants were employed, and after two days the poisoning symptoms disappeared; but the paralysis remained, and was accompanied by hanging of the head and dulness. Blisters were applied along the spine, and the use of the strychnine renewed in doses of two and a half grains twice a day. Under this treatment, the paralytic symptoms again diminished; in fifteen days the patient was able to walk and turn with comparative ease, and appeared in the fair way of recovering, when, unfortunately, the owner, tired of waiting, had the animal destroyed.

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, the solution is sometimes applied to the skin of the affected part. 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,' and 'Battle's Vermin Killer,' which, besides starch, sugar, and Prussian blue, contains ten per cent. of strychnia. Battle's shilling packets have sixty grains, and the sixpenny twenty-five grains, of powdered strychnia. (Dr. S. Macadam.)

Doses, etc.—Strychnine is about ten times as active as nux vomica extract, about twenty times as active as the powdered nux. Of the alkaloid, or hydrochlorate, 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 *Phar.* solution is made with strychnine, grs. iv.; rectified spirit, f℥ij.; water, f℥vi.; with diluted hydrochloric acid, ♏vi., added to ensure solubility. Being so active, and so readily absorbed, it is eminently suitable for hypodermic injection, especially in local paralysis. 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 ($C_{23}H_{26}N_2O_4$, $4H_2O$) remains in the mother liquor from which strychnine or its nitrate is crystallized. It occurs in oblique four-sided prisms; is less bitter and more soluble than strychnine. According to Dr. Fuss, it is not a distinct alkaloid, but only a compound of strychnine and colouring matter. It is reddened by nitric acid and chlorine. The bright-red coloration caused by nitric acid is changed to violet or green by sodium hyposulphite and other reducing agents, which decolourize 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-twentieth of its activity.

Igasurine or igasuria, said to occur in nine different varieties, resembles strychnine in most of its characters.

OAK BARK.

Quercus Cortex. Dried Bark of the small branches and young stems of Quercus pedunculata. Collected in 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 tannic acid, which varies in different specimens and at various seasons from 11 to 15 per cent. An infusion of bark has a powerful astringent taste, reddens litmus, gives a dark, blue-black precipitate with ferric salts, and a white flocculent precipitate with solution of gelatin. 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, and 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 and tonic. It is prescribed in all animals, for arresting 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. As a tonic, oak bark is inferior to cinchona, and probably to gentian; and is apt, when given too frequently or in too large amount, to cause intestinal derangement. It is occasionally used externally for stimulating unhealthy wounds, bracing up 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. It is generally administered in infusion or decoction, made with from one to two ounces of oak bark to the pint of water. It is often given with aromatics and bitters; in dysentery, with opium and starch gruel; in typhoid fevers, with camphor and mineral acids. Externally it is used in powder and solution, alone and in combination.

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 most parts of 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. These olives yield about 32 per cent. of oil, of which two-thirds come from the fleshy pericarp, the remainder of second quality from the seed and woody textures. The finest quality of oil, obtained by pressing the freshly-gathered fruit, is imported from Provence and Florence, and is got by expression alone. Medium qualities, often prepared from long-gathered and fermented fruit, are brought from Naples, and are prepared by steeping the olives in water previous to expression. Inferior varieties, obtained 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 and basylous radicle. Perfectly pure olive oil is chiefly oleine or oleic acid and glyceryl (C_3 H_5, 3 C_{18} H_{33} O_2). Commercial specimens contain 72 per cent. of the fluid oleine, holding in solution 28 per cent. of the crystalline margarine. It is transparent, unctuous, odourless, bland-tasted, and of the consistence of syrup. When pure, it is pale greenish-yellow; when impure, yellow or brown. Its specific gravity, at 59, is about 916. At 36° much of its margarine separates in crystalline grains; by ice it is completely solidified. It is not miscible with water, is scarcely soluble in alcohol, but dissolves in one and a-half times its weight of ether. It is a capital solvent for cantharidin, atropine, morphine, and other such active medicines. Exposed to the air, it oxidizes, thickens, and slowly becomes rancid, but does not dry up.

Actions and Uses.—Like other oleaginous bodies, olive oil, in small quantity, is easily digested and assimilated; it aids cell development, produces force, and by oxidation supports 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. Like other fluid fats, it causes death when injected into the veins, probably by obstructing capillary circulation. Half an ounce injected into the jugular speedily destroys a medium-sized dog. It used to be generally approved of as an antidote in irritant poisoning, but can only have a mild mechanical effect. To abraded and irritable surfaces it is applied as a demulcent and emollient, for which it is specially adapted, as it does not readily dry up or become rancid. Its high price stands, however, in the way of its extensive use in veterinary practice, and leads to the substitution of 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 is one of the most ancient articles of the materia medica, and derives its name from the Greek word ὀπὸς (*opos*), signifying juice. It may be obtained from any of the poppy species, several of which abound as annual weeds. The stem, unripe capsules, and other succulent parts of the poppy, contain a milk-white narcotic juice. The fresh red poppy petals are used as colouring agents, and when eaten by animals cause staggering gait, pain, diarrhœa, delirium, and sometimes stupor. (Veterinarian's *Vade Mecum.*) The roots of many species contain a cathartic principle. The poppy heads or capsules, gathered about twelve days after the petals fall off, and nearly ripe, are dried, contain mucilage, with a small but irregular quantity of morphine, and are used, digested in hot water, for making soothing infusions. The seeds, called maw seeds, contained in the capsules, are almost devoid of narcotic properties, but yield 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 from two to four feet high, has a round, smooth, erect stem, with a few white hairs on the peduncles or leaf-stalks; 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 varieties have hitherto been generally preferred, but the darker-flowered, especially the purple, are now believed to yield a larger quantity and better quality of opium.

In collecting the juice, horizontal superficial incisions are made towards sunset into the nearly ripened capsules, a few days after the falling off 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. In 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 dock, or in tobacco leaves and poppy petals. Upwards of thirty tons are annually consumed in this country.

Varieties.—There are several sorts of opium—Turkish or Smyrna, Constantinople, Egyptian, East Indian, Persian, and European—owing their differences in quality and appearance to different methods of collecting and making up the juice, and to variable proportions of water and impurities.

TURKEY or SMYRNA OPIUM is mostly of fine quality, and highly prized in the English market, is collected in Anatolia in Asia Minor, and exported from Smyrna, and in lesser quantity from Constantinople. It is generally covered with impressions of the seed of the rumex, or with poppy leaves; and occurs in round flattened pieces weighing from six ounces to three pounds. It is soft, moist, and ductile, of uniform structure, and, when minutely examined, is seen to be made up of small lenticular pieces. 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. It contains on an average eight per cent. of morphine, and is also rich in meconic acid. Constantinople opium is of unequal quality, darker, drier, more resinous, and usually inferior to Smyrna opium.

EGYPTIAN OPIUM corresponds nearly with the second-rate qualities of Turkey opium. It is in round flattened cakes of a red colour, hard, dry, brittle, and covered with the remains of the leaf of the oriental plane (Professor Bentley), and contains on an average about five per cent. morphine. Like other sorts, it varies in appearance, and is sometimes made up in imitation of whatever kind happens at the time to be in highest repute.

EAST INDIAN OPIUM, chiefly prepared near Benares and Patna, and in the province of Malwa, is mostly all disposed of to the Chinese, who prefer it to Turkey opium, and purchase annually many thousand pounds weight of it, at the rate of twenty shillings per pound. It is usually inferior to Turkey opium, and contains less morphine but more narcotine. 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. The outer case gradually becomes black, hard, unyielding, of the appearance of a large bullet; and usually contains about 3½ lbs. standard opium, which remains for a long time soft and ductile, and has a dark appearance, resembling pitch. East Indian opium, not intended for exportation, is dried in the sun, until it contains only a small quantity of water or volatile matter,—in the Benares Agency not more than 10 per cent. being separable by continued exposure to 200°. It is then moulded into square pieces, weighing rather more than two pounds each, enveloped in oiled Nepaul paper, and packed in wooden boxes. (*Phar-*

maceutical Journal, vol. xi.) It is firm, dry, of a yellow-brown colour, and nearly equal to Smyrna opium in quality and percentage of morphine.

PERSIAN OPIUM, usually from Trebizond, of low quality, and scarcely saleable in this country, occurs in round irregular lumps, occasionally in rolls, five or six inches long, about the size of the finger, and enveloped in paper. The designation of Persian opium is probably a misnomer, much of it being manufactured in London.

EUROPEAN OPIUM.—Opium has been prepared in several parts of France and Germany, and its cultivation has also been attempted in Great Britain. In 1818, Dr. Young cultivated poppies near Edinburgh, and obtained nearly six ounces of excellent opium from a fall of ground, being at the rate of 57½ lbs. per acre. A still more extensive trial was made in 1823 in Buckinghamshire, where twelve acres of poppies were grown with a return of 16 lbs. per acre of very fine opium, which realized the highest price in the London market. From the high price of Turkey opium at the time, and the low rent of land, the speculation was tolerably lucrative. At present, however, the preparation of opium in this country would not, it is believed, be profitable, unless returns could be realized like those got in India, where the acreable yield is 30 lbs., and sometimes more. But, in favourable circumstances, poppies might be cultivated here expressly for the preparation of morphine, which could be directly obtained from the juice without first inspissating it.

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 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 6 to 17 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. Water dissolves about two-thirds of a good specimen of opium, and forms a red-brown solution, including most of the active ingredients. Rectified spirit dissolves about four-fifths, and forms a dark-brown tincture, which includes all the active principles. Acids, when strong, disorganize 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 many other metals.

Impurities.—As the better qualities of Turkey opium usually bring about 18s. per pound, there is great temptation to substitute inferior qualities, or to mix with various 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 that red tint and agreeable aromatic odour which characterize good specimens; water and alcohol dissolve them imperfectly. Many different substances are used for adulterating opium. The most common are starch and molasses, the bruised leaves and chips of the poppy, the juice, pulp, or extract of the prickly pear, and inferior tobacco. These additions are generally made before the drug is imported; and their presence may sometimes be ascertained by minute inspection. Such inorganic matters as sand, stones, clay, and mud may also be detected by inspection, especially if the specimen be first 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 17 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 *Brit. Phar.*, yield six to eight grains of morphine.

Composition.—Opium is a complex substance. It contains several crystalline alkaloids, combined with sulphuric and meconic acids. Of these alkaloids, the most important are morphine, narceine, meconine, codeine, narcotine, cryptopine, and thebaine. Opium further contains a brown, acid, bitter, extractive matter, probably a complex body, amounting to 20 per cent., and possessed of slight narcotic action; a volatile oil, to which is owing the aroma of the drug, variously estimated at from 3 to 6 per cent., with from 10 to 20 per cent. of water. A more detailed notice is given of the several crystalline alkaloids in the subjoined paragraphs:—

Morphine or Morphia ($C_{17} H_{19} NO_3, H_2 O$), the most important of the crystalline principles of opium, is prepared by decomposing with ammonia a solution of morphine muriate (p. 437), washing the precipitate, and drying at a gentle heat. The yield from different specimens of opium varies from 4 to 9 per cent. It crystallizes in transparent right rhombic prisms, usually arranged in tufts; has an intensely bitter taste, and alkaline reaction. It dissolves sparingly in water or ether, but readily in alcohol, alkalies, and weak acids, with which it forms crystallizable and usually soluble salts. With 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. 439.)

Apomorphine ($C_{17} H_{17} NO_2$), a recent crystalline derivative from morphine, is prepared by heating morphine hydrochlorate for several hours in a hermetically-closed tube, when water is abstracted. It is the most certain and active emetic known. $\frac{1}{4}$ grain in solution in water, $\frac{1}{10}$ grain injected hypodermically, cause in men and dogs emesis within five or ten minutes.

Meconine ($C_{10} H_{10} O_4$) 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 port wine colour. 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 tranquillizing effects were produced than by the less soluble narceine.

Narceine ($C_{23} H_{29} NO_9$) is 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 glycerine and diluted hydrochloric acid. In dogs, grs. v. subcutaneously injected produces calmative and slight hypnotic effects, similar to what would be induced by less than a grain of morphine. Poisonous doses, as with morphine, arrest the respiratory movements, but do not cause convulsions. (Dr. Harley.)

Cryptopine or Cryptopia ($C_{21} H_{23} NO_5$), an alkaloid discovered by Messrs. T. & H. Smith, of Edinburgh, is present in such small amount that an ounce only is yielded by a ton of opium. It occurs in colourless six-sided prisms, is more bitter than morphine, and soluble in water acidulated with hydrochloric or acetic acids. In the dog, one grain injected subcutaneously caused excitement, dilatation of the pupil, illusion of vision, agitation, and frenzy. Its hypnotic action is greater than that of meconine and narceine, about one-fourth that of morphine. Poisonous doses, as with morphine, destroy life by arresting respiratory movements. (Dr. Harley.)

Codeine or Codeia ($C_{18} H_{21} NO_3, H_2 O$) is a colourless bitter alkaloid, crystallizing in rhombic octahedra, soluble in 50 parts water at 60°, in two parts at 212°, and also in alcohol and chloroform. Unlike morphine, it is insoluble in cold, weak, caustic potash, and unaffected by ferric-chloride. It is present in opium in the proportion of about one-half per cent. It exhibits, like the other alkaloids, the twofold soporific and excitant action. It stimulates the heart and motor centres, and usually dilates the pupil and deranges the vagus functions. (Dr. Harley.)

Narcotine ($C_{22} H_{23} NO_7$) exists in opium in quantities varying from 1 to 8 per cent., and generally in inverse proportion to the amount of morphine. It 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 fluted striated prisms have an insipid taste, and are soluble in ether, alcohol, and weak acids, but scarcely in 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 probably devoid of narcotism, but is tonic and antiperiodic, and has been used in India as a substitute for quinine in the treatment of intermittent and remittent fevers. Two to seven grains injected hypodermically kill birds.

Thebaine or Paramorphia ($C_{19} H_{21} NO_3$) is in minute, colourless, rectangular prisms, has an acid taste and alkaline reaction, is almost insoluble in water, but soluble in 45 parts rectified spirit. Its narcotic effect is slight, but it is a convulsant, like strychnine; excites and deranges the motor centres, especially those presiding over respiration. One to two grains injected hypodermically produce fatal tetanus in dogs. (Dr. Harley.)

Papaverine ($C_{20} H_{21} NO_4$), another crystalline base recently found, is analogous to thebaine. Other alkaloids have also been isolated—opianine, laudanine, codamine, protopine, laudanosine, and hydrocotarnine. (Professor Attfield.)

Meconic Acid ($C_7 H_4 O_7, 3 H_2 O$), found only in opium, in quantities varying from 4 to 7 per cent. (Mülder), 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. 437) with twenty parts boiling water and three parts 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. Eight grains given to dogs, cows, and frogs, four and five grains to men, produced no effect. (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 crystallizes 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, for the tests for meconic acid are very delicate, and afford indication of opium, even when it is in such minute quantities as to be undetectable by testing for morphine. 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 decolourizes the meconate, but does not affect the sulpho-cyanate.

Actions and Uses.—Opium and its active principles are narcotic; they act upon the nervous system; they notably exhibit the twofold action of true narcotics; they are at once stimulants and sedatives, or excitants and soporifics. Dr. John Harley describes them as soporifics which include anæsthesia, and excitants which include cramp and convulsion. The prominence of one or other of these dissimilar actions mainly depends upon the temperament of the patient. In most horses, receiving full doses, the excitant action predominates; in most dogs the two antagonizing actions are more evenly balanced—there is usually delirium with stupor; in most men the soporific action speedily obscures the excitant action. In all animals poisonous doses arrest respiratory movements. Medicinal doses are narcotic, sedative, antispasmodic, anodyne, stimulant, diaphoretic, and cardiac tonic. They are stimulants of the sympathetic nervous system. Digestion or absorption, secretion or excretion, are not retarded by stimulant or feebly soporific doses, but are checked or arrested by full soporific or anæsthetic doses. Applied topically, opium acts as it often does when given internally—it first stimulates, and then soothes and paralyses; 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.

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 vaso-motor nerves, deranges and depresses the functions of the vagus, and thus developes 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, given to horses, 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, nor continuously contracted as in man, but is contracted whilst the dog is asleep or narcotized. 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, convulsions, stertorous breathing, and, as death approaches, stupor—never, however, so deep or lasting as in the human subject, 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 25 lbs. weight; she was nauseated, in fifteen minutes she vomited, had spasms of the diaphragm, the bowels acted, mucus ran from the mouth; within an hour the pulse had fallen from 120 to 78, and was irregular; the animal lay quiet, but did not sleep or show narcotism. Twenty minims more were injected; the pulse fell to 72 and was 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, but does not yield on analysis any indications of the poison. The digestive mucous membrane is usually congested. The lungs are bloodless and collapsed, the right side of the heart engorged.

In the treatment of opium poisoning, which, however, is not so common amongst the lower animals as in man, any unabsorbed poison is to be promptly got rid of either by the stomach-pump or emetics, the latter being most effectual both in men and dogs. 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 antagonize paralysis of respiration. Blood drawn from the jugular vein also helps to relieve lung congestion. Tincture of galls and other chemical antidotes are of little avail. Strychnine has a decided antagonizing effect. Dogs in hopeless stupor are roused in a few minutes, especially when the strychnine is used hypodermically. Belladonna, whether given before, along with, or immediately after a poisonous does of opium, prevents in dogs nausea and vomiting, relieves bronchial spasm and stimulates the over-taxed heart (Dr. Harley).

No article of the Materia Medica is more frequently and generally prescribed. 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 seldom occurs either in dogs or pigs; when it does, it is generally relieved by a few grains of opium daily. A little chloroform or creosote have often a similar effect. When food is hurried too rapidly through the canal, as is not uncommon in weakly young growing animals, opium checks excessive secretion and peristaltic motion, and conjoined with arsenic should be given shortly before feeding. A drachm of laudanum and an ounce of Fowler's solution suffice for horses or cattle. Diarrhœa, whether occurring from congestion of the alimentary mucous membrane, or as a symptom of other ailments, is often removed by a laxative which carries away offending matters. Occasionally, however, the intestines get into an irritable relaxed condition; opium in such cases relieves irritability, 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 opium, a drachm powdered galls or half a drachm tannin, and half an ounce chalk. These ingredients may either be made into balls with treacle or linseed meal, or dissolved in a pint of ale or gruel, and given twice or thrice a day as required. An ounce laudanum, thirty drops sulphuric acid, two drachms powdered catechu, with an ounce of ginger, aniseed, or fenugreec, make a good anodyne drench for diarrhœa in the cow, and may be given in gruel, ale, or spirits and water. Another useful prescription for such diarrhœa cases 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 will suffice for three-months-old 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 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 for horses, and thrice for cattle. Whilst febrile symptoms continue, this mixture, or indeed opium itself, must be used cautiously, and an occasional laxative may be necessary.

Antagonizing muscular spasm, opium is valuable in intestinal colic, so common amongst improperly and irregularly fed horses. In such 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 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 from 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, opium and calomel are prescribed in the earlier stages, and opium, belladonna, and ether, in the second stages. In peritonitis, whether common or puerperal, the chief hope of cure lies in the frequent administration of large doses of opium, which lessen irritability and pain. Where acute pain is to be blunted or violent spasm counteracted, it should be used in large doses, conjoined with belladonna extract, and given in solution. Either horses or cattle, in such cases, take a drachm of each narcotic repeated every hour, until five or six doses have been swallowed. There is little fear of any bad consequences, for in such circumstances the system attains great toleration of narcotics. In the earlier febrile stages of pleurisy, and when used with caution in bronchitis and pneumonia, in nephritis, cystitis, and rheumatism, whether in horses, cattle, or dogs, one drachm opium and thirty grains calomel are administered for horses and cattle ; ten grains opium and three grains calomel for dogs. Such doses, repeated every two hours, seldom fail to abate pain, lower excessive temperature, and reduce the pulse. After being used six or eight times, if no benefit occurs, they should be discontinued. Conjoined with a little chloroform and glycerin or treacle, so as to lubricate the passages as it is swallowed, opium allays troublesome, irritable cough. Along with stimulants, it is usually serviceable in epizootic catarrh, pneumonia, and rheumatism, and, indeed, in the several epizootic disorders recognised under the common title of influenza, long and fatally doctored by antiphlogistics. A good combination for such cases consists of a drachm of opium, an ounce sweet spirit of nitre or ether, conjoined, if the appetite is indifferent or the patient feverish, with two ounces Epsom salt ; or, if the bowels be unduly relaxed, with an ounce of kino or catechu. An ounce each of laudanum, potassium chlorate, and ether is also useful ; should be given in cold gruel, and repeated every second or third hour. Similar treatment is also effectual in relieving asthma—a common complaint amongst dogs. In diseases of the respiratory organs, when the breathing is shallow and embarrassed, opium, on account of its tendency to apnœa, is unsuitable, and cough and pain are then better controlled by belladonna. In typhoid fever in horses, especially where the bowels are irritable and relaxed, opium is given in frequent small doses, conjoined with potassium chlorate and stimulants. Rheumatism is often 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 belladonna, is often of signal benefit; whilst in the more serious cases amongst adults, it relieves the spasms and morbidly acute sensibility which characterize the disease. 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 diabetes; but is less to be depended on than iodine. It has no power to arrest phthisis pulmonalis; but is often serviceable in relieving the cough and diarrhœa which accompany that malady.

Opium is contraindicated 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 are injurious where there is tendency to death by apnœa.

Externally, opium is used to relieve the pain of wounds, bruises, boils, blistered and cauterized 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 local anodyne, opium is, however, inferior to belladonna; whilst, for combating nervous pain, it is less effective than 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 injection, it is used to check purging in enteritis, typhoid fever, and dysentery, and to allay pain and spasm in inflammatory affections 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 doses 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 developed by combination with calomel, aconite, or tartar emetic ; its stimulant and antispasmodic actions are increased by combination with sulphuric, chloric, or nitrous ether ; its antispasmodic and anodyne effects are hastened, intensified, and prolonged by giving it with belladonna ; its anodyne and soporific actions are greatly increased by union with belladonna, hemlock, or henbane ; its diaphoretic virtues are produced when it is conjoined with friction, 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, is excellent for veterinary practice, being cheaper than the tincture, and more prompt and effectual than the solid drug. Tincture of opium, popularly known as laudanum, is thus prepared by the *Brit. Phar.* process :—'Take of opium in coarse powder an ounce and a half ; proof spirit, one pint ; macerate for seven days in a closed vessel, with occasional agitation ; strain, press, filter, and add sufficient proof spirit to make one pint.' This brown-red tincture has the odour and taste of opium, the specific gravity ·942; every 15 minims contain one grain of opium. The evaporation of a known quantity, and the weighing of the residuum, are the best safeguards against adulteration. An ounce of good laudanum should leave from 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 fʒiij.; for sheep and pigs, fʒii. to f℥vi.; for dogs, ♏xv. to ♏xl. The vinegar and wine of opium are seldom used in veterinary practice. An ammoniated tincture may be prepared with an ounce of opium to a pint of ammonia spirit. An etherial 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 water, when the morphine meconate and sulphate are dissolved out. Calcium chloride is added to the solution, mutual decomposition ensues, calcium meconate and sulphate are precipitated, and morphine muriate remains in solution. The solution is concentrated, the morphine salt is crystallized out, purified by strong pressure in flannel or stout calico, which removes narcotine and colouring matter, and then redissolved in hot water, and again crystallized. Several crystallizations, 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 crystallized. (*Brit. Phar.*) When the process is carefully managed, good Turkey opium yields from 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 characterizes morphine and all its salts. It is soluble in its own weight of water at 212°; in fourteen parts of water 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 dirty-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 *Brit. Phar.* gives the following purity tests:—'Entirely destructible by heat, leaving no residue. Twenty grains of the salt dissolved in half an ounce of warm water, with ammonia added in the slightest possible excess, 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.'

MORPHINE ACETATE.—Acetate of morphia, or morphiæ acetas ($C_{17}H_{19}NO_3, C_2H_4O_2$), 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 and acetate, possess, in concentrated form, the several actions of opium. They have the same twofold excitant and soporific character. They destroy life by paralysis of respiration. They act both on sensory and motor nerves. They are used medicinally to antagonize irritability, spasm, and pain.

Dr. Harley and Messrs. Mavor (*Old Vegetable Neurotics*) found that in horses four grains morphine acetate, subcutaneously injected, accelerated the pulse 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. Twelve grains, dissolved in three drachms 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.

A brown bitch, weighing twenty-five pounds, had half a grain 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 narcotized that the eyes were insensible to light; 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. In other dogs the soporific is superseded by the excitant effects; the spinal cord is more notably acted on than the brain; there are vomiting, nausea, restlessness, and delirium. In mice, Dr. Harley records cramp of the spine and restlessness, hypnosis altogether an after effect, narcotism only occurring after a dangerous dose.

Dr. Harley's interesting experiments show that opium and belladonna mutually accelerate and intensify each other's effects. 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 is checked; respiratory restraint on the action of the heart is counteracted; the effects of both medicines are intensified; the antispasmodic and anodyne virtues are especially increased; whilst narcotism, so rarely produced by either drug alone, is developed.

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; and by Mr. Mavor of London, Mr. Fearnley of Leeds, and other practitioners, have been successfully used, especially in neuralgia, acute rheumatism, and enteritis in horses. Great results are, I believe, to be obtained in veterinary practice from the hypodermic use of morphine and atropine, used conjointly, especially in tetanus, spasmodic cough, and enteritis in horses.

Doses, etc.—The hydrochlorate and acetate are given to horses and cattle in grs. iij. to grs. x.; to sheep and pigs, grs. ss. to grs. ij.; to dogs, gr. $\frac{1}{8}$ to gr. $\frac{1}{2}$. They may be given in bolus, or dissolved in diluted spirit, slightly acidulated 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 from 10 to 20 parts of water.

PEPPERMINT.

Mentha piperita. Oleum Menthæ piperitæ. The oil distilled in Britain from fresh-flowering peppermint, Mentha piperita. —*Brit. Phar.*

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, a small herbaceous plant, growing wild in damp situations, with a smooth annual stem, and stalked ovate oblong smooth leaves. The plant, 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 half or one per cent. of a colourless or yellow volatile oil, which concentrates the properties of the plant, is obtained by distilling with water the fresh herb when in flower, and consists of a special hydrocarbon, menthene (C_{10} H_{18}), conjoined with hydrous menthene, a crystalline stearopten (C_{10} H_{18} H_2 O) (Attfield). The oil is occasionally prescribed in indigestion, flatulence, and griping, in doses of about ♏xx. for horses and cattle, and ♏iij. for dogs. 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. 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. To prepare black pepper, the best of which is the Malabar, the berries are pulled before they are ripe, dried in the sun, and ground without separating their outer covering. To prepare the milder white pepper, of which Tillycherry is the most valued, 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 grey spadices one or two inches long. Cubebs or cubebæ are the berries of the Piper Cubeba—a plant indigenous to the Spice Islands. 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 white crystallizable, feeble alkaloid piperine ($C_{17}\ H_{19}\ N\ O_3$), a volatile oil and two or more resins.

Jamaica pepper, pimento or allspice, closely resembles the true peppers; are the dried, unripe berries of Eugenia pimenta, a fine evergreen West Indian tree of the natural family Myrtaceæ. The berries are about the size of those of the Piper nigrum, have the same penetrating aromatic odour, and hot, pungent taste, but are more truly aromatic and less acrid. They contain an acid volatile oil and two crystalline bodies.

Capsicum—the dried ripe fruit of Capsicum fastigiatum—is also known as Chilly pepper, Chillies, 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 to powder, 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 oil, an acrid resin, and an alkaloid called capsicine, half a grain of which volatilized in a large room suffices to make every one who enters cough and sneeze.

Actions and Uses.—The peppers are irritant, stomachic, and rubefacient. Large doses, especially in carnivora and omnivora, act as irritant poisons, causing inflammation of the alimentary canal, and sometimes also of the urino-genital organs, with general vascular excitement. The popular belief, that they are especially poisonous to pigs, is erroneous. Properly-regulated doses exert a local stimulant action, and are stomachic and carminative. Rubbed into the skin, they cause redness, irritation, swelling, and sometimes suppuration. The several peppers differ considerably in the intensity of their action. The black is more active than the white and long peppers, which are considered 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; with other appropriate remedies in cases of colic; and for covering the disagreeable taste, and preventing the nauseating effects 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 introduce serious intestinal irritation.

Doses, etc.—Of black pepper, as a stomachic and carminative, horses may have ʒij.; cattle, ʒiij.; sheep and swine, grs. xx. to ʒi.; dogs, grs. v. to grs. x. These doses, repeated two or three times a day, may be 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 bitumens usually found in the tertiary strata, and varying in density and solidity from the hard brittle asphalt and mineral pitch to the viscid mineral tar and fluid naphthas. The 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. Within the last twenty years enormous quantities of petroleum have been brought from the oil springs or wells of Canada and the Northern States of America. It contains paraffin and other allied hydrocarbons, is soluble in ether and volatile oils, and when purified is extensively used for burning. 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 a dull, greenish-brown colour, with a strong, disagreeable, persistent naphthous odour, and a bitter acrid taste. Like other allied substances, it becomes hard and pitch-like when exposed to the air; when heated it first liquefies, and by and by evolves a volatile naphtha, leaving a solid residue of asphalt. The fixed and volatile oils are its best solvents.

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, 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 grey; sweetish in odour; bitterish, sub-acrid, and nauseous in taste' (*Brit. Phar.*). For upwards of forty years the root has been known as an emetic and cathartic. Thirty to sixty grains act in the human subject much in the same way as jalap; but the unpleasant sensations produced in the throat, with the nausea, vomiting, and depression often following its administration, greatly limit its use.

The resin or podophyllin is prepared by percolating rectified spirit through the powdered root. It is 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 (*Brit. Phar.*). It consists of two resins associated with the brilliant yellow alkaloid beberine, which is also present in various plants of the Berbery tribe and in calumba root. Podophyllin is the active principle of the drug, has been extensively employed by medical men in America since 1847, and has more recently been used by many British practitioners. Half a grain to a grain slowly evacuates the bowels, and is believed to act especially upon the liver; indeed, as a cholagogue, it is by some authorities considered more certain and effectual than mercury. It is serviceable in habitual constipation and congested states of the liver, and in smaller doses as an alterative in skin diseases and rheumatism. Dr. F. G. Anstie, of the Westminster Hospital, made, in 1863, a series of interesting experiments with an alcoholic solution of podophyllin, which he injected into the peritoneum of dogs, cats, and rats. With dogs about eighteen inches high, an alcoholic solution, containing one to two grains, 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 three-penny 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 draws 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 does 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 of podophyllin, half a grain of 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 feces were little altered in colour; there were no indications of any special action upon the liver. Dr. John H. Bennett found that two to eight grains given to healthy dogs diminished the solid constituents of the bile, whether purgation was produced or not.

As is the case with many other medicines, podophyllin has even less effect on cattle and horses than on men and dogs. To three healthy shorthorn cows I have given three drachms each, and to another cow half an ounce, without observing any laxative effect whatever. I have repeatedly given healthy horses, prepared by mash diet, two drachms podophyllin without perceiving any increased action of the bowels. Two drachms, even when united with one or two drachms of aloes, added, to determine, if possible, its action on the bowels, produced only slight softening of the dung, such as might be expected from the aloes alone. I am again indebted to Mr. Dollar for the following interesting experiments :—

A thorough-bred horse, well prepared by mashes, had two drachms podophyllin without its producing the slightest 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 domesticated animals; and 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 decided nauseant and sedative effects. It may probably be found useful 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 podophyllin may be given to horses and cattle in doses of ℨi. to ℨij., united with a drachm of calomel, or an ounce or two of nitre or of Epsom salt. For dogs, gr. i. to grs. ij. may be conjoined with calomel, gr. i. grey powder, grs. v. to grs. x., or about the same quantity of ipecacuan.

POTASSIUM AND ITS MEDICINAL COMPOUNDS.

POTASSIUM HYDRATE. Potassa caustica. Potassa fusa. Potassium hydroxide. Hydrate of potash. Caustic potash. K HO.

POTASSIUM HYDRATE SOLUTION. Liquor Potassæ. Solution of potash.

Potassium salts are obtained chiefly from the mineral carnallite found in Prussia, 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 slaked lime produce by double decomposition liquor potassæ—potassium hydrate solution. 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, crystallizable 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. Boiled down, until a drop removed on a stirrer becomes hard on cooling, and the oily liquid then poured into pencil-like moulds, there is formed grey 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 giving with platinum chloride a yellow crystalline precipitate of platinum and potassium chloride ($Pt\ Cl_4\ 2\ KCl$); and with excess of tartaric acid a white granular precipitate of potassium acid tartrate ($KH,\ C_4\ H_4\ O_6$). 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, another in the violet.

Actions and Uses.—Potassium hydrate in large doses is irritant, corrosive, and a cardiac sedative; in medicinal doses, antacid, febrifuge, and diuretic; externally it is used as a caustic. Excessive doses, when swallowed either in a fluid or solid state, dissolve, soften, and corrode the coats of the œsophagus and stomach, sometimes so severely as to cause perforation. Hertwig found that two drachms 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 caustic potash, 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 near the pylorus three-quarters of an inch in size, and surrounded by a hard thickened margin. (Christison on Poisons.) Smaller or more diluted doses gradually interfere with swallowing, 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.

Dr. Paul Guttmann states that potassium salts are two or three times more powerful than corresponding sodium salts, that all are equally poisonous when used in the same way, the acid or radical in combination playing no part in the fatal result. Poisonous doses cause great muscular weakness, affecting first the hinder extremities, and depending upon paralysis of the spinal cord. There is, he states, no action on the muscles or on the periphreses of nerves. There is 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—an effect which, as it follows even when the vagi are divided and the medulla removed, must depend upon the potash salt acting 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 very soluble. Like other alkalies, the hydrate and carbonates appear to aid the digestion of the fatty matters of the food. Given after eating, they neutralize undue acidity. They increase the secretion of gastric fluid, and probably of other acid secretions; but probably diminish that of the salivary glands, liver, and pancreas. They have a high diffusion power, probably stimulate oxidation and tissue metamorphosis, exert a solvent power over albuminoids, and thus in inflammation prevent the deposition of exudate. They are excreted from the body mainly by the kidneys, increasing chiefly the watery parts of the urine, and neutralizing 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 refrigerent—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.

Neither caustic potash nor the solution is much used internally. Dr. John Shortt, of Madras, finds potassium hydrate solution the most effectual antidote for the poison of snakes and vipers. The solution, in doses of half a drachm, repeated twice daily, usually relieves feeding sheep affected with vesical and urethral calculi. Caustic potash is used externally for stimulating unhealthy wounds, eradicating warts and fungous growths, and making issues. Being very deliquescent and apt to spread, it must be applied cautiously. Mixed with lime, caustic potash becomes less deliquescent, and hence more safe and manageable.

POTASSIUM CARBONATE. Potassæ Carbonas. Carbonate of Potash. ($K_2 CO_3$.)

POTASSIUM BICARBONATE. Potassæ Bicarbonas. Bicarbonate of Potash. ($HK CO_3$.)

The American pot, or wood ashes, in their partially purified condition of pearl ashes, contain nearly eighty per cent. of potassium carbonate, with about 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 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.

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 not deliquescing when exposed to the air, and by its giving, in diluted solution, no precipitate with Epsom salt or corrosive sublimate.

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 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 usually 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 antagonizing 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 up 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 has found that both the carbonates and hydrate, as well as the corresponding sodium salts, greatly 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 30 to 40 parts of water, the bicarbonate forms a soothing dressing for the earlier weeping stages of eczema, or red mange, in dogs.

Doses, etc.—Of either carbonates, horses and cattle may have from ℥ss. to ℥i.; sheep and pigs, ʒss. to ℥i.; dogs, grs. x. to grs. xl. These doses may be repeated several times a day, liberally diluted with water. When prescribed in dyspepsia, with the view of stimulating the secretion of gastric juice, they should be given half an hour before eating. Excessive gastric secretion is only temporarily benefited by alkalies given during or after feeding, and is more likely to be permanently removed by the use of acids.

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 oxidizes 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 a 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 coughs, rheumatism, and skin diseases, in doses of one to three drachms for horses and cattle, and two to ten grains for dogs. Once a panacea for all kinds of poisoning, it is now used only occasionally in poisoning by lead, which it converts into a black insoluble and almost inert sulphide.

Potassium Sulphate. Potassæ Sulphas. Sulphate of Potash. ($K_2 SO_4$.)

Potassium Bisulphate. Potassæ Bisulphas. Bisulphate of Potash. ($HK SO_4$.)

The residue left in the preparation of nitric acid from equal parts of sulphuric acid and nitre, consists of potassium sulphate, with some excess of sulphuric acid, which may be got rid of by adding to the solution potassium or calcium carbonate, filtering and evaporating the mixture, when potassium sulphate crystallizes out 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 five 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 crystallizing. 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 greater solubility, by its acid taste and reaction, and by 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 the human subject, large doses of sulphate (in one case two ounces, in another ten drachms) are said to have proved fatal. 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 much used for facilitating the trituration of such tough vegetable substances as opium, ipecacuan, and jalap.

POTASSIUM IODIDE. Potassii Iodidum. Potassic iodide. Hydriodate of potash. (KI.)

The iodide is conveniently prepared by decomposing a solution of iron iodide with potassium carbonate. The *Brit. Phar.* recommends the following process:—'Put a gallon of solution of potash into a glass or porcelain vessel, and add twenty-nine ounces, or a sufficiency of iodine, in small quantities at a time, with constant agitation, until the solution acquires a permanent brown tint. Evaporate the whole to dryness in a porcelain dish, pulverize 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 through paper, wash the filter with a little boiling distilled water, unite the liquids, and evaporate the whole until a film forms on the surface. Set it aside to cool and crystallize. Drain the crystals, and dry them with a gentle heat. More crystals may be obtained by evaporating the mother liquor, and cooling. The salt should be kept in a stoppered bottle.' In this detailed process, potassium iodide and iodate are first produced. Fusion with charcoal deoxidizes the iodate, converting it into iodide. The subjoined equations indicate the two stages in the process:

Potassium hydrate.	Iodine.		Potassium iodide.	Potassium iodate.	Water.
$6\ KHO$,	$3\ I_2$	=	$5\ KI$,	KIO_3,	$3\ H_2O$.

Potassium iodate.	Charcoal.		Potassium iodide.	Carbonic oxide.
$2\ KIO_3$,	$3\ C_2$	=	$2\ KI$,	$6\ CO$.

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 volatilizing unchanged, dissolving in two-thirds of its weight of water at 60°, and in half its weight of boiling spirit. Both aqueous and alcoholic solutions dissolve iodine freely, and are hence useful vehicles for its exhibition. The following tests of the *Brit. Phar.* guard against the common impurities:—'The addition of tartaric acid and mucilage of starch to its watery solution does not develope 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 active. Large doses are irritant; medicinal doses are alterative, deobstruent, and diuretic. 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) says, that two or three drachms given to horses act as an irritant poison, and that three or four drachms cause fatal intestinal hemorrhage. But I have repeatedly given horses two drachms, in the form of bolus; and, from experiment, find that an ounce, given either to horses or cattle, is devoid of irritant or poisonous properties, and acts only as a diuretic or mild cathartic. In colds and febrile attacks, and during recovery from inflammatory complaints, it is used, commonly in combination with tonics or stimulants. A good formula for either horses or cattle consists of a drachm each of potassium iodide and ammonium carbonate, and half an ounce of gentian, given twice daily, either in ball or solution.

Administered in small and often-repeated doses, it appears in all animals to accelerate those reparative changes always going on within the body. It is prescribed in scrofulous glandular enlargements, in chronic rheumatism, and externally in the reduction of tumours. It is believed to aid the removal of lead mercury and other metals from the body, probably causing their re-solution and expulsion in the urine. In many of its uses it resembles the bromide, which is especially useful in dogs in allaying nervous and bronchial irritability, particularly when following distemper. The iodide 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. These doses are repeated three times a day, and given either in bolus or solution in water or spirit.

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 large tracts of ground. 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 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 crystallization. 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. 100 parts of water at 32° dissolve 13 parts of nitre; at 77°, 38 parts are dissolved; at 212°, 246 parts; during solution, much heat is abstracted. Warmed in a test-tube, with sulphuric acid and copper filings, it evolves ruddy fumes; 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.—Nitre, in large doses, is irritant and cathartic; is used medicinally as a diuretic, alterative, antiseptic, febrifuge, and refrigerant; and externally, as a stimulant and refrigerant.

Large doses are required to produce fatal 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 great muscular weakness, first overtaking the hinder 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 probably oxidizes the products of tissue metamorphosis, it expedites their removal, especially by the kidneys. To these actions are probably due most of its 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 of disease, it is conjoined with sedatives and salines; 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. Many agriculturists give nitre to their horses, whilst on hard food, in doses of an ounce, mixed 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 salammoniac. Five ounces of nitre, with five of salammoniac, dissolved in sixteen fluid ounces 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, expedite 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 up 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 united with 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 often 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 nitre and Dover's powder, and one grain calomel, either placed upon the tongue, bolted in a bit 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 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 six or seven parts of temperate water, and in nineteen parts at 120°; thrown on red-hot coal it deflagrates; triturated with sulphur it explodes. It is distinguished by the negative reaction of its solution with silver nitrate, by a crystal evolving oxygen when heated, and by the residue boiled with a few drops of water, then giving, with silver nitrate, the white precipitate of chloride. Explosive gases are evolved when it is heated either with sulphuric or hydrochloric acids.

Actions and Uses.—Potassium chlorate is febrifuge, antiseptic, refrigerant, and diuretic; used externally, it is stimulant and refrigerant. When swallowed, it is absorbed into the blood, is excreted by the salivary and buccal glands, exerting a very beneficial action on aphthous or other such eruptions about 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 decomposition of albuminous matters, preventing undue multiplication of white corpuscles and bioplasms, and promoting secretion. In fever cases, whether in horses or cattle, no medicine is more effectual in lowering the pulse and temperature, cleaning the tongue, restoring the appetite, gently stimulating the bowels, and rendering 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 all zymotic cases it is specially indicated; 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. In many such cases its regular use during a week or two appears to ward 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 both 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 ℨi. to ℨij.; cattle, ℨij. to ℨiij.; sheep and pigs, grs. xx. to grs. lx.; dogs, grs. v. to grs. xv. These doses may be given either in bolus or solution, alone or conjoined, with bitters, tonics, or stimulants.

Potassium Permanganate. Potassæ Permanganas. Condy's fluid. ($K_2 Mn_2 O_8$.)

When manganese black oxide is fused with potassium hydroxide and chlorate, a green mass, or with addition of water, a green solution, is formed of potassium manganate. When this oxidizes slowly by exposure to the air, or more rapidly by addition of a little sulphuric acid, the permanganate is formed. It may be crystallized 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.

Actions and Uses.—In contact with organic matter, they rapidly lose a portion of their large supply of oxygen, and with it their distinctive colour, which varies from purple to pink according to concentration. The amount of the permanganates used, and the rapidity with which the colour is removed, indicate the extent of organic contamination in the water, other fluids, or even in the air experimented with. Permanganates, often in the form of Condy's Fluid, are used on a large scale to cleanse the water supplies both of men and animals. Four ounces Condy's Fluid, stirred amongst a hundred gallons of stale-smelling, unsightly rainwater, 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 oxidizing 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 deodorizers 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 deodorized, 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. Crace Calvert found that meat soaked in permanganate solution, and placed in closed bottles, became tainted in two days, and putrified 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 it does not appear to possess any properties which lead to its preference to the chlorate. Dissolved in from fifty to a hundred parts of water, Condy's Fluid proves serviceable for cleaning and deodorizing the mouth in febrile cases, in aphtha, ozœna, and ulceration of the fauces, as a refreshing wash in typhoid fever, and as a mildly stimulating deodorizing lotion for offensive wounds.

POTASSIUM ACETATE. Potassæ Acetas. Acetate of potash. ($K\ C_2\ H_3\ O_2$.)

When potassium carbonate is neutralized by acetic acid, the white striated, 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.

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 crystallization, occurs in white, hard, crystalline masses, with a sharp acid taste. Administered in large quantities, it causes in all animals inflammation of the alimentary canal. Doses of several ounces operate on horses and cattle as a mild laxative; lesser quantities induce diuresis, and act, like nitre, as an alterative and febrifuge.

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 radicle cyanogen (NC or Cy). It may be extracted from various plants, especially of the almond tribe, by crushing and moistening them with water, when their albuminoid principle emulsine excites in the amygdaline a species of fermentation, from which are evolved hydrocyanic acid, a volatile oil, and some other products.

The diluted medicinal solutions usually sold contain from 1 to 5 per cent. of pure anhydrous acid.

Anhydrous Prussic Acid, one of the most active of poisons, is prepared by decomposing 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 liquid, with a specific gravity of ·696, 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 very volatile and inflammable, boils at 80°, and when dropped on the skin produces a sensation of numbness.

Medicinal or Diluted Acid may be obtained by decomposing any of the cyanides, as of potassium, mercury, or silver; but the most convenient and economical method is by the action of sulphuric acid on potassium ferrocyanide, or yellow prussiate of potash, which is thus prepared :—Azotized animal refuse, such as scrapings of hides, cuttings of hoofs and horns, when heated with potassium carbonate and waste iron filings in an iron retort, give off cyanogen gas, which unites with the potassium (K Cy), and, when subsequently boiled with water, takes up iron and crystallizes in four-sided tabular yellow prisms of potassium ferrocyanide (K_4 Fe Cy_6).

For the making of medicinal prussic acid, the *Brit. Phar.* gives the following directions :—'Take of yellow prussiate of potash, two and a quarter ounces; sulphuric acid, one fluid ounce; distilled water, thirty fluid ounces, or a sufficiency. Dissolve the prussiate of potash in ten ounces of the water, then add the sulphuric acid previously diluted with four ounces of the water and cooled. Put the solution into a flask or other suitable apparatus of glass or earthenware, to which are attached a condenser and a receiver arranged for distillation; and having put eight ounces of distilled water into the receiver, and provided efficient means for keeping the condenser and receiver cold, apply heat to the flask, until by slow distillation the liquid in the receiver is increased to seventeen fluid ounces. Add to this three ounces of water, or as much as may be sufficient to bring the acid to the required strength, so that one hundred grains (or 110 minims) of it, precipitated with a solution of nitrate of silver, shall yield ten 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 Everitt's yellow salt, and potassium acid sulphate. The changes, probably somewhat complex, are formulized as follows:—

Potassium ferrocyanide.		Sulphuric acid.		Everitt's yellow salt.		Potassium acid sulphate.		Hydrocyanic acid.
$2K_4FeCy_6$	+	$6H_2SO_4$	=	FeK_2FeCy_6	+	$6KHSO_4$	+	$6HCy$.

Prussic acid, even when carefully made by the same process, is liable to variations of strength, and is, moreover, apt to volatilize 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 Edinburgh acid, as formerly prepared, when treated with silver nitrate, yielded 15 grains of precipitate; and hence contained one-fifth of this, or three grains of anhydrous acid. 100 grains Pharmacopœia acid should yield ten grains of silver cyanide, or contains, in other words, two per cent. of anhydrous acid. The Dublin acid was formerly of rather irregular strength, varying from two to four per cent. Scheele's acid, as usually sold, is also rather uncertain in strength, containing from one to four per cent. of anhydrous acid.

These medicinal acids have most of the properties of the anhydrous acid;—the same distinctive penetrating diffusible odour, cause the same numbness of the parts on which they are dropped, are volatile, and rapidly diminish in strength, unless kept in well-stoppered bottles protected from light. The *Brit. Phar.* acid has the specific gravity ·997; reddens litmus only very slightly and transiently; evaporated on a platinum capsule, it leaves no residue.

Prussic acid is generally very pure; its price of about a halfpenny per ounce affords no temptation for intentional adulteration. A trace of sulphuric acid, 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 a mixture of a ferric and ferrous salt; a greyish-green precipitate is thrown down, which, on the addition of a little hydrochloric acid to re-dissolve the ferrous oxide, assumes 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, cyanogen gas, which, if kindled as it passes from a narrow tube, burns with a rose-coloured flame, surrounded by a blue halo. (*d*) Boiled with ammonium hydrosulphide, previously boiled with sulphur, and with ammonia solution, sulpho-cyanic acid (H Cy S) is produced, and when the liquid is acidified with hydrochloric acid, gives a blood-red solution with ferric-chloride solution. (*e*) Schönbein's test is very delicate, and 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, neutralized 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, add ten or twelve drops of strong sulphuric acid, gently stir with a glass rod; sufficient heat is evolved to volatilize any prussic acid, which condenses on a watch-glass inverted over the crucible, 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 chloride or any other mixed ferrous and ferric salt, and then a drop of hydrochloric acid, when Prussian blue is developed. If the watch-glass is moistened with ammonium hydrosulphide, and exposed for a few minutes over the crucible, from which prussic acid is given off, sulpho-cyanic acid is produced, and is identified by wetting it with ammonia solution, cautiously evaporating to dryness, and adding a drop of hydrochloric acid and of ferric chloride, when the blood-red ferric sulpho-cyanide is developed. As hydro-cyanic acid is readily volatilized and decomposed by many organic bodies, 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 in succession the brain, spinal cord, and motor nerves; the paralysis extends from the trunk to the periphery (Kolliker). Its paralysing sedative effects are not preceded by stimulation. Death usually depends upon paralysis of respiration. Its mode of killing, and its efficacy in allaying irritability of the stomach and respiratory organs, point to a special sedative action on the vagus. Medicinal doses are sedative, anodyne, and antispasmodic. Externally it is used to allay irritability and itching in eczema and other skin complaints.

No poison is more active than anhydrous prussic acid. Injected into the jugular vein of the dog, it causes almost instant death. One to four drops, weighing from a third of a grain to a grain and a fifth, placed on the tongue or within the eyelids of dogs, cats, rabbits, or such small animals, begin to operate in from ten to thirty seconds, and prove fatal in about a minute—one or two deep, rapid inspirations, and a hurried convulsive expiration, being the only antecedents of death. It is stated to act more powerfully in dogs when the mouth is kept closed. Ten to twenty drops produce similar effects in horses. The medicinal acid, given to dogs and cats, in doses of forty to ninety minims, sometimes acts with a rapidity scarcely inferior to the anhydrous acid; more commonly, however, life is prolonged for some minutes, and death is preceded by giddiness, convulsions, salivation, irregularity of the circulation, loss of power of voluntary motion, convulsions, and sometimes coma. If the animal lives for an hour, perfect recovery may usually be expected. Professor Coleman gave an aged horse repeatedly, at intervals of several days, doses varying from 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. The convulsions depend upon a deranged and depressed action on the spinal cord, and not, as with strychnine, on a stimulant action. 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. 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.

The *post-mortem* appearances vary with the dose and concentration of the poison. There is 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. This odour can seldom, however, be detected where life has been prolonged for some hours, 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 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. Chlorine and chloral-hydrate also act beneficially as diffusible stimulants. Cold affusion is often 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 often the immediate cause of death. Atropine stimulates the nervous centres of respiration and antagonizes prussic acid, especially when hypodermically injected (Preyer). 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. & H. Smith of Edinburgh, who proposed this antidote, advise potassium carbonate grs. xx. dissolved in one ounce of water; and immediately after this is swallowed, ferrous sulphate grs. x., ferric chloride tincture fʒj., dissolved in an ounce of water. These quantities should neutralize nearly two grains of prussic acid.

As a calmative and antispasmodic, it is occasionally prescribed in paroxysmal cough, where there is no organic disease. In such cases in horses, twenty minims of acid may be united with a drachm each of camphor and belladonna extract, made into a ball with liquorice powder or linseed meal, and repeated twice or thrice a day. In obstinate vomiting in dogs, in palpitation and in rheumatism, it is also given. Mild cases of tetanus, especially in young animals, are sometimes benefited; but in aggravated cases, and in aged animals, it is of little permanent use. Externally it allays the irritation of some skin eruptions, especially of eczema in dogs; and, for such purposes, a drachm of acid and an ounce of Goulard's extract are dissolved in six ounces of water.

Doses, etc.—Of the *Phar.* acid, horses and cattle take ♏xx. to fʒi.; sheep and pigs, ♏x. to ♏xx.; dogs, ♏ii. to ♏v. It is given in water sweetened with simple syrup; as its soothing effects are transient, the doses should be repeated four or five times a-day; until perfectly regulated, their effects must be carefully watched. It does not appear to be cumulative, so that in well-regulated doses it may be given with perfect safety for a long time. With a fresh sample of the medicine, the dose should at first be considerably reduced, to guard against variation in strength. 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.

PYROXYLIC OR METHYLIC SPIRIT.

Spiritus Pyroxylicus Rectificatus. Methylic Alcohol. Wood Naphtha. Wood Spirit (CH_3 HO).

Wood spirit is the hydrate or alcohol of the radical methyl (CH_3), and its general properties resemble spirit of wine, the hydrate or alcohol of the ethyl series. It must be distinguished from the 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. The acid liquor resulting from the destructive distillation of wood, when redistilled, is sold as wood naphtha or pyroligneous ether. The impurities it then contains are got rid of by distillation with calcium chloride and subsequently with quick-lime. It is then limpid colourless; gradually becomes yellow by keeping; has a peculiar smoky spirituous odour, and a warm aromatic disagreeable taste. Its specific gravity is ·845; it is volatile and very inflammable; boils about 145°; mixes with water in all proportions, and forms a cheap and convenient solvent for many organic substances.

Actions and Uses.—It is narcotic, stimulant, diaphoretic, and antiseptic. It is used to relieve chronic cough; to allay irritability of the stomach and vomiting in dogs; to serve the various purposes of an antiseptic; to dissolve the active principles of many plants; and, on account of its inflammability, to singe the hair of horses. For horses and cattle the dose is f℥ss. to f℥i.; for sheep and pigs, fʒi. to fʒij.; for dogs, ♏v. to ♏xx. Half-ounce doses, united with an equal quantity of ammonia solution or spirit, and given in cold gruel, prove a good anodyne in typhoid cases in horses, and help to relieve irritability of the respiratory organs. It is extensively used for making methylated spirit, which consists of one part of the wood naphtha and nine of rectified spirit, and is sold for pharmaceutic and other technical purposes free of duty.

QUASSIA WOOD.

Quassiæ lignum. The wood of Picræna excelsa. From Jamaica. (*Brit. Phar.*)

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

The dense, tough, white quassia wood, the produce of a handsome West India tree, is imported from Jamaica 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 is not now imported. Quassia has no odour, but a purely bitter taste. Its active principle, quassin, is neutral crystalline, soluble in spirit, but scarcely soluble in water or ether.

Actions and Uses.—Quassia is stomachic, bitter tonic, febrifuge 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 for their destruction the infusion is placed in shallow vessels about the premises.

Doses, etc.—Horses and cattle take of the powder about ℥j. ; sheep and pigs, ʒi. ; dogs, grs. x. to grs. xx. The extract is not used by veterinarians ; the infusion and tincture are made by maceration, and administered alone or conjoined with salines, acids, or iron salts, with which, unlike most vegetable bitters, it mixes without decomposition or discoloration.

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.

The plant or plants yielding medicinal rhubarb grow wild in Central Asia, but have not yet been seen or identified by any European naturalist. The known plants of the family are herbaceous, and their familiar leaf-stalks have a pleasant acid taste, due to the presence of malic and oxalic acids. Of the several commercial varieties, the Russian or Turkey is the best. It is collected in summer from the mountain ranges of the interior of China, Chinese Tartary, and Thibet, from plants six years old, and is packed in chests containing about 150 lbs. It occurs in trapezoidal, round, cylindrical, or flat pieces, frequently bored with a hole, reddish-yellow externally, with a greyish-red marbling internally. The powder is bright yellow, 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 variety known as Chinese or East Indian rhubarb is rather coarser and less aromatic. English rhubarb, grown extensively near Banbury, Oxfordshire, is used when powdered for mixing with the better sorts, is softer and more mucilaginous, has less aroma and grittiness, contains much 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, alcohol, and proof spirit; and less readily by cold and hot water, with the latter of which it forms an orange-coloured solution. Rhubarb contains bitter matters, tannic and gallic acids, three aromatic resins, calcium oxalate, and a golden yellow, odourless, tasteless, feeble crystalline principle, variously styled rhein rhaponticin, rheic or chrysophanic acid. Good qualities the *Phar.* describes as 'free from decay, not wormeaten; boracic acid does not turn the yellow exterior brown.' This test shows the absence of turmeric, which, with flour of wheat, is sometimes largely mixed with the rhubarb powder.

Actions and Uses.—Rhubarb is stomachic, tonic, astringent, and cathartic. Small and repeated doses improve the appetite, correct slight gastric derangements, and may be detected in the blood, urine, and occasionally in the milk. Larger doses act, in dogs and cats, as mild cathartics; but in horses and cattle it has scarcely any purgative effect. Even 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.) Purgative doses are stated to act chiefly on the stomach and duodenum, and specially to increase the secretion of bile; but this is by no means established. On the skin or mucous surfaces, it acts as an astringent.

Doses, etc.—As a stomachic and tonic, repeated several times a day, horses have ℥i.; cattle, ℥ij.; sheep, ʒi.; and 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, is prepared by mixing thoroughly a pound of magnesia, two ounces of ginger, and four ounces of rhubarb—all in fine powder. It is a stomachic and antacid, and may be given in doses twice as large as those of the simple rhubarb. In chronic diarrhœa and dysentery in calves and foals, many veterinarians recommend two drachms each of rhubarb and magnesia, with half a drachm of opium, given several times a day in flour gruel, with a table-spoonful or two of brandy or sweet spirit of nitre. Half the quantity answers well for diarrhœa amongst lambs.

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 Monadelphiæ.

The Juniperus Sabina is a shrubby, evergreen plant, a native of Southern Europe, but easily 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}.)

Actions and Uses.—Savine is an irritant, is allied in its actions to the turpentines, and produces gastro-enteritis when swallowed in large doses. 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. Fatal effects, notwithstanding, do sometimes occur from savin. Thus, in the *Veterinary Record* for 1850, Mr. Rose mentions a case of five horses poisoned by it, 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. In carnivora it is more actively irritant. Four drachms, according to Orfila, destroyed a dog in thirteen hours, when the gullet was tied to prevent vomiting; and the same 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 sometimes 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 after. No judicious practitioner will, however, use savin to produce abortion; for this result is only attainable when the drug is given in poisonous doses sufficient to produce violent intestinal irritation. It is occasionally given 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, the dose of the oil for cattle or horses is about f℥iij. or f℥iv.; for the dog, ♏iij. to ♏v. It may be conveniently dissolved in any fixed oil. For external application, an infusion is made with one part of the fresh tops to six or eight parts of water and two parts of spirit. The ointment generally preferred is thus prepared:—'Take of fresh savin tops, bruised, eight ounces; yellow wax, three ounces; prepared lard, sixteen ounces. Melt the lard and the wax together on a water bath, add the savin, and digest for twenty minutes; then remove the mixture, and express 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 for 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 the silver nitrate, remaining in solution when evaporated, crystallizes 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 cȏntact with organic matters. It is soluble in its own weight of temperate water, and in four parts of 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; medicinal doses are tonic, stimulant, and astringent. Applied externally, it is caustic, stimulant, and astringent. 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 given in concentrated solution. Medicinal doses are absorbed, and, when given for some time, the metal has been discovered in the liver and spleen, and also in the structure of the skin, where it produces a black stain. As a tonic for the dog, it is prescribed in chorea, epilepsy, and other nervous diseases. Half a grain, repeated several times daily, is useful in chronic diarrhœa, dysentery, and cholera in dogs; and in such cases, enemeta of ten to twenty grains to the ounce of distilled water or starch gruel are sometimes also useful.

Its external applications are numerous and important. Its causticity and astringency in part depend upon its uniting with the albuminoids and salts of the tissues. Applied to irritable, relaxed, broken skin or mucous surfaces, it coagulates mucus and albumin, produces a white film, which gradually deepens in colour owing to the reduction of the silver salt to the metallic state. The eschar remaining, after a liberal dressing, gradually cracks and peels off, leaving usually a healthy surface beneath. The solid silver nitrate, being readily localized in its effects, is for some purposes preferable to the fluid caustics or the deliquescent caustic potash. It is used to remove fungous growths, warts, and angleberries; to improve indolent sores; to heal callous ulcers. 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 five to ten grains to an ounce of water, abates the pain and congestion of conjunctivitis, and other such limited and superficial inflammations. 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. It 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 fifteen to twenty 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 an injection, 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. For all patients the doses are repeated three or four times a day, and on account of their disagreeable taste are best given in bolus, made up with meal, bread crumb, or other convenient excipient. For external purposes 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 used, made with grs. v. to grs. viij. of the nitrate 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. $KC_{18} H_{33} O_2$.
Sodium or hard soap. Sapo durus. $Na C_{18} H_{33} O_2$.

Soaps are prepared by boiling solutions of caustic potash or caustic soda with oleaginous matters, when mutual decomposition ensues (see Glycerin, p. 318). Soaps are therefore chiefly potassium or sodium oleates. When made of the more solid fats, they contain, besides, margarates and stearates. Many soaps now contain a large admixture of silicates. Similar oleates are formed when ammonia or lime solutions are boiled with oils. To make soft soap, palm or cocoa nut oils, or other fatty matters, usually of the commoner sorts, are boiled with caustic potash until saponification occurs,—excess of water being got rid of usually by evaporation. To make hard soaps, similar fatty matters are boiled with caustic soda; the commoner sorts are simply evaporated and run into moulds. To get the better qualities, the gelatinous boiling solution is treated with common salt; the soap in flakes, separating from the alkaline impurities and glycerin, floats to the top, is ladled off, and transferred to moulds. Mottled and marbled soaps owe their colour to the presence of a little iron. The *Phar.* 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, ought not to impart an oily stain to paper. When heated they fuse, swell up, and leave charcoal and carbonate of their alkalies.

Actions and Uses.—Soaps are mildly laxative, diuretic, emetic, and antacid; externally they are used as stimulants, detergents, and lubricants; and in pharmacy as excipients. Although not employed alone either as laxatives or diuretics, they form a convenient adjunct to more active medicines, 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, a convenient preparation is made by mixing six ounces of soap and one pint each of proof spirit, liquor ammoniæ, and linseed oil or oil of turpentine. To this may also be 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. For eczema and other itching skin disorders, nothing is more generally useful than Dr. M'Call Anderson's prescription of equal parts of soft soap, oil of cade, and rectified spirit. Gently rubbed over slight burns or scalds, soap prevents access of air and greatly relieves irritation. In pharmacy, soaps are much used for making up boluses, liniments, and ointments.

SODIUM AND ITS MEDICINAL COMPOUNDS.

Sodium Carbonate. Sodæ Carbonas. Carbonate of Soda. $Na_2\ CO_3$.

Sodium Bicarbonate. Sodæ Bicarbonate. 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 natrium 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 a furnace with sulphuric acid; the sulphate is converted into sulphide, and thence into carbonate by roasting with coal or slack and limestone, or other form of calcium carbonate; lixiviating, calcining, and crystallizing. When a saturated solution of this soda ash stands, there separate large transparent monolithic crystals of hydrated carbonate ($Na_2 CO_3, 10H_2 O$), used for washing purposes. The water may be driven off by heat, when the dried sodium carbonate of the *Phar.* 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. They are distinguished by their negative reaction with the several group tests, hydrochloric acid, hydrogen sulphide, ammonium hydrosulphide, ammonium carbonate, and ammonium arsenite, 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 eight parts of cold water, and is distinguished from the carbonate by its feeble alkalinity. Soda water, as ordinarily sold, is simply aerated water; but the official article contains in every pint 30 grains bicarbonate, with one pint carbonic acid gas, dissolved under pressure of seven atmospheres.

Actions and Uses.—Sodium carbonate and bicarbonate differ only in the degree of their action, and closely resemble the corresponding potassium salts. The sodium salts are not, however, so powerful, exert no depressing action on the heart, little diminution of temperature, and no paralyzing influence on the spinal cord. They neutralize acidity in the alimentary canal, and are useful in some forms of indigestion and in poisoning by acids. They become absorbed and while in the blood act as alteratives, and relieve febrile attacks, rheumatism, and some other abnormal conditions. They are got rid of by the kidneys, increasing the quantity and alkalinity of the urine, and are used as mild diuretics, and also occasionally in men and dogs as antilithics. Weak solutions are used, especially by Continental veterinarians, as soothing lotions for the irritable weeping stages of eczema, and also as injections in leucorrhœa.

Doses, etc.—The carbonate is given to horses and cattle in doses of ℨij. to ℨvj.; to sheep and pigs, grs. xx. to grs. lx.; to dogs, grs. x. to grs. xx. The bicarbonate, having about half the activity, is given in double the doses of the carbonate. Both salts are used either in bolus or 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 flattened six-sided prisms covered with a greasy deposit, said to be native boron. It is purified by re-crystallization. Borax is also readily got by boiling together boracic acid and sodium carbonate. Its colourless oblique prisms have a saline cooling taste, are soluble in twelve parts of cold and two parts of hot water, and are still more soluble in glycerin, which is hence a capital vehicle for applying it. Heated, it loses its water of crystallization, becomes calcined borax, and at higher temperatures becomes glass of borax or boron trioxide ($B_2 O_3$).

Actions and Uses.—Borax resembles the carbonate and bicarbonate, is feebly irritant, alkaline, antacid, refrigerant, and diuretic. It is stated to be more effectual than other sodium salts in neutralizing uric acid. It is chiefly used externally as a stimulant and detergent. The powder or strong solution is used for dressing the small, round, superficial ulcers of aphtha, occurring especially in calves and lambs. It often allays the itching of eczematous eruptions, especially in dogs, and 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 is found as an efflorescence on the surface of the soil in various parts of India, and as a constituent of many aperient mineral waters. It is a by-product in the preparation of chlorinated lime, and is usually got by heating sodium chloride with sulphuric acid, as in the preparation of hydrochloric acid, and in the first stage of the process for making sodium carbonate. It occurs either in large rhombic prisms or in needle-like crystals, and is colourless, transparent, and of a saline, bitter taste. It is soluble in three parts of water at 60°, and, like most other sodium salts, effloresces when exposed to the air.

Actions and Uses.—It is cathartic, diuretic, alterative, and febrifuge. Like other saline purgatives, it acts irregularly on horses. Among cattle it is 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. Like other salines, when given in small and repeated doses, insufficient to act freely on the bowels, it notably diminishes the proportion of fibrine in the blood.

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 Acid Sulphite. Sodæ Sulphis. Sulphite or Bisulphite of Soda. $NaH\ SO_3,\ 4H_2O$.

The sulphite is manufactured chiefly for the dyer. By passing sulphurous acid gas through a concentrated solution of sodium carbonate, four-sided crystals of acid 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 ($Na_2\ SO_3,\ 7H_2O$). This, when gently heated with a little sulphur, yields sodium hyposulphite ($Na_2\ S_2\ O_3,\ 5H_2O$).

Actions and Uses.—It is antiseptic, disinfectant, a deodorizer, as well as an alterative, febrifuge, and insecticide.

It arrests fermentation, destroys septic germs, and rapidly removes most offensive smells. These antiseptic and disinfectant properties are greatly increased when it is used along with carbolic or cresylic acids. When standing long in contact with water, the sulphite has, however, the disadvantage of decomposing, and gives off hydrogen sulphide. Swallowed, it is absorbed, is rapidly diffused, acts especially upon organized bodies probably of degenerate type, often removes the noisome smell and acridity from unhealthy secretions, is excreted comparatively unchanged. Like carbolic acid, it acts as a septicide, but may be used more freely without risk of poisoning. Professor Polli, of Milan, has made upwards of three hundred experiments with acid sulphite, mostly upon dogs, and finds that, besides ordinary antiseptic properties, it neutralizes, or at any rate materially diminishes, the effects of animal poisons. He gave it to dogs in quantities of 225 grains daily with impunity for a fortnight; and so thoroughly does it permeate the system, that even moderate doses are 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 glanderous 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 it at first seemed 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, frequently repeated and verified, indicate that sodium sulphite, and probably other sulphites and hyposulphites, are valuable antidotes to animal poisons. They either destroy organized germs, arrest their development, or in some way protect the body against their attacks. They are antiseptics and alteratives, and of signal service in arresting or modifying various blood disorders. In the human subject, sodium sulphite has been advantageously given to remove boils, and to lessen the purulent secretion in bad cases of phthisis. Amongst horses it is of benefit in febrile attacks, purpura, inveterate skin disorders, tedious cases of strangles, rheumatism, farcy, and also as a palliative in glanders. In indigestion in all animals it is often of value, particularly for counteracting flatulence. Ounce doses given thrice daily, I have found, lower the temperature, and ease the 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. Mixed with treacle and placed within the lips, it diminishes irritation, smell, and acrid discharge in foot-and-mouth disease. With potassium chlorate it frequently appears to prevent in young cattle attacks of congestive fever or black leg, and for this object half-ounce or ounce doses are given 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 and Spain, 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 two and a half times its weight of water, at all temperatures. It is rather more than twice as heavy as water.

Actions and Uses.—Salt is irritant, cathartic, and emetic; small doses are stomachic, alterative, and antiseptic; externally it is stimulant, antiseptic, and refrigerant; it is, moreover, an essential article of diet.

On horses its cathartic action 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 the secretion of urine and the proportion of urea. On pigs it acts as a purga tive, 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 from eight to twenty-four hours, from the eating of about four and a half ounces of salt, 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).

For cattle and sheep common salt is the most useful of purgatives. It is more prompt and powerful than Epsom or Glauber salts, and is especially effective when given with Epsom salt. By causing thirst, it induces the animal to drink large quantities 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 extensively used for all the ordinary purposes of a purgative. It is administered to evacu ate 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, exerting its ordinary antiseptic virtues, and perhaps also exciting counter-irritation. It is the best antidote for silver salts. Small and repeated doses are stomachic, and useful in all animals in indigestion and irregularity of the appetite. In such cases, an ounce of salt is often given to horses or cattle, with an equal quantity of powdered ginger and gentian, made either into a ball with linseed flour and water, or given as a draught in a quart of ale. Salt regularly given lessens the liability to intestinal worms, and an injection of half an ounce to a pint of water will often bring 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 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 salammoniac is dissolved in 30 to 40 parts of water; or one part of salt is mixed with two parts 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 very 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.

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 has made some very interesting experiments regarding the dietetic value of common salt (*Annales de Chemie et de Physique*, 1847, Tom. xix.). He 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 ounces 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, though 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 space of 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 is thought to be the natural stimulant of the digestive system in all animals; to become decomposed and afford chlorine for the hydrochloric acid of the gastric juice, and sodium for the bile; to perform some important functions in regard to the blood discs; and to assist the blood in maintaining its 'fluidity, its stimulating properties, and its powers of self-preservation.'

Doses, etc.—As a purgative for the adult ox, the dose varies from three-quarters of a pound to a pound and a half; and for sheep, from one ounce to three. Instead of using common salt by itself, I prefer for cattle, as more prompt and effectual, 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 extreme torpidity of the bowels, it is often necessary to expedite and increase the effects of salines by the addition of other purgatives; and in such cases, an effectual combination may be made with three-quarters of 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 emetic for a medium-sized dog consists of a tea-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.

When chlorine is passed into a solution of sodium carbonate, a colourless alkaline bleaching liquid is produced, recognised by the *Phar.* as liquor sodæ chloratæ, known also as Labarraque's disinfecting fluid, and stated to contain 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 resembles chlorinated lime in its properties and uses. Coster found that the solution neutralized the poison of rabies and of syphilis; but its power of destroying the germs of small-pox, scarlet fever, or typhus is not yet fully established. It is an antidote for poisoning by hydrogen sulphide and hydro-sulphides. Its antiseptic properties recommend it in typhoid fever, purpura, and erysipelas in horses. As an antiseptic, although more expensive, it is for some purposes preferable to chlorinated lime, as 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. As an antiseptic and deodorizer, it is a valuable dressing for foul sloughing wounds and ulcers, for checking excessive noisome discharges from the skin or mucous surfaces, and for controlling eczema and prurigo.

Doses, etc.—Of the *Phar.* solution, horses and cattle take f℥i. to f℥ij.; sheep and pigs, fʒi. to fʒij.; dogs, ♏xv. to ♏xxx. dissolved in water. Labarraque's disinfecting fluid contains one part of the chlorinated soda dissolved in one of 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 soft, slightly oily, translucent white, crystalline substance, with the density ·943. It is tasteless, odourless, tough, and difficult to powder, unless previously moistened with a few drops of spirit. It is insoluble in water, sparingly soluble in cold alcohol, readily soluble in hot alcohol and oils, and does not melt under 100°. It consists of a small quantity of sperm oil and cetine—the neutral crystalline cetyl palmitite ($C_{16}H_{33}$, $C_{16}H_{31}O_2$), which when saponified does not, like ordinary fats, yield glycerin or glyceryl hydrate, but ethal or cetyl hydrate ($C_{16}H_{33}HO$).

Actions and Uses.—It is emollient and demulcent, is rarely given internally, but is frequently used for making ointments and plasters.

STARCH.

Starch or amylum is largely present in the cereal grains, in the stems of many plants, and in most roots. Wheat flour contains 72 per cent. of starch, 11 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, 17 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, split into columnar masses, and coloured by addition of a little indigo. Arrow-root is the starch of the Maranta arundinacea; sago, the granulate starch, from the sago palm; tous-les-mois from the rhizomes of several species of Canna; tapioca or cassava starch from the expressed juice of the roots of Manihot utilissima. Starch consists in minute granules, varying in size with the source from which it is obtained. It is insoluble in cold water, forms a gelatinous mass with boiling water, and is converted first into dextrin or British gum, and thence into grape sugar, by diluted sulphuric acid, by a temperature of 300°, or by diastase and various fermentescible animal matters. Its distinctive test is the blue compound boiled solutions, allowed to cool, give with iodine. Its formula is $C_6\ H_{10}\ O_5$; it is isomeric with cellulin.

Actions and Uses.—Starchy substances are easily digested and nutritive, especially when given conjoined with albuminoids. Like other such proximate principles, pure starch does not however alone, or for any lengthened period, support life. As demulcents and emollients, they are used for protecting and softening irritable surfaces. In diarrhœa and dysentery, starch mucilage, about the consistence of cream, at the temperature of 100°, either alone or with laudanum and sugar of lead, or other astringents, 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. Heated with about eight parts of glycerin until it forms a translucent jelly, it is applied as a soothing dressing. It is used for mixing and subdividing medicines, and as a vehicle for administering them.

STAVESACRE SEEDS.

Staphysagriæ Seminæ. The seeds of Delphinium Staphysagria. Imported from the south of Europe (Pereira).

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

Stavesacre or larkspur is a stout herb about two feet high, growing throughout the south of Europe. Its officinal seeds are brown, wrinkled, with three or four irregular sides; contain a white oily nucleus; are bitter, acrid, and nauseous, and have a disagreeable smell. They owe their activity to a volatile acid and about eight per cent. of the colourless, acrid, crystallizable alkaloid delphinine ($C_{27}\ H_{19}\ N\ O_7$).

Actions and Uses.—Stavesacre seeds are irritant, narcotic, and insecticide. They 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 applied in infusion made by boiling an ounce of seeds in a quart of water. 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 beet-root, and in America from the sugar-maple. But most of the sugar used in this country is got from the sugar-cane, which is extensively cultivated in the West Indies, has a perennial root, a jointed annual stem from six to twelve feet high, and long grassy leaves, which send out a flowering stem terminating in a panicle of beautiful silver-grey flowers. The lower parts of those canes which have not previously borne flowers are richest in saccharine matter. The canes are crushed between heavy rollers ; the pale-green expressed juice, which contains nearly 20 per cent. of sugar, is mixed with lime to neutralize acids and precipitate albuminoids, and concentrated, when yellow-brown crystals of raw sugar are formed, and there remains a variable quantity of brown, uncrystallized molasses. The raw, brown, or muscovado sugar of commerce, when brought to this country, is dissolved in water by the help of steam, is again treated with milk of lime, filtered through animal charcoal, concentrated in vacuo at about 170°, quickly dried in small crystals, or poured into conical moulds and crystallized 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 *Phar.* (C_{12} H_{22} O_{11}), is colourless, odourless, porous, friable, and sweet ; like sulphur it has an amorphous and crystalline form ; its crystals are monoclinic prisms ; its specific gravity is 1·606. It is soluble in about half its weight of water at 60°, phosphoresces in the dark, is decomposed by mineral acids, and readily fermented by yeast. When slowly crystallized by suspending threads in a strong watery solution, to which a little alcohol is generally added, sugar-candy is formed. At 160° it melts, loses its property of crystallizing, and, run into little moulds, forms barley-sugar. Above 356° it parts with water, loses its sweet taste, acquires a dark colour, and becomes caramel, which is used as a colouring agent.

Acids and ferments convert cane sugar into grape sugar and sugar of fruits, an uncrystallizable variety known as inverted sugar or levulose ($C_6 H_{12} O_6$), so called on account of its rotating a ray of polarized light to the left, instead of, like cane sugar, to the right. The amount of rotation of polarized light is occasionally used as an index of the amount of sugar in syrups and diabetic urine.

Grape sugar, glucose, or dextrose ($C_6 H_{12} O_6, H_2O$), is present in many plants; is found in 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, crystallizes in cakes or square plates, and is not charred by sulphuric acid. When heated with solution of cupric sulphate and caustic potash, the bluish-green precipitate first formed rapidly becomes bright red, from deoxidation of cupric oxide and formation of cuprous oxide ($Cu_2 O$). The supernatant liquid also becomes colourless. With cane sugar, the bluish-green precipitate first formed undergoes little change, and the solution still retains its blue tint. This test readily discovers the presence of glucose and levulose, and also serves to distinguish these from sucrose.

Molasses, treacle, theriaca, or sacchari fæx, is the uncrystallizable, 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.

Honey or mel, the saccharine secretion deposited in the honeycomb by the hive bee, when first collected, is stated to be a mixture of dextrose and levulose, with a little sucrose; but exposure to air appears to increase the proportion of crystallizable sugars. 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_{22} O_{11}, HO_2) is prepared by evaporating whey, filtering, and crystallizing. It is obtained from the homœopathic chemists, who use it for subdividing their medicines. It occurs in translucent, greyish-white, hard, cylindrical masses of rhombic prisms. It is gritty, and not so sweet as either of the vegetable sugars; is not directly fermentable, and requires for solution six times its weight of cold water and two of boiling water.

Liquorice is the root or underground stem of glycyrrhiza glabra or echinata, grown in England, or imported from Spain or Italy. The natural juice or watery infusion, when concentrated until it becomes solid, forms the familiar extract of liquorice or black sugar. It contains an uncrystallizable unfermentable sugar, glycyrrhizin.

Actions and Uses.—The sugars are important nutritive bodies. 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, from eight to twelve ounces to dogs, increase the amount and fluidity of the feces, and usually augment the 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 various vegetable, and some soft animal substances, and for making up various medicines. It increases the solubility of lime salts (p. 206), and retards the oxidation of ferrous compounds (p. 344). Simple syrup, the syrupus simplex of the

Phar., used for flavouring, preserving, and suspending medicines, is made by mixing, with the aid of gentle heat, five pounds refined sugar and two pints distilled water, and adding after cooling as much distilled water as may be necessary to make the weight of the product seven pounds and a half. 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 expediting 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. Like sugar, it is antiseptic, and is 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 together equal weights of treacle and linseed flour.

Doses, etc.—Sugar and treacle are given as laxatives for horses and cattle, in doses of lbi.; for sheep, ℥iij. or ℥iv.; for pigs, ℥ij. or ℥iij.; for dogs, ℥i. or ℥ij. They are often 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 is obtained by decomposing metallic sulphides, or more conveniently by distilling the crude Sicilian sulphur, which occurs in large beds as a product of volcanic action. Stick or roll sulphur is prepared by melting the purified article, and running it into moulds. 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, milk of sulphur is formed, and there is thrown down a greyish-yellow soft powder of precipitated 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.

Properties.—Sulphur in mass is a yellow, opaque, brittle solid. Being a bad conductor of heat, when grasped in the warm hand it crackles and sometimes splits into fragments. Sublimed sulphur is a yellow crystalline powder; its natural crystals are rhombic octahedra; its specific gravity 2·7. Sulphur is without odour or taste; insoluble in water, but soluble in carbon disulphide, in alcohol, ether, milk, and the fixed and volatile oils. It is entirely volatilized by heat; is inflammable, and burns with a pale blue flame, evolving sulphurous acid, more correctly entitled sulphur anhydride or dioxide (SO_2). When heated, sulphur passes through various allotropic conditions; at 212° it melts, becoming as fluid as water, and of the colour of amber; at a higher heat it thickens, and becomes as dark as treacle; at 480° it is so tenacious that it adheres to the vessel even when it is inverted; while from that temperature to 788°, at which it boils, it again becomes thin, and recovers in great part its original colour. Sulphur is usually of sufficient purity for all medicinal and pharmaceutical purposes. Traces of arsenic are, however, sometimes present in that made from pyrites.

Actions and Uses.—Sulphur in large doses is irritant; in medicinal doses, a laxative, alterative, and stimulant of the mucous surfaces; applied externally, a stimulant and effectual antiparasitic.

A pound causes in horses 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 grey. The muco-purulent discharge from the nostrils increased daily; the patient, though well fed, became gradually emaciated, and so debilitated, that by the seventh day he was unable to rise. After the tenth day, the blood, even in the arteries, became dark coloured, thin, and slow to coagulate. On the seventeenth day, the animal was destroyed. The mucous lining of the stomach, colon, and cœcum was of a reddish-blue colour, soft, and easily torn. The lungs, muscles, and intestinal contents smelt strongly of hydrogen-sulphide, but the blood had no such odour. (Hertwig.) . Within the body, sulphur is speedily converted into a soluble sulphide, which readily enters the circulation, exerts a topical stimulant effect on the mucous surfaces, and, from its disagreeable hydrogen-sulphide odour, is readily detectable in most of the secretions and excretions. Waldinger mentions that a small quantity of sulphur, given for some time to sheep, imparted a very disagreeable flavour to the flesh.

Gently to open the bowels, to keep up the action of more powerful purgatives, or to promote secretion, sulphur is given to most of the domestic animals in chronic pulmonary disorders, in rheumatism, in convalescence from acute diseases, and in many skin affections. Its efficacy as a vermifuge has probably been over-estimated. A piece of roll-sulphur in the water which the animal drinks is a popular preventive of distemper, as well as of 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 application comes into immediate and fatal contact, not only with fully developed, but with embryo acari. In chronic and intractable mange cases, besides scrupulous attention to cleanliness and the internal use of arsenic and alkalies, it is desirable at short intervals to vary the application, using in turn sulphur, tar oil, mercurial ointment, and alkaline washes.

Doses, etc.—As a laxative, horses take ℥iij. to ℥iv., as an alterative, about ℥i.; cattle, as a laxative, ℥v. or ℥vi., as an alterative, ℥i. or ℥ij.; sheep and pigs, as a laxative, ℥i. to ℥ij., as an alterative, ʒvi.; dogs, as a laxative, ʒvi., as an alterative, ʒi. to ʒij. 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 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 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, or sulphur vivum, and four of lard. One part mercurial ointment is sometimes added, and occasionally one-eighth part white hellebore; but this irritant is not commendable, and is apt to cause blistering, especially in dogs. The simple liniment is made with one part of sulphur and four or six parts 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 of potassium carbonate, and eight of lard or of oil. Where the skin is irritable from rubbing, or affected with itching, tar should be used with the sulphur, in the proportion of one part each to six or eight of lard or oil.

SULPHURIC ACID.

Acidum Sulphuricum. Hydrogen Sulphate. Oil of Vitriol. An acid produced by the combustion of sulphur and the oxydation 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, sulphurous acid gas (SO_2) is introduced from the burning of sulphur or the roasting of iron pyrites. Jets of steam convert it into sulphurous acid ($H SO_2$). Nitric acid ($2H NO_3$), obtained from potassium or sodium nitrate, treated with sulphric 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 oxidizing the sulphurous acid, is reduced to the condition of nitric oxide ($N_2 O_2$), absorbs oxygen from the air, becomes nitric trioxide ($N_2 O_3$), is again deoxidized by the sulphurous acid, and 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 or commercial oil of vitriol. For pharmaceutical or chemical purposes, it is further concentrated in platina or glass vessels.

Properties.—Pure sulphuric acid has the specific gravity 1·848, is dibasic or bivalent, and forms two series of salts, one neutral, the other acid. The strong acid of commerce contains 96·8 per cent. of real acid, has the specific gravity 1·843, is oily-looking, colourless, odourless, with an intensely acid acrid taste. It freezes at 36°, boils at 600°, absorbs moisture from the air, and hence, if kept in unstoppered bottles, speedily becomes diluted. It absorbs water from the soft animal tissues, coagulates their albumen, decomposes and chars them. It has great affinity for water, mixes with it in all proportions, and in combining with it evolves much heat. The acidum sulphuricum dilutum or medicinal acid contains about $13\frac{1}{2}$ per cent. of real 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, has no acid reaction, and combined with sulphuric acid forms the fuming or Nordhausen acid (SO_3, H_2SO_4). The test for sulphuric acid is its forming, in diluted solution, with soluble barium salts, an abundant white precipitate ($BaSO_4$), insoluble in other acids.

Impurities.—The specific gravity and the neutralizing 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 neutralization 1000 grain measures of the volumetric solution of soda.'—*Brit. Phar.* Lead or arensic are discovered by diluting the acid, and adding hydrogen sulphide. Iron 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 an irritant 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.

Full medicinal doses are 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 converted into salts previous to absorption. The small quantity of alkali present in the intestinal canal, is moreover insufficient to neutralize the doses of acid usually given. Absorbed into the blood, they doubtless liberate weaker acids and lessen its alkalinity, but the precise changes produced are unknown. Observation shows that it diminishes thirst, and is astringent and tonic. Its refrigerant properties are increased when it is given with gentian, quassia, or other bitters. For arresting excessive sweating, it is best conjoined with zinc sulphate, and the patient also sponged over with a dilute acid solution. It stimulates the salivary and other alkaline secretions. It is prescribed for all animals in feebleness and atony; during convalescence from acute disease; and in other cases where mineral tonics are indicated. 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. 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 influenza in horses, 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. 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.

Applied to the skin, a strong acid combines with its moisture, bases, and albuminoids, and disorganizes the cuticle, exposing the nervous febrillæ. Its fluidity adapts it for cauterizing 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, is used in France for removing cancerous and other swellings; half an-inch layer placed over a tumor the size of an egg sometimes removes 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, diminishes their disagreeable taste and rather increases their activity.

Doses, etc.—Of the medicinal acid, horses take f℥i. to f℥ij.; cattle, f℥ij. to f℥iv.; sheep, f℥ss. to f℥i.; pigs, ♏x. to ♏xx.; dogs, ♏ij. to ♏vi. It is repeated several times a day, is given diluted, so that it does no topical injury, and is often conjoined with aromatics and bitters. As an external astringent, ten to twenty to thirty drops of medicinal acid are mixed with an ounce of water.

SULPHUROUS ACID.

Acidum Sulphurosum. A solution in water of 12 per cent. of acid ($H_2 SO_3$).

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 colourless, liquefiable, suffocating gas — sulphur 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 crystallizable, unstable, and dibasic, forming a double series of sulphites. The sulphurous acid of the *Pharmacopœia* contains, dissolved in water, nearly 12 per cent. of this acid, or 9 per cent. of sulphurous gas. It is a colourless liquid, has a pungent sulphurous odour, reddens litmus, bleaches colouring matter, leaves no residue when heated, has the specific gravity 1·03. 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 oxydizer, it abstracts oxygen, becoming converted into sulphuric acid.

Actions and Uses.—Both the gaseous and liquid acids are irritant poisons. The gas, insufficiently diluted, causes suffocation. Both are used medicinally as stimulants, alteratives, antiseptics, and disinfectants. Externally they are applied as stimulants, antiseptics, and insecticides, and are also employed as general antiseptics, disinfectants, and deodorizers.

Its destroying organic and organized germs is the clue to its various important applications. Its chemical activity in reducing or deoxidizing may, in part, account for its useful properties. It stops the multiplication of the yeast fungus, and kills many of the lower forms of life. 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 months. Professor Graham stated that 'animal odours and emanations are immediately and most effectually destroyed by it.' 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 neutralizes 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 potassium chlorate, 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 solution or spirit of ammonia. In young calves, tympanitic from hasty or careless feeding, ounce doses act, however, more certainly than in older animals.

Burning sulphur, used since the time of Homer, is still one of the most effectual disinfectants. The gas is readily evolved, in the stable or premises to be purified, by scattering flowers of sulphur over some embers on a shovel or in a chaufer. 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, farcy, or glanders in horses, the animals in the same or adjacent premises, besides breathing daily, for say half an hour, the diluted acid, should also be daily sponged over with a diluted 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 oxidizes hydrogen sulphide; it converts ammonia into ammonium sulphite, itself a valuable antiseptic. The lime and whitewash abounding about the abodes of most animals are 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.—The medicinal solution is given to horses and cattle in doses of f℥i. to f℥ij. ; to sheep and pigs, fʒss. to fʒi. ; to dogs, ♏xx. to ♏lx. It is 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 acid solution to be a more effectual antiseptic than either the sulphites or hyposulphites. As a soothing application in skin irritation, the *Pharmacopœia* acid is mixed with equal bulk of glycerin. Baths are readily made by conducting the vapours of burning sulphur into water. In skin complaints amongst animals, baths or strong solutions are more effectual than fumigation. As a disinfectant, it is fittingly used with carbolic acid, but not with chlorine or bleaching powder, which neutralize it.

SWEET SPIRIT OF NITRE.

Spiritus Ætheris Nitrosi. A spirituous solution containing ethyl nitrate or nitrous ether.

When rectified spirit, sulphuric and nitric acids are heated with copper clippings, the nitric acid is deoxidized by the copper; the resulting nitrous acid (NO_2) seizes the ethyl of the alcohol ($C_2 H_5 HO$, or $Et HO$), and there is formed nitrous ether ($C_2 H_5 NO_2$). This ether, when diluted with three times its bulk of rectified spirit, constitutes sweet spirit of nitre. In this process, complicated reactions doubtless occur, aldehyd ($C_2 H_4 O$) is produced, but the ultimate results are represented by the formula :—

Alcohol.	Nitric acid.	Sulphuric acid.	Copper.	Nitrous ether.	Water.	Copper sulphate.

$$Et HO + H NO_3 + H_2SO_4 + Cu = Et NO_2 + 2H_2O + Cu SO_4$$

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 *Brit. Phar.* furnishes the following explicit details :—'Take of nitric acid three fluid ounces; sulphuric acid, two fluid ounces; copper, in fine wire (about No. 25), two ounces; rectified spirit, a sufficiency. To one pint of spirit add gradually the sulphuric acid, stirring them together; then add, in the same way, two and a half fluid ounces of nitric acid. Put the mixture into a retort or other suitable apparatus into which the copper has been introduced, and to which a thermometer is fitted. Attach now an efficient condenser, and, applying a gentle heat, let the spirit distil at a temperature commencing at 170°, and rising to 175°, but not exceeding 180°, until twelve ounces have passed over and been collected in a bottle, kept cool, if necessary, with ice-cold water; then withdraw the heat, and having allowed the contents of the retort to cool, introduce the remaining half ounce of nitric acid, and resume the distillation as before, until the distilled product has been increased to fifteen fluid ounces. Mix this with two pints of the rectified spirit, or as much as will make the product correspond to the tests of specific gravity and per-centage of ether separated by chloride of calcium. Preserve it in well-closed vessels.'

Properties and Tests.—'Transparent and nearly colourless, with a very slight tinge of yellow, mobile, inflammable, of a peculiar penetrating apple-like odour, and sweetish, cooling, sharp taste. Specific gravity, 0·845. It effervesces feebly or not at all when shaken with a little bicarbonate of soda. When agitated with the solution of sulphate of iron and a few drops of sulphuric acid, it becomes deep olive-brown or black (owing to the formation and solution of nitric oxide). If it is agitated with twice its volume of saturated solution of chloride of calcium 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.'—*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, and a powerful antiseptic in typhoid cases and convalescence from debilitating disorders; an effectual stimulant of the skin and kidneys in cold, rheumatism, and local congestion. Like alcohol and ether, properly regulated doses lower excessive animal temperature and antagonize pyæmia and most forms of blood-poisoning.

Doses, etc.—As a stimulant, antispasmodic, and antiseptic, 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. It is usually administered in cold water, beer, or linseed tea. As an antispasmodic, it is often united with opium, 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. 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. When serous exudation is suspected, as a sequel of inflammation, or from other causes, 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.—Solanaceæ or 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, and in the United States. 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 a 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 the month of August, and the leaves are dried, twisted, and carefully packed, with great compression, in hogsheads. The different tobaccos owe their several peculiarities chiefly to the manner in which they are prepared for sale; the 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 from one to three months, according to the sort of snuff required; the fermented product is ground and sifted.

Commercial tobacco, examined by the Analytical Sanitary

Commission, was found to contain about 12 per cent. of moisture, 40 to 44 per cent. of matters soluble in cold water, 2·5 to 4 of matters insoluble in cold water but soluble in boiling water, 40 to 45 of ligneous materials and insoluble salts. The active principle is nicotine or nicotia ($C_{10}H_{14}O_2$)—a colourless volatile oily alkaloid, with an acrid odour and taste. It is present in all parts of the plant, constitutes from $\frac{1}{10}$ to 1 per cent. of the dried leaf, and occurs in combination with malic and citric acids. It is soluble in water, alcohol, ether, the fixed and volatile oils. It is an energetic poison, almost as potent as prussic acid.

Actions and Uses.—Tobacco is a narcotico-acrid poison. It paralyzes the brain, but tetanizes the cord. Medicinally, it is used as an antispasmodic, anodyne, and anthelmintic, as well as an auxiliary emetic and cathartic. Externally, it is used to poison acari, lice, and other skin parasites.

Hertwig has 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 from three to ten beats per minute, and became irregular and intermittent; whilst a repetition of such doses increased the evacuation both of feces and urine. Large doses, especially when injected into the veins, accelerated the pulse, impaired the appetite, 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, produced heightened temperature of the skin, acceleration of the pulse from 65 to 70, 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, after consuming about four pounds of tobacco leaves, speedily became very restless, ground his teeth and groaned, lay with outstretched limbs and distended rumen, passed quantities of thin, fetid feces, 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 corroded, particularly where in contact with the tobacco. Hertwig further mentions that goats are similarly affected by doses of 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 a ligature round 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. A decoction containing half a drachm, injected into the rectum of a dog, produced most of the same symptoms, but did not prove fatal. Two and a half drachms, applied to a wound, destroyed a dog in an hour.

Death appears to depend on a perverted and paralyzed state of the nervous centres, producing coma, syncope, or apnœa. The usual appearances after death are fluidity and dark colour of the blood, venous congestion, especially of the nervous centres, and redness of the alimentary mucous membrane.

The appropriate antidotes are the stomach-pump and emetics, alcohol, ether, ammonia, or any other diffusible stimulants; carefully watched doses of strychnine, and artificial respiration.

In general action, as well as in botanical characters, tobacco resembles belladonna, hyoscyamus, and stramonium. Like opium, it relaxes muscular fibre, increases secretion, paralyzes the brain functions, and causes convulsions. Its poisonous and medicinal effects also ally it to prussic acid. The power of tobacco to relax muscular spasm is beneficially exerted in colic, tympanitis, forcible contraction of the neck of the bladder, tetanus, and occasionally in strangulated hernia, which is now, however, more generally relieved by chloroform or by operation. In tetanus in man, one or two drops of nicotine—equivalent probably to about a drachm of Virginian tobacco—have been given at intervals of two hours, usually with the result of allaying the spasms; a decoction applied directly to the affected muscles, also seems to afford relief; but, as with other remedies used in tetanus, the symptoms are only temporarily removed. In enteritis, peritonitis, and obstinate torpidity of the bowels, whether from lead-poisoning or other causes, tobacco sometimes proves a useful anodyne and adjunct to active purgatives. In most of these cases it is most conveniently and effectively given in the form of tobacco-smoke clysters. Howsoever administered, it poisons intestinal worms, and diluted solutions thrown into the rectum readily bring way ascarides lodged there.

Externally, it is used to kill the acarus 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 dangerous nausea and fainting; but one part to thirty or forty of water may be used with perfect safety. A good non-poisonous wash or dip for sheep, effectual in destroying ticks and warding off for a considerable time attacks of flies, and not injurious to the colour or texture of the fleece, is made with a 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. The active principle of the tobacco must previously be extracted by boiling for ten or fifteen minutes in a couple of quarts of water. These quantities suffice to dip thirty lambs or a score of big sheep. For the destruction of the scab acari, a solution of double the above strength may be 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 a soothing antispasmodic laxative clyster, the smoke is generally 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 suffice for a time, and may be repeated at intervals of an hour, or as required. For external application, or for enemata, 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.

NICOTINE causes paralysis and convulsions. Professor Alfred Taylor gave a rabbit a single drop: in fifteen seconds it lost all power of standing, was violently convulsed, its back arched; a frothy alkaline mucus having the odour of nicotine ran from its mouth; in three and a half minutes it was dead (Taylor on Poisons). Kölliker teaches that (1) nicotine quickly paralyzes the brain, and destroys voluntary movement; (2) that it excites the medulla oblongata and the cord, producing tetanus, which continues only a short time, and is unaccompanied by increased reflex irritability; (3) that the motor nerves are paralyzed, and if the tetanic movements are severe, they assist in producing this paralysis; (4) that the sensory nerves do not appear to be affected by nicotine; (5) that the heart continues to pulsate long after nicotine-poisoning; (6) that the muscular irritability is unaffected by nicotine. Other observers teach that nicotine feebly paralyzes the motor nerves, and destroys muscular irritability.

Nicotine appears to tetanize the heart; for when, from a mechanical cause, this organ has ceased to contract after death, on the direct application to it of nicotine, the pulsations recommence, and the heart soon becomes rigidly contracted—tetanized in fact—and then, of course, the beating again ceases. In birds and animals killed by chloroform, when the ventricles are immobile and dilated, and respond most imperfectly to stimuli, a drop of nicotine, directly applied, immediately occasions strong contractions in the heart, and causes the organ to respond energetically to mechanical and galvanic stimuli. (*Handbook of Therapeutics* by Sydney Ringer, M.D.)

TURPENTINES.

Nat. Ord.—Coniferæ. *Sex. Syst.*—Monœcia Monadelphia.

Most of the trees of the natural family 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, when subjected to smothered combustion, yield tar, which, when distilled in its turn, breaks up into volatile oil of tar, and leaves a residue of pitch. These several substances 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 of the coniferæ 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 oxidized. They have a peculiar pungent bitter taste and odour, are scarcely soluble in water, partially soluble in alcohol, but soluble in oils and ether ; 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 Turpentine, principally imported from the United States, from Norway, and other northern countries of Europe, is the produce chiefly of the Pinus palustris, 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 spring and summer incisions are made in the lower part of the trunk, two or three feet of bark are removed, and the hollow thus made becomes filled with the oleo-resin. Turpentine as imported is semi-fluid, but its consistence varies considerably with the temperature, and when kept it gets solid from the volatilization and resinification of the volatile oil. It has a yellow colour, an aromatic odour, and a warm pungent taste. Unless melted and strained, or, as it is technically called, rectified, it usually contains leaves, twigs, and other impurities. Water acquires its flavour, but does not separate its active principles. Alcohol and ether dissolve it almost entirely; 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 turpentine, obtained from Pinus pinaster, is at present imported only in small amount.

VENICE TURPENTINE (Terebinthina Veneta), chiefly imported from Austria, Baden, and Italy, is got from the common larch, the Abies, or Larix Europea—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. Holes are bored into the tree, wooden spouts attached, and the resinous juice purified by filtration. It is generally thick, tenacious, and opaque, but less apt than common turpentine to concrete with keeping; it has a yellow, olive-green colour, an acrid bitter taste, and a terebinthinate odour, somewhat weaker than that of common turpentine. It contains from 15 to 25 per cent. of volatile oil. It nearly resembles Strasburg turpentine, generally the produce of the silver fir. Most of the Venice turpentine of the shops is an artificial mixture made by melting five ounces of oil of turpentine with a pound of black resin.

CANADA BALSAM, or balsam of Gilead, the purest of the natural turpentines, is found in vesicles lying between the bark and wood of Abies balsamea. It is 'a pale yellow ductile oleo-resin of the consistence of thin honey, with a peculiar agreeable odour, and a slightly bitter, feebly acrid taste; by exposure drying very slowly into a transparent adhesive varnish; solidifying (after a few hours) 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. 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 lofty tree of the Mastich order.

Frankincense, or Thus, was formerly described as the turpentine got from the Norway spruce fir (Abies excelsa); but the official Thus Americanum is the concrete turpentine from the Pinus palustris, and occasionally from P. Tæda, and is imported from the Southern States of North America. Both American and Norwegian Thus, when melted and strained, constitute Burgundy pitch, which occurs in yellow-brown masses, breaks with a shining conchoidal fracture, has an empyreumatic turpentine odour and 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 per-centage of oil, and hence of activity, they stand as follows: Canada balsam, Venice turpentine, common turpentine, and frankincense. They are given as stimulants in indigestion, colic, and general debility; as laxatives, especially when in combination; and as anthelmintics, diuretics, and inspissants of excessive mucous discharges; but are now little used internally. 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 human subject, in the treatment of rheumatism, bronchitis, and even of phthisis. (*Edinburgh Medical Journal* for 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 astringent. They are administered with linseed gruel, milk, oils, mucilage, eggs, treacle and water or about 1-20th part of magnesia. Externally, they are used alone, or made into liniments with oil, or ointments with lard.

II. Oil of Turpentine.

Oil of turpentine, oleum terebinthinæ, often improperly called spirits or essence of turpentine, is got from the common white or American turpentine by melting, straining, and distilling with water. Leaving the resin, the volatile oil passes over, is recognised as common or unrectified turpentine, or turps, is denser, more viscid and acid than the rectified *Phar.* oil, which is obtained by redistilling the crude oil with water and potash solution. The pure oil is colourless, limpid, very volatile, with a penetrating odour, and pungent bitter taste. Its specific gravity is about ·870; it boils at 314°; is very inflammable, burning with a heavy yellow flame, and producing much smoke; is neutral to test-paper; 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, resinous principles, India-rubber, and gutta-percha, and has been economically substituted for alcohol in the making of some veterinary tinctures. Exposed to the air, it oxidizes and thickens from the formation of resin. Its composition is $C_{10} H_{16}$. It is isomeric with oils of juniper, savin, citron, nutmeg, and other essential oils.

Actions and Uses.—Oil of turpentine in large doses is an irritant narcotic; it produces irritation of the digestive organs, congestion of the lungs, inebriation, delirium, and convulsions. Medicinal doses are stimulant, antispasmodic, antiseptic, astringent, cathartic, anthelmintic, diuretic, and diaphoretic. Externally it is irritant, astringent, and antiparasitic. In its actions and uses it nearly resembles alcohol.

Injected into the veins of the horse, it causes fatal pulmonary congestion. Two drachms given to a dog produced 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 and lung congestion. It poisons lice, worms, and other entozoa, whether lodged in the bowels, bronchial tubes, or skin. When swallowed it is speedily absorbed, and may be detected in the chyle, breath, and sweat, which have a strong terebinthinate odour, and in the urine, to which it imparts the odour of violets. It acts upon the nerves and nervous centres; in large doses deranging and paralyzing, in smaller doses stimulating and controlling irregular action. It promotes capillary circulation, and, according to Dr. L. Beale, destroys bioplasms, and checks their formation. As an antiseptic it is, however, inferior to the members of the alcohol series and the naphthas, although superior to most other volatile oils.

It is administered to the several domestic animals in many different diseases. As a stimulant for horses, it is serviceable in congestion of the lungs, in influenza, in many cases of indigestion, flatulence, and overloading of the stomach, 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 appears to brace up dilated, weakened vessels, and exert antiseptic and astringent properties. As a prompt antispasmodic in colic it is usually conjoined with aloes or oil, laudanum, or belladonna. Its combination of stimulant and antispetic, diuretic and diaphoretic actions, renders it useful in all animals in rheumatism, in which it is employed alike internally and externally. Except in excessive doses, when given alone, its cathartic action is uncertain, but, in combination with aloes, oils, and salines, it is of much service in all veterinary patients in overcoming long-standing and obstinate constipation, and for such cases it is given in repeated doses several times 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 weakness, and unconnected with kidney irritation. Like some 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. It appears to be an antidote to phosphorus, and to prevent the necrosis of the jaw so apt to occur in persons working with the ordinary phosphorus (Dr. Letheby). Personne to five dogs gave phosphorus, and they all died. To five others, an hour or two after the phosphorus, he gave turpentine, and only one died. To five others he gave turpentine immediately after the phosphorus, and only one dog 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, ounce doses, given every three or four hours, usually abate the febrile symptoms, the excessive temperature, the cough, and difficulty of breathing. In puerperal apoplexy it is advantageously given with ammonia; in puerperal peritonitis with laudanum, and also applied externally. Where blackleg occurs amongst young cattle or sheep, there is no more promising antidote for septicæmia and congestion than 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. Whether used alone, or, as it frequently is, with iron chloride tincture, turpentine is often serviceable in chorea and epilepsy in dogs. In some of these cases it doubtless does good by destroying worms, and is often prescribed directly for that purpose. For getting rid of tape-worms in dogs, areca nut is, however, safer and more effectual.

To bring away intestinal worms, turpentine should be given after the bowels have been emptied by a cathartic, whilst the patient is fasting, and conjoined with a laxative. 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 by the mouth; two or three doses, at intervals of a day or two, 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.

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; is applied to control inflammation of the air-passages, bowels, and joints; is conjoined with oils, mustard, and ammonia. A piece of flannel wrung out of hot water and sprinkled with the oil is often used. As with other external irritants, a moderate continuous effect is more likely to be of service than a 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, as in old sores, sitfasts, dry gangrene of dogs' ears, and troublesome 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. Being 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 turpentine, one ounce each of oil of amber and mucilage, and one drachm corrosive sublimate.

Doses, etc.—For horses and cattle as a stimulant and antispasmodic, the dose is f℥i. to f℥ij.; as a diuretic, from 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 chloride tincture, 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 a still larger amount of soap and water; in diarrhœa or dysentery it is mixed with laudanum and starch gruel. For external application oil of turpentine is used alone or mixed with linseed oil, soap, ammonia, or mustard. As a stimulating dressing equal quantities of soft soap and turpentine are mixed with an ounce of camphor. A smart blister for cattle is made with half a pint each of oil of turpentine, strong ammonia, and linseed oil, to which even greater activity may be given by the addition of an ounce of croton oil. As an embrocation for rheumatism, equal quantities of oil of turpentine, laudanum, and linseed oil or soft soap are mixed. For dogs a prompt and sharp blister is got by mixing an ounce each of bland oil and turpentine with half an ounce of strong ammonia.

III. Resin, Rosin, Resina.

Resin is 'the residue of the distillation of the turpentines from the various species of Pinus and Abies' (*Brit. Phar.*). 'It is run while liquid into metallic receivers coated with whiting to prevent adhesion, and from these is ladled into wooden moulds or casks. When the distillation is not carried too far, the product contains a little water, and is the official resin' (Pereira). When this yellow resin is fused, water is driven off, and transparent black or fiddlers' resin remains. The brown American resin is brighter, freer from impurities, and now brings a better price than that made in England. Commercial resin is yellow or dark brown, and of variable transparency, according to the proportion of water it contains; is inflammable, of a faint turpentine odour and taste, and rather heavier than water. It is insoluble in water, partially soluble in alcohol, readily dissolved in ether and volatile oils; and unites with fats, wax, spermaceti, and alkalies. It is reddened by sulphuric acid. It consists of two isomeric acids, pinic and sylvic ($H\ C_{20}\ H_{29}\ O_2$); but the yellow or white resins further contain pimaric acid, also isomeric with pinic acid, which when heated yields colophonic acid (Attfield).

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 many diuretic masses to increase their activity and 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 check bleeding. For imparting firmness and adhesiveness to stimulant plasters, resin is largely used. The simple digestive ointment is made with resin, eight ounces; yellow wax, six ounces; lard and almond oil, of each three ounces; melt with a gentle heat, strain the mixture while hot through flannel, and stir 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 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 the head of petroleum (p. 444). Coal tar is obtained from the destructive distillation of coal, and is a by-product in the manufacture of gas. Wood tar, of which the best comes from Stockholm and Archangel, is generally got by stacking carefully billets of the roots, branches, and refuse timber of the pine tribe in pits dug on a bank or inclined plane. The heaps are closely covered with turf; fire is applied, and as smothered combustion proceeds, as in the making of charcoal, the tar runs into iron pots placed at the bottom of the pit, and thence by a spout into the barrels in which it is exported. Tar is soluble in ether and oils. Water agitated with it, dissolves out part of its volatile oil and creasote, acquires its odour, taste, and brown colour, and constitutes tar water, once considered a very valuable medicinal article. Tar is a complex substance, containing modified resins, modified oil of turpentine, acetic acid, and water (Christison), with creasote, paraffin, and other products of the destructive distillation of plants. When tar is distilled, oil of tar, a reddish, limpid, impure oil of turpentine, is given off; and if the process be pushed sufficiently far, pitch is left—a black, bituminous substance, solid and brittle, with a shining fracture, and consisting of modified resins, soluble in alcohol and alkalies.

Actions and Uses.—Tar is stimulant, diuretic, diaphoretic, and vermifuge, but is scarcely ever given 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 acids. Mixed with equal parts of oleaginous matter, or with cow-dung, so as to give it proper consistence, it forms a capital stopping for horses' feet, keeping the horn moist and soft, and stimulating the secretion of horn. With the following adjuncts, it is recommended by Mr. Miles for maintaining the horn in a tough, elastic, and healthy state :—A quarter of a pound each of tar, bees' wax, and honey ; a pound and a half of lard, and three ounces of 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 twofold advantage of stimulating and deodorizing unsound noisome textures, and preventing the attacks of flies. Undiluted, it is the best remedy for chronic mallenders, usually superior 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 used for many of the purposes of oil of turpentine. Containing creasote and similar empyreumatic substances, it cures mange and scab, destroys other parasites, is added to various sheep dips, but has the disadvantage of discolouring the wool, and does not mix well with other ingredients, whilst large doses or strong solutions are apt to become absorbed and cause serious pulmonary congestion.

Pitch, or Pix nigra, is used in veterinary practice, chiefly as a mild stimulant in such diseases of the feet as thrush, canker, and sandcrack in horses, and foot-rot in sheep, and for giving adhesiveness to plasters.

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 official valerian consists of the short yellow-white tuberous root stock, with the attached radicles 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 extractive matters and resin; nearly 2 per cent. of a clear, neutral, volatile oil, somewhat complex in composition; whilst associated with the oil, and developed from it, is about 1 per cent. of valeric or valerianic acid ($H\,C_5\,H_9\,O_2$)—a colourless, limpid, acrid liquid, sparingly soluble in water, but soluble in alcohol and ether, and obtained artificially, as for the making of the valerianates, by the oxidation of fusel or grain oil, otherwise known as amylic alcohol ($C_5\,H_{11}\,HO$).

Actions and Uses.—Valerian is an excitant of the cerebro-spinal system, a diffusible stimulant, antispasmodic, and anthelmintic. It resembles assafœtida, the other gum resins, camphor, and the Sumbul 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. Administered for some time, it is thought to improve the appetite, and produce tonic effects. On account of its pungent volatile oil, it is a feeble vermifuge.

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; and 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 the oxidation of fusel or grain oil, by heating it with potassium bichromate and sulphuric acid. It is a soluble white solid, with a greasy, soapy feel, a sweet, nauseous taste, and an odour of valerian. It is not used medicinally. Dissolved and heated with zinc sulphate solution it yields zinc valerianate, which may be crystallized in snow-white tabular plates, has a slight odour of the acid, and a taste more resembling its metallic base. Four or five grains have been given to dogs, and one or two grains to cats, without much success in chorea and epilepsy, and have been used externally, instead of the acetate, as an astringent and sedative.

IRON VALERIANATE is made by mixing, in the cold, solutions of sodium valerianate and iron sulphate. The precipitate 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 rather more certain than zinc valerianate, and is used in similar doses.

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 alcohol and ether. Like the other valerianates, it was first brought into notice by Prince Louis Lucien Bonaparte, who used it successfully in the agues prevalent in the marshes around Rome. I have seen it given to dogs, in doses of two or three grains, with apparent advantage, in chorea, and in those troublesome nervous disorders which accompany and follow distemper. It is useful in similar cases amongst cats, in doses of one or two grains, either given alone, or with a grain or two of camphor. On account of its bitterness, it is best administered in pill.

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 grey or brown and rough; internally, greyish-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 probably also green, hellebore contain the pale grey acrid amorphous alkaloid veratrine or veratria (C_{32} H_{52} N_2 O_8). It occurs in combination with gallic acid and a special volatile acid, the cevadic, and is coloured in succession yellow, red, and violet by forming sulphuric acid. Three other alkaloids are also said to be present—sabadilline, colchicine, and jervine.

Actions and Uses.—White hellebore in poisonous doses produces muscular paralysis; medicinal doses are emetic, cathartic, and sedative; topically applied, it proves irritant, anodyne, and antiparasitic. It resembles aconite, colchicum, and digitalis. The green or American hellebore is scarcely used in this country, resembles the white hellebore in its nauseating and sedative effects, but is less notably purgative (Pereira).

Kölliker's experiments lead to the conclusion that white hellebore and veratrine do not affect the brain sensory or motor nerves, but excite the medulla and spinal cord, cause transient tetanic convulsions, directly paralyze striped muscle, and paralyze the heart. Their prominent symptoms 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, Bradninch, in the *Edinburgh Veterinary Review* for 1863, records the case of a three-year-old filly which 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. Astringents, such as infusion of nut-galls or solution of tannin, should also be given, as they form insoluble compounds with the veratrine.

Some veterinary authorities consider that hellebore 'powerfully rouses the absorbent system into increased action' (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 in cutaneous diseases, for destroying vermin infesting the skin, for smearing setons, 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 apt to suffer in this way. 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, with death sometimes in four hours. Congestion of the mucous membrane of the stomach, lungs, and heart, were the notable *post-mortem* appearances (*Veterinarian*, February 1873).

Doses, etc.—As an anodyne and 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 water 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.

Veratrine.—Magendie found that one grain of 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. Dr. Paul Guttman's recent experiments indicate that, although frogs are tetanized, warm-blooded animals commonly suffer from muscular paralysis, die either from respiratory or cardiac paralysis, whilst the muscles after death rapidly undergo rigor-mortis, and have an acid reaction. In human medicine, it has been used externally for neuralgia and rheumatism; but for these and other purposes it is probably inferior to aconite.

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 solidifies, freezes, or crystallizes at 32°, expanding and giving out latent heat; it reaches its greatest density at 39·2°; it slowly volatilizes at all temperatures; at 212° it boils, rising in steam or gas, and increasing in bulk 1700 times. 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. Hence the melting ice or evaporating water abstract heat from any bodies in contact with them, and 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 acid, 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. Organic matters 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. When the saline ingredients exceed one-5000th part, the water is said to be hard, and is unfit for many pharmaceutic and domestic purposes, is not so well liked by animals, 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.

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 organized 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 acid gas, and thus throws down calcium carbonate, the cause of temporary hardness. Sodium carbonate neutralizes 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.

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 an active irritant. Cold water is refrigerant and tonic; topically it is excitant, depressant, and anæsthetic.

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. Insufficient and excessive supplies of water are alike injurious; but animals in health very 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. In febrile and inflammatory diseases, water in moderation does no harm, and is perfectly safe and greatly more palatable and satisfying when given cold than in the usual tepid state. As in the human subject, 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. These additions favour the 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, 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 both 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. Cold water injected checks bleeding, produces general reaction, and occasionally expels ascarides. Injected into the vagina, it stays the discharge of blood or of leucorrhœa. 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 in bruises, strains, and some 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. In like manner, steaming of the head and throat is often useful in relieving catarrh, sore throat, and strangles. Such soothing vapours, medicated, if need be, by laudanum, belladonna, ether, vinegar, sulphurous acid, or alkaline chlorates, 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 continued quantities of steam are driven off by plunging a hot iron into it at short intervals. Lint, tow, or spongio-piline, saturated with hot water, and covered with oiled silk or gutta-percha cloth to retard evaporation, is frequently substituted for fomentations and poultices, and is often 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 soft flannel. When applied to the chest or abdomen of horses or cattle, several folds of thick woollen horse-rug are sometimes placed round the patient, and nearly boiling water from time to time poured amongst the folds of the rug. The smart and widespread counter-irritation thus rapidly developed seldom blemishes even in the horse, and proves of signal advantage in pneumonia and pleurisy, colic, enteritis, peritonitis, and obstinate constipation both in 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, and tonic effects. Calico bandages constantly wetted relieve chronic strains, jars, and windgalls in the legs of horses. The cold water treatment is specially serviceable in broken knees, open joints, and circumscribed burns and scalds, in which the great matter is to keep the raw surface scrupulously covered by folds of wadding constantly wetted. In all such cases, continuous irrigation with cold water is preferable to occasional douching, and is readily effected through a small vulcanized India-rubber pipe brought from a supply tank on a higher level. Cold water dashed over the head and neck exerts a stimulant effect on the nervous system, and is 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 applied in a bag or bladder exerts similar but more intense effects. Two parts mixed with one of salt form a powerful freezing mixture applied to prevent too sudden rise of temperature and gangrene in frost-bite, to arrest circumscribed congestion and inflammation, to check bleeding, 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 now preferred. 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 paralyzes 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 most important alike for the preservation and cure of disease. As in human medicine, they are used of varying temperature. Cold baths range from 33° 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 New 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, 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 especially 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 equalized, excessive heat reduced, spasm counteracted. In febrile cases, whether in horses or cattle, the water should at first be at a temperature only 12° or 15° less than that of the body; the sponging should not occupy more than three minutes; the animal should be wisped dry and clothed. Within two or three hours the operation may be repeated, especially if the temperature rises again to 102° or 103°; 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 waxy matters resembling that furnished by the bee, but bees' wax must be regarded as an animal secretion, for it has been produced by bees fed exclusively upon pure sugar. The comb, after the 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 decolorizing 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. It fuses at about 145°, readily unites with fats and resins, but is imperfectly saponified by caustic alkalies. It consists of about 22 per cent. of the volatile crystalline, cerotic acid, or cerinc ($H\,C_{27}\,H_{53}\,O_2$); 73 per cent. of myrcin, or melissyl palmitate, a body analogous to spermaceti or Chinese wax, and about 5 per cent. of the tenacious wax-like ceroleine. The ordinary impurities in wax do not interfere with its veterinary uses. Adulterations with starch may be detected by iodine; resin, by its separating on the addition of cold alcohol; 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 probably also less nutritive, than fatty matters. Medicinally, it is demulcent and emollient. Given for some time continuously, it causes constipation, and hence is sometimes prescribed to correct diarrhœa. Its chief use, however, is as a constituent of ointments, cerates, and plasters, to which it is added in order to impart consistence and prevent rancidity. Yellow wax, mixed with hogs' lard, or any of the common fixed oils, is much used as a simple ointment, for preserving irritable parts from the action of the external air, 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 must be regulated by the required consistence of the ointment. One part of yellow wax to four of hogs' lard, or two and a half of olive 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 galvanized 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 bivalent; its salts are colourless. They are not precipitated by hydrochloric acid. Ammonium hydrosulphide precipitates the white sulphide (Zn S), insoluble in acetic acid, but soluble in the stronger acids. Ammonia solution throws down the white hydrate (Zn 2HO), which, unlike the aluminum hydrate, is soluble in excess. Cobalt chloride solution gives a green colour with zinc salts heated in the blow-pipe flame.

When metallic zinc or the carbonate is exposed to a red heat, the oxide is produced—a soft, nearly colourless, tasteless, odourless powder, insoluble in water, but soluble in acids and 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 and corrosive of the zinc salts; the sulphate and acetate are more energetic than the less soluble oxide or carbonate. Salts of zinc resemble those of silver and copper.

They are corrosive, irritant, astringent, tonic, and antiseptic. As an astringent tonic, the oxide has been prescribed in doses of ʒij. to ʒiv. for horses and cattle, of grs. x. to grs. xv. for dogs. Externally, the powdered oxide is used as a desiccant in chafing, irritation, and weeping of the skin. Eczema and erythema or mud fever are often benefited by the powder solution or ointment, which, by the *Phar.* process, is made by mixing with a 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 greyish brown, usually earthy-looking, and effervesces with acids. The *Phar.* 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 hydrate and water ($Zn\ CO_3$, $Zn\ 2HO$, $H_2\ O$). 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 *Phar.* salt is got by dissolving granulated zinc in 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 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 crystallization, and at high temperatures is decomposed. Any impurities occasionally present do not interfere with its veterinary uses.

Actions and Uses.—It is irritant, emetic, astringent, antiseptic, tonic, and antispasmodic. Externally, it is irritant, astringent, antiseptic, and desiccant. As with some other metallic irritants, doses of several ounces are given to horses and cattle without producing irritation. 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 on the œsophagus, much smaller quantities sufficed to destroy dogs, in about three days, with symptoms of 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 an albuminate, are detected in the spleen, liver, feces, and urine. It does not, like lead or digitalis, 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* for January 1844). As a tonic it resembles, but is inferior to, iron and copper sulphates. For arresting spasmodic diseases in the lower animals it is not so effectual as copper sulphate, arsenic, or quinine. For drying up excessive discharges, especially from the alimentary canal, for checking undue perspiration and hæmorrhage, frequent small doses are given along 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. Externally, it is much used in weakly, over-secreting wounds, in simple ophthalmia, in 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 or forty parts of water. Dissolved along with lead acetate, it 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 dissolved in hydrochloric acid, the solution evaporated to dryness, and the residue melted, there remains the greyish-white, opaque, waxy-looking, deliquescent chloride, usually moulded into sticks, with an astringent metallic taste, and soluble in water, alcohol, and ether.

Actions and Uses.—Large doses are irritant and corrosive; 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 deodorizer. It is not administered internally. As an energetic caustic, it resembles butter of antimony; is used to control luxuriant granulations, unhealthy ulcerations, fistulæ, and foot-rot in sheep, and for such purposes is sold in pencils similar to those of silver nitrate. 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 eczema both in horses and dogs, a good application for foot-root 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, and 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 such organic matters; 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 deodorizer 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. $Zn\ 2C_2H_3O_2$.

Zinc acetate is prepared by dissolving zinc, its oxide or carbonate, in diluted acetic acid; or by mixing solutions of zinc sulphate and lead acetate, when mutual decomposition ensues, lead sulphate is precipitated, and zinc acetate remains in solution. The suitable proportions are about three-quarters of an ounce of the zinc salt and an ounce of the lead salt. These proportions dissolved in a pint of water, and the solution clarified by decanting or filtering, constitute the White Lotion so extensively and successfully used by the late Professor Dick. Zinc acetate crystallizes 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 seldom used internally. Externally, it promotes the healing of wounds, dries up excessive discharges, relieves eczema and impetigo, allays superficial inflammation. Professor Tuson (*Veterinary Pharmacopœia*) recommends a solution for saturating at short intervals the wash leather bandages applied to the jarred, swollen legs of hunters. According to the purposes for which it is used, two to twenty grains are dissolved in the ounce of water.

INDEXES.

I. INDEX OF DISEASES.

ABORTION: Slipping; Premature Birth.
Perfect quiet.
Sloppy laxative food.
Opium; belladonna.
Tonics.
Cleanliness.
Disinfectants.
Isolation from pregnant animals.

ABSCESS: Swelling, containing Serum or Pus.
Fomentations.
Poultices.
Counter-irritants.
Knife; Cautery.
Carbolic acid dressing.
Stimulating injections.
Sulphites; Potassium chlorate internally.

ACARI.
Soft soap and alkalies.
Potash and soda ash.
Sulphur.
Carbolic acid; Tar oils.
Corrosive sublimate.
Arsenic.
Stavesacre.
Tobacco.
Linseed and other oils.

ACIDITY OF STOMACH.
Alkalies, their carbonates and bicarbonates.
Alterative doses of aloes with alkalies.
Chalk; Magnesium carbonate.
Mineral acids.
Bismuth.
Arsenic.
Nux vomica or strychnine.

ACNE: Pimples.
Fomentations.
Poultices.
Zinc chloride solution.
Sulphur; Arsenic; Alteratives internally.

AFTER PAINS: Heaving.
Remove clots from uterus.
Raise hind quarters.
Clysters of tepid linseed tea, and laudanum or belladonna extract.
Syringe out uterus with Condy's fluid and anodynes.
Belladonna; Opium; Chloroform.
Draw away milk.

AMAUROSIS: Gutta Serena; Glass Eye.
Cathartics.
Blisters; Setons.
Tonics.
Diuretics.
Nux vomica or strychnine.

ANÆMIA: Bloodlessness.
Iron and copper salts.
Gentian; Quinine; Bitters.
Potassium chlorate.
Mineral acids.
Generous diet.
Pure air; Exercise.

ANEURISM: Swelling connected with an Artery, and containing Blood.
Pressure; Truss; Bandages.
Acupressure.
Catgut ligature.
Potassium iodide.

ANGLEBERRIES; see also WARTS.
Remove with knife or torsion.
Remove with ligature or caustic.

COUGH—*continued.*
- Pure air.
- Comfortable housing and clothing.
- Laxative.
- Alterative doses of aloes and opium.
- Balsams.
- Demulcents.

COUGH, CHRONIC, OF HORSES.
- Careful Dieting.
- Food damped.
- Epsom salt occasionally.
- Professor Dick's recipe.
- Belladonna extract; Camphor and prussic acid.
- Mustard; Other counter-irritants.
- Seton.

CRIB-BITING.
- Iron stable fittings.
- Spiked collar strap.
- Chalk and antacids.

CURB: Sprain or Injury of straight Ligament of Hock.
- Foment.
- Lead acetate solution; Refrigerants.
- Counter-irritants.
- Mercury red iodide ointment.
- Firing iron.
- High-heeled shoe.

COW-POX; see VARIOLA VACCINA.

CYSTITIS: Inflammation of Bladder.
- Aconite; Belladonna; Opium.
- Rugs rung out of boiling water, or sheepskin to loins.
- Emollient anodyne clysters.
- Linseed tea; Barley water; and Diluents.

DEBILITY.
- Easily assimilated nutritive food.
- Alcoholic stimulants.
- Calcium phosphate.
- Sodium sulphite.
- Iron salts.
- Good nursing.

DELIRIUM.
- Cold affusion.
- Laxatives.
- Belladonna.
- Chloral hydrate.

DENTITION FEVER.
- Soft laxative food.
- Rest; Pure air.

DENTITION FEVER—*continued.*
- Lancing of gums.
- Remove irregular temporary teeth.

DIABETES, INSIPIDUS: Polyuria.
- Iodine with potassium iodide.
- Iodine with copper sulphate.

DIABETES, SACCARHINE.
- Soup; Cooked animal food.
- Acids.
- Opium.
- Iodine.

DIARRHŒA; Scouring.
- Laxatives.
- Chalk and bitters.
- Oak bark or tannin.
- Opium and lead acetate.
- Starch gruel and opium clysters.
- Digestible light diet.
- Antiseptics.

DISLOCATIONS: Luxations.
- Reduce.
- Retain in position by splints, bandages, or plasters.
- Abate inflammation by fomentations or cold water.

DISTEMPER IN DOGS.
- Emetic.
- Gentle laxative.
- Milk diet.
- Potassium chlorate.
- Belladonna.
- Ether; Alcohol.
- Iron salts.
- Antiseptics internally.
- Counter-irritants to check congestion.
- Disinfectants.

DROPSY.
- Remove vascular obstruction.
- Diuretics.
- Potassium iodide.
- Friction and other external stimulants.
- Ammonia acetate; Sweet spirit of nitre; Oil of turpentine; and other stimulants internally.

DYSENTERY.
- Occasional laxatives.
- Opium and mineral astringents.
- Gallic and tannic acids.
- Silver nitrate.
- Starch gruel and laudanum clysters.

MALNUTRITION.
Liberal oleaginous dietary.
Calcium phosphates.
Iron salts ; Iron iodide.
Alteratives ; Antiseptics.
Tonics ; Alcohol ; Stimulants.

MAMMITIS: Garget; Inflammation of Udder.
Cathartic.
Aconite ; Salines.
Fomentations.
Poultices of spent hops.
Support.
Frequent milking.
Teat syphon.
Belladonna.
Open abscesses.
Amputate gangrenous quarters.

MANGE : Irritation caused by Parasites of Genera Sarcoptes, Dermatodectes, and Symbiotes.
Destroy acarus.
Soap and water.
Sulphur iodide ointment.
Stavesacre solution.
Corrosive sublimate solution.

MEGRIMS : Vertigo ; Giddiness.
Remove pressure from neck.
Cold affusion.
Laxative diet.
Cool stable.
Arsenic and tonics.

MELANOSIS : Black Cancer.
Remove by knife or caustic.
Dress with antiseptics.

METRITIS : Inflammation of Uterus and Bowels after Parturition.
Oil and laudanum.
Aconite.
Anodyne clysters and injections.
Fomentations, hot cloths and sheepskins to loins.
Belladonna and opium.
Chloroform and ether.

MOON BLINDNESS ; see OPHTHALMIA, PERIODIC.

MORTIFICATION ; see GANGRENE.

MUD FEVER ; see also ERYTHEMA.
Rest.
Fomentations.
Laxatives ; Salines.
Zinc oxide ointment.
Lead acetate solution with oil.
Glycerin carbolate.

MUMPS ; see VIVES.

MURRAIN : Foot-and-Mouth Disease; see EPIZOOTIC APHTHA.

MYOSITIS: Inflammation of Muscle.
Rest.
Foment.
Cathartic.
Rubefacient.

NASAL GLEET : Ozœna.
Blister over sinuses.
Remove faulty teeth.
Zinc chloride injections.
Sulphurous acid inhalations.
Bleaching powder scattered in box.
Copper sulphate and arsenic.
Turpentine drenches.
Trefine sinuses.

NAVICULAR DISEASE : Grogginess.
Remove shoes.
Rest.
Cold wet swabs.
Cathartic.
Laxative diet.
Mildly blister coronet.
Frog setons.
Neurotomy.

NEBULÆ OF CORNEA.
Silver nitrate.

NECROSIS : Death of Bone.
Removal of sequestrum.
Antiseptic dressings.

NETTLE RASH : Urticaria; see SURFEIT.

NEPHRITIS : Inflammation of Kidney.
Linseed ; Barley water ; Diluents.
Anodyne clysters.
Fomentations ; Mustard or fresh sheepskins to loins.
Aconite.
Gentle laxative.
Belladonna ; Opium ; Camphor.

OBSTRUCTION OF BOWELS.
Laxative and nutritive clysters.
Fluid food.
Diluents.
Opium and Belladonna.

ŒSTRUS EQUI ; see BOTS.

OPEN JOINTS.
Close wound by suture.
Rest in horse by slinging.

Open Joints—*continued.*
Splints and bandages.
Antiseptic dressings.
Cold water.
Laxatives and salines.
Blister.

Ophthalmia, Periodic: Moon Blindness of Horses.
Cathartic.
Aconite.
Salines.
Fomentations; Anodynes.
Belladonna or atropine.

Ophthalmia, Simple; see also Conjunctivitis.
Remove any irritant.
Foment.
Poppy heads.
Belladonna extract.
Atropine solution.
Silver nitrate.

Osteo-Sarcoma.
Remove tumors.
Antiseptic dressings.
Soft nutritive diet.

Ostitis: Inflammation of Bone; Sore Shins in Horses.
Fomentations.
Cold applications.
Cut through periosteum.
Purgatives.
Salines.
Alteratives.

Otorrhœa: Inflammation of Lining Membrane of Ear.
Hot fomentations.
Cathartic.
Laudanum and lead acetate dropped into ear.
Morphine subcutaneously.

Over-reach; see also Bruises.
Foment.
Cold water.
Protect with pad.
Shorten and round off offending shoe.

Ozœna; see Nasal Gleet.

Pain, Inflammatory.
Foment.
Cathartic.
Aconite.
Calomel and opium.
Counter-irritant.
Rest.

Pain, Nervous.
Aconite.
Cold affusion.
Refrigerants.
Morphine and atropine subcutaneously.

Paralysis.
Rest and quiet.
Light digestible food.
Remove any cause of irritation.
Mustard.
Counter-irritants.
Nux vomica or strychnine.
Electricity.

Parturient Apoplexy; see Apoplexy, Parturient.

Patella Dislocation.
Keep limb extended.
Cord round foot to neck.
Shoe high at toe and projecting forward.
Blister stifle.

Pericarditis: Inflammation of Serous Covering of Heart.
Aconite.
Digitalis.
Hyoscyamus.
Counter-irritants.
Perfect rest.

Peritonitis: Inflammation of Serous Covering of Bowel.
Aconite.
Calomel and opium.
Hot fomentations.
External irritants; Mustard.
Morphine and atropine subcutaneously.

Phlebitis: Inflammation of Vein.
Blister.
Cathartic.
Laxative diet.

Phrenitis: Inflammation of Brain; Mad Staggers.
Bleeding.
Cathartic.
Laxative clysters.
Aconite.
Cold to head.

Phthisis Pulmonalis: Pulmonary Consumption.
Generous oleaginous dietary.
Linseed cake and oil.
Alcoholic stimulants.
Comfortable warm lodgings.
Tonics; Iron salts.

II. INDEX OF MEDICINES.

MURRAY AND GIBB, EDINBURGH,
PRINTERS TO HER MAJESTY'S STATIONERY OFFICE.

88 PRINCES STREET,
Edinburgh, May 1873.

EDMONSTON & DOUGLAS' LIST OF WORKS.

——ooo——

The Culture and Discipline of the Mind, and other Essays.
By JOHN ABERCROMBIE, M.D. New Edition. Fcap. 8vo, cloth, 3s. 6d.

Wanderings of a Naturalist in India,
The Western Himalayas, and Cashmere. By DR. A. L. ADAMS of the 22d Regiment. 8vo, with Illustrations, price 10s. 6d.

"The author need be under no apprehension of wearying his readers. . . He prominently combines the sportsman with the naturalist."—*Sporting Review.*

Notes of a Naturalist in the Nile Valley and Malta.
By ANDREW LEITH ADAMS. Author of 'Wanderings of a Naturalist in India.' Crown 8vo, with Illustrations, price 15s.

"Most attractively instructive to the general reader."—*Bell's Messenger.*

The Orkneyinga Saga.
Edited, with Notes and Introduction, by JOSEPH ANDERSON, Keeper of the National Museum of the Antiquaries of Scotland. 1 vol. demy 8vo. [*In the press.*

Alexandra Feodorowna, late Empress of Russia.
By A. TH. VON GRIMM, translated by LADY WALLACE. 2 vols. 8vo, with Portraits, price 21s.

"Contains an amount of information concerning Russian affairs and Russian society."—*Morning Post.*

Always in the Way.
By the author of 'The Tommiebeg Shootings.' 12mo, price 1s. 6d.

Australian Beef and Mutton, and how to make the best of them. By Miss C. L. H. DEMPSTER. Sewed, price 1d.

The Malformations, Diseases, and Injuries of the Fingers and Toes, and their Surgical Treatment. By THOMAS ANNANDALE, F.R.C.S. 8vo, with Illustrations, price 10s. 6d.

Odal Rights and Feudal Wrongs.
A Memorial for Orkney. By DAVID BALFOUR of Balfour and Trenaby. 8vo, price 6s.

Works by John Brown, M.D., F.R.S.E.

LOCKE AND SYDENHAM. Extra fcap. 8vo, price 7s. 6d.

HORÆ SUBSECIVÆ. Seventh Edition. Extra fcap. 8vo, price 7s. 6d.

LETTER TO THE REV. JOHN CAIRNS, D.D. Second Edition, crown 8vo, sewed, 2s.

ARTHUR H. HALLAM; Extracted from 'Horæ Subsecivæ.' Fcap. sewed, 2s.; cloth, 2s. 6d.

RAB AND HIS FRIENDS; Extracted from 'Horæ Subsecivæ.' Forty-seventh thousand. Fcap. sewed, 6d.

RAB AND HIS FRIENDS. Cheap Illustrated Edition. Square 18mo; ornamental wrapper, 1s.

RAB AND HIS FRIENDS. With Illustrations by Sir George Harvey, R.S.A., Sir J. Noel Paton, R.S.A., and J. B. New Edition, small quarto, cloth, price 3s. 6d.

MARJORIE FLEMING: A Sketch. Fifteenth thousand. Fcap. sewed, 6d.

OUR DOGS; Extracted from 'Horæ Subsecivæ.' Nineteenth thousand. Fcap. sewed, 6d.

"WITH BRAINS, SIR;" Extracted from 'Horæ Subsecivæ.' Fcap. sewed, 6d.

MINCHMOOR. Fcap. sewed, 6d.

JEEMS THE DOORKEEPER: A Lay Sermon. Price 6d.

THE ENTERKIN. Price 6d.

Memoirs of John Brown, D.D.

By the REV. J. CAIRNS, D.D., Berwick, with Supplementary Chapter by his Son, JOHN BROWN, M.D. Fcap. 8vo, cloth, 9s. 6d.

Select Hymns for Church and Home.

By R. BROWN-BORTHWICK. 18mo, price 2s. 6d.

The Finger of God in the Disruption and the Christian

Ministry, being the Opening and Closing Addresses delivered at the General Assembly of the Free Church of Scotland, May 1872, by CHARLES J. BROWN, D.D., Moderator. 8vo, price 1s.

The Biography of Samson

Illustrated and Applied. By the REV. JOHN BRUCE, D.D., Minister of Free St. Andrew's Church, Edinburgh. Second Edition. 18mo, cloth, 2s.

The Life of Gideon.

By REV. JOHN BRUCE, D.D., Free St. Andrew's Church, Edinburgh. 1 vol. fcap. 8vo, price 5s.

"We commend this able and admirable volume to the cordial acceptance of our readers."—*Daily Review.*

By the Loch and River Side.

Forty Graphic Illustrations by a New Hand. Oblong folio, handsomely bound, 21s.

The De Oratore of Cicero.

Translated by F. B. CALVERT, M.A. Crown 8vo, price 7s. 6d.

My Indian Journal,

Containing descriptions of the principal Field Sports of India, with Notes on the Natural History and Habits of the Wild Animals of the Country. By COLONEL WALTER CAMPBELL, author of 'The Old Forest Ranger.' 8vo, with Illustrations, price 16s.

Popular Tales of the West Highlands,

Orally Collected, with a translation by J. F. CAMPBELL. 4 vols. extra fcap. cloth, 32s.

Inaugural Address at Edinburgh,

April 2, 1866, by THOMAS CARLYLE, on being Installed as Rector of the University there. Price 1s.

Carswell's Gaelic Prayer Book.

The Book of Common Prayer, commonly called John Knox's Liturgy. Translated into Gaelic, A.D. 1567, by Mr. JOHN CARSWELL, Bishop of the Isles. Edited, with an English Translation, by THOMAS M'LAUCHLAN, LL.D., Translator of the Book of the Dean of Lismore. 4to, *half Roxburghe*. Price 30s.

On the Constitution of Papal Conclaves.

By W. C. CARTWRIGHT, M.P. Fcap. 8vo, price 6s. 6d.

"A book which will, we believe, charm careful students of history, while it will dissipate much of the ignorance which in this country surrounds the subject." —*Spectator*.

Gustave Bergenroth. A Memorial Sketch.

By W. C. CARTWRIGHT, M.P. Author of 'The Constitution of Papal Conclaves.' Crown 8vo, price 7s. 6d.

"To those who knew this accomplished student, Mr. Cartwright's enthusiastic memoir will be very welcome."—*Standard*.

Life and Works of Rev. Thomas Chalmers, D.D., LL.D.

MEMOIRS OF THE REV. THOMAS CHALMERS. By REV. W. HANNA, D.D., LL.D. 4 vols., 8vo, cloth, £2 : 2s.

——— Cheap Edition, 2 vols., crown 8vo, cloth, 12s.

POSTHUMOUS WORKS, 9 vols., 8vo—

Daily Scripture Readings, 3 vols., £1 : 11 : 6. Sabbath Scripture Readings, 2 vols., £1 : 1s. Sermons, 1 vol., 10s. 6d. Institutes of Theology, 2 vols., £1 : 1s. Prelections on Butler's Analogy, etc., 1 vol., 10s. 6d.

Sabbath Scripture Readings, Cheap Edition, 2 vols., crown 8vo, 10s.

Daily Scripture Readings. Cheap Edition, 2 vols., crown 8vo, 10s.

ASTRONOMICAL DISCOURSES, 1s. COMMERCIAL DISCOURSES, 1s.

SELECT WORKS, in 12 vols., crown 8vo, cloth, per vol., 6s.

Lectures on the Romans, 2 vols. Sermons, 2 vols. Natural Theology, Lectures on Butler's Analogy, etc., 1 vol. Christian Evidences, Lectures on Paley's Evidences, etc., 1 vol. Institutes of Theology, 2 vols. Political Economy; with Cognate Essays, 1 vol. Polity of a Nation, 1 vol. Church and College Establishments, 1 vol. Moral Philosophy, Introductory Essays, Index, etc., 1 vol.

Characteristics of Old Church Architecture, etc.,

In the Mainland and Western Islands of Scotland. 4to, with Illustrations, price 25s.

Dainty Dishes.

Receipts collected by LADY HARRIETT ST. CLAIR. New Edition, with many new Receipts. Crown 8vo. Price 5s.

"Well worth buying, especially by that class of persons who, though their incomes are small, enjoy out-of-the-way and recherché delicacies."—*Times.*

The Constitution Violated.

An Essay by the Author of 'The Memoir of John Grey of Dilston,' dedicated to the Working Men and Women of Great Britain. Crown 8vo, 3s. 6d.

Country Life in Jamaica. 1 vol. fcap. 8vo. [*Immediately.*

Sir John Duke Coleridge.

Inaugural Address at Edinburgh Philosophical Institution, Session 1870-71. 8vo, price 1s.

Wild Men and Wild Beasts—Adventures in Camp and

Jungle. By LIEUT.-COLONEL GORDON CUMMING. With Illustrations by Lieut.-Col. BAIGRIE and others. Second edition. Demy 4to, price 24s.

Also, a Cheaper Edition, with *Lithographic* Illustrations. 8vo, price 12s.

Notes on the Natural History of the Strait of Magellan

and West Coast of Patagonia, made during the voyage of H.M.S. 'Nassau' in the years 1866, 1867, 1868, and 1869. By ROBERT O. CUNNINGHAM, M.D., F.R.S., Naturalist to the Expedition. With Maps and numerous Illustrations. 8vo, price 15s.

"There is a good deal of interesting and novel information in the present volume, and we can recommend it especially to those whose tastes lie in that direction."—*Standard.*

The Annals of the University of Edinburgh.

By ANDREW DALZEL, formerly Professor of Greek in the University of Edinburgh; with a Memoir of the Compiler, and Portrait after Raeburn. 2 vols. demy 8vo, price 21s.

Gisli the Outlaw.

From the Icelandic. By G. W. DASENT, D.C.L. Small 4to, with Illustrations, price 7s. 6d.

The Story of Burnt Njal;

Or, Life in Iceland at the end of the Tenth Century. From the Icelandic of the Njals Saga. By GEORGE WEBBE DASENT, D.C.L. 2 vols. 8vo, with Map and Plans, price 28s.

Select Popular Tales from the Norse.

For the use of Young People. By G. W. DASENT, D.C.L. New Edition, with Illustrations. Crown 8vo, 6s.

Plates and Notes relating to some Special Features in Struc-

tures called Pyramids. By ST. JOHN VINCENT DAY, C.E., F.R.SS.A. Royal folio, price 28s.

By the same Author.

Papers on the Great Pyramid.

8vo, price 4s.

Some Evidence as to the very early Use of Iron.

8vo, sewed, price 2s. 6d.

The Law of Railways applicable to Scotland, with an Appendix of Statutes and Forms. By FRANCIS DEAS, M.A., LL.B., Advocate. 1 vol. Royal 8vo, price 38s.

On the Application of Sulphurous Acid Gas to the Prevention, Limitation, and Cure of Contagious Diseases. By JAMES DEWAR, M.D. Thirteenth edition, price 1s.

Rheumatism and Rheumatic Gout treated on Antiseptic Principles. By JAMES DEWAR, M.D. Price 1s.

Dick and I.

Uniform with 'Little Tales for Tiny Tots,' with six Illustrations. Square 18mo, price 1s.

Memoir of Thomas Drummond, R.E., F.R.A.S., Under-Secretary to the Lord-Lieutenant of Ireland, 1835 to 1840. By JOHN F. M'LENNAN, Advocate. 8vo, price 15s.

"A clear, compact, and well-written memoir of the best friend England ever gave to Ireland."—*Examiner.*

Political Survey.

By MOUNTSTUART E. GRANT DUFF, Member for the Elgin District of Burghs; Author of 'Studies in European Politics,' 'A Glance over Europe,' &c. &c. 8vo, price 7s. 6d.

"In following up his 'Studies in European Politics' by the 'Political Survey' here before us, Mr. Grant Duff has given strong evidence of the wisdom of the choice made by the Ministry in appointing him Under-Secretary for India. In the space of about 240 pages, he gives us the cream of the latest information about the internal politics of no less than forty-four different countries under four heads, according to their situation in Europe, Asia, and Africa, Northern and Central America, or South America."—*Pall Mall Gazette.*

By the same Author.

Elgin Speeches. 8vo, cloth, price 8s. 6d.

A Glance over Europe. Price 1s.

Address as Rector at the University of Aberdeen. Price 1s.

East India Financial Statement, 1869. Price 1s.

Remarks on the Present Political Situation. Price 1s.

Expedit—Laboremus. Price 1s.

Veterinary Medicines; their Actions and Uses.

By FINLAY DUN. Fourth Edition, revised and enlarged. 8vo. [*In the press.*

Social Life in Former Days;

Chiefly in the Province of Moray. Illustrated by letters and family papers. By E. DUNBAR DUNBAR, late Captain 21st Fusiliers. 2 vols. demy 8vo, price 19s. 6d.

Life of Father Lacordaire.

By DORA GREENWELL. Fcap. 8vo. Price 6s.

"She has done a great service in bringing before the English public the career of a great man whose biography they might have refused to read if written by a Roman Catholic."—*Church Times.*

Scenes from the Life of Jesus.

By SAMUEL GREG. Second Edition, enlarged. Ex. fcap. 8vo, price 3s. 6d.

"One of the few theological works which can be heartily commended to all classes."—*Inverness Courier.*

Arboriculture; or, A Practical Treatise on Raising and

Managing Forest Trees, and on the Profitable Extension of the Woods and Forests of Great Britain. By JOHN GRIGOR, The Nurseries, Forres. 8vo, price 10s. 6d.

"He is a writer whose authorship has this weighty recommendation, that he can support his theories by facts, and can point to lands, worth less than a shilling an acre when he found them, now covered with ornamental plantations, and yielding through them a revenue equal to that of the finest corn-land in the country. . . . His book has interest both for the adept and the novice, for the large proprietor and him that has but a nook or corner to plant out."—*Saturday Review.*

"Mr. Grigor's practical information on all points on which an intending planter is interested is particularly good. . . . We have placed it on our shelves as a first-class book of reference on all points relating to Arboriculture; and we strongly recommend others to do the same."—*Farmer.*

An Ecclesiastical History of Scotland,

From the Introduction of Christianity to the Present Time. By GEORGE GRUB, A.M. 4 vols. 8vo, 42s.

Chronicle of Gudrun;

A Story of the North Sea. From the mediæval German. By EMMA LETHERBROW. With frontispiece by J. NOEL PATON, R.S.A. New Edition, price 5s.

Notes on the Early History of the Royal Scottish Academy.

By Sir GEORGE HARVEY, Kt., P.R.S.A. 8vo, price 3s. 6d.

The Resurrection of the Dead.

By WILLIAM HANNA, D.D., LL.D., author of "The Last Day of our Lord's Passion," etc. 1 vol. fcap. 8vo, price 3s. 6d.

The Wars of the Huguenots.

By REV. WILLIAM HANNA, D.D., LL.D. Ex. fcap. 8vo, price 5s.

The Life of our Lord.

By the REV. WILLIAM HANNA, D.D., LL.D. 6 vols., handsomely bound in cloth extra, gilt edges, price 30s.

Separate vols., cloth, extra gilt edges, price 5s. each.

1. THE EARLIER YEARS OF OUR LORD. 8th Thousand.
2. THE MINISTRY IN GALILEE. Second Edition.
3. THE CLOSE OF THE MINISTRY. 6th Thousand.
4. THE PASSION WEEK. 5th Thousand.
5. THE LAST DAY OF OUR LORD'S PASSION. 47th Thousand.
6. THE FORTY DAYS AFTER THE RESURRECTION. 9th Thousand.

The Guidman of Inglismill, and The Fairy Bride.

Legends of the North. With Glossary, etc. 4to, price 2s. 6d.

Heavenly Love and Earthly Echoes.

By a Glasgow Merchant. 4th Edition. 18mo, price 1s. 6d.

"We have read this volume with unmingled satisfaction. We very cordially recommend it, as one much fitted to commend religion to the young, to cheer and help the tempted and desponding, and indeed to have a wholesome influence on the minds and hearts of all."—*Original Secession Magazine.*

"Fitted to be useful and heart-stirring to all who are in earnest in religion. We hope and believe it will reach many more editions."—*Christian Work.*

Herminius.

A Romance. By I. E. S. Fcap. 8vo, price 6s.

Historians of Scotland.

Price to Non-Subscribers, 15s. *per volume.* An Annual Payment of £1 will entitle the Subscriber to Two annual volumes.

Vols. for 1871-2. { FORDUN'S SCOTICHRONICON. Vol. I.
WYNTOUN'S CHRONICLE. Vol. I. }

Vols. for 1872-3. { WYNTOUN'S CHRONICLE. Vol. II.
FORDUN'S SCOTICHRONICON. Vol. II. }

*** *Detailed Lists of the forthcoming Volumes on application.*

If the Gospel Narratives are Mythical, what then?

Crown 8vo, price 3s. 6d.

"This is a striking little essay . . . thoughtful and subtle. It is an attempt to show that something like the philosophy of the Christian Gospel would be forced upon us by the facts of our spiritual nature."—*Spectator.*

Lectures on Scotch Legal Antiquities.

By COSMO INNES, F.S.A., author of "Scotland in the Middle Ages."

Contents:—I. Introductory. II. Charters. III. Parliament. IV. The Old Church. V. Old Forms of Law. VI. Rural Occupations. VII. Student's Guide Books. VIII. Appendix. In 1 vol. demy 8vo, price 10s. 6d.

Sketches of Early Scotch History.

By COSMO INNES, F.S.A., Professor of History in the University of Edinburgh. 1. The Church; its Old Organisation, Parochial and Monastic. 2. Universities. 3. Family History. 8vo, price 16s.

Concerning some Scotch Surnames.

By COSMO INNES, F.S.A., Professor of History in the University of Edinburgh. Small 4to, cloth antique, 5s.

Instructive Picture-Books.

Folio, 7s. 6d. each.

"These Volumes are among the most instructive Picture-books we have seen, and we know of none better calculated to excite and gratify the appetite of the young for the knowledge of nature."—*Times.*

I.

The Instructive Picture Book. A few Attractive Lessons from the Natural History of Animals. By ADAM WHITE, late Assistant, Zoological Department, British Museum. With 54 folio coloured Plates. Eighth Edition, containing many new Illustrations by Mrs. BLACKBURN, J. STEWART, GOURLAY STEELL, and others.

II.

The Instructive Picture Book. Lessons from the Vegetable World. By the Author of 'The Heir of Redclyffe,' 'The Herb of the Field,' etc. New Edition, with 64 Plates.

III.

Instructive Picture Book. The Geographical Distribution of Animals, in a Series of Pictures for the use of Schools and Families. By the late Dr. GREVILLE. With descriptive letterpress. New Edition, with 60 Plates.

IV.

Pictures of Animal and Vegetable Life in all Lands. 48 Folio Plates.

V.

Recreative Instruction. Pictorial Lessons on Form, Comparison, and number, for Children under 7 years of age, with explanations. By Nicholas Bohny. Fifth edition. 26 Oblong folio Plates, price 7s. 6d.

The History of Scottish Poetry,

From the Middle Ages to the Close of the Seventeenth Century. By the late DAVID IRVING, LL.D. Edited by JOHN AITKEN CARLYLE, M.D. With a Memoir and Glossary. Demy 8vo, 16s.

Johnny Gibb of Gushetneuk. 12mo, ornamental boards, price 2s.

Sermons by the Rev. John Ker, D.D., Glasgow.

Ninth Edition. Crown 8vo, price 6s.

"This is a very remarkable volume of sermons. And it is no doubt a most favourable symptom of the healthiness of Christian thought among us, that we are so often able to begin a notice with these words.

"We cannot help wishing that such notice more frequently introduced to our readers a volume of Church of England sermons. Still, looking beyond our pale, we rejoice notwithstanding.

"Mr. Ker has dug boldly and diligently into the vein which Robertson opened; but the result, as compared with that of the first miner, is as the product of skilled machinery set against that of the vigorous unaided arm. There is no roughness, no sense of labour; all comes smoothly and regularly on the page—one thought evoked out of another. As Robertson strikes the rock with his tool, unlooked-for sparkles tempt him on; the workman exults in his discovery; behind each beautiful, strange thought, there is yet another more strange and beautiful still. Whereas, in this work, every beautiful thought has its way prepared, and every strange thought loses its power of starting by the exquisite harmony of its setting. Robertson's is the glitter of the ore on the bank; Ker's is the uniform shining of the wrought metal. We have not seen a volume of sermons for many a day which will so thoroughly repay both purchase and perusal and re-perusal. And not the least merit of these sermons is, that they are eminently suggestive."—*Contemporary Review.*

"The sermons before us are indeed of no common order; among a host of competitors they occupy a high class—we were about to say the highest class—whether viewed in point of composition, or thought, or treatment.

"He has gone down in the diving-bell of a sound Christian philosophy, to the very depth of his theme, and has brought up treasures of the richest and most *recherché* character, practically showing the truth of his own remarks in the preface, 'that there is no department of thought or action which cannot be touched by that gospel which is the manifold wisdom of God.' These subjects he has exhibited in a style corresponding to their brilliancy and profoundness — terse and telling, elegant and captivating, yet totally unlike the tinsel ornaments laid upon the subject by an elaborate process of manipulation—a style which is the outcome of the sentiment and feelings within, shaping itself in appropriate drapery."—*British and Foreign Evangelical Review.*

Studies for Sunday Evening; or, Readings in Holy Writ.

By LORD KINLOCH. New edition, in 2 vols. fcap. 8vo, price 9s.

Also separately.

Readings in Holy Writ, and Studies for Sunday Evening.

Price 4s. 6d. each.

Faith's Jewels.

Presented in Verse, with other devout Verses. By LORD KINLOCH. Ex. fcap. 8vo, price 5s.

The Circle of Christian Doctrine;

A Handbook of Faith, framed out of a Layman's experience. By LORD KINLOCH. Third and Cheaper Edition. Fcap. 8vo, 2s. 6d.

Time's Treasure;

Or, Devout Thoughts for every Day of the Year. Expressed in verse. By LORD KINLOCH. Fourth and Cheaper Edition. Fcap. 8vo, price 3s. 6d.

Devout Moments.

By LORD KINLOCH. Price 6d.

Hymns to Christ.

By LORD KINLOCH. Ex. fcap. 8vo, price 3s. 6d.

The Philosophy of Ethics:

An Analytical Essay. By SIMON S. LAURIE, A.M. Demy 8vo, price 6s.

Notes, Expository and Critical, on certain British Theories

of Morals. By SIMON S. LAURIE. 8vo, price 6s.

The Reform of the Church of Scotland

In Worship, Government, and Doctrine. By ROBERT LEE, D.D., late Professor of Biblical Criticism in the University of Edinburgh, and Minister of Greyfriars. Part I. Worship. Second Edition, fcap. 8vo, price 3s.

Life in Normandy;

Sketches of French Fishing, Farming, Cooking, Natural History, and Politics, drawn from Nature. By an ENGLISH RESIDENT. Third Edition, crown 8vo, cloth ex. gilt, price 4s. 6d.

A Memoir of Lady Anna Mackenzie,

Countess of Balcarres, and afterwards of Argyle, 1621-1706. By ALEXANDER LORD LINDSAY (Earl of Crawford). Fcap. 8vo, price 3s. 6d.

"All who love the byways of history should read this life of a loyal Covenanter." —*Atlas.*

Lismore, Book of the Dean of.

Specimens of Ancient Gaelic Poetry, collected between the years 1512 and 1529 by the REV. JAMES M'GREGOR, Dean of Lismore—illustrative of the Language and Literature of the Scottish Highlands prior to the Sixteenth Century. Edited, with a Translation and Notes, by the Rev. THOMAS MACLAUCHLAN. The Introduction and additional Notes by WILLIAM F. SKENE. 8vo, price 12s.

Literary Relics of the late A. S. Logan, Advocate, Sheriff

of Forfarshire. Extra fcap. 8vo, price 3s. 6d.

Little Ella and the Fire-King,

And other Fairy Tales. By M. W., with Illustrations by HENRY WARREN. Second Edition. 16mo, cloth, 3s. 6d. Cloth extra, gilt edges, 4s.

Little Tales for Tiny Tots.

With 6 Illustrations by WARWICK BROOKES. Square 18mo, price 1s.

A Survey of Political Economy.

By JAMES MACDONELL, M.A. Ex. fcap. 8vo, price 6s.

"The author has succeeded in producing a book which is almost as easy reading as a three-volume novel."—*Athenæum.*

"Of its class it is one of the best we have seen; and had we to choose for a beginner among the crowd of manuals and introductions to the study, there is much which would induce us to recommend the present volume."—*Spectator.*

"Mr Macdonell's book, entitled 'A Survey of Political Economy,' establishes him as a writer of authority on economical subjects."—MR. NEWMARCH.

Ten Years North of the Orange River.

A Story of Everyday Life and Work among the South African Tribes, from 1859 to 1869. By JOHN MACKENZIE, of the London Missionary Society. With Map and Illustrations. 1 vol. crown 8vo, cloth, extra gilt, price 4s. 6d.

Nugæ Canoræ Medicæ.

By DOUGLAS MACLAGAN, Professor of Medical Jurisprudence in the University of Edinburgh. A new edition, enlarged, with Illustrations by THOMAS FAED, R.A.; WILLIAM DOUGLAS, R.S.A.; JAMES ARCHER, R.S.A.; JOHN BALLANTYNE, R.S.A., etc. In 1 vol. 4to, price 7s. 6d.

Select Writings: Political, Scientific, Topographical, and

Miscellaneous, of the late CHARLES MACLAREN, F.R.S.E., F.G.S., Editor of the *Scotsman.* Edited by ROBERT COX, F.S.A. Scot., and JAMES NICOL, F.R.S.E., F.G.S., Professor of Natural History in the University of Aberdeen. With a Memoir and Portrait. 2 vols. crown 8vo, 15s.

Memorials of the Life and Ministry of Charles Calder
Mackintosh, D.D., of Tain and Dunoon. Edited, with a Sketch of the Religious History of the Northern Highlands of Scotland, by the Rev. William Taylor, M.A. With Portrait. Second Edition, extra fcap. 8vo, price 4s. 6d.

Macvicar's (J. G., D.D.)
The Philosophy of the Beautiful; price 6s. 6d. First Lines of Science Simplified; price 5s. Inquiry into Human Nature; price 7s. 6d.

Mary Stuart and the Casket Letters.
By J. F. N., with an Introduction by Henry Glassford Bell. Ex. fcap. 8vo, price 4s. 6d.

Max Havalaar;
Or, The Coffee Auctions of the Dutch Trading Company. By MULTATULI; translated from the original MS. by Baron Nahuys. With Maps, price 14s.

Why the Shoe Pinches.
A contribution to Applied Anatomy. By HERMANN MEYER, M.D., Professor of Anatomy in the University of Zurich. Price 6d.

The Estuary of the Forth and adjoining Districts viewed
Geologically. By DAVID MILNE HOME of Wedderburn. 8vo, cloth, with Map and Plans, price 5s.

The Herring:
Its Natural History and National Importance. By JOHN M. MITCHELL. With Six Illustrations, 8vo, price 12s.

The Insane in Private Dwellings.
By ARTHUR MITCHELL, A.M., M.D., Commissioner in Lunacy for Scotland, etc. 8vo, price 4s. 6d.

Creeds and Churches.
By the Rev. Sir HENRY WELLWOOD MONCREIFF, Bart., D.D. Demy 8vo, price 3s. 6d.

Ancient Pillar-Stones of Scotland:
Their Significance and Bearing on Ethnology. By GEORGE MOORE, M.D. 8vo, price 6s. 6d.

Heroes of Discovery.
By SAMUEL MOSSMAN. Crown 8vo, price 5s.

Political Sketches of the State of Europe—from 1814-1867.
Containing Ernest Count Münster's Despatches to the Prince Regent from the Congress of Vienna and of Paris. By GEORGE HERBERT, Count Münster. Demy 8vo, price 9s.

Biographical Annals of the Parish of Colinton.
By THOMAS MURRAY, LL.D. Crown 8vo, price 3s. 6d.

History Rescued, in Answer to "History Vindicated," being a recapitulation of "The Case for the Crown," and the Reviewers Reviewed, *in re* the Wigtown Martyrs. By MARK NAPIER. 8vo, price 5s.

Nightcaps:

A Series of Juvenile Books. By "AUNT FANNY." 6 vols. square 16mo, cloth. In case, price 12s., or separately, 2s. each volume.

1. Baby Nightcaps.	3. Big Nightcaps.	5. Old Nightcaps.
2. Little Nightcaps.	4. New Nightcaps.	6. Fairy Nightcaps.

"Neither a single story nor a batch of tales in a single volume, but a box of six pretty little books of choice fiction, is Aunt Fanny's contribution to the new supply of literary toys for the next children's season. Imagine the delight of a little girl who, through the munificence of mamma or godmamma, finds herself possessor of Aunt Fanny's tastefully-decorated box. Conceive the exultation with which, on raising the lid, she discovers that it contains six whole and separate volumes, and then say, you grown-up folk, whose pockets are bursting with florins, whether you do not think that a few of your pieces of white money would be well laid out in purchasing such pleasure for the tiny damsels of your acquaintance, who like to be sent to bed with the fancies of a pleasant story-teller clothing their sleepy heads with nightcaps of dreamy contentment. The only objection we can make to the quality and fashion of Aunt Fanny's Nightcaps is, that some of their joyous notions are more calculated to keep infantile wearers awake all night than to dispose them to slumber. As nightcaps for the daytime, however, they are, one and all, excellent."—*Athenæum.*

NEW NIGHTCAPS. New cheaper Edition, Fancy Cover, price 1s.

ODDS AND ENDS—*Price 6d. Each.*

Vol. I., in Cloth, price 4s. 6d., containing Nos. 1-10.
Vol. II., Do. do. Nos. 11-19.

1. Sketches of Highland Character.
2. Convicts.
3. Wayside Thoughts.
4. The Enterkin.
5. Wayside Thoughts—Part 2.
6. Penitentiaries and Reformatories.
7. Notes from Paris.
8. Essays by an Old Man.
9. Wayside Thoughts—Part 3.
10. The Influence of the Reformation.
11. The Cattle Plague.
12. Rough Night's Quarters.
13. On the Education of Children.
14. The Stormontfield Experiments.
15. A Tract for the Times.
16. Spain in 1866.
17. The Highland Shepherd.
18. Correlation of Forces.
19. 'Bibliomania.'
20. A Tract on Twigs.
21. Notes on Old Edinburgh.
22. Gold-Diggings in Sutherland.
23. Post-Office Telegraphs.

The Bishop's Walk and The Bishop's Times.

By ORWELL. Fcap. 8vo, price 5s.

Man: Where, Whence, and Whither?

Being a glance at Man in his Natural-History Relations. By DAVID PAGE, LL.D. Fcap. 8vo, price 3s. 6d.

"Cautiously and temperately written."—*Spectator.*

The Great Sulphur Cure.

By ROBERT PAIRMAN, Surgeon. Thirteenth Edition, price 1s.

Kidnapping in the South Seas.

Being a Narrative of a Three Months' Cruise of H. M. Ship Rosario. By CAPTAIN GEORGE PALMER, R.N., F.R.G.S. 8vo, illustrated, 10s. 6d.

France: Two Lectures.

By M. PREVOST-PARADOL, of the French Academy. 8vo, price 2s. 6d.

"Should be carefully studied by every one who wishes to know anything about contemporary French History."—*Daily Review.*

Suggestions on Academical Organisation,

With Special Reference to Oxford. By MARK PATTISON, B.D., Rector of Lincoln College, Oxford. Crown 8vo, price 7s. 6d.

Practical Water-Farming.

By WM. PEARD, M.D., LL.D. 1 vol. fcap. 8vo, price 5s.

On Teaching Universities and Examining Boards.

By LYON PLAYFAIR, C.B., M.P. 8vo, price 1s.

On Primary and Technical Education.

By LYON PLAYFAIR, C.B., M.P. 8vo, price 1s.

Popular Genealogists;

Or, The Art of Pedigree-making. Crown 8vo, price 4s.

The Pyramid and the Bible:

The rectitude of the one in accordance with the truth of the other. By a CLERGYMAN. Ex. fcap. 8vo, price 3s. 6d.

Quixstar.

By the Author of 'Blindpits.' A Novel, in 3 vols. Crown 8vo, price 31s. 6d.

Christ and his Seed: Central to all things; being a Series of

Expository Discourses on Paul's Epistle to the Ephesians. By JOHN PULSFORD, Author of 'Quiet Hours.' Square 8vo, price 8s. 6d.

A Critical History of the Christian Doctrine of Justification

and Reconciliation. By ALBRECHT RITSCHL, Professor Ordinarius of Theology in the University of Göttingen. Translated from the German, with the Author's sanction, by JOHN S. BLACK, M.A. 8vo, cloth, price 12s.

"An exceedingly valuable contribution to theological literature. The history begins no earlier than the Middle Ages; since he considers that in earlier times, while the theory of a price paid to Satan was current, there was no real theology on the subject. A more thorough historical study of the doctrine of the Atonement, and a correct understanding and appreciation of the various forms it has assumed in different schools, are very much needed in this country."—*British and Foreign Evangelical Review.*

Reminiscences of Scottish Life and Character.

By E. B. RAMSAY, M.A., LL.D., F.R.S.E., Dean of Edinburgh. Library Edition, in demy 8vo, with Portrait by James Faed, price 10s. 6d.

*** The original Edition in 2 vols., with Introductions, price 12s.; and the Popular Edition, price 2s., are still on sale.

"That venerable Dean, who is an absolute impersonation of the 'reminiscences' of all the Scottish Churches, who in his largeness of heart embraces them all, and in his steadfast friendship, his generous championship of forgotten truths and of unpopular causes, proves himself to be in every sense the inheritor of the noble Scottish name which he so worthily bears."—*Dean Stanley's Lectures on the Church of Scotland.*

Dean Ramsay's Reminiscences.

Twenty-first Edition, in fcap. 8vo, boards, price 2s.; cloth extra, 2s. 6d.

"The Dean of Edinburgh has here produced a book for railway reading of the very first class. The persons (and they are many) who can only under such circumstances devote ten minutes of attention to any page, without the certainty of a dizzy or stupid headache, in every page of this volume will find some poignant anecdote or trait which will last them a good half-hour for after-laughter: one of the pleasantest of human sensations."—*Athenæum.*

Recess Studies.

Edited by Sir ALEXANDER GRANT, Bart., LL.D. 8vo, price 12s.

Rights of Labour, and the Nine Hours' Movement.

Addressed to the Men of Newcastle. By a LADY. Price One Penny.

Past and Present: or, Social and Religious Life in the North.

By H. G. REID. 1 vol., crown 8vo, illustrated, price 6s.

"These papers show great good sense, a thorough appreciation of the importance of social questions, and a deep conviction of the influence of principle and truth in a nation's true progress."—*Freeman.*

Art Rambles in Shetland.

By JOHN T. REID. Handsome 4to, cloth, profusely illustrated, price 25s.

"This record of Art Rambles may be classed among the most choice and highly-finished of recent publications of this sort."—*Saturday Review.*

The One Church on Earth. How it is manifested, and what

are the Terms of Communion with it. By Rev. JOHN ROBERTSON, A.M., Arbroath. Extra fcap. 8vo, price 3s. 6d.

Historical Essays in connection with the Land and the

Church, etc. By E. WILLIAM ROBERTSON, Author of 'Scotland under her Early Kings.' In 1 vol. 8vo, price 10s. 6d.

Contents.

Standards of the Past in Weight and Currency.

Part I.—1. The Roman and Byzantine Pounds. 2. Talents of the Classical Era. 3. The Roman Currency. 4. The Stipendium. 5. Early Byzantine Currency. Approximate Standards.

Part II.—1. Early Substitutes for a Coinage. 2. Currency of the Early Franks and the House of Capet. 3. Early Germanic and Frison Currency. 4. Norwegian and Irish Currency. 5. Morabetin and Early Spanish Currency. 6. Early English Currency and Standards. Mediæval Standards.

The Year and the Indiction.

The Land.—1. The Acre. 2. The Hide. 3. The Land-gavel. 4. The Shire. 5. Scottish Measurements. 6. Irish Measurements. 7. Irish Land-tenure. 8. The Toshach and the Thane.

Chapters of English History before the Conquest.—1. The King's Wife. 2. Handfasting. 3. The King's Kin. 4. Dunstan and his Policy. 5. The Coronation of Edgar.

Rome.

In 1 vol. Demy 8vo, cloth, price 10s. 6d.

Scotland under her Early Kings.

A History of the Kingdom to the close of the 13th century. By E. WILLIAM ROBERTSON. In 2 vols. 8vo, cloth, 36s.

"Mr. Robertson, in the Appendix to his "Scotland under her Early Kings" on the English claims, appears to the Editor to have completely disposed of the claims founded on the passages in the Monkish Historians prior to the Norman Conquest. This paper is one of the acutest and most satisfactory of these very able essays."—*W. F. Skene in Preface to 'Chronicles of the Picts and Scots.'*

Doctor Antonio.

A Tale. By JOHN RUFFINI. Cheap Edition, crown 8vo, boards, 2s 6d.

Lorenzo Benoni;

Or, Passages in the Life of an Italian. By JOHN RUFFINI. With Illustrations. Crown 8vo, cloth gilt, 5s. Cheap Edition, crown 8vo, boards, 2s. 6d.

The Salmon;

Its History, Position, and Prospects. By ALEX. RUSSEL. 8vo, price 7s. 6d.

Druidism Exhumed. Proving that the Stone Circles of

Britain were Druidical Temples. By Rev. JAMES RUST. Fcap. 8vo, price 4s. 6d.

Gowodean:

A Pastoral, by JAMES SALMON. 8vo, price 6s.

Natural History and Sport in Moray.

Collected from the Journals and Letters of the late CHARLES St. JOHN, Author of 'Wild Sports of the Highlands.' With a short Memoir of the Author. Crown 8vo, price 8s. 6d.

A Handbook of the History of Philosophy.

By Dr. ALBERT SCHWEGLER. Fourth Edition. Translated and Annotated by J. Hutchison Stirling, LL.D., Author of the 'Secret of Hegel.' Crown 8vo, price 6s.

"Schwegler's is the best possible handbook of the history of philosophy, and there could not possibly be a better translator of it than Dr. Stirling."—*Westminster Review.*

The Scottish Poor-Laws: Examination of their Policy,

History, and Practical Action. By SCOTUS. 8vo, price 7s. 6d.

"This book is a magazine of interesting facts and acute observations upon this vitally important subject."—*Scotsman.*

Gossip about Letters and Letter-Writers.

By GEORGE SETON, Advocate, M.A. Oxon., F.S.A. Scot. Fcap. 8vo, price 2s. 6d.

"A very agreeable little *brochure*, which anybody may dip into with satisfaction to while away idle hours."—*Echo.*

'Cakes, Leeks, Puddings, and Potatoes.'

A Lecture on the Nationalities of the United Kingdom. By GEORGE SETON, Advocate, M.A. Oxon., etc. Second Edition. Fcap. 8vo, sewed, price 6d.

Culture and Religion.

By J. C. SHAIRP, Principal of the United College of St. Salvator and St. Leonards, St. Andrews. Third Edition, fcap. 8vo, price 3s. 6d.

"A wise book, and unlike a great many other wise books, has that carefully-shaded thought and expression which fits Professor Shairp to speak for Culture no less than for Religion."—*Spectator.*

John Keble:

Au Essay on the Author of the 'Christian Year.' By J. C. SHAIRP, Principal of the United College of St. Salvator and St. Leonards, St. Andrews. Fcap. 8vo, price 3s.

Studies in Poetry and Philosophy.

By J. C. SHAIRP, Principal of the United College of St. Salvator and St. Leonard's, St. Andrews. Second Edition, 1 vol. fcap. 8vo, price 6s.

The Shores of Fife; or the Forth and Tay.

Comprising Inland Scenery in Fife, Perth, Clackmannan, Kinross, and Stirling: with frontispiece—"Queen Margaret expounding the Scriptures to Malcolm Canmore," presented by SIR NOEL PATON, Knight, R.S.A., Her Majesty's Limner for Scotland; and original drawings, by WALLER H. PATON, R.S.A., SAMUEL BOUGH, A.R.S.A., JOHN LAWSON, W. F. VALLANCE, E. T. CRAWFORD, R.S.A., CLARK STANTON, A.R.S.A., J. H. OSWALD, JOHN T. REID, and other Artists. Engraved by WILLIAM BALLINGALL.

CONTAINING—

AN OUTLINE OF THE ARCHÆOLOGY OF FIFE, by A. LAING, F.S.A. Scot., Newburgh-on-Tay.

HISTORICAL AND DESCRIPTIVE ACCOUNT OF ST. ANDREWS, by the Very Rev. PRINCIPAL TULLOCH, D.D.

HISTORICAL AND DESCRIPTIVE NOTES ON FALKLAND PALACE, LOCHLEVEN, RUMBLING BRIDGE, PERTH, DUNDEE, NEWPORT, BROUGHTY-FERRY, BELL ROCK, etc., by the Rev. GEORGE GILFILLAN.

STIRLING, ALLOA, CLACKMANNAN TOWER, CASTLE CAMPBELL, DOLLAR, KINCARDINE, etc., by the Rev. J. MITCHELL HARVEY, M.A.

THE SHORES FROM LEVEN TO TORRYBURN, INCLUDING DUNFERMLINE, etc., by the Rev. JAMES S. MILL.

THE SHORES FROM LARGO TO ST. ANDREWS, by the Author of 'The Hotel Du Petit St. Jean.'

THE EDEN, CUPAR, KENNOWAY, KETTLE, LESLIE, MARKINCH, THORNTON, LEUCHARS, LADYBANK, etc., by JOHN T. REID, Author of 'Art Rambles in Shetland.'

AN OUTLINE OF THE GEOLOGY OF FIFE, by DAVID PAGE, LL.D., Professor of Geology, College of Science, Newcastle.

SKETCH OF THE MINERALOGY OF FIFE, by M. FORSTER HEDDLE, M.D., Professor of Chemistry, University of St. Andrews.

AN OUTLINE OF THE BOTANY OF FIFE, by CHARLES HOWIE, Secretary of the Largo Field Naturalists' Society.

4to, Cloth, price 30s.

A Memoir of the late Sir James Y. Simpson Bart. M.D.
By JOHN DUNS, D.D., Professor of Natural Science, New College, Edinburgh. Demy, 8vo.

Archæological Essays by the late Sir James Y. Simpson,
Bart., M.D., D.C.L., one of her Majesty's Physicians for Scotland, and Professor of Medicine and Midwifery in the University of Edinburgh. Edited by JOHN STUART, LL.D., Secretary of the Society of Antiquaries of Scotland, Author of 'The Sculptured Stones of Scotland,' etc. etc. 2 vols. sm. 4to, half Roxburghe, price £2 : 2s.

Proposal to Stamp out Small-pox and other Contagious
Diseases. By Sir J. Y. SIMPSON, Bart., M.D., D.C.L. Price 1s.

The Four Ancient Books of Wales,
Containing the Cymric Poems attributed to the Bards of the Sixth Century. By WILLIAM F. SKENE. With Maps and Facsimiles. 2 vols. 8vo, price 36s.

"Mr. Skene's book will, as a matter of course and necessity, find its place on the tables of all Celtic antiquarians and scholars."—*Archæologia Cambrensis.*

The Coronation Stone.
By WILLIAM F. SKENE. Small 4to. With Illustrations in Photography and Zincography. Price 6s.

Nearness of Kin: its Principle in Scripture and in Nature.
By REV. J. M. SLOAN. 8vo, price 6d.

The Sermon on the Mount.
By the REV. WALTER C. SMITH, Author of 'The Bishop's Walk, and other Poems, by Orwell,' and 'Hymns of Christ and Christian Life.' Crown 8vo, price 6s.

Disinfectants and Disinfection.
By DR. ROBERT ANGUS SMITH. 8vo, price 5s.

"By common consent Dr. Angus Smith has become the first authority in Europe on the subject of Disinfectants. To this subject he has devoted a large portion of his scientific life; and now, in a compact volume of only 138 pages, he has condensed the result of twenty years of patient study. To Sanitary officers, to municipal and parochial authorities, and, indeed, to all who are particularly concerned for the public health and life; and who is not? we sincerely commend Dr. Angus Smith's treatise."—*Chemical News.*

Life and Work at the Great Pyramid.
With a Discussion of the Facts Ascertained. By C. PIAZZI SMYTH, F.R.SS.L. and E., Astronomer-Royal for Scotland. 3 vols. demy 8vo, price 56s.

An Equal-Surface Projection for Maps of the World, and
its Application to certain Anthropological Questions. By C. PIAZZI SMYTH, F.R.SS.L. & E., Astronomer-Royal for Scotland. 8vo, price 3s.

Britain's Art Paradise; or, Notes on some Pictures in the
Royal Academy, 1871. By the EARL of SOUTHESK. 8vo, sewed, price 1s.

Sir Walter Scott as a Poet.
By GILBERT MALCOLM SPROAT. 8vo, cloth, price 2s. 6d.

Ruined Castles, Monuments of Former Men, in the Vicinity
of Banff. By JAMES SPENCE. Crown 8vo, price 5s.

Scottish Liturgies of the Reign of James VI., from MSS. in the British Museum and Advocates' Library. Edited, with an Introduction and Notes, by the REV. GEO. W. SPROTT, B.A. Extra fcap. 8vo, cloth, price 4s. 6d.

"The title of this book will be enough to make many pass it by as of mere denominational interest. It is, on the contrary, one of national importance, and ought to be carefully studied by all who, through any line of descent, connect themselves with early Scotch Protestantism."—*Courant.*

The Doctrine of Christ Developed by the Apostles: a Treatise on the Offices of the Redeemer, and the Doxology of the Redeemer. By REV. EDWARD STEANE, D.D. 8vo, Price 10s. 6d.

"I have now attentively, and with great pleasure, perused your volume, and I desire to express my sincere thankfulness to God and to you for so timely a publication."—J. H. HINTON, M.A.

"We have read this volume with more than ordinary pleasure. In the midst of so much in modern theological literature that is objectionable or doubtful, it is refreshing to meet with a clear, manly, outspoken exposition of those great evangelical doctrines which are in danger of being less 'commonly believed among us' than they were among our fathers. The style of the whole book is clear, free, and vigorous; it is characterised by a tone of sustained eloquence which reminds us more of the style of Dr. Chalmers than anything we have read for a long time."—*Wesleyan Methodist Magazine.*

"The style is graceful and flowing, the spirit devout and tender, and the theology of the Puritan type."—*General Baptist Magazine.*

"Here there is no uncertain sound on the doctrine of substitution and of expiatory sacrifice, nor on that which Luther called '*Articulus stantis vel cadentis ecclesiæ*,' the great doctrine of justification by faith."—*Daily Review.*

"In our judgment, a more valuable contribution in a single volume to the exposition, defence, and illustration of evangelical truth has not been often made. Thoughtful educated Christian laymen, students, and young ministers, will read it with equal pleasure and profit."—*The Literary World.*

"A handsome welcome book, full of the old Gospel, and rich in tenderness and feeling, the ripe fruit of an honoured and green old age. The work is conscientiously and lovingly done, and the result is a treatise on the Prophetic, Priestly, and Kingly Offices of Our Lord such as will give to all readers much intelligent thought and much holy and suggestive sentiment. The text gives proof of careful study and ample scholarship, and it is further enriched with notes taken from recent Biblical criticism."—*The Freeman.*

Memoir of Sir James Dalrymple, First Viscount Stair, President of the Court of Session in Scotland, and Author of 'The Institutions of the Law of Scotland.' A Study in the History of Scotland and Scotch Law during the Seventeenth Century. By Æ. J. G. MACKAY, Advocate. 8vo, price 12s.

History Vindicated in the Case of the Wigtown Martyrs.
By the REV. ARCHIBALD STEWART. Second Edition. 8vo, price 3s. 6d.

Dugald Stewart's Collected Works.

Edited by Sir WILLIAM HAMILTON, Bart. Vols. I. to X. 8vo, cloth, each 12s.

Vol. I.—Dissertation. Vols. II. III. and IV.—Elements of the Philosophy of the Human Mind. Vol. V.—Philosophical Essays. Vols. VI. and VII.—Philosophy of the Active and Moral Powers of Man. Vols. VIII. and IX.—Lectures on Political Economy. Vol. X.—Biographical Memoirs of Adam Smith, LL.D., William Robertson, D.D., and Thomas Reid, D.D.; to which is prefixed a Memoir of Dugald Stewart, with Selections from his Correspondence, by John Veitch, M.A. Supplementary Vol.—Translations of the Passages in Foreign Languages contained in the Collected Works; with General Index.

Jerrold, Tennyson, Macaulay, and other Critical Essays.

By JAMES HUTCHISON STIRLING, LL.D., Author of 'The Secret of Hegel.' 1 vol. fcap. 8vo, price 5s.

"The author of 'The Secret of Hegel' here gives us his opinions of the lives and works of those three great representative Englishmen whose names appear on the title-page of the work before us. Dr. Stirling's opinions are entitled to be heard, and carry great weight with them. He is a lucid and agreeable writer, a profound metaphysician, and by his able translations from the German has proved his grasp of mind and wide acquaintance with philosophical speculation."—*Examiner.*

Songs of the Seasons.

By THOMAS TOD STODDART, Author of 'The Angler's Companion.' Crown 8vo, price 6s.

Christ the Consoler;

Or, Scriptures, Hymns, and Prayers, for Times of Trouble and Sorrow. Selected and arranged by the REV. ROBERT HERBERT STORY, Minister of Roseneath. Fcap. 8vo, price 3s. 6d.

Recollections of Professor John Duncan.

By the Rev. A. MOODY STUART. Uniform with 'Colloquia Peripatetica.' Fcap. 8vo, cloth, price 3s. 6d.

Outlines of Scottish Archæology.

By REV. G. SUTHERLAND. 12mo, sewed, profusely Illustrated, price 1s.

Works by the late Professor Syme.

OBSERVATIONS IN CLINICAL SURGERY. Second Edition. 8vo, price 8s. 6d.

STRICTURE OF THE URETHRA, AND FISTULA IN PERINEO. 8vo, 4s. 6d.

TREATISE ON THE EXCISION OF DISEASED JOINTS. 8vo, 5s.

ON DISEASES OF THE RECTUM. 8vo, 4s. 6d.

EXCISION OF THE SCAPULA. 8vo, price 2s. 6d.

Taine's History of English Literature.

A New and carefully revised Library Edition. In 4 vols., small demy 8vo, price 7s. 6d. each. [*Vol. I. immediately.*

Taine's History of English Literature.

Translated from the French by HENRI VAN LAUN. Third edition. 2 Vols. demy 8vo, price 21s.

⁂ Copies of Vol. ii., Second Edition, may still be had to complete sets.

"'Taine's History of English Literature' shows a sounder appreciation of the spirit of our literature, and is a better exponent of its growth from stage to stage, and of the minute characteristics of each stage, than any of the numerous summaries and outline histories that have been produced by Englishmen . . . . Of the general method pursued by M. Taine in this work we cannot speak too highly. . . . We are bound to bear testimony at once to the very great ability with which M. Van Laun has translated the work."—*The Examiner.*

"Taine's short chapter on Chaucer is thoroughly well worth reading. . . . His chapter on our dramatic literature is particularly noteworthy. . . . A better exposition of the nature and ramifications of Shakspeare's genius could hardly be looked for within the limits of a moderately short chapter."—*The Examiner.*

"M. van Laun has done a difficult task admirably well, by translating into the English of a scholar one of the most brilliant books that France has produced for years. . . . . The analysis of a consummate critic and a brilliant rhetorician . . . with as true a sympathy as if all his life he had breathed the intellectual air of England."—*The Spectator.*

Thermodynamics.
By P. G. TAIT, Professor of Natural Philosophy in the University of Edinburgh. 1 vol. 8vo, price 5s.

Day-Dreams of a Schoolmaster.
By D'ARCY W. THOMPSON. Second Edition. Fcap. 8vo, price 5s.

Sales Attici:
Or, The Maxims, Witty and Wise, of Athenian Tragic Drama. By D'ARCY WENTWORTH THOMPSON, Professor of Greek in Queen's College, Galway. Fcap. 8vo, price 9s.

Two Little Rabbits, or the Sad Story of Whitetail.
By G. A. DALRYMPLE. With 8 Illustrations. Square 18mo, price 1s.

Hand-Book of the Education (Scotland) Act, 1872.
Containing—I. A digest of the Act, with subjects grouped for the convenience of School Boards. II. Copy of the Act, with Explanatory Notes. III. The Incorporated Acts, Industrial Schools' Act, etc., and Index. By JAMES TOD, Advocate. Fourth Edition. Crown 8vo, price 2s. 6d.

Twelve Years in China:
By a British Resident. With coloured Illustrations. Second Edition. Crown 8vo, cloth, price 10s. 6d.

Travels by Umbra. 8vo, price 10s. 6d.

Hotch-Pot.
By UMBRA. An Old Dish with New Materials. Fcap. 8vo, price 3s. 6d.

The Merchant's Sermon and other Stories.
By L. B. WALFORD. 18mo, price 1s. 6d.

"A volume of very modest appearance which deserves more than the brief notice for which we can find space. The four tales it contains are all pleasant and spirited little stories. The last of these, 'Dolly Spanker's Green Feather,' is really admirable."—*Spectator.*

A History of the Battle of Bannockburn, fought A.D. 1314.
With Map and Armorial Bearings, and Notices of the principal Warriors who engaged in that Conflict. By ROBERT WHITE, Author of 'A History of the Battle of Otterburn.' 1 vol. 8vo, price 12s.

Dante's—The Inferno.
Translated line for line by W. P. WILKIE, Advocate. Fcap. 8vo, price 5s.

Researches on Colour-Blindness.
With a Supplement on the danger attending the present system of Railway and Marine Coloured Signals. By the late GEORGE WILSON, M.D. 8vo, 5s.

An Historical Sketch of the French Bar, from its Origin to the Present Day. By ARCHIBALD YOUNG, Advocate. Demy 8vo, price 7s. 6d.

"A useful contribution to our knowledge of the leading French politicians of the present day."—*Saturday Review.*