A MANUAL

OF

VETERINARY THERAPEUTICS AND PHARMACOLOGY

BY

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PREFACE.

THE following work is intended as an introduction to the important and extensive subject of veterinary therapeutics and pharmacology. It is divided into three parts.

Part I. is introductory, and deals in a concise manner with the subjects of diagnosis and the general symptoms of disease in relation to therapeutics; the actions and uses of medicinal agents are also briefly noticed in a general manner.

Part II. is devoted to general therapeutics, and in it the author has followed the plan adopted by Dr. Mitchell Bruce in his excellent work on 'Materia Medica and Therapeutics,' viz., that of discussing the actions and uses of remedies under the physiological systems of the body.

Part III. deals with special therapeutics, and here again the author has arranged the actions of drugs on the plan adopted by Dr. Mitchell Bruce, which consists in discussing their actions from their first contact with the body, to their effects on the various organs and tissues until they become eliminated.

By this method the student is enabled to thoroughly understand the specific actions of medicinal agents and their rational employment in the treatment of disease.

The author has endeavoured as far as possible to group together those drugs possessing a similarity in action, and he ventures to hope that this method will be found preferable to following them according to their natural orders or alphabetically. Toxicology has only been briefly touched on whenever necessary, and for further information on this subject the student is referred to more pretentious text-books.

Only an outline of the preparation of drugs has been given, and botanical characters, impurities, etc., are purposely omitted, as the author does not consider these matters of importance to the veterinary student of the present day, whose time has already sufficient demands upon it in mastering the action of drugs and their employment in the treatment of disease.

The wholesale chemists have relieved both practitioners and students of a vast amount of trouble by preparing drugs in a reliable manner, and our time and energies are now more usefully employed in endeavouring to keep pace with the ever-increasing discoveries in the science of therapeutics.

A special chapter has been devoted to 'Anæsthetics' in consequence of the importance of this subject in the present day, and in it the author has given the results of practical observation with reference to the employment of chloroform in veterinary surgery.

In the Appendix some practical information is given on the subject of prescribing and dispensing, together with examples of prescriptions, which it is hoped will prove of some assistance to the student.

The author gratefully acknowledges the valuable assistance which he has received in the preparation of this work from Professor J. Macqueen, Royal Veterinary College, London; also from Professor F. Smith, A.V.D., Army Veterinary School, Aldershot. He has also to express his indebtedness to Professor W. Williams, Principal of the New Veterinary College, Edinburgh, for sound and rational teaching on all details of therapeutics received both as a student from his able lectures and from his eminent works on veterinary medicine and surgery.

The author is fully aware of the many omissions and imperfections which must of necessity exist in a work of this kind, in consequence of the limited time at his disposal for reference and research, and he hopes that the attempt may stimulate some abler hand to complete the task.

If it should prove of assistance to the veterinary student in commencing the consideration of an important and often difficult subject, and thus indirectly serve the profession even to a slight degree, the author will feel that his efforts have been amply rewarded.

18, Cook Street, Cork,
December, 1894.

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CONTENTS.

CHAPTER IV.

ON PRESCRIBING.

PART II.

GENERAL THERAPEUTICS.

CHAPTER I.

INTRODUCTORY.

CHAPTER II.

DIGESTION—THE MOUTH.

CHAPTER III.

DIGESTION—THE STOMACH.

CHAPTER IV.

ON VOMITION.

CHAPTER V.

DIGESTION—THE INTESTINES.

CHAPTER VI.

ON ENEMATA.

CHAPTER VII.

THE LIVER.

CHAPTER VIII.

THE BLOOD.

CHAPTER IX.

METABOLISM, OR THE PROCESS OF NUTRITION.

CHAPTER X.

THE CIRCULATORY SYSTEM.

CHAPTER XI.

THE RESPIRATORY SYSTEM.

CHAPTER XII.

THE NERVOUS SYSTEM.

CHAPTER XIII.

THE KIDNEYS.

CHAPTER XIV.

THE BODY HEAT AND ITS REGULATION; THE SKIN.

CHAPTER XV.

THE THERAPEUTICS OF THE SURFACE OF THE BODY.

PART III.

SPECIAL THERAPEUTICS.

CHAPTER I.

INTRODUCTORY.

CHAPTER II.

THE INORGANIC MATERIA MEDICA.

CHAPTER III.

INORGANIC MATERIA MEDICA—*continued.*

CHAPTER IV.

INORGANIC MATERIA MEDICA—*continued.*

CHAPTER V.

INORGANIC MATERIA MEDICA—*continued.*

PAGE

CHAPTER VI.

THE CARBON COMPOUNDS.

CHAPTER VII.

THE CARBON COMPOUNDS—*continued.*

CHAPTER VIII.

THE CARBON COMPOUNDS—*continued.*

CHAPTER IX.

THE VEGETABLE KINGDOM.

CHAPTER X.

THE VEGETABLE KINGDOM—*continued.*

CHAPTER XI.

THE VEGETABLE KINGDOM—*continued.*

CHAPTER XII.

THE VEGETABLE KINGDOM—*continued.*

CHAPTER XIII.

THE VEGETABLE KINGDOM—*continued.*

CHAPTER XIV.

THE VEGETABLE KINGDOM—*continued.*

CHAPTER XV.

THE VEGETABLE KINGDOM—*continued.*

CHAPTER XVI.

THE VEGETABLE KINGDOM—*continued.*

CHAPTER XVII.

THE VEGETABLE KINGDOM—*continued.*

CHAPTER XVIII.

THE VEGETABLE KINGDOM—*continued.*

CHAPTER XIX.

THE ANIMAL KINGDOM.

APPENDIX.

VETERINARY PHARMACY.

CORRIGENDA.

Page 36, line 8, for 'Intertracheal' read 'Intratracheal.'
Page 226, line 14, for 'p. 293' read 'p. 296.'
Page 226, line 15, after 'Sodii Salicylas' add '(see p. 510).'
Page 226, line 16, after 'Sodii Hypophosphis' add '(see p. 275).'
Page 236, line 2 from bottom, for 'p. 276' read 'p. 275.'
Page 251, after line 15 add '(see p. 370).'
Page 291, last line, after 'dithio-salicylic acid' add '(See p. 513).'
Page 374, line 10, for 'intertracheal' read 'intratracheal.'

VETERINARY THERAPEUTICS

AND

PHARMACOLOGY

PART I.

CHAPTER I.

INTRODUCTORY.

VETERINARY therapeutics is the subject which relates to the treatment of disease in the domesticated animals.

Taken in its wide sense, it would include all the means at our disposal in our efforts to combat disease and effect as early a restoration to health as possible. Thus, the subject would embrace, in addition to the various drugs which we employ, the details of hygiene and all that concerns the care of animals affected by disease, which are most important and vital adjuncts in treatment, and without a knowledge of which we cannot expect medicinal agents to be of service.

The student must, first of all, be familiar with animals in a state of health before he can recognise the changes produced by disease, and appreciate those symptoms which will lead him to a correct diagnosis and to rational treatment. He must become familiar with the actions of the various drugs on the different organs of the body in a state of health before he can apply them in the treatment of disease.

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It will not be sufficient for him to prescribe remedies in one case because similar remedies happened to afford relief in another case of the same nature; he must reason out the *rationale* of how each medicinal agent acts, and treat every case on its merits, according to the indications which are placed before him.

The student must also recognise what is termed the *vis medicatrix naturæ*, or the power of nature to cure disease, and by appreciating this power he will learn that the groundwork of rational treatment consists in helping the efforts of nature as much as possible, and using no means or remedies which are likely to frustrate them.

He will also, as he studies the effects of the different medicinal agents clinically, be often struck by the fact that in many cases where a certain curative effect is ascribed to the use of a particular drug, it was in reality nature that caused the so-called cure.

It will also be apparent to him that there are very few diseases which we can directly act on by means of medicinal agents, and bring about what is termed a *cure;* in the majority of instances we treat the secondary effects rather than the primary disease.

Take, for instance, a case of pneumonia. Here we cannot act directly on the lung, so as to shorten the course of the disease—we know that it must run a definite course — and our efforts are directed to keep up the strength of the patient, and to combat any complications which may arise as best we can.

We pay special attention to the character of the pulse, to the temperature, and to the respiratory movements, and also to the digestive system, and by every means possible endeavour to promote the appetite and tempt the patient to partake of nourishing and easily digested food. The veterinary therapeutist is placed at great disadvantages as compared with his confrère in human medicine. The latter has only the individuals of his own species to deal with; he can form his diagnosis both on information derived from the patient himself, termed *subjective* symptoms, and also on the symptoms which he observes by an examination of the patient, termed *objective* symptoms.

The veterinary therapeutist, on the other hand, has patients to deal with which, being incapable of the powers of speech, cannot afford him anything in the way of subjective symptoms.

All his efforts must be directed to the observation of objective symptoms, to appreciate which correctly requires a long period of study, and careful training combined with zealous clinical study. He has to treat different species of animals, each requiring careful study, in order to make his general therapeutical knowledge applicable to the peculiarities which exist in the different animals. Thus, to treat the diseases of cattle in a rational manner requires a similar clinical training to that required in the diseases of horses, and the same may be said with reference to the diseases of dogs.

He has also often to depend on the history of a case from attendants either very ignorant or unreliable, and, as a rule, anxious to shield themselves from blame or responsibility; and, as often occurs, the remedies he prescribes and the instructions given are not carried out in a satisfactory manner.

In veterinary practice we also find that cases are not often brought for treatment until the disease is well established, either by reason of its existence not having been noticed in the early stages, or because the owners or attendants have been trying remedies themselves, such remedies being often irrational and injurious to the patients.

It must be clearly impressed on the student that no amount of knowledge derived from text-books or lectures will enable him to treat diseases in their various phases in a satisfactory manner; he must combine careful clinical study with theory, and never fail to watch the course of a case attentively, and to note the signs of improvement and the effects of the medicinal agents employed.

He must also cultivate his powers of observation in order to be able to notice any changes which may occur in the condition of a patient during the course of an affection, and also to correctly note the presence of diagnostic symptoms during his examination of a patient.

We have now to consider the meaning of the term *Pharmacology*.

In former times this term referred to the preparation and source of the various drugs, as well as to a consideration of their chemical and physiological actions. It is now generally recognised as referring to the action of the various drugs on the different organs of the body in a state of health.

The subject of *Materia Medica* will teach the student the sources of each drug, its technical name, its formula, its properties, the preparations made use of by the therapeutist, its impurities, the substances with which it is compatible or incompatible, and its doses for the various animals. In this work it is not intended to notice the subject of materia medica further than to give the technical name of each drug, its source, the preparations of the drug which are in use in ordinary practice, and the doses for the different animals.

We shall also notice those drugs concerning which we are in possession of certain definite facts with reference to their physiological action, and, as a result of this knowledge, of their application in the treatment of disease.

We shall find that there are medicinal agents in use which we cannot explain in a satisfactory manner as to their therapeutical action; we know by experience that they produce certain results, but the manner in which they produce these results is not at all clear. The number of such agents, we shall find, is gradually decreasing as our knowledge of pathology is increasing.

In addition to our consideration of the actions and medicinal uses of the various drugs employed in the treatment of disease, we have to notice some of the major details of hygiene, and the important points in connection with the care of sick animals.

As a result of our knowledge, gained from a consideration of the special actions and uses of each drug, we are enabled to collect certain facts and principles, and these are classed under the heading of *General Therapeutics*. We can also class a certain number of drugs which resemble each other in their actions under separate headings, but we shall find, in many instances, that drugs have actions which entitle them to be placed under more than one heading, and such actions will vary according to the doses given. *Toxicology*, which treats of the effects of the various poisons in the system, with the post-mortem appearances and the antidotes, will receive a brief notice in Part III., in the separate description of each agent.

In the next chapter we shall consider the subject of *Diagnosis and the General Symptoms of Disease*.

CHAPTER II.

DIAGNOSIS AND THE GENERAL SYMPTOMS OF DISEASE.

The first essential in the rational treatment of disease is a correct *diagnosis*, and if, from the obscurity or non-development of the symptoms, at our first examination of the patient, this is impossible, we have then to direct our efforts to the treatment of whatever symptoms present themselves. The art of diagnosis consists in arranging the *symptoms* presented into signs of disease; or, in other words, we come at the true origin of the symptoms, which we term *the cause.*

We have to consider that there are some symptoms which are so characteristic to the practised eye that by recognition of them we can distinguish one disease from the other. Such are termed *diagnostic symptoms.* If a set of symptoms are peculiar to a certain disease, they are termed *pathognomonic.*

We have also to notice what are termed the *general symptoms of disease,* which are those changes occurring in many and varied diseases, and which, in conjunction with diagnostic symptoms, lead us to a correct diagnosis, and also enable us to judge of the condition of the patient and the indications for treatment.

They are the first phenomena looked for in the examination of a patient, and in the absence of diagnostic symptoms they give us valuable information with reference to primary indications for treatment, and are also of vital importance during the course of long and severe affections.

Thus we have symptoms connected with (1) *the condition of the pulse;* (2) *the visible mucous membranes;*

(3) *the temperature;* (4) *the respiratory functions;* (5) *the surface of the body;* (6) *the secretions* and *excretions.*

All these will merit a short consideration; but before proceeding to this we shall have to briefly notice the value of a *correct diagnosis* in the treatment of disease as compared with the indications afforded by the symptoms.

We must be cognizant of the fact that there are many affections presenting symptoms to our notice, which symptoms do not indicate to us the true nature of the disease; or, in other words, if we were to endeavour to treat the affection by acting on the symptoms, we should not be successful.

We meet with cases where the symptoms presented would lead us to infer that a certain organ, or set of organs, are affected by disease, whereas in reality, by means of reflex action and other causes, the symptoms arise from a different system of organs altogether.

Take, for example, a case of a dog affected with intestinal parasites, or foreign bodies in the stomach, and we often find symptoms which, without careful consideration, we would ascribe to a brain affection. Obviously, to treat the brain symptoms would be of little value, as the cause would be still at work; we must in all cases endeavour to ascertain the cause when possible, and our efforts will then be directed to remove it. Or, again, take a case of functional disorder of the heart, arising from indigestion or from parasites in the alimentary canal. Here it would be useless to try and treat the disorder of the heart; we must endeavour to ascertain the cause, and act on this as much as possible. Or take that affection in horses known as diabetes insipidus, where the animal is affected with constant thirst, and is continually passing urine. Here, along with the use of medicinal agents, we have to inquire after the quality of the food, and change it, as the affection is in reality due to deleterious changes in the food.

Many other instances might be cited of the same nature, such as a cough, depending on indigestion or various other causes, which must be treated according to its source; then we have cases of derangement of the digestive system, due to dental irregularities, etc. But sufficient examples have been shown to demonstrate to the student how careful he should be in ascribing any symptom, or set of symptoms, to their real cause, and along with a physical examination of the patient to form a correct diagnosis.

But we have to consider that there are many instances brought under the notice of the practitioner in which it is not possible at the time to form a correct diagnosis, either from the obscurity of the symptoms or from non-development of diagnostic symptoms.

Thus, take a case of that common affection termed influenza.

In one case we have presented to us the occurrence of rigors, with staring coat and coldness of the extremities; in another case we have weakness of the hind extremities and general muscular debility, etc.

We find the temperature is 104° or 105°, pulse and respiration accelerated, accompanied by almost total loss of appetite. But these are symptoms common to many affections; we cannot predict what organs will become affected in a day or so; either pneumonia, bronchitis, or pleurisy may supervene, the presence of which we shall be able to ascertain by a physical examination of the chest. What, then, are the indications for the therapeutist?

Obviously it would not be wise to defer treatment until he can be sure of a correct diagnosis.

He is quite well aware that such affections must run a definite course, and that, whatever organs may eventually become attacked, he must have two ends in view:

1st. To overcome the rigors, when such exist, by the administration of diffusible stimulants, so as to divert the circulation to the cutaneous vessels, and thus avoid a tendency to internal congestions.

2nd. To reduce the abnormal temperature by the administration of febrifuges, and to attend carefully to hygienic and dietetic measures.

Again, take cases where the prominent symptom is the manifestation of pain. We see this symptom in a great variety of affections; thus, it occurs in simple colic, in enteritis, in peritonitis, in volvulus, in affections of the stomach, and also in pleurisy, nephritis, etc.

The experienced practitioner judges by the character of the pain of its probable cause, but in many instances in the primary stages this is not possible; and in others such a variety of symptoms present themselves that it is only in the postmortem examination he sees how much in error he may have been in his diagnosis.

All his efforts must be directed in such cases to the alleviation of the pain, as continued pain exerts such a depressing influence on the whole system as to quickly lead to a fatal result. In cases of acute enteritis, volvulus, etc., which are usually fatal, all that the therapeutist can do is to administer anodynes, with a view to alleviate the agonizing pain, as curative results are seldom possible.

Even if he were to form a correct idea of the nature of the affection on which the pain depended in such cases, his treatment would not be altered, and in reality it is the symptom which he endeavours to combat, and not the cause.

But in cases of simple colic and affections of the stomach, such as acute indigestion, etc., also in cases where pain exists in systems other than the digestive, such as pleurisy, nephritis, etc., he is enabled more readily, by studying other symptoms presented, to form a diagnosis, and to bring to his assistance valuable aids in the way of therapeutic agents.

Thus, in the case of simple colic, depending on a spasmodic contraction of the muscular coats of the intestines, due to the presence of irritating ingesta, it is clear that, in addition to relieving the pain, we should also direct our efforts to the removal of the cause by the administration of mild purgatives, such as ol. lini, and also by the administration of enemas. Such remedies will remove the source of irritation and thus prevent a recurrence of the pain.

In the other instances stated, appropriate treatment must be adopted in addition to the alleviation of the existing pain. Thus, in the case of affections of the urinary system accompanied by pain, we have to bring to our aid a chemical and microscopical examination of the urine, in addition to a careful observation of the symptoms presented, before we can form a correct diagnosis and prescribe suitable treatment.

In the majority of cases of affections of the respiratory system, the practitioner has to depend more on treating the general symptoms which present themselves, instead of endeavouring to act directly on the organs affected. The pulse and temperature will require careful watching, and the strength must be kept up by stimulants if necessary, and by tempting the animal to partake of nourishing and easily digested food.

The irrational treatment of former days, viz., by administering sedatives and by blood-letting, etc., combined with severe counter-irritation, and pouring quantities of fluid foods down the animal's throat, can only be ascribed to a prevalent idea that the course of the disease could be cut short by the adoption of such measures.

In considering the subject of the general symptoms of disease, the student will find much scope for reflection. As previously remarked, such symptoms cannot by themselves lead him to a correct diagnosis, but they afford him valuable indications as to the condition of the patient, and as a guide to the adoption of therapeutic measures during the course of febrile affections.

We shall first consider the indications afforded by a study of the character of

The Pulse.

As we are aware that the pulse is an index of the condition of the heart, and that so long as the action of the heart is maintained we have life in the animal, we see at once the great importance of the character of the pulse to the therapeutist.

It is essential that the student should make himself familiar with the character of the healthy pulse in the different animals, so as to be able to appreciate the changes induced by disease. He should carefully note its tension, its regularity, its volume, before he proceeds to study the alterations presently to be described.

The pulse is usually regarded as the wave which is sent through the arterial system with each contraction of the heart.

Its character depends on the condition of the heart itself, and also on the condition of the walls of the blood-vessels, and the quality and quantity of the blood itself. Depending on so many circumstances, we cannot be surprised at observing how easily its character may be modified, and when we regard the wonderful mechanism by which the heart is controlled, we must be aware that, in order to draw correct conclusions, a very close and careful examination will be required.

If the heart is affected by organic disease, then it is palpable that the pulse will be altered in character according to the parts of the organ affected. If the walls of the arterial vessels are relaxed, the blood will pass more easily into the veins, and, as a result, the arterial tension will be slight, and the pulse will feel soft and compressible, and also large. The pulse-wave may become exaggerated, and may be mistaken for an extra pulse-beat, such a condition being termed *dicrotism.*

If the quantity or quality of the blood itself be altered, there will also be a change in the character of the pulse. Thus plethoric animals generally, but not always, have a strong, full pulse.

Then, in certain diseases, such as *purpura hæmorrhagica* in horses and *red water* in cattle, the quality of the blood is deteriorated, and the pulse may be found fluttering or trembling, appearing to have a double beat, with the artery relaxed. So that the student will clearly see the great possibility of a grave error in diagnosis, if he were to depend on the character of the pulse alone, without taking other symptoms into consideration.

There is a common tendency to ascribe many cases where irregularity or intermittency in the pulse-beats occurs to be due to cardiac affection, whereas we often find the disorder to be functional, and depending on derangements of the digestive organs or nervous affections.

The normal standard of the pulse of the horse is generally stated to be 40 beats per minute, but this is subject to variation as regards nervous temperament, excitement, etc.

In cattle the pulse cannot be regarded as a reliable guide, as even the act of approaching the animals will be sufficient to cause increased pulsations, as also does the act of rumination.

The pulse of the dog varies, according to the size and breed of the animal, from 80 to 100 per minute, and, in judging of its character, it is essential that the animal be not excited in any way, and be quietly approached and handled.

The varieties of the pulse which are found in veterinary practice require for their appreciation careful clinical study. The following varieties are recognised:

1. The frequent pulse, or its reverse, the infrequent pulse.
2. The quick pulse, or its reverse, the slow pulse.
3. The large and the small pulse.
4. The compressible and the incompressible, also termed the hard and the soft pulse.

1. **The Frequent Pulse** is referable to the number of beats in a given time.

As previously remarked, this number may vary within certain limits in individuals of different temperaments.

Exercise or excitement will cause a frequent pulse, which will return to normal when the animal becomes passive.

Again, excessive repletion of the digestive organs will increase the frequency of the pulse, and we find in the various fevers and in inflammations of visceral organs that the frequent pulse is usual in the primary stage.

Moderate blood-letting will increase the frequency of the pulse-beats; excessive blood-letting causes extreme frequency, which is also found in diseases characterized by great prostration and debility.

The Infrequent Pulse is often associated with slowness it is found in cases of brain disorders, in some disordered conditions of the digestive system, in diseases in which changes in the blood occur, and sometimes in cases of fatty degeneration of the heart.

2. **The Quick Pulse.**—In this variety each beat occupies less than the usual time, although the whole number of pulsations in a given time may not be increased. It depends on the mode of contraction of the ventricles.

It is found in cases where there is great increase of nervous irritability, and also in some cases of valvular disease of the heart.

The Slow Pulse is the reverse of the quick pulse. In it there is a slower contraction of the ventricles.

3. **The Large Pulse** is that form in which the volume is greater than usual. It depends on various conditions, and may occur either with strength or with feebleness of the pulsations.

Thus, we may have the artery full in volume, but the pulsation feeble, the impulse weak, and the artery yielding to the pressure of the finger.

We find such a condition in cases of severe pulmonary congestion. Here the fulness of the artery is palpable, but the pulsations are weak, due to excessive congestion of the pulmonary vessels. This has been termed the 'oppressed pulse,' and it is benefited by a moderate abstraction of blood, which relieves the overgorged vessels.

The Small Pulse is that form in which the volume is smaller than usual; it may arise from feeble action of the heart, from anæmia, or from excessive tonicity of the arterial coats.

4. **The Hard Pulse** arises from contraction of the muscular coat of the arterial walls. In this condition the artery is incompressible to the touch, and when associated with smallness of the pulse it is termed 'wiry,' or 'thready.'

We find this character in the early stages of inflammations of serous membranes, such as pleurisy, peritonitis, etc.

In affections which are ushered in by rigors, we find the pulse, in the first stages, small and hard, the arteries being in a state of contraction.

In the second stages, sometimes called the *acme* of the affection, when the fever is established, the pulse changes its character, the arterioles relax, it becomes larger, but not yet being weakened, it is large and full.

When the disease exhausts the patient, the pulse becomes softer, more compressible, and short and feeble.

Sometimes the hard pulse is associated with largeness, as in laminitis, which pulse is described as quick, full, and bounding.

The Soft Pulse presents several varieties.

The small, soft pulse is found to occur towards the end of slow, exhausting diseases; the tension of the arteries is small, the impulse of the heart weak, and the amount of blood propelled at each ventricular contraction is deficient. We may also find this condition in some cases of anæmia.

Strength and Weakness of Pulse.—For the purposes of diagnosis, prognosis, and the indications for treatment, it is important for the student to distinguish *strength* of pulse from a *full but feeble pulse*.

In a strong pulse the impulse is vigorous; there is continuous resistance to pressure, and a certain amount of fulness.

On the other hand, we may find the pulse *full* but *feeble* at the same time, which is generally associated with slow action of the heart and relaxation of the arterial coats.

Intermittent Pulse.—In this form of pulse an occasional beat is missed. This may occur at regular periods and often, or at irregular periods. We must be careful to distinguish between an intermittent and an *irregular pulse.* In the latter form the beats differ in length, force, and character; it is a far more serious condition, being generally due to cardiac disease.

An intermittent pulse may be due to individual idiosyncrasis, or may arise from indigestion or from nervous and functional diseases.

It may be compatible with perfect health, and there are many animals with an intermittent pulse which never seem to be affected by it in any way.

Having concluded this brief description of the varieties of pulse usually met with, we have now to consider the indications which these various forms give to the therapeutist. It is obvious, as previously remarked, that he cannot be too careful to avoid haste in his diagnosis, by relying on the character of the pulse, and that he has to take other symptoms into consideration in addition, if he is to ascribe the altered conditions to their real cause and prescribe suitable treatment.

Thus, in the quick full pulse which usually accompanies sthenic diseases, such as laminitis, the use of sedatives and febrifuges will be indicated, such as tr. aconiti, etc., while in the full soft pulse found in the febrile stage of respiratory affections we must be careful to avoid the depleting effects of sedatives, knowing well the debilitating nature of such diseases, and how quickly the pulse may assume a weak character.

Again, if we find a frequent small and compressible pulse, it indicates the administration of alcoholic stimulants, which have the effect of strengthening the weakened heart, reducing the frequency of the beats, and lessening the compressibility of the bloodvessels.

In the various forms of pulse found in cardiac affections, both functional and organic, we shall find the use of different agents indicated, depending on the stage of the affection and its nature. We shall have to consider when stimulants are indicated, or the reverse; also the indications for sedatives, and the value, uses, and indications for heart tonics, such as digitalis.

In the treatment of functional disorders of the heart, it is essential that we come to a correct conclusion as to their cause, whether due to derangements of the digestive organs or to nervous affections.

All these conditions will require appropriate treatment, and also attention to dietetic measures.

Symptoms connected with the Condition of the Visible Mucous Membranes.

To observe these symptoms we examine the Schneiderian mucous membrane, the mouth, the tongue, and the conjunctiva. We glean very valuable assistance from such an examination, both with regard to the condition of the patient and as an aid to diagnosis.

The Schneiderian mucous membrane, in a state of health, is of a palish-red or carnation colour, which also is the condition of the conjunctiva.

This condition may be altered by a variety of circumstances; thus, severe exercise or excitement will cause increased redness and vascularity, independent of any disease.

In cases of venous engorgement and imperfect aeration of the blood, we find a dark, dusky hue present. In cases of acute inflammatory affections, such as enteritis, we find deep congestion present.

When the liver is not performing its functions, either from derangement or structural changes, and the bile pigment is either not removed from the blood or is reabsorbed, we find a yellow tinge in the visible mucous membranes. In depraved conditions of the blood, such as exists in purpura hæmorrhagica there is noted the presence of petechial spots in the visible mucous membrane. In anæmia a condition of *pallidity* is found, and in hæmorrhage this pallidity occurs suddenly.

A slate-coloured appearance of the Schneiderian mucous membrane is found to exist in cases where the poison of glanders is present in the system, and it is in this membrane that the characteristic ulcers appear.

The condition of the buccal mucous membrane also merits our attention. In cases of indigestion and dyspepsia we find it foul and soapy, the tongue sometimes being furred, especially in the dog.

This membrane is found dry in cases of febrile and inflammatory affections, and excessively moist, due to an over-supply of saliva, in cases of irritation of the mouth and fauces. A similar condition is found to exist in irregularities of the teeth, and also where irritating medicines have been administered without proper dilution.

The Temperature.

As an aid to diagnosis, and as an indication to the therapeutist of the condition of his patient and his progress during the course of a febrile affection, too much importance cannot be attached to the information gained by the use of the clinical thermometer. In the primary stages of many affections we are enabled to recognise the serious condition of the patient, and prescribe suitable treatment before complications manifest themselves.

In some serious contagious diseases, we are enabled to recognise the existence of the specific virus in the system before diagnostic symptoms appear, *e.g.*, pleuro-pneumonia contagiosa in cattle, and glanders in horses in the chronic form. Again, during the course of a febrile affection, with acute inflammation of important organs, by paying close attention to the temperature in conjunction with other symptoms, we can judge with tolerable accuracy of the condition of our patient, and the results of our treatment.

We know that when the temperature remains high the patient is in a serious condition, and we can also recognise the occurrence of a relapse during the progress of a disease by the appearance of a sudden rise in the temperature. In extensive surgical operations and in severe wounds, the temperature is also a useful guide, giving us an indication of the extent of irritative fever which may be present.

The normal temperature of the horse may on an average be stated as 100·4°, but this is liable to variations in a small degree. It is higher in young than in adult animals, and in the very aged it may be found below the average.

During the course of febrile affections, the temperature is as a rule higher in the evening than in the morning, and when possible, it is advisable that two daily observations be taken.

Fever.—Under the term fever are included many concomitant phenomena besides the abnormal rise in temperature, such as changes in the character of the pulse, the respirations, the secretions and excretions, the nervous system, these changes varying in degree according to the nature of the affection of which the fever is but either a precursor or an accompanying symptom. We have also to recognise that fever may follow the performance of operations, or may occur as a result of wounds, when it is termed *irritative fever.*

Simple Fever.—That we have in the horse the occurrence of fever, unconnected with any appreciable change in internal organs, and arising independently of any accompanying affection, we are perfectly well aware as a result of experience. Such a condition we term *simple fever*. It is essentially a disturbed state of the majority of the chief functions of the body, arising from causes which we are not able to explain in a satisfactory manner.

Various causes are suggested, such as sudden variations in temperature, fatigue, sudden changes in hygiene and dietetics.

We must, however, recognise that many such cases of simple fever, if not treated in a rational manner, or if the patients are kept at work, may develop into far more serious affections, with perhaps inflammatory changes in internal organs.

The subject of fever will be again noticed under the section dealing with *General Therapeutics*.

Symptoms connected with the Respiratory Functions.

When we consider the frequency of diseases of the respiratory system in the equine species, and the variety and importance of such affections, we see the necessity for a careful study of the symptoms under this heading.

There is a close relationship between the functions of respiration and circulation in health, the proportion being about one respiration to three or four pulsations; thus, taking the average pulse of the horse at about 40 per minute, the respirations would be from 12 to 15 in the same time.

This relationship does not exist in the bovine species, especially during rumination, when the pulse may rise to 70 or 80 per minute, while the respirations may be about 10.

During exercise or exertion in a state of health this relationship is generally maintained. Thus, if the circulation be increased, there is a larger amount of blood passing through the lungs requiring aeration, which is provided for by an increase in the number of respirations.

But as a result of disease this relation is disturbed, and we may have an increase in the number of pulsations out of all proportion to the number of respirations, or the respirations may be greatly increased without a corresponding increase in the pulsations.

The indications afforded to the therapeutist by changes in the character of the respirations are various and important, but we have to remember that they are not always diagnostic of respiratory affections. Thus, we may have accelerated respirations or difficult breathing in many acute diseases, due to either an altered condition of the blood or perverted functions of the nervous system.

We have acceleration of the respirations in cases of enteritis, peritonitis, volvulus, etc., also in many cases of cardiac affection.

A consideration of other symptoms, together with a physical examination of the chest, will lead us to ascribe the changes in the character of the respirations to their true cause.

We may inquire as to the causes of this alteration in the character of the respirations, or, as it is termed when severe, *dyspnœa.*

These causes are various, and depend upon the structures involved by the disease. Thus, in pleurisy, in the first stages we have pain, which limits the movements of the thoracic walls, and hence impedes the respiratory movements. In the later stages, when there is effusion into the chest cavity, there is mechanical resistance to the entrance of air to the lungs. In pneumonia and bronchitis we have the exudation causing interference with the passage of the air, and hence increased respiratory movements are required. In affections of the larynx there may be extreme dyspnœa, from its calibre being diminished, etc.

There are certain varieties of breathing which we may observe in different affections, which are of great importance as aids to diagnosis.

1. **Abdominal Breathing.**—In this variety we find that the animal endeavours to limit the movements of the thoracic walls as much as possible, and these movements are made up by the action of the abdominal muscles being brought into play; the ribs being fixed as much as possible, there is the appearance of a hollow line extending along the lower borders of the false ribs from the sternum to the anterior spine of the ilium.

Such a condition is found to exist in cases of pleurisy and hydrothorax, the respirations being performed quickly and incompletely.

2. **Thoracic Breathing.**—In this variety the abdominal muscles are kept in abeyance as much as possible, and extra movements of the thoracic walls have to make up for the deficiency.

This condition is observed in cases of flatulent colic, ascites, peritonitis, and in extensive abdominal tumours.

Another variety of respiration met with is that termed *irregular*. We find it occurring in that affection termed 'broken wind,' where the inspiratory movement is performed rapidly and in a jerky manner, whilst the expiratory is performed slowly and with a double action, especially of the abdominal muscles.

We have also to notice that symptom termed a *cough*.

A cough, although a very trivial matter in some cases, is a very important one in others. It occurs as a symptom of respiratory affections, being then generally due to some irritation of the larynx, bronchial tubes, etc., and an effort is made to remove the source of this irritation, which effort is generally involuntary.

A cough, however, may depend on other causes than irritation of the air-passages; thus, we may have a cough present in cases of indigestion, intestinal parasites, etc., such a form being termed *sympathetic.*

There are many varieties of cough met with, all being of interest to the therapeutist as an aid to diagnosis.

The Moist Cough is met with in the secondary stages of catarrhal affections, and indicates that there is an increased secretion of mucus, etc.

The Dry Cough presents several modifications.

It is present during the first stages of catarrhal affections, when the secretion of the mucous follicles is arrested.

In cases of pleurisy the dry cough becomes short and painful, the forced expiratory movement causing pain.

In that affection termed *broken wind* there is a characteristic dry cough, which is short, shallow, and suppressed, and usually single.

The Chronic Cough varies in intensity, and presents modifications from that of a deep sound to that verging on to the cough found in *broken wind.* In that disease termed 'roaring,' the cough is deep and hollow, and in cases where cough occurs from the irritation of teething, termed a *dental cough*, it is loud and paroxysmal.

The value of the character of a cough as an aid to diagnosis, when taken in conjunction with other symptoms, is certainly valuable, but we must be careful to attribute it to its real cause, and prescribe appropriate treatment.

Symptoms furnished by the Condition of the Surface of the Body and Extremities.

In a normal state and under ordinary conditions, the surface of the body and the extremities are of an equable temperature.

In severe inflammatory diseases the general surface of the body and the legs and ears will be found extremely cold; and if, in addition, there be a cold perspiration over the body, it generally indicates a fatal termination. We find a staring coat, with severe rigors, in the premonitory stages of some affections; and in cases of indigestion, the presence of parasites in the alimentary canal, and improper feeding, there is a dry, scurfy condition of the skin, which has lost the gloss and feel of health, and to which the term *hide-bound* is applied.

Symptoms furnished by the Secretions and Excretions.

In the primary stages of febrile affections there is often a diminution of all the secretions; such a condition soon gives way to increased action of some particular organs, such as the skin, the kidneys, or the bowels.

The functions of secretory organs are diminished in the early stages of inflammatory diseases. Thus, in the primary stages of pleurisy the surfaces of the pleuræ are dry, there being arrest of the natural secretion; as the disease continues, the secretion returns, but with a large amount of inflammatory effusion. Glands and mucous membranes are affected in a similar manner by inflammatory diseases.

The condition and character of many excretions, such as those of the bowels, the kidneys, the skin, are also modified by the effects of disease, and will merit attention in the section on *General Therapeutics.*

CHAPTER III.

THE ACTIONS AND USES OF DRUGS.

Before the student can apply the various remedies in the treatment of disease, he must be familiar with the effect which they exert on the body in a state of health —that is, if he is to treat disease in a rational manner. By this we mean that he can give a logical reason for prescribing certain drugs, the rationale of the manner in which he expects such drugs to overcome the diseased condition, or to help nature to afford as early a restoration to the normal state as possible.

As we shall see further on, this is not always possible, as there are some drugs which we know from experience perform certain beneficial actions in certain diseases, and yet we cannot explain in a satisfactory manner how these results are brought about.

To thoroughly understand the actions of the various drugs, and their employment in the treatment of disease, the student must be perfectly familiar with the subjects of physiology, pathology, and chemistry. He must follow the actions of each drug from the time it gains an entrance to the body by the various channels, and its effects on the vital organs and systems, to the time it is expelled by the excretory organs. To do this effectually, it follows that he cannot have too much knowledge with reference to the functions of every portion of the body; and to form deductions and conclusions as to the use of such drugs in the treatment of disease, it is clear that he must possess an intimate knowledge of the changes produced by disease, while to understand the complex chemical changes which often occur, an acquaintance with chemistry will be necessary.

The Action of a Drug is a certain dynamical effect which it produces on separate organs or on the various organs of the body.

The actions of drugs have been demonstrated by systematic experiments on animals.

The manner in which each drug is attracted to certain portions of the body, and has a special effect on various organs, and in some cases only on portions of vital systems, we cannot yet explain in a satisfactory manner. Thus, for example, we know by experiment that strychnine, no matter by what channel it enters the system, will stimulate the motor tracts of the spinal cord, and in large doses will cause violent convulsions.

From a knowledge of this action we find that in small doses strychnine is beneficial in paralysis depending on imperfect action of the cord and general want of nerve tone.

We know as the result of experiments that chloral hydrate has a special action on the brain, digitalis on the heart, ergot of rye on the bloodvessels and on involuntary muscular tissues, belladonna on the respiratory and circulatory systems and on the nervous supply of the iris, and from this knowledge we are enabled to apply these different drugs in the treatment of disease.

When we have demonstrated the precise action of a drug on the healthy animal, we term it the *physiological action* of the drug.

As we shall see further on, the actions of many drugs will depend on the *amount* which is administered, whether in medicinal doses, in maximum doses, or in toxic doses; also on the *duration of the period of administration*, and on the intervals between each dose.

As a rule, we find that most drugs which act on the circulatory and nervous systems, if given in excessive doses, will have an opposite effect to that which they produce in medicinal doses.

Thus, every stimulant to the heart and circulatory system, if administered in large doses, will act as a depressant. Again, any set of nerves, if over-stimulated by large doses, will become paralyzed, as also will the nerve centres.

It will also be found that drugs which act on the nervous system produce their effects by acting on different portions of it. Thus, some have a special effect on motor nerves, others on sensory; some act on the nerve centres in the medulla and cord, others act chiefly on the sympathetic nervous system.

All these actions will require special study when the actions of the various drugs are being treated of separately. Thus we shall have to closely follow the effects of a drug in its journey through the body, from the channel by which it enters the body to its excretion by the various organs.

Some act locally, such as demulcents, caustics, astringents, etc.; others, with or without such local effects, have a remote action on organs at a distance.

Most drugs administered by the mouth enter the circulation from the capillary vessels and absorbents of the stomach and small intestines, being carried by the mesenteric and portal vessels. Some substances make the round of the circulation in a very short space of time, as has been proved by experiment.

The full effect of drugs is, as a rule, not produced until they reach the organ or tissue on which they have a special action. After remaining in the system for a variable time, they are removed from the body by one or several of the excretory channels either unchanged or altered in their chemical composition.

During this process of excretion from the body drugs may have a special action on the channels through which they pass.

We may now inquire as to the manner in which drugs are believed to act in the treatment of disease. Briefly, we may state that the adoption of the majority of remedies is founded on their physiological actions. The therapeutical action is simply the physiological action exercised or modified by disease. For the purposes of description we may divide the use of remedies into two great classes:

1. Those which are intended to act *antipathically.*

The physiological action of such agents overcomes the morbid condition which exists by producing a condition which is directly opposite to it.

Examples.—Purgatives in cases of constipation, stimulants in debility and depression, astringents in diarrhœa, etc. This division is more applicable to the treatment of symptoms and local diseases.

2. Those which are intended to act *allopathically*, *i.e.*, such agents as, when administered, cause a short manageable disease which overcomes the existing disease.

Examples.—The use of diaphoretics in febrile cases, diuretics in cases accompanied by dropsy.

This is often nature's method of recovery—for example, the occurrence of diarrhœa in cases of indigestion, etc., due to unnatural or irritating food. By this means the ingesta producing the irritation are removed from the alimentary canal.

This point is of interest to the therapeutist, as it teaches him that he must not endeavour to check this spontaneous diarrhœa immediately; in fact, in some instances it is desirable to administer a slight laxative in order to help nature to remove the cause of irritation.

When we come to consider the actions of each drug separately, we shall find it of advantage to follow a certain line of research, commencing with the effect of the drug on the channels of entrance to the body, the actions on the various vital systems, the various channels of excretion, and any actions on special organs or tissues.

We must, as far as possible, account for the various phenomena presented, although we shall encounter many difficulties in such a study from the complex manner in which some drugs establish their actions, while in others many points in this respect are not as yet definitely known or understood. As previously remarked, an intimate knowledge of physiology will be required in order to follow the various actions in a systematic manner, and to understand the complex effects on the different divisions of the nervous system.

The following plan will be found the most convenient for the purposes of description:

1. *The Immediate Local Action.*
2. *The Action in or on the Blood.*
3. *The Specific Action.*
4. *The Remote Local Action.*

1. The Immediate Local Action.

We may subdivide this into:

(*a*) The effects produced by the drug on the skin or exposed mucous membranes.

(*b*) The immediate action of the drug when it reaches the stomach and intestines.

Examples.—The immediate local action of belladonna, *i.e.*, depressing the sensory nerve-endings in the skin and contracting the capillaries; and its action when coming in contact with the mucous membrane of the stomach, *i.e.*, acting as an anodyne.

For other examples we may note the effect of the application of cantharides to the skin, which acts as a vesicant, and the effect of sulphate of zinc when it comes into contact with the walls of the stomach, acting as an emetic.

2. The Action in or on the Blood.

Most agents are absorbed into the blood from the alimentary canal, and enter into the composition of its plasma.

Such substances, as a rule, have an effect *in* the blood and not *on* it, or, in other words, the blood acts the part of a conveying medium. We shall have to notice, however, some exceptions to this rule, where some drugs, such as quinine, have a distinct action on the corpuscles of the blood.

3. The Specific Action.

This is usually the chief action of the drug. It leaves the circulation, and is attracted to certain tissues and organs, producing some specific effects thereon.

Examples.—The action of alcohol on the brain and of strychnine on the spinal cord.

4. The Remote Local Action.

This is a certain effect which some drugs produce during their excretion from the system by the various excretory channels. The kidneys are the chief channels of excretion for drugs after they have passed through the tissues and organs; next come in order the lungs, skin, bowels, mouth, and mammary glands. Such drugs are either excreted in the same form as they were administered or in the form of the products of decomposition in the system.

As these drugs pass through the excretory organs, they may exert a certain influence on them, which may resemble their immediate local action.

Examples.—The effect of belladonna and hyoscyamus on the urino-genital organs, which exert an anodyne or soothing effect in cases of irritation of the bladder or of the urethra.

CHAPTER IV.

ON PRESCRIBING.

When the student has become perfectly familiar with the various actions of the different drugs, and their application for therapeutical purposes, based on a knowledge of such actions, he will then be in a position to utilize the different agents for the treatment of disease, the art of which is termed *prescribing*.

When this is attempted for the first time, he will find it rather a difficult matter. He must select an agent, out of a large number at his command, which will best meet the exigencies of his case, and in such a selection he must pay attention to many important details.

The art of prescribing may be most conveniently studied under the following heads:

1. *The Selection of the Remedy.*
2. *Contra-indications.*
3. *Idiosyncrasy.*
4. *The Circumstances which modify the Action of Medicines.*
5. *Combinations—Chemical and Physiological Incompatibles.*
6. *The Prescription.*

1. Selection of the Remedy.

The selection of the remedy is the most important part of the art of prescribing.

The nature of the disease must be carefully studied, and a drug selected which possesses actions suitable for our purpose, but which must not possess other actions that may be detrimental to the case.

This leads us to a consideration of the second heading in our list, viz. :

2. Contra-indications.

We say that a certain drug is contra-indicated in certain diseases, when we are aware that it produces effects which would be prejudicial to the cases, although it might possess one actiou which would be of service ; for example, we say that opium is contra-indicated in diseases of the respiratory organs with shallow, embarrassed breathing, also in congested and inflammatory conditions of the brain and in affections of the kidneys. Again, purgatives are contra-indicated in inflammatory conditions of the intestines, and depressant remedies are contra-indicated in all typhoid and debilitated cases, and irritating diuretics in cases of nephritis. The contra-indications of the various drugs will be noticed when we consider the therapeutical value of each medicinal agent.

3. Idiosyncrasy.

By this term is meant a peculiar susceptibility which some animals possess to the action of certain medicines.

In the majority of instances this means increased susceptibility, though we sometimes meet with the reverse.

Examples.—Purgatives. Some horses are very severely affected by even a moderate dose of aloes, which may even go into superpurgation ; on the other hand, we meet with cases where the medicinal dose has little or no effect.

We also meet with instances where there is great susceptibility to the action of nux vomica, the physiological effects being produced by even medicinal doses. Amongst other examples may be noticed the susceptibility of some horses to the action of blisters, and the peculiarities of action of opium, and its alkaloid morphia, in different individuals.

4. The Circumstances which modify the Action of Medicines.

These are most important to the student, and will require a detailed consideration. We will notice them under the following heads:

(*a*) The Modes and Forms of Administration of Drugs.
(*b*) The Species of Animal.
(*c*) Age and Size.
(*d*) The Effect of Diseases.
(*e*) The Dose.
(*f*) Frequency.
(*g*) Time.
(*h*) Duration, Toleration, Habit, Accumulation.
(*i*) The Effect of Climate and Surroundings.

(*a*) **The Form and Mode of Administration of Drugs** have an important effect in modifying the effects of the drugs in the system. The more soluble the preparation, the more quickly it is absorbed and produces its specific effects.

There are varieties of preparations of each drug, which will be noted when dealing with the special therapeutics of each, some having decided advantages over others. There are many ways of introducing drugs into the system, some very commonly employed, others only occasionally. Some are not intended to be absorbed, but to act only locally, such as gargles, insufflations, local anæsthetics, and local anodynes.

1. **By the skin**, or mucous membrane continuous with the skin, either rubbed in or painted on the surface, or applied in the form of dry powder.

Usually only a local effect is desired, but some may become absorbed.

Examples.—Gargles to the throat; insufflations to the nasal cavities and facial sinuses; liniment of belladonna applied to painful parts; cocaine as a local anæsthetic; the use of atropia in inflammatory conditions of the eye; and the various collyria employed.

2. **By the mouth**, both in some cases to act locally on the stomach and intestines, and to be absorbed into the system chiefly from the stomach and duodenum. We may administer medicines by the mouth in various ways, in the form of either balls, drenches, powders, or electuaries. The form of electuary is convenient when it is found either dangerous or impossible to administer the other forms.

Thus, in cases of acute laryngitis, there is great danger in the administration of drenches; from the irritable condition of the throat, there is a risk of the animal struggling and the fluid entering the trachea and bronchial tubes.

In such cases we can place the medicinal agent in the form of an electuary between the molar teeth, when it will not only become absorbed, but in the case of such agents as belladonna, potass. chlor., etc., there will also be a beneficial local effect produced. Again, in cases of tetanus, we cannot administer remedies in the usual manner, and we find the form of electuary very valuable. We may also refer to the administration of ol. crotonis as a quick and effectual purgative in cases where others cannot be administered; this agent will produce its effect when placed on the tongue.

3. **By Subcutaneous or Hypodermic Injection.**—In this method the active principle of the drug in solution is introduced under the skin or into the subcutaneous tissues by means of a syringe and hollow needle. It constitutes the quickest and surest mode of bringing the system under the influence of a drug.

By this means the active principle at once gains entrance to the circulation, and produces its specific effect with certainty and rapidity.

The introduction of the agent is simple; the bulk of fluid should be as small as possible, and should be prepared so as not to irritate the tissues.

The part selected should be one where the skin is loose and thin, such as that of the chest or neck.

A fold of skin is taken up, the needle is then pushed into it, and the fluid forced in by the syringe.

After the completion, the part is gently manipulated, so as to favour the absorption of the fluid.

Mishaps may occur by reason of the solutions being irritant or too large in bulk, or the syringe and needle not being perfectly aseptic; in such instances irritation, abscess, and sloughing may occur.

The hypodermic method is of great value in veterinary practice, as it ensures the full action of the drug, and is easily applied in cases where other means would not be practicable, or where the drugs would take too long a time to act.

In cases of violent abdominal pain it is often impossible to administer medicines by the mouth, and much of the dose is lost; also in cases of inflammation of the intestines there is very little power of absorption from the alimentary canal.

4. **Intravenous Injection.**—By injecting the agent direct into the venous system, it produces its effects very quickly; but this is a method rarely adopted for therapeutical purposes, as its drawbacks are more than its advantages. No irritating substance can be used in this manner, nor any substance which has the power of coagulating albumen.

5. **Intertracheal Injection.**—The respiratory mucous membrane possesses very rapid powers of absorption, as has been proved by experiment.

The injection of medicines into the trachea is practised in cases of that parasitic disease termed 'husk,' or 'hoose,' in cattle, where the object is to act directly on the parasites. A mixture containing turpentine and other agents is employed for the purpose, and is introduced into one of the spaces between the rings of the trachea.

Any irritating fluids which gain entrance to the bronchial mucous membrane cause great respiratory distress, and may cause mechanical bronchitis or pneumonia. It is said that fatty oils are not absorbed by the bronchial mucous membrane, but are rejected by the trachea and nostrils.

These points are of importance when administering fluids to horses or cattle in the form of drenches, as it may happen, from keeping the head too high, from the struggles of the animal, or from laryngitis, that a portion of the fluid may find its way down the trachea, and cause a very serious condition of the animal.

6. **By Inhalation.**—By this method volatile substances are intended to enter the blood from the pulmonary capillaries, or to act on the bronchial tubes and bronchioles.

As examples of the former we have the inhalation of chloroform and ether as general anæsthetics, and of the latter we have the inhalation of steam, medicated with various disinfectant and soothing remedies, such as ol. eucalypti, creolin, etc.—of great value in cases of bronchitis, lessening irritability, softening the exudation, and preventing decomposition therein.

(*b*) **The Modifying Effect of Different Species of Animals on the Action of Medicines.**—Briefly, the species of animals which we are called upon to treat are horses, cattle, sheep, pigs, and dogs.

We shall have to consider carefully the differences in action of the various medicinal agents in these different species, such differences mainly depending on special arrangements of certain vital systems in each.

There is only a slight difference in the arrangement of the circulatory and respiratory systems in these various species; consequently, the action of medicinal agents is tolerably uniform on these systems.

In the nervous, digestive, and cutaneous systems, however, a marked distinction exists in the different species, so that the action of drugs on these systems is considerably modified according to the species to which they are administered. We may take it as a rule that the more highly developed a system or an organ is, the greater will be the effect of agents which have a specific action on it.

Thus, opium and its alkaloid, morphia, which in the highly-developed cerebrum of man causes deep stupor in large doses, acts in the horse as a motor excitant, causing the animal to walk round and round the box in one direction, and in some cases violent delirium occurs.

In the horse we have many physiological peculiarities to notice, especially with reference to the digestive system. The stomach is small, aud the intestines very capacious, and, according to the results of experiments, there is little or no absorption from the stomach.

The arrangement of the mucous membrane of the stomach is peculiar, the cuticular portion being a continuation of the membrane of the œsophagus; and this portion does not secrete gastric juice; the villous portion secretes the true digestive juice.

There are other peculiarities, such as the inability of vomition in the horse, and the presence of lactic acid instead of hydrochloric in the gastric juice. These will be again referred to in the section dealing with the general therapeutics of this system.

In the horse the excreta carry away about two-thirds of the water of the food, while in dogs only 5 per cent. is got rid of in this manner.

In herbivora only 30 per cent. of the water escapes by the kidneys, while the amount in carnivora is 70 per cent.

In herbivora 70 per cent. of the water is removed by the lungs and skin, while in carnivora only 30 per cent. escapes in this manner.

Vegetable purgatives act better than mineral in horses, the latter being very uncertain.

The purgative generally resorted to is aloes, which acts chiefly on the large intestines.

Emetics have no action in the horse, even when given in large doses; some may appear to have a sedative effect.

The kidneys are easily acted on by diuretics, but the skin is not so readily acted on as in man, so that to enable diaphoretics to produce their effect, the animal must be warmly clothed, otherwise the agents will pass off by the kidneys acting as diuretics.

The horse is very insusceptible to the actions of sedatives. Many drugs which produce a sedative and soporific effect in man act in this animal as cerebro-spinal excitants, even when given in large doses.

In cattle we find great differences to exist with regard to the actions and doses of medicinal agents as compared with the horse.

These animals are usually of a dull, phlegmatic temperament, and possess a peculiar arrangement in the alimentary canal; the stomach is divided into four compartments, of which only the fourth division is capable of performing the function of digestion. The first division, termed the rumen, is of enormous size, and capable of holding a large amount of ingesta. The intestines are small in proportion, and we may remark that affections of this portion of the alimentary canal are rare compared with those of the stomachs, which are a fruitful source of disorder in ruminants.

Very large doses of purgatives are required to produce an effect, of which saline purgatives largely diluted prove most beneficial.

Large doses of stimulants and tonics are also required in these animals; the skin and kidneys are not readily acted on, and they are not susceptible to either the excitant or soporific effects of opium or its alkaloids to any extent.

We have to consider that in many cases of serious affections in cattle it is often more advantageous to have the animal destroyed for the butcher than to have the owner run the risk of expense, and to have the animal die of the disease. Taking into consideration the usual value of cattle, we should be careful to avoid administering substances which are likely to impart a disagreeable flavour to the flesh, such as ether, oil of turpentine, etc.

With reference to sheep, similar observations will apply; they usually take about one quarter the doses of cattle.

Dogs resemble man to a certain extent. The alimentary canal is short and straight, and easily affected by purgatives, of which a combination is preferable to a large dose of a single purgative.

The stomach is readily acted on by emetics, and the act of vomition is very easily produced in this animal; thus, dogs by instinct obtain a certain grass, which has an emetic effect, when they feel deranged from any source of irritation in the stomach.

In prescribing medicines for dogs, it is necessary to bear in mind that the agents used should be as palatable as possible, in order to avoid the risk of having them expelled from the stomach.

Although in many instances dogs take similar doses of medicinal agents as man, still there are notable exceptions. For example, they will take very large doses of aloes as compared with man, and very small doses of calomel and oil of turpentine as compared with him.

Pigs are similar to dogs in their peculiarities to the action of medicines, of course making allowance for increase of doses on account of their increased size.

(*c*) **The Influence of Age and Size.**—As animals of each species vary very much in size, it is necessary to remember that, as a rule, the smaller the size the more diminutive should be the dose.

Young animals are more readily acted on by medicines than adults, and in very old animals medicinal agents have a greater effect, as the vital organs become weakened by age.

We may remark that the alimentary canals of young animals, such as foals and young dogs, are very susceptible to the action of purgatives, and that only the mildest forms and moderate doses should be employed.

(*d*) **The Effect of Diseases on the Action of Medicines.**—In cases of fever the arterial tension is altered, and absorption is retarded. In cases of inflammation of the stomach or intestines, the absorption of drugs is retarded, and the severe pain which accompanies such affections resists the action of anodynes and soporifics.

Thus, in cases of enteritis very large amounts of drugs, such as morphia, etc., will be tolerated with very little effect. In cases of hyper-secretions, such as diarrhœa, polyuria, elimination is hastened, and drugs such as opium and alcohol have only a slight effect. When the secretions are diminished, we observe the effects of the accumulation of a drug in the system.

In cases of affections of the kidneys, where the excretion of urine is diminished, drugs which are carried away from the system by this channel are likely to be retained if administered in repeated doses, and may exert a sudden effect.

In excessive nervous derangement, such as tetanus, very large doses of nerve sedatives are tolerated.

Affections of a debilitating nature do not stand the action of sedatives or depressants well, and such remedies should be avoided.

(*e*) **The Dose.**—This is a very important portion of the subject under consideration, and one that can only be studied practically. The dose, or the amount of any drug which it is safe or advisable to administer to any patient for therapeutical purposes, depends on the variety of circumstances that we have just described.

The quantity of any drug given will have a material effect on its action. Thus, small doses of the salts of magnesia are alterative and diuretic, while large doses are purgative.

Aloes is a tonic in small doses; in full doses it is an active purgative.

The proper doses can only be learned by experience, as we have seen that they depend on so many circumstances, and also on individual peculiarities and temperaments.

The doses generally laid down are the smallest useful doses which it is safe to begin with; there are many affections, however, in which it is necessary to administer drugs in such doses that their physiological effects will be produced before any therapeutical results will be obtained.

As previously stated, the age of the patient must be taken into consideration. With reference to horses, we may calculate roughly that yearlings require one-third of the dose for an adult, two-year-olds half the dose, and three-year-olds two-thirds.

With reference to dogs no fixed rule can be laid down, as so much depends on the size and breed. We may, however, state that in most cases it is safer to prescribe small doses when treating one of these patients for the first time.

With regard to purgatives, both for horses and dogs, a proper dose should be given, and if a sufficient amount of purgation is not produced, the agent is kept in the system longer than necessary, and much nausea results.

(*f*) **Frequency.**—We prescribe medicines to be given either in a single dose or to be repeated in certain doses at certain intervals. Thus, purgatives are generally given in one dose, tonics twice a day, febrifuges and stimulants at short intervals, so as to keep up their effect, and so that the effects of one dose will not have passed away before the next is given.

(*g*) **Time.**—We take advantage of natural tendencies in order to assist the action of drugs. Thus, alkaline stomachics are given before feeding to increase gastric secretion. Acid stomachics are given after feeding, when the natural acid is deficient. Drugs which have a tendency to irritate the mucous membrane of the stomach are administered either along with the food or immediately after feeding.

Example.—Arsenic.

Some require a special preparation of the alimentary canal before administration. For example, *purgatives*, in which it is essential that the horse be properly prepared by being kept on bran mashes for a reasonable time beforehand, so as to have the intestinal contents in a soft condition. When prescribing iodine, we must be careful to administer it at a proper interval between the times of feeding in herbivorous animals, so as to avoid the insoluble iodide of starch being formed, as the food of such animals contains a large proportion of starch.

(*h*) **Duration, Toleration, Habit, Accumulation.**—The length of time during which a drug may be administered depends on circumstances.

There are some drugs which, after administration to the same individual for a certain time, commence to lose their characteristic effect, and the system can be made to resist even very large doses—in fact, such doses as would have a toxic effect in other individuals; examples of such drugs are opium and arsenic.

We may remark that, in prescribing arsenic, we have to commence with small doses, and to gradually increase them as the system of the patient gets accustomed to its effects. By *accumulation* we mean to infer that there are certain drugs which, when given in repeated doses for a period of time, may not produce any appreciable effects at first, when after an indefinite period of administration they may suddenly exert their physiological effects in a marked degree. Such drugs are said to be *cumulative*, examples of which we find in digitalis, mercury, strychnine, etc., and in prescribing these we must be careful that they are not allowed to enter the system more quickly than they can be excreted.

(*i*) **The Effect of Climate and Surroundings.**—Narcotics are said to act more effectually in hot than in cold climates. Chemical reactions and the protoplasmic movements are facilitated by a slightly elevated temperature.

In damp, humid climates the animal system becomes relaxed and out of tone; hence smaller doses of drugs are borne than in dry, bracing climates. The effect of surroundings has a material bearing on the subject of prescribing; horses kept in badly ventilated and overcrowded stables are generally prone to diseases of a debilitating or typhoid nature, and do not stand depletive measures. Well-bred animals in good condition and in proper surroundings, when attacked by acute inflammatory diseases, bear depletion well, and the effects of sedatives are beneficial.

In canine practice we must be careful in distinguishing the varieties of patients in prescribing; for example, the pet dog, always accustomed to an indoor life and the excesses of the table, will require different treatment to the sporting dog, or one accustomed to an outdoor life in the country.

Having concluded the description of the circumstances which modify the actions of medicines, we will now consider the fifth important section of the art of prescribing, viz.:

5. Combinations—Chemical and Physiological Incompatibles.

It is often found of advantage to combine one drug with another in a prescription, so that one will increase the action of the other, or neutralize any unpleasant effects. To effectually combine drugs we must be perfectly acquainted with their chemical composition and properties, and also with their physiological actions.

In the combining of certain drugs, chemical reactions may occur, and either a useless or dangerous compound may be formed. Such drugs are said to be *chemically incompatible* with each other. There are some incompatible drugs, however, which we do combine, but we are aware of the actual compound which is formed, and which suits our purpose.

For example, the familiar *white lotion*, so useful as an astringent application, is, technically speaking, incompatible, being composed of a mixture of acetate of lead and sulphate of zinc in water, the result being the formation of acetate of zinc in solution, and the sulphate of lead, which, being insoluble, is thrown down as a white precipitate. Persalts of iron are incompatible with substances rich in tannin, such as cinchona, etc.

Chlorates should not be prescribed with iodides, as a chemical change occurs which may cause irritation of the stomach.

There are many other examples of chemical incompatibles which the student will learn when at practical work in the pharmacy ; his knowledge of chemistry will teach him that acids should not be combined with alkalies or *vice versâ*.

Attention must, however, be drawn to the danger of mixing substances which are likely to cause an explosive mixture.

Thus, chloride of lime mixed with sulphur forms an explosive compound. Oil of turpentine and sulphuric acid is also dangerous, and the same may be said of chlorate of potash and sulphur.

Other examples are permanganate of potash and chromic acid, mixtures of chlorine with ammoniacal salts, nitrates with organic bodies, etc. The chief incompatibles will be mentioned under the heading of each drug in special therapeutics.

By *physiological incompatibles* we mean those drugs which neutralize the effects of each other in the system; such agents are also termed *physiological antagonists*.

For example, the action of strychnine on the motor tracts of the spinal cord and of Calabar bean on the same region is antagonistic, the former stimulating, the latter depressing and paralyzing, the same region.

Advantage is taken of the knowledge of the actions of antagonistic drugs to form reliable *antidotes* in cases of poisoning. There are some drugs which, although physiologically incompatible as regards certain actions, are useful to combine in therapeutics.

Thus, morphia and atropia are antagonistic as regards their action on the pupil, but are very useful in combination as sedatives and anodynes. We also employ some drugs which are antagonistic to a slight degree to overcome certain unpleasant effects, such being termed *correctives*.

6. The Prescription.

As a result of the consideration of the preceding sections, the student will now be able to combine the remedies which he judges will be of benefit to his patient, the writing of which in a handy and legible form for the dispenser is termed the prescription.

Prescriptions should contain as few drugs as possible, as it is an irrational proceeding to combine a number of these agents, without paying attention to the specific action of each.

The classical prescription is formed on certain definite lines, as follows;

1. **The Basis**; that is, the selection and form of preparation of the drug which it is intended to employ. The selection of the drug is the most important part of the prescription, as this is the chief portion of the combination which is to produce the special therapeutical effect.

2. **The Adjuvant.**—This is the addition of some agent which is intended to assist and hasten the action of the basis.

3. **The Corrective,** which limits or modifies the action of the basis, and prevents unpleasant effects.

4. **The Vehicle or Excipient.**—This is some substance added so as to have the preparation in a convenient form for administration.

Example of a Classical Prescription.

℞. Aloes Barb., ʒv.
Ext. belladonnæ, ʒss.
P. zingiber, ʒii.
Theriacæ, q.s.
Ft. bol. i.

In this, which is a formula for a purgative ball for the horse, the aloes is the basis; the belladonna is the adjuvant, as it increases the action of the aloes; the ginger is the corrective, as it prevents griping; and the treacle is the excipient, or vehicle in which the substances are mixed so as to make a bolus of proper consistency.

We may remark, however, that there are few prescriptions written according to these fixed rules, as in many instances the basis and the vehicle or excipient are only prescribed.

The subject of prescription-writing will be again referred to in the addendum on veterinary pharmacy.

PART II.

GENERAL THERAPEUTICS.

CHAPTER I.

INTRODUCTORY.

The subject of general therapeutics includes a consideration of the evidence of the usefulness of therapeutic measures, the rationale of their operation, and the indications for their employment.

We shall find that it is impossible to lay down strict rules for the application of therapeutical measures; all that can be done is to present a careful consideration of general principles, with the important points in their application. And to have this application successful requires special knowledge and sound judgment and reasoning. We may inquire as to how the facts and principles of general therapeutics are obtained.

We may answer this by stating that these principles are the result of experiment and of experience, and a knowledge of the physiological action of drugs.

Experience, although valuable as regards the utility of a particular method of treatment, is open to objection. It is founded on certain experimental evidence either of the beneficial effects of a certain method of treatment in the course and termination of a series of cases of the same disease, or to the immediate effects of certain treatment, irrespective of the termination or duration of the diseases.

The former evidence is open to objection, because we know that no two series of cases of a disease are exactly alike in all particulars, but depend on many circumstances, such as the severity of the disease, the constitution of the patient, the existence of complications, etc.

It does not follow that because a certain line of treatment is beneficial in a certain number of cases that it should be so in individual cases. The practitioner should endeavour to deal with cases of disease individually, and not in the aggregate.

Nevertheless, we must admit the value of the results of experience, in order to test the therapeutical value of medicinal measures.

Methods of treatment may be originated by a study of the physiological action of drugs, but the practical test is afforded by experience.

We are also aware that our knowledge of many important remedies was acquired altogether by experience, before we were able to explain the rationale of their actions, and that even in the present day we are prescribing some remedies with success, while we cannot in a satisfactory manner explain their *modus operandi*. However, the number of such remedies is gradually decreasing as we are improving our knowledge of pharmacology, physiology, and pathology.

General therapeutics may be said to depend on four considerations, which may be designated as follows: (1) *health;* (2) *pharmaco-dynamics—physiological action;* (3) *pathology;* (4) *recovery.*

(1) **Health.**—The term 'health' is not a definite one; that is, it does not signify any fixed or unchangeable condition of the body.

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There are many degrees or gradations of health to which we cannot apply the terms disorder or disease.

The physiological state of the body is not a constant one; it is capable of being acted on by various surrounding influences, which influences are themselves constantly changing, such as temperature, air, food, etc. Thus, country horses can thrive on a different quality of food, and in different surroundings, to what those in well-kept stables in town are accustomed to; but it is possible to get animals accustomed to these different influences.

We have also to consider that it is possible to have certain changes in organs which are not vital, without any appreciable alteration in what we term the health of the animal. In veterinary practice it is impossible to determine definitely in many instances the exact period at which there is a departure from the normal state and the commencement of disorder or disease, as our patients are incapable of the powers of speech, and the first symptoms have to be noticed by the attendants, who are not always gifted with keen powers of observation.

Except in cases which are characterized by the appearance of pain, the usual symptoms first noticed by the attendants are dulness and loss of appetite, etc., and it is quite clear that many affections will be in a definite stage of development before such cases are brought under the notice of the practitioner.

(2) **Pharmaco-Dynamics — Physiological Action.** — We possess a certain power of interference over the physiological state of an animal. We can alter the character of the food and the system of feeding; we are able to modify his surroundings in the way of ventilation, etc.; we can order exercise or keep him at rest; we can apply clothing to the body; and lastly, we can introduce into his system certain medicinal agents to modify or increase

the functions of certain organs. This power or control we term *acting physiologically on them* by such means, and the action thus exerted we term a *physiological action*. The science which relates to the power of modifying physiological activity we term *pharmaco-dynamics*.

(3) **Pathology.**—It is difficult to draw a line between health and disease, as we cannot recognise a definite state for the former term. It is also difficult to separate influences into physiological or into morbid or pathological.

The change from what we are accustomed to recognise as health, when sufficiently definite, we term *disorder*, or when more marked and attended with decided suffering, *disease*.

(4) **Recovery.**—This is the aim of the therapeutist, and in this direction he is ably assisted by nature, and it is of the greatest importance in treatment to imitate and help such efforts of nature, and not to retard them.

The body possesses certain provisions not only for recovering from the effects of disease, but also for preventing disease.

We have to consider that in veterinary practice we have to ascertain as definitely as possible whether our patients will recover in such a manner as to be of practical utility to their owners. Of course, in the case of dogs used as companions or pets, such a consideration may not be so necessary, but in horses and cattle it is of supreme importance.

If a horse is suffering from a chronic affection, which is liable to be continuous or to recur frequently, so as to practically unfit him for work, all our efforts to sustain life will be of no benefit, as after a long and expensive illness he would be of no benefit to his owner, but a source of loss.

The same may be said with reference to the majority of cases of fractures, except in animals such as brood mares, or mares which can be so utilized.

In horses, in consequence of the difficulty experienced in keeping the fractured limb in a state of repose, complications are apt to ensue, and such a condition of the limb may be brought about that the animal will be unfitted for any work, and the most humane proceeding will be to have him destroyed at the commencement.

In cattle, if there is no reasonable chance of the animals recovering, or of their being fattened for the butcher, immediate destruction must be resorted to, as not only is there the expense of treatment to no purpose, but also the risk of the medicinal agents injuring the quality of the meat, besides the loss of condition, which soon leaves the carcase of no value.

We may also refer to diseases not only incurable, but also dangerous to other animals and to mankind, by reason of their contagious nature, such as glanders, rabies, etc. Here treatment is out of the question, and compulsory slaughter becomes the most beneficial measure.

In canine practice, however, with the exception of rabies, the majority of diseases among favourite animals require the skill of the practitioner, without the same consideration of practical utility in the event of recovery.

There are six means which the body possesses by which variation of functional activity can be secured and morbid influences can be met and overcome. These natural means of recovery are of the greatest importance to the therapeutist, as by a consideration of them he is enabled to prescribe a line of treatment best suited to the indications of a case.

1. **Reserve Force.**—The body possesses a certain amount of latent force which is called into action when it is required; this is termed *reserve force*, and we have examples

in the increase of size of muscles when they are constantly called into action, and also in the heart, which possesses reserve force when required for great exertion.

2. **There is a Power of overcoming the Cause of Disorder.**—Thus, if the reserve force is being constantly called into action, the result will be enlargement or hypertrophy of tissues or organs. We have examples of this in hypertrophy of the left ventricle, when it has extra work to perform in cases of some valvular lesions. This is termed *compensation*. Also in enlargement of one kidney when the other is diseased.

3. **The Cause of the Disorder may be expelled by Regulating Mechanisms.**

Example.—The occurrence of vomition in the dog when the stomach is overgorged with food, or of purgation when the presence of irritating ingesta irritates the intestines.

4. **Vicarious Compensation.**—This occurs where, in certain affections, one organ endeavours to perform the work of another; for example, in cases where the functions of the kidneys are suspended, the urea accumulates in the blood and is excreted by the skin and intestines.

This may be taken as an effort to remove the effects of a disorder.

5. **Nature has a power of insuring rest,** *e.g.* the loss of appetite seen after a case of engorgement of the stomach, which gives that organ a necessary rest.

6. **By Repair.**—When anatomical changes have occurred as the result of disease, we find that nature possesses the power of repair to a certain extent by means of an increase of nutritive activity.

There are *four* foundations of **Rational Therapeutics** which will now engage our attention, and are of great importance.

1. The organs of the body act in obedience to surrounding natural forces.

2. We have a certain power of controlling or modifying these natural forces.

3. We regard disorder or disease as the result of some disturbing influence acting on glands, tissues, or organs; the phenomena produced are what we would expect in those affections of which we have a tolerably accurate knowledge of their pathology.

4. The functions of organs, and even the anatomical state, if the disease is not too far advanced, will return to the normal if the influences become normal.

These are all very important considerations to the therapeutist, as they indicate to him that he must take advantage of these numerous natural forces in his treatment, and endeavour to promote a return to the normal state by acting in accordance with these forces as much as possible, or, when necessary, by neutralizing or counteracting the effects by the employment of other forces.

Different Kinds of Treatment.

We will now consider the various kinds of treatment in a general manner:

1. **Preventive Treatment.**—Hygiene is the science and art of preserving health, and, as will readily be seen, it is founded on an accurate knowledge of physiology.

Prophylaxis recognises the causes of disease at work, and avoids or counteracts them by every possible means.

Infection may be guarded against by avoiding all sources of it; by the system of preventive innoculation, or by the administration of certain drugs, which have the effect of rendering the system capable of resisting the action of the morbid influence; for example, the administration of sodii hyposulphis as a preventive of distemper in the dog.

2. **Immediate Treatment.**—This includes the **Removal of the Cause**, attention to dietetics, and the use of medicinal agents.

For example, in cases of indigestion, due to engorgement of the stomach, we remove the indigestible food from the stomach by the administration of an emetic in the dog, and a purgative in the horse; we destroy and remove parasites in the intestinal canal by means of vermicides and vermifuges.

This is nature's third method of recovery.

3. **Symptomatic or Palliative Treatment.** — This is nature's fourth method of recovery. If we are unable to remove the morbid cause at work in the system, we must neutralize or correct its effects in the body. This is, of course, not so desirable a method as that just mentioned, as we are now treating the effects instead of removing the cause. We select such remedies as act in an opposite direction to the effects of the morbid cause.

4. **Expectant Treatment.**—In this form we treat the symptoms presented to us before the disease is fully developed, and before it is possible to form an accurate diagnosis.

5. **Rational and Empirical Treatment.**—*Rational Treatment* is that which is founded on chemical, physiological, and pathological knowledge, and on a consideration of the powers possessed by nature, which we have described.

Empirical treatment is founded on the results of experience, and is not guided by any laws; but we must remember, as previously stated, that many of our most valuable remedies were prescribed in this manner in former times, and their value ascertained by the statistics of recoveries.

As our physiological and pathological knowledge advanced, and also the subject of pharmaco-dynamics became better understood, a large number of such remedies were entitled to be placed under the heading of *rational* treatment, and the tendency of the present day is to make empiricism give way to rationalism, and thus render therapeutics a perfect science. As well expressed by Bouchard, 'the indications for the future of rational therapeutics will be realized when physiological therapeutics is controlled by statistical.

In the next series of chapters we will consider the general therapeutics of the different vital systems of the body, and for convenience of description, and as explaining the rationale of treatment, each system will be noticed under five sections, as follows :

1. A brief description of the **physiological relations** of the system in the horse, cow, and dog.

2. The **pharmaco-dynamics** of the system, and also the use of non-medicinal measures when required.

3. The **pathological relations** of the system—disorders and derangements being selected, rather than actual disease of the parts, so as to illustrate the actions and uses of remedies.

4. **Natural recovery**—notice being also taken of the limits of treatment.

5. **Rational therapeutics**—which will be founded on the four preceding sections.

CHAPTER II.

DIGESTION—THE MOUTH.

I. Physiological Relations.

THE process of digestion commences with the reception of the food into the mouth, where it is triturated and mixed with saliva and mucus, and the starchy constituents partly converted into sugar.

The duration of mastication varies in different species of animals. The movements of mastication in carnivora are confined to tearing the food into pieces small enough to be swallowed.

In herbivora a much longer time is required, and the food has to be reduced to a condition of fine comminution.

In the horse the food must be thoroughly macerated before reaching the stomach, hence the duration of mastication will be longer than in the ruminant, where the food is acted on in the rumen and remasticated in the mouth.

1. **Food.**—The subject of food is a most important one, and will require special study. The student is referred to 'Veterinary Hygiene,' by Professor F. Smith, and to 'Veterinary Physiology,' by the same author, for valuable information on all the details of dietetics.

2. **The Flow of Saliva.**—This is the result of nervous influences. Afferent nerves convey sensations to the medulla from the mouth, viz., the gustatory division of the fifth, and the glosso-pharyngeal. The impulse is then conveyed to the glands by efferent nerves, and secretion results.

The submaxillary gland is supplied by the chorda tympani, which supplies dilator fibres to the vessels, and secretory fibres to the gland-cells.

It is also supplied by a branch of the sympathetic, which gives constrictor fibres to the walls of the artery supplying the part.

The nerve supply of the parotid consists of the glosso-pharyngeal and the sympathetic.

3. The **sensory nerves of the mouth** receive and transmit to the cerebrum and medulla the impressions of taste, whether bitter or sweet; these impressions are transmitted to a special centre in the medulla, from which they are reflected to the stomach, modifying its functions, and to the salivary glands of the mouth, which they influence through the chorda tympani.

II. Pharmaco-dynamics.

1. **Food.**—We can alter the quantity and quality of the food, and the form of the food; thus, we can order the oats to be crushed or the hay to be chopped, as we may see desirable for different cases.

2. We can influence the sensory apparatus of the mouth by the administration of aromatic bitters, by the members of the spirituous group, and by acids.

Aromatic bitters increase the relish for food by stimulating the secretion of the digestive fluids in the mouth and also in the stomach, as will presently be described. These increase the relish for food, and provide for the digestion of the same by an increase of the digestive fluids of the mouth and stomach.

Examples.—Aromatic oils, gentian, quassia, etc.

Sialagogues increase the secretion of saliva. These include the greater number of stimulants of the sensory apparatus, diluted mineral acids, and vegetable acids.

We divide *sialagogues* into those which act locally by being absorbed and acting on the gland structure directly, and *specific sialagogues*, which act on the terminations of the nerves in the salivary glands, or on the cells themselves, by whatever channel they enter the system.

As examples of *ordinary sialagogues* we have dilute mineral acids, vegetable acids, and their salts, etc., which have the effect of removing thirst.

As examples of *specific sialagogues* we have jaborandi and its active principle pilocarpine, mercury, iodine, and physostigma.

Indirect emetics, such as antimony and ipecacuanha, also act as sialagogues.

Anti-sialagogues are those drugs which diminish the secretion of saliva, such as dilute solutions of alkalies, as potash and soda.

Specific anti-sialagogues act upon the secretory nerves, such as belladonna and its active principle atropine, also opium in excess.

Demulcents are substances which afford an artificial covering to the mouth, tongue, and fauces, when the natural secretion fails.

Examples. — Mucilaginous preparations, linseed-tea, gums, honey, syrups, etc.

III. Pathological Relations.

1. **In the food** we find the chief cause of digestive disorders. If mastication is not properly performed from various causes, it follows that the food in herbivora will not be in a fit state for digestion in the stomach.

2. **Loss of Taste.**—This occurs in fever and catarrhal affections, and is often associated with loss of the sense of smell, a matter of great importance in our patients,

which depend so much on the smell of food, the result being interference with appetite.

3. **Disorders of the Secretions of the Mouth.**—In acute febrile diseases we have deficiency of saliva and dryness of the mouth and fauces; also in long-standing cases of indigestion. This condition also occurs when large doses of such drugs as opium and belladonna have been administered.

Salivation consists in an excessive secretion of saliva. It depends on many causes, and is also termed *ptyalism.* It arises from irregularities or diseases of the teeth, the action of irritating food on the mouth and tongue, and also from disease of the nervous centres, and in affections of the pharynx; also from the presence of a foreign body in the œsophagus, and occurs as the result of the administration of certain drugs, such as mercury, to the effects of which the cow and dog are particularly susceptible. If given in too large doses, iodine has a similar effect.

4. **Derangements of the Excretions of the Mouth.**—In the dog we find an offensive smell from the mouth in cases of digestive derangements; also from accumulations of tartar round the base of the teeth, *from diseased teeth, and in some respiratory affections.*

Glossitis, or inflammation of the tongue, arises from injuries and from chemical irritants, or the administration of medical agents not sufficiently diluted, such as spts. ammon. aromat., ol. tereb., potash, and soda.

IV. Natural Recovery.

The sense of taste returns when the febrile affection subsides.

Salivation ceases after the removal of the cause, and the offensive odour from the breath also disappears if the cause is removed.

V. Therapeutics.

We will now consider the rational treatment of diseases originating in the mouth.

1. **Attention to the Food.**—The precaution of avoiding food of an irritating nature, the mode of ensuring proper mastication of the food, and the preparation of the food according to the requirements of the case.

2. **Disorders of the Sensory Apparatus of the Mouth.**—The deficiency of saliva in fevers, etc., must be treated by dilute mineral acids, and the acid tartrate of potash, which have the effect of removing thirst. In chronic indigestion, with dryness of the mouth, we prescribe aromatic bitters, and in loss of appetite we rouse the nerves of taste by aromatic bitters with alcohol.

3. **Unpleasant Excretions from the Mouth** will be treated by ascertaining the cause and acting on it.

Glossitis will be treated by the use of astringent gargles, such as borax and water and solutions of potass. chlor., with honey, etc., and demulcents. In cases where it results from the action of irritating medicinal agents not sufficiently diluted, such as preparations of ammonia, it will be found that weak solutions of vinegar with honey will have a beneficial effect.

4. **Defects of the Mechanical Apparatus of the Teeth** will require special attention and surgical interference.

5. **Salivation** must be treated according to the cause. If due to the action of drugs their employment must be ceased and belladonna administered.

In concluding our consideration of the mouth and contiguous parts, we have to draw attention to an imaginary disease of the palatine bars of the mouth, termed *lampas*. This, in reality, is due to a temporary congestion of the parts in young horses during the process of dentition; and in adult horses the parts are swollen in cases of indigestion. Obviously, the rational treatment will depend on acting on the cause; but the most abominable cruelties are often perpetrated in such cases by farriers, who, with a red-hot iron, endeavour to burn away the swollen membrane.

It hardly seems credible that any owners of horses will permit such barbarity in the present enlightened age, but we have to confess from experience that some persons, otherwise intelligent, believe the ignorant ideas of grooms and farriers on this subject.

CHAPTER III.

DIGESTION—THE STOMACH.

I. Physiological Relations.

In commencing this brief description, we must draw attention to the fact that substances which stimulate the nerves of taste produce in a reflex manner activity of the gastric functions, and that proper insalivation with the alkaline secretion of the mouth renders the food in a proper state for gastric digestion by increasing the flow of the gastric juice.

An important law must be noticed, viz., that *acid substances stimulate alkaline secretions*, and *alkalies stimulate acid secretions.*

In the different species of patients we find that the stomach varies in arrangement, and that this variation has a very important bearing in pharmacology and therapeutics.

In the horse the stomach is small in comparison to the size of the animal and to the volume of the intestines. For various reasons, the occurrence of vomition, except under certain grave conditions of disease, is impossible.

This organ is rarely empty, although it has been proved that shortly after food enters it commences to pass on to the intestine.

The food entering the empty stomach passes on to the pylorus. As more food is taken, the same process goes on, but the amount passing out does not equal that coming in.

When the feed is finished, this passage of ingesta into the duodenum ceases, or only small quantities will pass out, and a long time elapses before the stomach is really empty. The best condition of the organ for the function of digestion is when it is two-thirds full.

Other important points in connection with the stomach of the horse are that only a portion of the mucous membrane is capable of secreting a digestive fluid, viz., the villous portion.

Also the cardiac and pyloric orifices are situated close together, and the cardiac orifice is contracted except when food is entering.

The difference in appearance between the cuticular and villous mucous membrane, and the situation of the organ, which rests on the colon, and is not in contact with the abdominal walls, are other points worthy of note.

In ruminants the stomach is divided into four compartments, of which the first three may be considered as dilatations of the œsophagus.

It is only in the fourth division that true gastric changes occur.

The stomach of the pig is a type between the carnivorous and ruminant—all portions of it do not possess the same powers of digestion. There are two acids formed in gastric digestion in the pig; for the first hour or two of digestion the acid is lactic, and afterwards hydrochloric acid. The stomach of this animal empties itself very slowly when no fresh food is given.

The stomach of the dog is large, and coated throughout with a mucous membrane secreting gastric juice.

We may study the functions of the stomach from three standpoints:

1. The secretion of gastric juice.
2. The movements in the organ for the mixing of foods and their passage on to the intestines.
3. Absorption.

1. The gastric juice is an acid secretion, which is derived from the gastric glands. The acidity of this secretion in the horse has been proved to be due to the presence of lactic acid, while in other animals the acid believed to be present is hydrochloric. The digestive ferment is termed pepsin, which has the power of converting proteids into peptones.

The gastric juice is stimulated to flow by the following agencies: (*a*) the mechanical presence of food; (*b*) by the products of digestion; (*c*) by impressions on the nervous centres, such as tastes, etc.; (*d*) by the presence of the saliva and any dilute alkaline fluids at the mouths of the gastric tubules.

2. As digestion proceeds, the gastric vessels dilate, there is movement of the muscles of the gastric walls, complex changes occur in the food, and what we term the chyme is formed.

3. As the result of digestive changes, we find that in the stomach about 40 to 50 per cent. of the carbohydrates of the food have been converted into sugar, and

40 to 70 per cent. of the proteids have been converted into peptones; this renders the food fit for absorption.

In the horse it has been proved by experiment that little or no absorption takes place from the stomach, so that the chief process of absorption must occur in the intestines.

In the ruminant, the greater portion of the food is acted on in the divisions of the stomach, so that the intestines occupy a minor position in the *rôle* of digestion in these animals.

The Nervous Mechanism of the Stomach.—Of the nerves which govern the secretion of the gastric juice, nothing is yet definitely known. We know that the contact of food, the products of digestion, and dilute alkalies, increase the secretion of the gastric juice. Also that the stomach possesses nervons ganglia in its walls independent of its outside nervous supply, and that the movements of the stomach-wall are excited by the presence of food and stimulation of the vagus nerve.

The stomach is supplied by two sets of nerves, and a centre in the medulla—the pneumogastrics, probably the afferent nerves, and the splanchnics the efferent. If the pneumogastrics be stimulated, powerful contraction of the walls of the stomach occurs; while if the splanchnics be stimulated, the movements will cease; we therefore term the pneumogastrics augmentor nerves and the splanchnics inhibitory nerves to the stomach-wall.

Impressions reaching the cerebrum and centre in the medulla are reflected as impulses to the stomach.

Impressions from other organs, such as the intestines, liver, kidneys, and all impressionable parts, have also a decided effect on the different functions of the stomach.

A point of interest in connection with the nerve-supply of the stomach of ruminants is that the nerves of the third compartment are distinct from those of the remainder, as stimulation of the pneumogastrics has no effect on the omasum, while it produces contraction of the other three divisions.

II. Pharmaco-dynamics.

We may now inquire as to the power we have of acting physiologically on the stomach.

With regard to horses and ruminants we must admit that from physiological peculiarities our power of interference is far less than in the case of dogs, so that in our consideration of the following points we shall have to draw attention to any important differences which may exist in this respect.

1. **Food.**—We have great powers of control over the quantity and quality of the food of animals. We can order special diet for certain cases, and pay attention to the periods of feeding. We can regulate the supply of water, and make sure that it is allowed at a proper time as regards the time of feeding. We can use measures to ensure the proper mastication and insalivation of the food.

2. **The Power of Interference with the Gastric Juice**—(*a*) *Alkaline stomachics* increase the flow of the gastric juice. They consist of dilute alkaline solutions, such as sodii bicarb., etc., administered before feeding. The increase of the salivary flow will also increase the amount of gastric juice secreted.

(*b*) *Digestive Adjuvants.* — If the constituents of the gastric juice are deficient, we may administer dilute hydrochloric acid or pepsin, or both combined, either along with the food or immediately after feeding.

3. **The Power over the Nerves of the Stomach**—(*a*) *Stimulants to the Nerves of the Stomach.*—These increase the sensibility of the nerves, and cause increase of not only

the local but also the general circulation; they increase the activity of the glands, dilate the vessels, and produce a feeling of hunger.

These include aromatic bitters, such as gentian, simple bitters, such as calumba, and spirituous preparations of the same.

(*b*) *Gastric sedatives* reduce the sensibility of the gastric nerves; sensation and the reflection of impressions is lessened.

These include opium and belladonna, bismuth, and dilute hydrocyanic acid.

There are certain drugs also acting as gastric sedatives which have the power of arresting disorder of the mucous membrane, such as creasote, creolin, and carbolic acid. These are termed *gastric disinfectants.*

(*c*) We can act on the gastric nerves reflexly by applications to the epigastrium, such as fomentations, poultices, counter-irritants.

4. **The Power over the Gastric Circulation**—(*a*) *Stimulants of the Gastric Circulation.*—Those agents which are stimulants to the nerves, dilate the vessels, and increase the blood supply, such as aromatics, bitters, and alcohol, etc.

(*b*) *Gastric astringents* render the local gastric circulation less active. They are indirectly gastric sedatives.

Examples.—Dilute acids, opium, salts of zinc, lead, tannic acid, and substances containing it.

5. **The Power over the Movements of the Stomach**—(*a*) *Gastric or Stomachic Tonics.*—Under this head we have such agents as dilute hydrochloric acid and dilute nitric and nitrohydrochloric acid. These, by increasing the acidity of the chyme, increase the movements of the stomach. We have also to include *specific nervo-muscular stimulants*, such as nux vomica and its active prin-

ciple, strychnine. These have a special action in imparting tone to the walls of the stomach, and increasing its movements.

(*b*) *Substances which diminish the Movements of the Stomach.*—These include gastric sedatives, such as opium and dilute hydrocyanic acid; also alkalies, given after meals, which reduce the acidity of the contents.

6. **The Power of Interference with the Contents of the Stomach**—(*a*) *Antacids.*—These are substances which neutralize the contents of the stomach, such as alkalies.

(*b*) *Gastric Disinfectants.*—These have the effect of correcting the process of decomposition in the contents of the stomach, and preventing the formation of gas, and include carbolic acid, creasote, creolin, aromatic oils, etc.

(*c*) We may also note the use of *antidotes* in cases of poisoning as coming under this head.

7. **Carminatives.**—These are substances which stimulate the gastric nerves, increase the gastric circulation, excite the muscular contractions, and probably relax the cardiac orifice of the stomach in dogs. They possess more than a local effect, as previously remarked; general stimulation also occurs; thus they are one form of diffusible stimulants.

Examples.—Aromatic and pungent oils, alcohol, ether, etc.

III. Pathological Relations.

The chief cause of disorders of the stomach in all animals may be attributed to errors of feeding.

In the horse the stomach is by no means so subject to disease as in ruminants and dogs, because in this animal the intestines have the most important part of digestion to perform, consequently we find that the latter organs are more liable to be affected by disease.

The reverse holds good in ruminants. As we have already mentioned, the large and complicated stomach performs the major part of digestion, hence it is more prone to disorders, while the intestines are rarely affected in comparison.

In the dog, although derangements of the stomach are frequent, still, in consequence of the ready power of vomition possessed by this animal, many serious affections are avoided.

In the horse affections of the stomach are very serious; thus, in engorgement, as emetics have no effect in this animal, and as food improperly prepared is retained by the action of the pyloric structures, very fatal terminations are apt to ensue, especially so when we consider the small size of the organ in comparison with the bulk of food usually taken.

Dyspepsia, or derangement of the gastric digestion, is in ruminants and dogs an affection of very common occurrence.

We have also to consider that although in horses the effects of this disorder may not be attributed directly to the stomach, still, it has an important bearing on intestinal affections in an indirect manner by reason of the alimentary matter leaving the stomach before the necessary changes have been produced in it, so as to fit it for intestinal digestion.

There are many ways in which derangement of gastric digestion may be brought about, and for all practical purposes we may briefly refer to the following conditions as those most commonly met with in all animals:

(*a*) Acute indigestion, with engorgement of the stomach.

(*b*) Indigestion without engorgement—chronic indigestion.

(*c*) Gastritis—acute and chronic.

1. For all these different conditions we can assign many causes, but to the food must be attributed first place in causation, especially as regards the conditions (*a*) and (*b*).

Thus, in the horse indigestion with engorgement is generally due to ingestion of food too abundant in quantity, and quickly swallowed without proper mastication and insalivation.

The action of cooked foods must be particularly noticed. These when given in large quantities, and especially when the horse is hungry and fatigued, are not properly masticated and acted on by the saliva, the result being that they are rapidly swallowed, and being unfitted to be acted on by the stomach, are retained in it, causing distension of the walls of this organ, the formation of gases, paralysis of the walls, and may even terminate in rupture of the latter.

Such foods have the character of bulk and indigestibility and liability to undergo fermentation in the stomach, although they may not of necessity be innutritious.

In cattle we have the conditions of distension of the rumen with solid matters, termed *plenalvia*, and also distension of that organ with gases, derived from fermentation of the food, termed *hoven*, the latter generally due to the ingestion of fresh green food when the animal is not accustomed to such, and the former depending on the introduction of solid matters in such amount as to paralyze the organ by over-distension, such as grain, food, chaff, potatoes, etc. In the dog engorgement of the stomach is generally relieved by spontaneous vomition, or by the animal naturally eating a certain grass of an emetic nature; consequently we see those conditions noted under headings (*b*) and (*c*) oftener than actual engorgement. As regards conditions other than the quantity and quality of the food as causes of gastric indigestion, we may note the following:

2. *Irregularities and diseased conditions connected with the teeth.*

3. *Deficiency of gastric juice in relation to the amount of the food taken; also diminution of the gastric secretion after cases of severe illness.*

4. *Deficiency of the acid of digestion, or of the pepsin ferment.*

5. *Disorder of the muscular functions of the stomach.*

In one case we may have feebleness of the movements, from which cause the contents are not exposed in a proper manner to the gastric secretion; there is also feebleness of the expulsive efforts, and the chyme is kept too long in the stomach, digestion being thus retarded.

We may have in another case excess of the peristaltic movements, which has the effect of causing the food to enter the duodenum before gastric digestion is completed. A similar effect will occur if water be given to horses immediately after feeding, the food being washed out of the stomach, and causing intestinal derangement.

6. In young animals we find indigestion occurring from removal from the dam at too early an age, and allowing the young animal to suckle at irregular intervals, such as when the dam is working daily. In such instances diarrhœa is usually the chief symptom present.

7. The occurrence of excessive acidity, termed *pyrosis*, manifested by the animal having a tendency to lick walls, eat clay, etc.

8. *Arising from nervous origin.*

These are due to impressions originating in the intestines, liver, kidneys, etc.

9. Organic diseases of the stomach.

10. The actions of certain drugs, such as opium,

arsenic, digitalis, etc., administered for medicinal purposes.

If from any of the causes enumerated gastric digestion be not properly performed—in the case of a heavy feed the constituents are only partially acted on—acid decomposition ensues with the formation of organic acids, and we have instead of normal chyme a fermenting mass, resulting in excessive formation of gas.

The heart and neighbouring organs become impeded in their action, the nerves, vessels, and glands of the stomach become irritated, the mucous membrane swollen and of a pallid hue, and the surface is covered with a tenacious mucus. The nervous centres are irritated, causing vomiting and eructations of gas in the dog.

In the case of the horse, if no relief be given, very serious and fatal results may ensue, either in the occurrence of cerebral complications or rupture of the organ.

If not severe, the contents may pass on to the intestines, causing derangement of the latter by irritation and by reason of excessive acidity.

After the acute symptoms have passed off, the morbid state of the mucous membrane may continue with excessive secretion of mucus and arrest of digestive power. There may be pain and loss of appetite, all of which will require appropriate treatment.

(*b*) *Indigestion without Engorgement—Chronic Indigestion.*—In this form the attacks are less severe, but may be almost continuous. It may occur from any of the causes mentioned, and must be looked upon as a very troublesome disorder in all animals, and, as we shall see further on, a species of chronic gastritis or gastric catarrh is sometimes responsible for chronic indigestion, especially in dogs.

From whatever cause the disorder proceeds, in all animals the result is perverted or defective secretion of the gastric glands, evidenced in the horse by capricious appetite, a habit of licking the walls of his stall, and eating clay, foul matters, etc., with acid eructations, thirst, and a sour condition of the mouth.

In cattle, chronic indigestion may depend on irregular feeding, bad quality of food, etc., and the presence of parasites, and we may draw attention to a condition of the rumen, in which, either due to a want of tone in its walls, or from the presence of a foreign body in the reticulum, there are frequent attacks of tympanites or hoven. In the dog, as causes of chronic indigestion in addition to dietetic influences, we may include the presence of parasites and foreign bodies in the stomach.

(*c*) *Gastritis—Acute and Chronic.*—Gastritis, or inflammation of the mucous membrane of the stomach, may be considered as either *acute* or *chronic*, and also a condition termed *gastric catarrh.*

Acute gastritis, except as the result of the action of irritant poisons, is not so frequent an occurrence in the horse as in other animals. Chronic gastritis may occur from continued errors of dieting, leading to serious alterations in the structure and functions of the stomach.

It may also depend on organic disease of the organ, or on disease of the liver, in which there is interference with the portal circulation.

In cattle gastritis occurs in that affection termed *fardel bound*, which, although considered by many as due to impaction of the omasum, is in the majority of instances inflammation of the abomasum, or true digestive division of the stomach.

We also find gastritis in cattle due to the presence of parasites in the abomasum, especially in young stock, which has often caused serious losses.

Also we find gastritis in cattle due to the action of irritant poisons.

In the dog acute gastritis, affecting the muscular and mucous coats, is seldom seen except as the result of irritant poisoning.

We have, however, to notice a very serious disorder of this animal, termed *gastric catarrh*, consisting of congestion or subacute inflammation of the mucous membrane, with great irritability of the organ, so that it will neither retain food nor medicines. It may arise from the long-continued use of indigestible foods, or the presence of parasites or of foreign bodies in the stomach.

It has a tendency to extend to the intestines, causing a very fatal condition.

IV. Natural Recovery.

In cases of indigestion with engorgement in the dog, the occurrence of vomition affords relief, but the after-effects require therapeutical interference.

In horses and cattle prompt and effectual means are required both to remove the cause and to treat the effects which remain.

In organic diseases of the organ, treatment can only be palliative.

V. Therapeutics.

1. **Prophylactic Treatment**—(*a*) *Dieting.*—This comes first in order, and is one of the most important details not only in the prevention of the various conditions which we have mentioned, but also in their treatment.

(*b*) *By artificial means*, such as the administration of hydrochloric acid or pepsin, either with or after feeding, in cases where these are deficient.

(*c*) *By increasing the gastric secretion* in cases where this is not secreted in sufficient amount, such as by the administration of aromatic bitters, with alcohol and an alkaline stomachic. For example, tincture of gentian with bicarbonate of soda given before feeding.

This is an imitation of the natural insalivation of the food.

2. **Immediate Treatment.**—When acute indigestion with engorgement exists, the indications are to evacuate the stomach of its contents, to relieve pain, if it be present, to neutralize the excessive acidity, and to expel or absorb the gas which may be formed.

In the horse we find that to restore the functional power to the stomach it is necessary to act on the whole alimentary canal by means of a purgative, which has the effect of removing the excess of food from this organ.

If combined with the excessive formation of gas, the administration of oil of turpentine in a purgative dose of linseed-oil will be of service, while if pain be present we prescribe in addition a few doses of sulphuric ether. If this pain is not relieved, it will be necessary to employ the hypodermic injection of morphine.

The addition of an alkali, to render the contents less acid and more fitted for their passage into the intestines, will be indicated, such as the bicarbonate of soda with spts. ammon. aromat., and an aromatic bitter, such as gentian. We must remember the extreme danger of engorgement of the stomach in the horse, both as regards cerebral complications and rupture of the organ, so that prompt treatment will be required.

In cattle the rumen and omasum are the divisions of the stomach which become affected by engorgement and loss of functional activity, the abomasum being the division liable to chronic indigestion or to gastritis. In these animals all our efforts must be directed to expel the contents from the divisions impacted by means of saline and oleaginous purgatives, and to encourage a return to the normal state of activity by the means already stated.

In the dog, if the impaction of the stomach be not relieved by spontaneous vomition, it will be necessary to administer an emetic.

3. **Treatment of the Effects.**—If much irritability of the stomach remains, gastric sedatives will be indicated.

The organ will require rest, so that only small amounts of easily-digested food should be allowed; if there be much prostration of strength, moderate doses of stimulants will be useful. Small doses of bicarbonate of soda and tr. gentian co., administered before feeding, will help to restore the normal secretion of the gastric juice, and neutralize excess of alkaline mucus which may be present.

4. **Chronic indigestion** is to be treated by carefully ascertaining the cause, and by strict attention to feeding and to the times of feeding. The flow of the gastric secretion may require stimulation, but this must not be overdone.

The acid of the gastric secretion or the pepsin may be deficient, and will require the administration of digestive adjuvants after feeding.

The nervo-muscular structures may require strengthening, such as by the administration of nervo-muscular stimulants and tonics, such as nux vomica and quinine.

If there is a tendency to excessive fermentation in the contents, gastric disinfectants will be indicated. If there be a condition of chronic catarrh of the mucous membrane, gastric astringents will be required, such as kino, catechu, and substances containing tannin.

5. **Gastritis** is to be treated by securing as much rest and quietude for the stomach as possible, gastric sedatives being employed, and demulcents.

In the dog the stomach becomes very irritable in this affection, persistent vomition being present, so that neither food nor medicine can be retained. Dilute hydrocyanic acid (gtt. i. to gtt. iii.) with bismuth, and alkaline carbonates, will be found useful in allaying the gastric irritation, and the food must be of a bland, mucilaginous nature. Externally poultices and fomentations to the abdomen should be adopted.

6. In organic diseases of the stomach our treatment can only be palliative. The different symptoms presented will require therapeutical measures on the lines already laid down.

CHAPTER IV.

ON VOMITION AND THE ACTIONS AND USES OF EMETICS.

I. Physiological Relations.

For various physiological reasons, the act of vomition does not occur in the horse except under very grave pathological conditions.

In ruminants we find the act very rare, and although it would appear that the physiological arrangement would tend to render the act easily performed, we find the reverse to be the case, so that it is reasonable to conclude that in these animals the vomiting centre is either very rudimentary or not sensible to ordinary impressions.

In the dog the act of vomition is very easily induced, both as an effort of nature to relieve the stomach from the presence of irritating or indigestible food, and also by the action of emetics.

In the act of vomition there are coutractions of the longitudinal fibres of the œsophagus, which dilate the cardiac orifice; the abdominal muscles and the diaphragm contract, and compress the stomach, while the pyloric orifice is closed.

The act is a reflex one, depending on afferent nerves from the fauces, stomach, abdominal viscera, peritoneum, etc.; a centre in the medulla, situated close to the respiratory centre; and efferent nerves, the phrenic and nerves to the abdominal muscles.

Vomiting may be produced by impressions from distant areas, and also by direct irritation of the nervous centres, such as the presence of certain substances, as apomorphia, in the blood flowing through them. In the act of vomition there are certain associated conditions which occur, besides the evacuation of the contents of the stomach. Thus, a flow of saliva generally precedes the act. The gall-bladder may be forcibly emptied of bile, which may enter the stomach and become expelled. The respiratory centre is stimulated, expiratory movements occur, the chest is compressed, the respiratory passages are cleared. Perspiration is excited, and the cardiac and vascular centres are depressed.

II. Pharmaco-dynamics.

Emetics are those substances which produce vomiting when administered. Emetics are of two kinds: 1, *direct emetics*; 2, *indirect emetics*.

Direct emetics are those which, given by the mouth, cause emesis by local irritation of the nerves of the stomach.

Examples.—Sulphate of zinc, sulphate of copper, and the popular emetics, such as salt and warm water, mustard and water, etc.

Indirect emetics cause emesis by whatever channel they enter the body; on reaching the blood, they act on the vomiting centre in the medulla, and cause far greater depression than the direct emetics, and also depress the other centres in the medulla.

Examples.—Apomorphine, which is the quickest emetic known, and can be administered hypodermically; antimony, and ipecacuanha. The last two act both as direct and indirect emetics.

Anti-emetics avert or arrest emesis:

1. Substances which reduce the irritability of the vomiting centre, such as amyl nitrite, chloral, opium, bromides.

2. Sedatives to the afferent nerves of the stomach, such as bismuth, dilute hydrocyanic acid, dilute alkalies, such as limewater, water given as hot as it can be borne, and ice.

3. Measures acting indirectly, such as poultices, fomentations and blisters to the epigastrium.

III. Pathological Relations.

We have two conditions to consider: 1, *excessive vomiting*; 2, *defective vomiting.*

Excessive vomiting may occur in affections of the stomach, of the brain, and of other organs. It may also occur from irritation of the vomiting centre, such as from the action of retained urea in the blood, or from the effects of certain poisons.

Defective vomiting, with attempts at retching, occurs sometimes from either direct or indirect stimulation of the centre. In cases of poisoning by narcotics, no natural attempt at vomiting occurs, and emetics may be urgently required to get rid of the poison.

IV. Natural Recovery.

Vomiting may cease after the cause has been removed; but in some cases it may persist, calling for interference.

If allowed to continue, the irritability of the gastric mucous membrane becomes increased, also the sensibility of the vomiting centre, and great weakness and prostration of strength, due to want of nourishment, is apt to ensue.

V. Therapeutics.

1. **Excessive Vomiting.**—The first indication in the treatment of excessive vomiting is to ascertain the cause, and if possible remove it. In the dog, if due to the presence of irritating food, the administration of an emetic will help to remove it; while if the vomiting occurs in the second stage of indigestion, with irritation of the gastric mucous membrane, gastric sedatives will be indicated. If due to the presence of a poison, then suitable antidotes will be given. If the vomiting be due to some injury or disease of the brain, nervous sedatives, such as bromides of potassium or ammonium, will be useful. If we ascertain the cause to be the presence of some intrinsic poison, such as urea in the blood, which irritates the vomiting centre, we must endeavour to remove it by increasing the action of the bowels, kidneys, and skin. If we fail to ascertain the cause, we must endeavour to reduce the irritability of the gastric nerves and the centre by the administration of such agents as opium, dilute hydrocyanic acid, etc.

2. **Defective Vomiting—the Use of Emetics.**—For obvious reasons, the consideration of the above will only apply to animals which have the power of vomition, as the dog and pig, because horses and ruminants do not respond to the action of emetics. In cases where the presence of indigestible food is not removed by spon-

taneous vomition, also in cases of foreign bodies in the cervical portion of the œsophagus, and in affections in which the respiratory passages are blocked, the use of emetics is indicated. In the latter instance, however, great judgment is necessary in order to avoid depressing the patient.

Sulphate of zinc, in doses from 10 to 20 grains in 2 ounces of warm water, forms an effectual emetic for the dog. The quickest emetic in cases of poisoning is apomorphia in a dose of $\frac{1}{16}$ grain to $\frac{1}{12}$ grain hypodermically.

In cases where emetics are indicated in respiratory affections, the use of the vini ipecacuanha, or carbonate of ammonia, is recommended.

In instances where drugs are not at our command, we may administer a tablespoonful of mustard in a cup of hot water as an emetic. As contra-indications to the employment of emetics, we may mention the period of gestation, irritation of the gastric mucous membrane, and in cases of debilitating affections.

CHAPTER V.

DIGESTION—THE INTESTINES.

I. Physiological Relations.

In the horse the intestines are of large size and capacity, and represent a large extent of mucous membrane.

In the ruminants, as previously remarked, the major portion of digestion is carried on by the vast and complex stomach. In the dog the intestines are short and small; while in omnivora, represented by the pig, the intestines, as regards size, occupy a mean between the carnivora and herbivora.

6

When the chyme enters the small intestines, it meets three digestive fluids, viz., the bile, coming from the liver; the pancreatic juice, from the pancreas; and the succus entericus, from the glands of the small intestines. As a result of the complex chemical changes which occur, the chyme becomes changed as follows: it changes its physical character, and becomes alkaline in reaction, and in a fit state for absorption by the lacteals and vessels of the intestines.

In connection with the intestines we have to consider: 1. *Absorption;* 2. *Excretion;* 3. *Peristaltic action, or transit;* 4. *Evacuation.*

1. **Absorption.**—As the chyme passes along the small intestine, certain portions of it become absorbed by the lacteal and portal systems; it is then carried on to the large intestine, where a further absorption takes place, the remainder forming the fæces.

An important point to notice is that a certain amount of fluid passes from the intestine to the blood, and from the blood to the intestine.

If absorption be slow there will be more fluid directed into the intestine from the blood, and more rapid transmission of the contents, and, as a consequence, the fæces will assume a liquid character. On the other hand, if the absorption be active, there will be less fluid poured out, the transit will be slower, and the fæces will be of a firm character.

We can only explain the absorption of water and salts by the portal system on the principles of diffusion, or osmosis. This process will depend on the amount of water, salts, and proteids in the bowel as compared with those in the blood, and also on the nature of these salts and the activity of the circulation through the veins.

2. **Excretion.**—In the small intestine there is a large

amount of watery excretion, which is greater than the amount absorbed, consequently the contents are fluid.

This excretion is accomplished by the process of osmosis from the vessels, and also by the glands of the intestine being acted on by nervous influence.

3. **The Transit of the Contents.**—This is accomplished by means of peristaltic action.

Peristaltic action is governed by the action of certain nerves, the vagus, when irritated, increasing peristaltic action, and the splanchnics inhibiting it.

The intestines also contain local ganglia, which are capable of sustaining the action of the bowel independently of outside nerve-supply.

The ordinary stimuli consist of the presence of ingesta, and probably of a certain proportion of gases in the intestine; also by the presence of the bile, which increases peristalsis.

The intestinal movements are also either increased or diminished by the action of different medicinal agents.

4. **The General Effects of Evacuation of the Bowels.**—The effect is more than a local one, as the whole system is influenced, especially in active purgation. The following are among the principal effects:

(1) A certain amount of water is removed from the blood. This is especially the case with some purgatives.

(2) The bile is cleared out from the small intestine, and the liver thus indirectly stimulated.

(3) Deleterious substances are removed from the system, also irritating ingesta and parasites from the intestines.

(4) The circulation in the abdomen is modified, the pressure is lessened in the bloodvessels, and the blood flows more freely in the portal system. The circulation

in the liver is rendered more free and the volume of blood reduced, the cerebral circulation is depressed, the circulation in the kidneys is increased, and diuresis is more readily induced.

II. Pharmaco-dynamics.

We can modify the action of the intestines in various ways, either by attention to the food, by increasing peristaltic action, by increasing the intestinal secretion, or by modifying absorption and excretion.

1. **Food.**—We must pay attention to the fact that perfect digestion in the stomach is one of the most important factors in promoting intestinal digestion and preserving a proper action of the intestines.

If the food enters the intestine before it is properly acted on by the gastric secretion, it will cause irritation of the intestinal mucous membrane, setting up either colic or enteritis, or, as an effort of nature to remove it, spontaneous diarrhœa.

Certain coarse articles of food, such as bran, have the effect of increasing the action of the intestines and acting as laxatives, and are largely used for this purpose.

2. **Agents which act upon the Intestinal Bloodvessels.**—We may divide these into: (*a*) *Drastics*; (*b*) *Astringents*; (*c*) *Constringents*.

(*a*) *Drastics.*—These are powerful and often dangerous purgatives. They cause dilatation of the intestinal bloodvessels, and a transudation of fluid into the walls and cavity of the intestines. They produce a condition of mild catarrh of the intestinal mucous membrane, and liquid evacuations, and require to be prescribed with great caution.

Examples.—Croton-oil, gamboge, elaterium.

These purgatives are indicated in cases where immediate purgation is necessary, such as in affections of the brain, etc., and croton-oil has the advantage of being capable of administration in patients where there is inability to swallow, being small in bulk, and acting when placed on the tongue.

(*b*) *Intestinal Vascular Astringents.*—These contract the walls of the intestinal bloodvessels, and reduce the amount of the watery excretion, and thus diminish the liquidity of the fæces.

Examples.—Salts of lead, diluted mineral acids, etc.

(*c*) *Intestinal Constringents.*—These have a special action on the tissues supporting the small vessels of the intestinal mucous membrane; they increase the compactness of these tissues, diminish the circulation, and reduce the amount of exudation through the vessel walls.

Examples.—Persalts of iron, tannin, and substances containing it, such as catechu, kino, etc.

3. **Agents which influence Absorption and Excretion**—*Saline Purgatives.*—These modify the process of osmosis in the intestinal wall, and produce two important effects. First, they increase the flow of fluid from the bloodvessels into the cavity of the intestine. Secondly, they are absorbed with a certain amount of fluid into the bloodvessels and into the general circulation, being again partly excreted into the intestine by the intestinal glands, a certain portion being again absorbed. As a result of these processes, a fluid evacuation of the bowels occurs, the rationale of which is not yet clearly understood. According to some authorities, saline purgatives also act by increasing the peristaltic action of the intestines.

Examples of Saline Purgatives.—Sulphate of magnesia, sulphate of soda.

These purgatives require to be dissolved in a proper proportion of water in order to produce the desired effects.

4. **Agents which influence the Intestinal Glands**—(*a*) *Carthartics and Hydragogue Carthartics.*—Mercurials moderately increase the secretions of the intestinal glands, and saline purgatives also act as glandular stimulants.

Hydragogue cathartics produce very fluid evacuations, and also probably act on the vessels and nerves.

Examples.—Jalap, colocynth, podophyllin, etc.

(*b*) *Substances which directly diminish the Intestinal Secretions.*—Opium, lead, and lime directly diminish the intestinal secretions. Alkalies and their carbonates indirectly produce a similar effect by interfering with the acidity of the chyme, when given in full doses.

5. **Agents which influence the Nervo-Muscular Structures of the Intestines.**—As we have already seen, there are many substances which act on the intestines through the muscular coat, the nerves, or a combination of both. Drastics even act in a reflex manner. Thus, croton-oil will cause increased peristalsis of the intestine before it has left the stomach.

(*a*) *Nervo-Muscular Intestinal Stimulants.*—These are generally known as *simple purgatives*, and the mildest of the group are termed *aperients* or *laxatives*, such as castor-oil, raw linseed-oil, etc. Simple purgatives act chiefly or entirely on the intestinal muscles, and cause a much less fluid evacuation than that produced by saline or cathartic purgatives, with less action on the portal and general circulation.

Examples.—Aloes, rhubarb, etc.

They are generally combined with a carminative, to prevent pain from excessive muscular contraction.

Certain drugs assist the action of such purgatives, such as nux vomica, belladonna, the latter acting by its power of lessening the inhibition of the splanchnic nerves.

(*b*) *Nervo-Muscular Intestinal Sedatives.*—These arrest the movements of the intestine, either directly or by acting on the nerves.

Examples.—Opium, morphine, lead, etc.

Bismuth, chalk, etc., diminish peristaltic action by forming a protective coating on the mucous membrane, and indirectly by diminishing the acidity and irritability of the contents.

All the substances under this heading are astringents.

6. **Cholagogues.**—These increase peristaltic action of the intestines by increasing the flow of the bile, which is a natural stimulant of the muscular coat. They are divided into:

(*a*) *Direct cholagogues*, which stimulate directly the liver-cells and the gall-bladder.

Indirect cholagogues, which indirectly stimulate the biliary secretion by clearing out the bile which is present in the intestine, and thus a fresh flow is induced.

Examples of Direct Cholagogues.—Podophyllin, sulphate of soda, etc.

Examples of Indirect Cholagogues.—Mercurials, such as calomel, pil. hydrargyri, etc.

We have also to mention that most purgatives are indirect cholagogues, and that many purgatives are direct cholagogues, while all cholagogues are purgatives.

7. **Anthelmintics** are medicines which kill or expel parasites from their various locations in the body. They are divided into:

1. *Vermifuges*, which expel the parasites without of

necessity destroying them. These belong to the group of cathartic purgatives, and by their action the parasites are removed from the intestine in the excreta.

2. *Vermicides* destroy the parasites, and it is clear that a combination of both a vermifuge and a vermicide will be advantageous.

Certain vermicides have a special action on certain species of parasites. Thus, areca-nut and the extract of male shield fern are useful for acting on the varieties of tapeworm, santonin for round worms. The oxyures, or thread-worms, found in the rectum, are best acted on by anthelmintic enemata, such as decoctions of quassia or aloes.

Oil of turpentine is a valuable anthelmintic in horses and cattle, but requires to be used with great caution in dogs. All anthelmintics act better when the stomach and intestines are moderately empty and the contents soft, and in many instances the medicinal agents will require repetition. Small doses of salines and mineral tonics will also be useful to induce a healthy condition of the alimentary canal.

The parasites infesting the bronchial tubes of young cattle and lambs are best acted upon by intertracheal injections of solutions specially prepared, generally consisting of small amounts of such agents as oil of turpentine, carbolic acid, etc. By this method the parasites are directly destroyed and expelled.

III. Pathological Relations.

Under the above heading we have the following conditions to consider, and may remark that in ruminants affections of the intestines are seldom met with in comparison to their frequency in horses and dogs.

1. *Excessive Intestinal Action—Diarrhœa.*
2. *Deficient Intestinal Action—Constipation.*
3. *Impaction of the Large Intestines, with Paralysis of the Muscular Coat.*
4. *Spasm of the Intestines, or Colic.*
5. *Inflammation of the Intestines, or Enteritis.*
6. *Volvulus and Intussusception.*
7. *Tympanitis of the Intestines, or Flatulent Colic.*

1. **Excessive Intestinal Action** is often referable to gastric indigestion, and may depend on irregularities in feeding, and the passage of the food into the intestines before it has been properly acted on by the gastric secretion. Certain poisons originating in the body itself, such as urea, and the poison of pyæmia, will also cause diarrhœa.

It may also occur as the result of an overdose of a purgative, or in cases of individual idiosyncrasies from the action of even a moderate purgative.

In young animals, such as foals, diarrhœa is frequently seen from mismanagement, such as overworking the dam, feeding her on improper food, and allowing the young animal to suckle her at irregular intervals, when the stomach of the foal has become weakened by prolonged abstinence, the result being that indigestion occurs. These cases often become serious if unchecked, as a form of catarrh of the mucous membrane of the intestinal canal is apt to ensue. We must regard diarrhœa rather as a symptom than as an actual disease.

2. **Deficient Intestinal Action, or Constipation,** depends on various causes. It may be due to a want of tone in the muscular coat of the intestines, depending on loss of vigour of the nerves, which do not respond to the natural stimuli. Also to insufficient exercise, and a long con-

tinuance in dry articles of food. Defective biliary secretion is also a common cause.

We must regard constipation as but a symptom of some existing condition rather than as a disease.

Dogs, especially those kept as pets, with pampered appetites and insufficient exercise, are very subject to deficient action of the intestines, often leading to serious conditions.

In foals, shortly after birth, there may be a condition of constipation due to inability to pass off the meconium, which, if not relieved, may lead to grave consequences.

3. **Impaction of the Large Intestines.**—This may depend on loss of tone in the muscular coat, whereby the intestinal contents accumulate and completely arrest the action of the bowels, and block the passage.

In the horse the double colon is often the seat of this affection, dry, bulky, indigestible food being a predisposing cause. Calculi and concretions formed in the intestine also are causes of obstruction, and tumours mechanically interfering with the parts are sometimes met with.

In the dog, impaction with paralysis of the intestine is an occurrence very frequently met with, and a peculiar symptom sometimes is present in such cases, *i.e.*, the occurrence of paralysis of the hind extremities of the animal. In this animal accumulations of fæcal matter may assume a very hard character, causing serious symptoms. We may also refer to the presence of foreign bodies and sharp bones swallowed as causes of intestinal obstruction in the dog.

4. **Spasm of the Intestines, or Colic,** is an affection of very frequent occurrence in horses. It consists of a spasmodic contraction of the muscular coats of the intestine, and is generally referable to irregularities in feeding,

the processes of mastication, salivation, and gastric digestion not being properly performed from various causes. Irritation is set up in the intestines, leading to the occurrence of the symptoms which we recognise as those of colic.

5. **Inflammation of the Intestines, or Enteritis**, is one of the most fatal affections to which the horse is liable. It may arise from various causes; in many instances it is impossible to assign any definite cause, and authorities are not yet agreed as to whether colic if severe and unchecked will terminate in enteritis, or whether the latter affection has a distinct origin and course of its own.

Enteritis consists in inflammation of the mucous coat of the intestines, the large being oftener attacked than the small. As the disease progresses, all the coats of the intestines become involved in the inflammatory process. In some cases the disease runs a very rapid course, the postmortem appearances showing extensive extravasation of blood into the cavity of the bowels, resembling a form of apoplexy of these organs rather than an ordinary form of inflammation.

6. **Volvulus and Intussusception**, and other forms of grave intestinal lesions, are generally hopeless cases, and beyond the aid of the therapeutist. However, we may venture to hope in the near future, when abdominal surgery shall be better understood as applied to animals, that surgical interference may be brought to bear with benefit in such cases.

7. **Tympanitis of the Intestine, or Flatulent Colic**, is that condition in which there is distension of the bowels by the presence of gas, arising from food which easily undergoes fermentation, the pain not being so acute as in the spasmodic form, but the constitutional disturbance greater.

Tympanitis may occur during the progress of another disease, where exhaustion is a prominent feature. It also occurs in cases of obstruction of the intestines from calculi, tumours, and other mechanical causes, and must always be regarded as a very grave symptom.

IV. Natural Recovery.

As previously stated, we often find that diarrhœa is an effort of nature to remove some irritating material from the intestinal canal. When this cause is removed the symptoms may cease, but we shall find that therapeutic measures will be required either to help the removal of the irritant, or to combat excessive symptoms in many cases.

In all the other pathological conditions noted, the aid of the therapeutist will be required, as spontaneous recovery is seldom seen.

V. Therapeutics.

The Uses of Purgatives.—The intestines of the horse present a very extensive surface of mucous membrane, and great care is essential in the administration of purgatives in order to avoid the occurrence of super-purgation. If possible, for two days prior to the administration of a purgative, the animal should be prepared by being fed on bran-mashes, so as to render the intestinal contents soft and easily acted on, and thus to avoid any irritating effects as much as possible. By this means a much smaller dose of the purgative will suffice to bring about desired results.

Up to the present the drug chiefly employed to produce purgation in the horse is aloes, administered in the form of a properly-prepared bolus. Saline purgatives have an uncertain action in this animal, while the use of laxatives, such as raw linseed-oil, are indicated in cases where we wish to act on the intestines without danger of any irritating effects.

The animal having been properly prepared, if a moderate dose of aloes be administered in the morning, purgation will usually ensue in from *ten to twelve hours.* The animal should have gentle walking exercise until the physic commences to operate, when he should be placed in his stall, with proper clothing applied, and a liberal supply of warm bran-mashes allowed, care being taken to avoid cold drinks by having the chill taken off the water allowed.

In ruminants, in consequence of the development of the stomach and the large amount of ingesta contained therein, the action of purgatives is slow and often uncertain, the average time being *twelve to sixteen hours.* Saline purgatives largely diluted give the best results, while in obstinate cases croton-oil with calomel are to be preferred.

Sheep generally take about one-fourth the dose required for cattle. Sulphate of maguesia largely diluted or castor-oil are the safest agents; drastics such as croton-oil should be avoided.

In the dog purgation is easily induced, the alimentary canal being comparatively small and the ingesta not bulky. Either castor-oil, or jalap with calomel, gives the best results, while it is important to remember that the mixture should be prepared in as palatable a form as possible, so as to avoid the tendency to produce vomition. Purgatives generally act in from *five to eight hours* in this animal, and in obstinate cases should be assisted by the administration of enemas.

In the pig either castor-oil or sulphate of magnesia acts well.

We will now consider the therapeutical relations of the following conditions.

1. *Deficient Intestinal Action—the Use of Purgatives.*
2. *Excessive Intestinal Activity—the Use of Astringents, and the Treatment of Diarrhœa.*

1. Deficient Intestinal Action varies in degree from what is known as ordinary constipation to a condition of great gravity, in which there is total stoppage of the bowels, with perhaps paralysis of the muscular coat of the intestine.

In the treatment of ordinary constipation *the cause* must first be discovered and removed. Attention must be directed to the food, to the digestion, to the amount of exercise, and to the state of the liver.

If the condition become chronic, it will generally be found due to *a want of tone, or torpidity of the muscular coat of the intestine*, in which nervo-muscular stimulants will be indicated, after free purgation has been induced by the administration of a purgative. Thus, medicinal doses of nux vomica, with small doses of aloes and belladonna, will be found very useful in such cases, with occasional administration of saline cholagogues, such as sulphate of soda.

In cases of impaction of the intestines, violent purgatives should be avoided, the use of oleaginous laxatives being indicated, with the liberal use of purgative enemata, administered by means of a special long tube.

In cases of *colic*, or *spasm of the intestines*, generally due to the presence of irritating ingesta, an oleaginous purgative should be administered, with an antispasmodic to relieve the pain.

Other Uses of Purgatives.—Besides the use of purgatives for the conditions we have mentioned, there are many other important indications in which they are employed with benefit.

(*a*) *For the Reduction of the General Blood Pressure.*—In cases of cerebral congestion, of dropsy due to overloading of the portal system and systemic veins, hydragogue cathartics and salines are very useful, relieving the circulation, and removing a large amount of fluid by the intestines.

(*b*) At the commencement of some inflammatory affections, such as lymphangitis, laminitis, irritative fever due to wounds, etc.

(*c*) In cases of inflammation of the liver and kidneys purgatives have a beneficial action, removing by the intestines the excrementitious matters which, by reason of the loss of function of the former organs, remain in the system.

(*d*) For removing from the alimentary canal parasites, and also for relieving the stomach of irritating ingesta, and in cases of engorgement of that organ leading to cerebral complications. Also in cases of diarrhœa due to the presence of irritating material in the intestines, a moderate aperient is the first indication in treatment.

Contra-indications of Purgatives.—In inflammatory conditions of the intestines, in peritonitis, in volvulus and intussusception, in hernia, etc., purgatives must be studiously avoided, as peristaltic movements increase the diseased condition, and temporary paralysis of the intestine must be aimed at.

Again, in all cases of a debilitating nature, such as influenza, respiratory affections, etc., purgatives have a depressing and weakening effect, and if their use is absolutely required, only the mildest laxatives should be employed, with the use of enemata in addition.

2. **Excessive Intestinal Activity—the Treatment of Diarrhœa.**—The first step in the treatment of diarrhœa is to ascertain *the cause*, and, if possible, remove it. If due to irrational methods of feeding, these should be immediately attended to. Some animals, especially horses, are very subject to an attack of diarrhœa without any appreciable cause, and require careful attention in the way of feeding. Care should be taken that the food is properly acted on in the mouth, and also that gastric digestion is properly performed, and that the animal is watered at a proper time.

Unless the diarrhœa is excessive, it will be advisable, in cases where it is due to the presence of irritating ingesta in the intestines, to help the efforts of nature to remove the cause by the administration of an oleaginous laxative.

In young animals, where the affection is often due to the milk being deteriorated in quality, and allowed at irregular intervals, a similar course should be adopted at the commencement, bearing in mind, however, the great danger of intestinal catarrh, with weakness of the patient, supervening if the condition is allowed to continue without treatment being adopted.

If the diarrhœa be due to renal or hepatic disorders, cholagogues with diuretics in moderate doses will be useful. If it be due to excessive acidity of the duodenum, alkalies, such as bicarbonate of soda or chalk, should be administered.

If the diarrhœa persists after our efforts to remove the cause, we are compelled to treat the effects, remembering that these should not be allowed to continue too long before treatment is adopted. For this purpose we prescribe intestinal constringents with intestinal nervo-muscular sedatives. Substances containing tannic acid, such as catechu or kino, with preparations of opium, such as the tincture of opium or chlorodyne, to which may be added a dose of prepared chalk, give excellent results, and may be administered in flour or starch gruel, the former by preference. The drinking water should have the chill removed, and the food should be of as digestible a nature as possible, and the animal kept sufficiently warm.

In cases of superpurgation due to the excessive action of cathartics, very careful attention is necessary. Many of such instances will yield to a dose of tincture of opium combined with a carminative, but some cases require the use of stimulants, of which brandy is to be preferred.

In cases of dysentery, the intestinal vascular astringents are employed, such as lead combined with opium and dilute sulphuric acid.

Treatment of Flatulent Colic.—In this condition our efforts must be directed to neutralize the gas in the intestine, to promote action of the bowels, and to relieve the pain. For these purposes the oil of turpentine, with some preparation of ammonia and a large dose of raw linseed-oil, gives satisfactory results, and the action should be assisted by the use of enemata.

In very severe cases, with symptoms of great distress, it will be necessary to perform the operation of puncturing the distended bowel with a special trocar and cannula, so as to allow the excessive amount of gas to pass off, and thus avert a fatal termination.

Treatment of Enteritis.—In this affection, as previously stated, all purgatives should be rigidly withheld, as the chances of recovery, although very slight, will depend on keeping the inflamed part in as complete a state of rest as possible.

The skill of the therapeutist should be directed to subduing the excessive pain by the administration of anodynes, of which opium and its alkaloid, morphia, combined with atropia, are those in general use. We have to consider that in this affection very large doses of these drugs will be tolerated, and as in many horses those agents mentioned act as cerebro-spinal excitants, and fail to give relief, it will be necessary to administer a hypnotic, such as chloral hydrate or the drug cannabis indica, which is now coming into favour as a valuable anodyne for the horse.

The Treatment of Obstruction of the Intestine due to Impaction or other Causes.—In these cases the use of strong purgatives is also contra-indicated, as likely to cause rupture of the intestinal wall, or enteritis. Oleaginous laxatives should be administered and purgative enemata persevered in, the long rectum tube being of vast service in such cases. If we are enabled to diagnose the case to be a paralyzed condition of the colon, with accumulation of the contents, then the use of hypodermic injections of eserine, combined with pilocarpine, is indicated, and has given most satisfactory results, the former of these drugs causing energetic contractions of the muscular coat of the intestines, with increased secretion of the intestinal fluids, the latter causing excessive secretion of the intestinal glands.

If the obstruction be due to other causes, this treatment will only hasten the fatal result, besides causing excessive pain to the animal.

Finally, we may state that in all intestinal disorders, where pain is a prominent symptom, our immediate efforts should be directed to subdue it, as pain, if allowed to continue, will lead to very serious results.

If we could always diagnose the cause of abdominal pain correctly, then indeed our efforts should be directed to remove this cause, and treat the effects which may remain. If we are positive from our observation and judgment of the symptoms that a certain case is one of spasmodic colic, due to the presence of irritating ingesta in the intestines, then the rational treatment would be the administration of a cathartic immediately. But, unfortunately, in all cases the symptoms presented are not sufficiently diagnostic to enable us to do this with certainty, and the primary symptoms of abdominal pain may be the precursor of very serious conditions, where active purgatives would be not only injurious, but would increase the tendency to a fatal result. We have also to take into consideration the length of time which a cathartic dose will take to produce its effects in a horse which is not prepared.

Practitioners differ in their opinions with reference to treatment in such cases, some advocating the administration of an active cathartic on the first symptoms of spasmodic colic being shown, with an antispasmodic to relieve the pain; others regard the relief of the pain as of primary importance, and at the same time administer an oleaginous aperient, which, in the event of a more serious condition supervening, cannot be productive of any injurious effect. We may add that the latter is the practice recommended by authorities on human medicine.

CHAPTER VI.

ON ENEMATA.

ENEMATA are fluids of various compositions introduced into the rectum for the following therapeutical purposes:

1. To procure evacuation of the bowels.
2. To restrain severe diarrhœa.
3. To destroy and remove parasites in this location.
4. By reflex action to procure soothing effects on the pelvic organs.
5. To act as nutrients to the system when feeding by the mouth is impossible or contra-indicated.

1. Enemata for the purpose of procuring evacuation of the bowels may be either *simple*, consisting of warm water with soap rubbed up therein, or *purgative*, such as injections of castor-oil, raw linseed-oil, or solutions of aloes. In either of these instances we do not intend the action to be merely a local one by removing the contents of the rectum, but to stimulate the whole intestinal tract to increased peristaltic action.

In the case of simple enemata, to effect this purpose it is necessary to introduce a large amount of fluid, so that the lower portion of the intestine shall be distended, and the action of the parts beyond this excited.

To perform this effectually certain points must be attended to. We must consider that the large colon is that portion of the intestine which is usually affected by impaction, etc., and that this part is out of reach of mechanical interference. Also, we have to consider the great length of the rectum and floating colon of the horse, the former being about two feet in length, the latter about ten feet.

To simply inject fluids into the rectum with an ordinary syringe and short tube in the hope of acting on impaction located in the large colon must of necessity be a failure, as, after a certain amount has been injected, it will pass out, and simply remove the contents of a portion of the rectum. What our object should be is this: to ensure that the fluid shall find its way as far up the intestine as possible, and remain there for a certain period so as to excite the peristaltic action of the portion of the intestine requiring it.

The rectum tube invented and recommended by Professor Smith, A.V.D., for this purpose is a most useful instrument in cases of impaction of the colon, but certain precautions are necessary in using it. The rectum should first be cleared of all excreta as far up as possible with the hand. The tube, being well smeared with vaseline, is attached to the enema syringe, the best pattern of the latter being that invented by Winton, which is slow and steady in its action. The tube is now carefully introduced into the rectum, and the syringe slowly and steadily worked. As the bowel becomes dilated by the fluid the tube can be easily passed along, no force being used at any time. By this means a large amount of fluid can be introduced into that portion of the intestine where its action will be productive of benefit, and where a certain portion will be likely to remain.

Of course, in cases of severe abdominal pain it would be a matter of impossibility to use such a tube. In such instances the pain should first be relieved by the administration of anodynes, either by the mouth or by subcutaneous injection.

The long tube is only required in cases of impaction of the colon, a tube of about half the length sufficing for ordinary cases.

In using purgative enemata, we should be careful to employ only moderate amounts at a time, so as to ensure that they shall be retained for a proper period.

Here again we find the long tube of infinite service in cases of impaction, a mixture of castor-oil and raw linseed-oil carefully injected producing most favourable results.

In canine practice for similar purposes, the long tube is an essential factor in the treatment of impaction of the colon. In the dog we find in these cases a condition of great irritability of the stomach, so that it is impossible to cause oleaginous remedies to be retained when administered by the mouth, as vomition quickly occurs.

We may also refer to the excellent results obtained by the use of enemata of glycerine in cases of impaction of the bowels, and in dogs the use of suppositories of glycerine often is most satisfactory.

In cases of flatulent distension of the bowels we find the use of enemata very beneficial, especially when such are medicated by the addition of such agents as oil of turpentine, asafœtida, etc., care being taken that the former is administered well mixed with some bland substance, so as to avoid its irritating effect on the mucous membrane.

2. Enemata to act as sedatives and astringents to the bowels in cases of severe diarrhœa should be small in bulk, the basis being of boiled starch medicated with tincture of opium, and astringents, such as acetate of lead or substances containing tannin.

3. Enemata to destroy parasites infesting the rectum are medicated with some vermicide, such as quassia, weak solutions of tincture of iron, or solutions of common salt.

4. Enemata of warm water produce soothing effects on the intestines and neighbouring organs, and are useful in reducing the pain of cystitis and pelvic and abdominal pain generally.

5. Nutritive enemata are employed in cases where swallowing is difficult or impossible, also in persistent vomiting, and in painful organic diseases of the stomach. Such enemata should be small in amount, and composed of bland, unirritating materials, so as to favour absorption from the intestinal mucous membrane.

The nutrient material should be prepared in a form capable of being freely absorbed, such as by the addition of pepsin and dilute hydrochloric acid, or by adding a pancreatic ferment, such as mixing a portion of the pancreas of an ox or pig with meat, both being reduced to a state of fine division, and rubbed together with warm water.

Eggs are capable of being absorbed without the process of peptonization.

CHAPTER VII.

THE LIVER.

I. Physiological Relations.

THE liver is the largest gland in the body, and has several important functions to perform, not only concerned with the process of digestion, but also with nutrition and excretion. Thus we may note the formation of the bile, the regulation of the supply of sugar to the system, the storing up of glycogen. We have also to remember that the liver is an excretory organ; thus, certain nitrogenous products of digestion are converted into urea and uric acid in this organ, and rendered capable of being excreted from the body.

Another point worthy of attention is that there is no gall-bladder in the horse, so that the bile flows into the intestine according as it is prepared in the liver; in the other animals a gall-bladder is present in which the bile is stored up until it is required. The absence of the gall-bladder in the horse is accounted for by the fact that in this animal food in more or less amount is continually passing along the small intestines, so that the bile is in constant demand, while in other animals, in which the food remains a certain time in the stomach, the bile is only required when the chyme passes on to the duodenum, and in the interval it is stored in the gall-bladder. The functions of the bile are very important; briefly they may be stated as follows: The emulsifying and saponifying of fats, and as an auxiliary to the pancreas in its action on starch, the prevention of putrefaction in the intestinal contents, and the promotion of the peristaltic action in the intestines.

The circulation of the bile is of great importance from a therapeutical point of view. The bile which flows into the intestine and mixes with the chyme is not all got rid of by the fæces. The biliary salts become reabsorbed and returned to the liver, from whence they are again secreted and carried to the intestine.

II. Pharmaco-dynamics.

We can influence the liver in various ways:

1. **Food.**—The amount of food allowed will influence the secretion of bile, the amount of urea and the proportion of glycogen stored up; the nature of the food will also have a similar influence.

2. **Exercise** will increase the amount of oxygen reaching the liver, and thus reuder more complete the processes carried on therein.

3. **The Supply to the Liver** can be diminished by hydragogue purgatives, which carry away a certain proportion of water from the radicles of the portal vein in the intestinal walls, and remove it from the system.

4. **The Products of the Liver** can be influenced, and important effects on the organ produced. If bile or urea accumulate in the liver, its functions will be interfered with. By means of *indirect cholagogues* we can clear out the intestines and the bile contained therein, consequently the bile-salts, instead of being absorbed, are removed from the body; their absence from the portal vein and liver causes the hepatic cells to secrete fresh bile. Mercurials are specially useful in this respect.

5. **The Metabolic Processes in the Liver can be modified by Specific Hepatic Stimulants and Depressants.**—Bicarbonate of soda, dilute nitrohydrochloric acid, and arsenic increase the flow of bile and glycogen. Amyl nitrite stimulates the glycogenic function. Direct cholagogues increase the flow of bile. Chloride of ammonium and iron increase the amount of urea. Opium and morphia reduce the whole process of hepatic activity; quinine and alcohol have a similar action in a less degree.

III. Pathological Relations.

Disorders of the liver are generally due to the following causes:

(*a*) Errors in feeding; (*b*) want of sufficient exercise and proper hygienic surroundings; (*c*) retention of the products of the organ due to inactivity of the other excretory organs—the kidneys, lungs, or bowels. The different causes inducing derangement of the liver produce certain definite phenomena in the organ and in the general system.

The chemical processes in the organ are disturbed, the composition of the excretions is altered, and certain symptoms are observed as a consequence of the presence in the blood of certain products. In the disturbance of the natural functions of the liver, whether due to structural changes in the organ or not, there are a few important symptoms which we recognise as generally present:

1. *Jaundice*—due to some disturbance in the formation and secretion of the bile, or to reabsorption of the bile after it has been secreted. We must, however, draw attention to the fact that in many cases of extensive disease of the liver this symptom may be absent.

2. There may be the exhibition of pain, evidenced by colicky symptoms or uneasiness.

3. Persistent lameness in the off shoulder in horses.

4. In far-advanced cases of liver diseases, with changes in the hepatic structure and obstruction to the portal circulation, we may have the occurrence of intestinal catarrh, and the presence of fluid in the abdominal cavity, termed *ascites*.

5. In dogs, obstinate and persistent vomiting.

As changes in the general system, the result of disorders of the liver, we may note disturbance of the nervous system and interference with general nutrition. The urine contains an excess of urea, the colouring matter is increased, and leucin and tyrosin are present. The bile is altered in quality and quantity, causing either diarrhœa, with pale, foul evacuations, or constipation. The glycogenic function of the liver may be disturbed, giving rise to the presence of sugar in the urine, one of the leading phenomena of that disease termed *diabetes mellitus*.

We may remark that liver affections are of very frequent occurrence in dogs, less often seen in horses and cattle, and that in many instances they are not diagnosed with facility. The affections usually met with are:

1. *Congestion of the Liver.*
2. *Hepatitis, or Inflammation of the Liver.*
3. *Chronic Diseases of the Liver.*
4. *Parasitic Diseases of the Liver.*

1. **Congestion of the Liver.**—The vascular arrangement of the liver renders the condition of excess of blood in its capillary system one which is, comparatively speaking, easily induced. We may divide this condition into: (*a*) *Passive congestion*; (*b*) *active congestion*; (*c*) *biliary congestion.*

(*a*) *Passive Congestion* is the most common form met with. It consists of obstructed blood-flow in the portal and hepatic veins, depending upon a reflux of blood from external organs and surfaces, with disease of certain viscera, such as the heart and lungs.

(*b*) *Active Congestion* depends on an increased or excessive supply of blood to the gland, in which the capillaries of the portal vein or hepatic arteries become distended.

A slight amount of active congestion of the liver accompanies the process of digestion, while over-feeding on highly stimulating food, without a proper amount of exercise, tends to intensify this condition.

(*c*) *Biliary Congestion* consists in overloading of the minute bile-ducts with bile, and depends on either or both of the conditions just described. In one case the bile-ducts are pressed upon by the engorged vessels, and the bile is prevented from escaping; in the other, there is excess of bile secreted from the extra supply of blood, and the ducts are not able to remove it.

All these conditions, if frequently occurring, lead to bilious contamination of the blood and to structural changes in the liver, with the usual train of symptoms.

2. **Hepatitis**, consisting of inflammation of the fibrous covering of the liver, or of inflammation of the component gland structure of the organ, is not often diagnosed, but the results of postmortem examinations show the condition to be more common than is usually supposed.

3. **Chronic Diseases of the Liver** are more commonly met with in dogs than in horses or cattle. The forms usually found are cirrhosis, fatty degeneration, albuminoid or lardaceous liver; also the occurrence of morbid growths, such as carcinomata, sarcomata, and tubercle must be noted.

4. **Parasitic Diseases of the Liver** are of great importance. Among these we may mention the cystic form of the Tænia echinococcus in the horse, and the presence of the Distoma hepaticum in sheep, causing that affection termed *liver-rot.*

IV. Natural Recovery.

In most cases the aid of the therapeutist will be required, but the usual nausea produced may cause abstinence from stimulating food, and thus give the organ rest, while bilious vomiting and bilious diarrhœa in dogs will help to remove the excess of bile.

The general depression and constitutional symptoms will require immediate treatment. We must consider that in cases of extensive structural change palliative treatment is the only resort.

V. Therapeutics.

Preventive treatment will consist in attention to feeding and exercise, and to a proper condition of digestion and of the excretory organs.

The immediate treatment will consist in all classes of patients in the administration of a cholagogue cathartic to clear out all bile from the intestine. This should be followed up by doses of salines, such as the sulphate of soda or of magnesia.

In chronic cases small doses of calomel are indicated, also bicarbonate of soda given after feeding. Dilute nitro-hydrochloric acid, with quinine and stomachics, are useful in bringing about a healthy condition of the organ.

In cases where there are severe effects as a result of hepatic disorder, we must direct our efforts to relieve them as well as acting on the organ itself. Thus, obstinate vomiting, which is often present in dogs, must be relieved by gastric sedatives, such as bismuth, dilute hydrocyanic acid, hot fomentations to the abdomen, etc.

If there be much debility present stimulants may be required, and even small doses of opium when pain is present; but these remedies should be avoided as much as possible, as they are likely to cause further hepatic disorder.

In cases of congestion of the liver, hydragogue cathartics are indicated to relieve the portal circulation. This treatment should be followed up by the administration of salines, such as the sulphates of magnesia and soda, which also act as diuretics, and thus help to afford relief to the liver.

In the treatment of diabetes mellitus the feeding is of first importance, saccharine and amyloid substances being avoided as much as possible.

As regards the use of drugs in this affection, the best results have been obtained from the administration of opium and its active principles, morphine, morphia and codeia, such drugs being borne in large doses in such cases.

CHAPTER VIII.

THE BLOOD.

We may regard the blood as a fluid medium bearing important relations to all organs of the body, such relations consisting in conveying nutrient material and oxygen to the tissues, and carrying away the results of tissue activity. There are few primary affections of the blood itself, but morbid changes occur, depending on its source of supply, and also on the organs performing the important functions of excretion, such changes being of special interest to the therapeutist.

We have also to notice an important fact, viz., that it is through the blood that the active principles of drugs reach the organs of the body, on which they produce their specific effect, and few drugs act directly on the blood itself.

I. Physiological Relations.

The liquor sanguinis or plasma is the medium of nutrition, carrying the various nutritive materials between the different organs of the body, and removing the products of the vital processes, viz., the carbonic acid, water, urea, salts, etc. It has an alkaline reaction, depending on the presence of salts of soda, and varies in composition according to the different active organs through which it is passing, so we may regard it as having a process of supply, of expenditure, and of excretion.

The White Corpuscles are believed to have a special nutritive function.

The Red Corpuscles have the important function of carrying oxygen from the lungs to the tissues, and consist chiefly of hæmoglobin, of which iron is an important component; the chief salts are those of potassium, generally in combination with phosphoric acid.

II. Pharmaco-dynamics.

We can influence the blood in various ways:

1. **By Influencing its Supply.**—This can be accomplished by modifying the food, by altering the digestion and the hepatic functions.

2. **The Alkalinity of the Plasma** can be increased or reduced within certain limits. It is increased by the administration of alkalies and alkaline earths, of which salts of potassium act the quickest, but salts of sodium, although acting slower, have a more permanent effect.

Alkalies may also act indirectly by combining with the uric acid, and being removed by the kidneys. It is difficult to reduce the natural alkalinity, as mineral acids administered enter the blood in the form of neutral salts of potassium, sodium, etc., but citric and tartaric acids have a partial effect in this direction.

3. **The Plasma can be influenced by acting on the Expenditure.**—Thus, by purgation the water, salts, etc., can be influenced through the portal system. By diuretics, the excretion by the kidneys is increased, and by diaphoretics the functions of the skin are stimulated. The nutritive value of the blood can be increased by sparing the action of the organs of vital energy and of waste, such as the muscles, and the amount of water can be increased by withdrawing a certain amount of blood by the operation of venesection.

4. **Influence over the White Corpuscles.**—Certain drugs, such as quinine, *reduce* the number of the white corpuscles, and cause their movements to cease. Substances which increase intestinal absorption increase

the production of the white corpuscles, such as aromatic oils, etc.

5. **Influence over the Red Corpuscles.**—(*a*) The number of red corpuscles can be *increased*, and their constituents in hæmoglobin augmented, by attention to food, digestion, air, exercise, etc. The administration of iron in suitable forms directly increases the amount of hæmoglobin; phosphoric acid either alone or in combination with iron or other bases has a similar effect. Substances which either directly or indirectly improve the quantity or quality of the hæmoglobin are termed *hæmatinics*.

(*b*) Some substances combine with the hæmoglobin, *reduce* it to a certain extent, and interfere with its quantity and the oxygenating power of the corpuscles, such as arsenic, citrates, and tartrates.

The *number* of the red corpuscles is reduced by lead, which also acts indirectly by interfering with digestion.

The *oxy-hæmoglobin* of the corpuscles is reduced by toxic doses of certain drugs, such as iodine, turpentine, dilute hydrocyanic acid.

(*c*) *Oxygenation can be reduced*, and the oxygen made to adhere more firmly to the corpuscles, by such substances as alcohol and quinine. Nitrous oxide gas interferes with oxygenation indirectly by taking the place of the oxygen in the corpuscles, and not by combining chemically with the hæmoglobin.

III. Pathological Relations.

These are numerous and important, but for our present purpose a short description will suffice. Broadly speaking, we have two great pathological conditions of the vital fluid, viz.: 1. *Plethora;* 2. *Anæmia.*

In plethora there is excess of blood, generally found in young fast-growing animals, fed on highly nutritious food and not receiving sufficient exercise.

In anæmia there is a deficiency in the quantity of the blood, and a deterioration in its quality; the albumins are deficient, and the proportion of water is increased. It may depend on various causes, such as insufficient food, imperfect digestion, neglect of hygienic precautions, excessive waste, as in exhausting diseases, etc.

As general symptoms we may note paleness of the visible mucous membranes, the pulse feeble, thready and jerky, palpitation being induced by any excitement; there is impairment of digestion, and the presence of venous murmurs can be detected in the large veins, due to the thin watery blood flowing in the partly-filled vessels with great rapidity.

In horses we observe the condition of anæmia in some instances during spring and autumn, when undergoing the process of casting their coats. The animals are not in a proper state of health to perform their work in the usual manner; they sweat on the smallest exertion; in some cases there may be anasarcous swellings on the limbs, sheath, abdomen, etc.

In considering other pathological conditions of the blood, we may remark that those of the plasma are most common, but are chiefly secondary, *i.e.*, depending on affections of organs from which it obtains its supply, or of some disorders of the excretory organs by which its products are removed from the body.

The following conditions will require notice:

(*a*) **The Water of the Blood** is increased in anæmia, and diminished in cases where its excretion from the system is excessive, such as severe diarrhœa, etc.

(*b*) **The Albumin of the Blood** is deficient in anæmia, and exists in a defective state in albuminuria, in dropsy, and in parasitic affections of the liver in sheep.

In that disease known as 'red water' in cattle, the albumin of the blood is in a degenerated condition; and in that affection in horses termed *azoturia*, or *hæmoglobinuria*, there is excess of albumin in the blood, which has undergone some complex chemical changes, which render it capable of producing certain morbid phenomena in the system, such as inability to rise, convulsions, and the presence of dark-coloured urine, etc.

(*c*) **The Elements of Fibrin may be in Excess or Deficient.**—The fibrin is formed in *excess* in certain acute inflammatory affections, such as acute rheumatism; it may also be increased by the application of external irritants. In some exhausting diseases, and in emaciated subjects, the fibrin may also be formed in excess.

There is *deficiency* of fibrin, and, as a result, imperfect coagulation of the blood, in all conditions where there is imperfect oxygenation of the blood. Thus, in subjects which have died from asphyxia the blood is found in a semi-fluid condition, dark in colour, and does not coagulate until exposed to the air. Various poisons, such as hydrocyanic acid, have a similar effect.

In low fevers of a typhoid character, such as influenza in horses, with unsanitary, badly-ventilated surroundings, the blood becomes very fluid in character, and tends to gravitate to the depending parts of the body, forming swellings on the extremities, the abdomen, the head, etc., and the appearance of petechiæ on the visible mucous membranes, a group of symptoms belonging to that affection termed *purpura hæmorrhagica*.

(*d*) **The Effects of Defective Excretion.**—Chyle in a defective condition is a cause of anæmia, etc.

When the organs of excretion are disordered or diseased, products accumulate in the blood. Thus, in arrested or defective excretion of urine urea accumulates in the blood, acting as a narcotic poison, and in smaller amounts as an irritant, giving rise to the pathological condition termed *uræmia*.

Again, in severe pathological conditions of the respiratory organs, the carbonic acid may accumulate in the blood to such an extent as to cause asphyxia.

(*e*) **Deficiency of Hæmoglobin—Reduction of Oxy-hæmoglobin.**—Deficiency of hæmoglobin may depend on the want of a sufficient quantity of blood as a whole, on want of a sufficient proportion of red corpuscles, or on deficiency of the individual corpuscles in hæmoglobin. The result is that the blood is reduced in its oxygenating powers, and the functions of the different vital systems are not performed in a proper manner.

Reduction of oxy-hæmoglobin may be brought about by the administration of certain drugs in poisonous quantities, such as dilute hydrocyanic acid, iodine, turpentine, phosphorus, etc. Some of these unite with the oxy-hæmoglobin, others seize and combine with the oxygen, the result being that reduced hæmoglobin is left, which becomes dissolved from the corpuscles and diffused through the blood.

IV. Natural Recovery.

Those affections of the blood which depend on an abnormal condition of the supply and of the excretions will return to a normal state when these influences become normal. The skill of the therapeutist will, however, be often required to assist the efforts of nature.

There is a limit to recovery when large amounts of a poison, such as carbonic acid, have entered the blood, and when the hæmoglobin has been excessively reduced.

V. Therapeutics.

The indications under this heading will be based on the facts which we have already laid down.

1. **Plethora.**—To reduce this condition it is manifest that a proper amount of exercise be enforced, that excessive quantities of stimulating foods be withheld, and the excretory organs kept in proper order.

2. **Anæmia.**—This condition must be treated on general hygienic and dietetic principles, in connection with agents which act directly on the blood.

In cases where the albumin of the blood is deficient or degenerated, strict attention must be given to the use of nitrogenous foods, along with the administration of chlorate of potash.

In cases where the fibrin is deficient, and there is a tendency to extravasations, etc., drugs which act directly on the blood, such as chlorate of potash with some preparation of iron, will be indicated to overcome this condition.

If we wish to increase the alkalinity of the blood, such as in cases of rheumatism, we administer salts of potassium, sodium, etc. These also combine with the probable cause of the disorder, and by their diuretic action cause its excretion from the system.

Certain poisons in the blood, the result of imperfect excretion, will be treated by either acting on the organs at fault, or, if this be impossible, by acting on other organs, and thus assisting in carrying off the deleterious products. Thus, in cases of uræmia we stimulate the bowels and skin to increased action, so as to remove the poison from the system; also we adopt a similar course in that affection of horses termed *azoturia,* where there is excess of nitrogenous products in the system, which the kidneys are unable to carry off.

In *deficiency of hæmoglobin* the first essential to treatment will be careful attention to hygiene and dietetics and the vital functions of the system. We must, in addition, prescribe agents which have the power of restoring the chemical elements of hæmoglobin to the red corpuscles. These are preparations of iron with potassium salts ; for example, the sulphate of iron with the carbonate of potassium, care being taken, however, that digestion and the action of the intestines are not interfered with.

In cases of *reduction of oxy-hæmoglobin*, such as the effects of poisoning by carbonic acid, hydrocyanic acid, etc., treatment will be of little avail unless it be immediate. All that can be attempted is to sustain the circulation and respiration by stimulants and artificial respiration, in hopes to preserve the vitality of the system by making use of the oxy-hæmoglobin which may have remained active.

CHAPTER IX.

METABOLISM, OR THE PROCESS OF NUTRITION.—THE ACTIONS AND USES OF ALTERATIVES.

I. Physiological Relations.

AFTER our notice of the different points of therapeutical interest in connection with the blood, we shall now be in a position to consider the complex subject of metabolism, which includes the activity of the tissues and the development of force by protoplasm in the presence of blood. This subject is an important one with reference to the actions and uses of many medicinal agents.

If we take the case of any definite structure, such as a muscle, we shall find the following phenomena in connection with it: First, a free and proper blood supply; second, a certain force during the period of contraction, developing energy and heat, and producing certain chemical substances, such as carbonic acid, water, nitrogenous bodies, and probably urea; third, after the blood has passed through the muscle, it loses its oxygen and a certain amount of proteids, and takes up the waste products for the purpose of excreting them—in other words, it has become venous blood.

In this process the molecules of the muscle are mixed with the oxygen and certain elements of the plasma, and an important point to note is that when any living tissue is in combination with metabolic materials, and forming certain results, such as force and other products from them, that the molecules of this living tissue become changed or altered to a certain extent. This change will depend on the character of the blood or plasma supplied. Again, the character of the force generated and of the products produced, and the chemical constitution of the active protoplasm of the living tissue, will vary according to the variation in the blood supplied. We thus see that in every organ and tissue of the body there is a relation between the character of the plasma supplied and the character of the protoplasm, the one acting and reacting on the other.

According to the structure and functions of the different organs and tissues, we find different substances formed from them, and particular kinds of force displayed in each case; for example, secretion, nervous energy, etc.

The process of metabolism is still very obscure, and there are many points in connection with it requiring elucidation. The precise manner in which the products of digestion are used up in the system, and the forms which they undergo before being broken down into carbonic acid, water, and nitrogenous compounds, is not yet clearly understood.

It is not always possible to judge the state of metabolism, or the process of nutrition, in the body with any degree of accuracy. We may consider the amount of force displayed, such as the tone of the muscles, the rate of growth, etc., and also the material consumed—that is, the amount of food taken—but when we come to examine the products of metabolism—that is, the excretions—we can glean some very valuable information to help us in clinical study. For example, by an examination of the urine, both chemically and physiologically, we can form a fairly accurate opinion as to the functional activity and condition of the kidneys, and in certain instances, of other organs of the body.

II. Pharmaco-dynamics.

The power of interference which we possess over the process of metabolism may be considered under the following heads:

1. *The Influence over the Blood and its Constituents.*
2. *By Means of increasing the Excretions.*
3. *By acting on the Trophic Centres.*
4. *By the Use of Medicinal Agents.*

1. **The Influence on Metabolism through the blood as a whole** has been already noticed in the last chapter. We can influence metabolism by—

(*a*) *Acting on the constituents of the blood* by means of supplying certain foods suitable for the purpose in view, as, for example, the special mode of feeding for horses in training, for pregnant animals, and for those nursing young.

We may employ certain agents which act as foods in cases of debility of certain organs; such agents are termed *nutritive tonics*.

Examples.—Cod-liver-oil, alcohol, etc.

(*b*) *By increasing the supply of oxygen in the blood* metabolism is increased. This can be brought about by a proper supply of fresh air, and by the administration of *hæmatinic tonics*, such as iron.

(*c*) We can increase protoplasmic activity *by giving a proper amount of exercise*, which includes also a proper amount of plasma and oxygen.

2. **By Means of increasing the Excretions** metabolism can be influenced; thus, by acting on the skin, stomach, intestines, liver, kidneys, and lungs, the removal of the products of tissue activity is hastened.

3. **By acting on the Trophic Centres** metabolism can be influenced, such as by applying to the surface of the body the extremes of heat or cold, or causing stimulation of the parts by the application of mustard, etc.; the impressions produced are carried to the centres by the afferent nerve fibres.

The nutritive activity of a part may be increased by acting *locally* on it, such as by the application of friction, exemplified by hand-rubbing, and by the use of stimulating liniments, composed of ammonia, alcohol, turpentine, camphor, etc.

The action of such applications is both direct, and also reflex through the medium of the trophic nerves. They cause dilatation of the vessels of the part, increased circulation and absorption, and the removal of the products of tissue activity is hastened by the lymphatics and veins. Such agents are termed *local alteratives* or *local tonics*.

The *modus operandi* of poultices and blisters will be discussed in a future chapter under the heading of *Counter-irritation.*

The surrounding temperature has an important bearing on metabolism. We can influence nutrition by the employment of baths of different temperatures, which act both locally and also through the vessels and nerves.

4. **By the Use of Medicinal Agents.**—In certain medicinal agents we possess powerful influences over the process of metabolism. These substances when administered are absorbed by the blood, and reach the tissues, and are taken up by them in a similar manner to that of the nutritive materials.

An important fact to note is that certain tissues and organs have the power of attracting and taking up certain medicinal agents. Such agents then are in a state of loose combination with the elements of the parts; they may form certain chemical compounds with the oxygen present in the tissues; they are ultimately excreted either unchanged or in an altered chemical condition. During this passage in the tissues they have a certain modifying effect on the force which these tissues are capable of displaying.

The precise manner in which certain tissues take up and are acted upon by certain drugs we cannot explain. Such drugs are said to have a '*specific action*' *on* such tissues. For example, iodine and its salts act specially on the glands of the body, and bromine on the nervous system.

We have to consider, however, that drugs can act on tissues in another manner besides that just described. They can also act by influencing the *vessels and nerves* of the part; ultimately they will probably act on the protoplasm also. Thus, alcohol increases the circulation and secretions of the skin by influencing the cutaneous vessels and nerves; belladonna causes an arrest of the secretion of the submaxillary salivary gland, by paralyzing the terminations of the chorda tympani nerve in the gland, the effects being dryness of the mouth and throat, due to a want of saliva.

Alteratives.—It is difficult to define an alterative, although we are aware of the therapeutical effects produced by the administration of the class of drugs included under this heading.

We employ such drugs to exert a beneficial effect or alteration in certain morbid conditions of the various tissues and organs of the body. The manner in which these effects are brought about is not always easy of explanation. We may regard alteratives as possessing a certain power of exercising the tissues, *i.e.*, increasing the nutritive activity, effecting some complex change in the protoplasm and molecules of the part—in other words, increasing the amount of work performed by the part.

Not only have medicinal agents this effect, but also diet and surroundings have an important bearing in the same direction.

We may divide agents possessing the power of influencing metabolism into *two* classes:

(*a*) *Those which increase Metabolism.*—These include such agents as iodine, mercury, arsenic, sulphur; and the manner in which each of these is believed to act will be described under the heading of each drug in the section on *Special Therapeutics.*

We may regard all as being taken into combination with the protoplasm of the tissues, on which they have a special action, then being removed in the metabolic products, and during the whole process a certain change is induced in the molecules of the part, nutrition is hastened, and a healthy exercise of the tissues is brought about.

(*b*) *Those which have the Effect of diminishing Metabolism.*—These agents have certain specific actions on the blood and on the protoplasm of the tissues. As examples of this class we may take alcohol and quinine.

Alcohol is a substance capable of being very readily oxidized in the tissues; consequently, it absorbs a large amount of oxygen from the cells of the tissues, while it also possesses the power of rendering the oxygen in a firmer state of combination with the red corpuscles of the blood.

The effects are: oxygenation of the tissues occurring less freely, the activity of tissue changes reduced—points of great therapeutical importance in connection with the employment of this agent in febrile affections.

Quinine also interferes with oxygenation, and thus checks metabolism. It also renders the oxygen in a firmer state of combination with the red corpuscles.

It is probable that drugs such as quinine, antipyrine, salicin, etc., also diminish the activity of the natural ferments of metabolism.

III. Pathological Relations.

There are a large number of diseased conditions depending on disorders of metabolism. Briefly, we may remark that the most frequent cause of such disorders can be ascribed to errors of diet and neglect of hygiene. Thus, excess of stimulating food, without proper exercise, has a disturbing influence on general nutrition, as well as on vital organs, such as the liver, kidneys, etc.

Want of proper food leads to an anæmic condition, resulting in an enfeebled character of the process of metabolism.

External influences, such as sudden changes of temperature, etc., may give rise to chills, catarrhal affections, etc.

The presence of specific organisms in the blood, inducing the various phenomena peculiar to each, with the usual symptoms of *fever*, may be also mentioned as disorders of metabolism. Such organisms are supposed to disturb metabolism both by their own life in the tissues, and also by their reproduction, and the products of their changes entering the blood, the result being a general infection of the system, with the general symptoms of fever, viz., high temperature, functional derangement, wasting, and increased excretion.

As other examples of disordered metabolism we may mention the different forms of degeneration of tissues, the presence of unnatural growths, such as cancer, and the various forms of inflammatory conditions.

IV. Natural Recovery.

Some of the disorders of metabolism will disappear spontaneously, being of a temporary nature.

We have to mention two great powers of nature in restoring a normal condition of metabolism, viz.: 1. *Reaction;* 2. *Repair.*

In some instances, however, anatomical changes appear in tissues and organs, forming a limit to recovery.

V. Therapeutics.

Under this heading only a slight sketch of the means at our command can be given, the subject being so extensive.

The first indication in the treatment of disordered metabolism is *to ascertain the cause*, and either remove it or act upon it.

For example, in the treatment of rheumatism we ensure the action of the bowels, liver, and kidneys, besides prescribing an agent such as *salicin*, which is supposed to act directly on the specific poison in the system which causes that disease.

In other instances we find it impossible to act directly on the cause, so that our only resource is to treat the symptoms.

In affections such as certain forms of diseases of the skin we prescribe alteratives, such as arsenic, sulphur, iodide of potassium, etc. These we suppose to have a special effect on metabolism, and a certain beneficial action on the structures of the skin.

There are many other affections depending on disorders of nutrition, such as specific diseases—examples, tuberculosis and cancer, in which our treatment can only be palliative, the chief considerations being, attention to general nutrition, by allowing highly nutritious foods and prescribing agents such as cod-liver-oil, and combating symptoms as they arise.

CHAPTER X.

THE CIRCULATORY SYSTEM.

I. Physiological Relations.

The above system is one of great importance to the therapeutist; but for our present purpose it will be sufficient to notice some points of interest in connection with which we possess certain powers of influence and interference.

The Pulse has already been considered in Part I., under the heading of *The General Symptoms of Disease.*

Some important points for the student to notice are that—

1. **The Heart is a Nervo-muscular Organ** possessing automatic action, which depends on the presence of intracardiac ganglia, and that the presence of the blood in the organ excites these ganglia, and the strength of the systole depends on this pressure of the blood. The coronary arteries supply nutrient blood to the heart.

2. **The Heart is provided with a Regulating Mechanism,** consisting of—

(*a*) *The Cardiac Centre in the Medulla.*
(*b*) *The Vagus or Inhibitory Nerve Supply.*
(*c*) *The Sympathetic or Accelerator Nerve Supply.*

(*a*) *The Cardiac Centre* is subject to many impulses from a variety of portions of the body, such as from the viscera, skin, central nervous system, lungs, and even from the heart itself; this centre receives these afferent impressions, which are then reflected to the heart as motor impulses either by the vagus or sympathetic. The afferent impressions from the heart itself travel through the vagus; in a normal condition these sensations are not perceived by the individual, but if greatly augmented by any cause, pain, distress, and palpitation occur, being reflected to the præcordium.

The cardiac centre is also affected by its blood-supply, depending on the quality of the blood and the blood-pressure in it.

(*b*) *The Vagus* has an inhibitory or controlling effect over the movement of the heart, its terminations being connected with the intracardiac ganglia. If the vagus be stimulated, the beats of the heart are reduced in force and frequency; if this nerve be divided, the heart beats rapidly, owing to its antagonist, the sympathetic nerve, having full power.

This inhibitory action of the vagus can be excited by reflex impressions carried to the medulla, such as by shock or by injuries to the abdominal region, etc.

(*c*) *The Sympathetic* is the antagonist of the vagus in its action on the heart, it being the augmenting or accelerator nerve. Stimulation of the sympathetic increases the action of the heart; division of this nerve reduces the number of beats of the heart.

The sympathetic nerve has extensive connection with the spinal cord, and is not in constant action, while the vagus is in constant action in its inhibitory power over the heart.

3. **With reference to the Pulse**, we must notice that its frequency and character *depends on the length of the diastole* or dilatation of the ventricles, as the length of the systole or contraction varies only to a very slight extent under any circumstances. If the diastole be long, an infrequent pulse is the result; if it be short, there will be a frequent pulse.

During diastole the ventricles are being filled from the auricles and veins, and the nervo-muscular structures are being rested and nourished, points of great therapeutical interest, as we shall see further on.

4. **The Arteries** are controlled by—

(*a*) *The Vaso-motor Centre;*

(*b*) *Vaso-constrictor Nerves*, *Vaso-dilator Nerves*,

besides possessing a local nervous mechanism.

(*a*) *The Vaso-motor Centre* is situated in the floor of the fourth ventricle in the medulla; by means of impulses passing out from this centre the tone of the bloodvessels of the body is maintained and controlled, they being dilated or contracted as required.

Certain centres exist in the spinal cord, and also local centres, all of which are subordinate to the centre in the medulla. The vaso-motor centre is subject to impressions from the viscera, surface temperature, sensations, etc., and also is affected by the quality and character of the blood circulating through it; thus, deficiency and poverty of the blood in oxygen stimulates it, causing contraction of the arterioles and a raising of blood-pressure.

It can also be acted on by certain drugs, being either stimulated or depressed. We must, however, be aware that, although stimulation of this centre causes constriction of the small vessels, it may in some cases result in inhibition of the part, resulting in vascular dilatation, such as is found to occur in certain diseased conditions. Afferent impressions reaching the vaso-motor centre from the heart have a special effect, which is of great therapeutical importance.

In cases where the heart is distended with blood, causing distress, or even a tendency to failure of its action, impressions reach the cardiac centre by means of the vagus; these are transferred to the vaso-motor centre, and impulses are sent to the vessels by the vaso-dilator nerves, with the result that the vessels become relaxed, the blood-pressure falls, and the heart is enabled to empty itself more readily, and becomes relieved. This provision of nature is termed the *depressor mechanism* of the circulation.

(*b*) *Vaso-constrictor Nerves, Vaso-dilator Nerves.*—These are distributed to the muscular walls of the small bloodvessels, both sets being under the control of the vaso-motor centre. If the vaso-constrictor nerves be stimulated, the resistance and pressure of the blood will be raised, and constriction of the vessels produced.

On the other hand, stimulation of the vaso-dilators will cause a lowering of the blood-pressure and dilatation of the vessels. Certain vascular areas, such as the skin, may be acted upon, producing either constriction or dilatation of the vessels, with a corresponding change in the blood-pressure.

5. **The Capillaries** are subject to the influence of the nervous system, of the blood passing through them, and on the condition of the arteries and veins at either extremity, besides being influenced by the activity of the process of nutrition.

6. **The Veins**, although probably influenced by nerves, are chiefly acted on in a physical manner.

The influences in this respect may be described as follows :

(*a*) *The Condition of the Heart.*—If the diastole be short, it follows that the action of the heart will be increased in frequency, consequently there will be less time given for the veins to empty themselves, and the blood pressure will be raised in them.

(*b*) *The Condition of the Arteries and Capillaries.*—If there be a low blood pressure in the arteries and a free flow through the capillaries, it follows that the pressure in the veins will be increased.

(*c*) *The Condition of the Veins* has an important effect on the heart and capillaries. Thus, if the blood pressure be high in the veins, with dilatation of their walls, the return of blood to the auricles is interfered with, consequently there is weakness of the systole from want of a sufficient amount of blood, with obstruction to the capillary flow, also disturbance of the process of metabolism.

9

II. Pharmaco-dynamics.

For convenience of description, we may consider the influence which we possess over—

1. *The Total Volume of Blood in Circulation.*
2. *The Heart.*
3. *The Arteries.*
4. *The Capillaries.*
5. *The Veins.*

1. **The Total Volume of Blood in the Circulation** may be influenced by *venesection.* By this means we can relieve the tension of the whole circulation, and also reduce the blood pressure in the heart and lungs. We must, however, remember that these effects are only temporary, as increased absorption occurs from the tissues and intestines into the circulation.

2. **The Heart.**—We can influence the action of the heart by acting both on its intrinsic and extrinsic nerve-supply.

(*a*) *Agents which act on the intrinsic nervo-muscular apparatus—Direct Cardiac Stimulants—Direct Cardiac Depressants.*

A healthy condition of the system, with a proper condition of the blood, rendering the coronary circulation active, constitutes a natural direct stimulus to the action of the heart. Certain drugs, such as alcohol, digitalis, ammonia, ether, etc., act as direct cardiac stimulants. Carminatives act as direct and indirect cardiac stimulants, the latter depending on reflex action from the gastric mucous membrane through the central nervous system. The heart may be stimulated indirectly by reflex stimulation, such as counter-irritation over the region of the præcordium, and by inhalation of ammonia, also by the cold douche and by flagellation.

Direct Cardiac Depressants.—These either soothe or depress the intrinsic nervo-muscular apparatus of the heart. They include drugs, such as opium, dilute hydrocyanic acid, aconite, chloral, chloroform, etc. Indirectly we may depress the same apparatus by the use of purgatives, diuretics, and diaphoretics, by warm applications to the præcordium, by the general hot bath, and by agents which have the power of shortening the diastole of the heart.

(*b*) *We can influence the afferent nerves of the heart*—that is, the means by which impressions are carried to the brain from the heart itself. These nerves are depressed by the administration of such drugs as opium, chloral, belladonna, etc.

(*c*) *The inhibitory nerves of the heart*—*i.e.*, the terminations of the vagus in the heart—may be *stimulated* by such drugs as digitalis, etc., and the action of the heart rendered less frequent. The same structures may be *depressed*, and the action of the heart increased in frequency, by such drugs as belladonna, hyoscyamus, amyl nitrite. There are many drugs which, given in large doses, have a similar effect.

(*d*) *The cardiac centre* may be either stimulated or depressed by certain drugs. It can be *stimulated* by digitalis, alcohol, ether, chloroform, in their primary actions; it is also stimulated by belladonna, and by such local measures as counter-irritation and the application of cold douches. It can be *depressed* by such drugs as alcohol and chloroform after their first stage, also by aconite, chloral, dilute hydrocyanic acid, opium, etc.

It is thus clear that we can influence the heart with regard to its frequency by means of acting on the vagus either through the cardiac centre or through its terminations. The diastole can be either lengthened or shortened, a matter of great importance in connection with the therapeutics of the subject. We may also remark that all drugs which have the effect of accelerating the action of the heart, if continued in large doses, prove to be cardiac depressants.

3. **The Arteries.**—We have the power of influencing the arteries by acting on the following structures:

(*a*) *The Vaso-Motor Centre.*—This can be *stimulated* by such drugs as alcohol, chloroform, etc., in their primary stages, and temporarily by ammonia, ether, digitalis, etc. It can also be stimulated by such measures as the application of cold to the surface of the body, by counter-irritation to areas of the skin, and by inhalation of ammonia, which stimulates the trigeminus. It can be *depressed* by alcohol and chloroform in the second stages, and by opium, dilute hydrocyanic acid, aconite, belladonna, etc.; also by the local application of anodynes, heat, etc.

(*b*) *By Acting on the Vaso - Constrictor Nervous Mechanism in the Arterial Walls.*—This can be stimulated by such drugs as digitalis and strophanthus, in the primary stages, and lead. Locally, by the application of cold, and by evaporation of spirituous and saline solutions, such as by lotions of rectified spirit, acetic acid, or chloride of ammonium. Such measures are termed *local vascular astringents.*

(*c*) *By acting on the Vaso-dilator Nervous Mechanism.*—We can bring about vascular dilatation by the action of alcohol, belladonna, nitrite of amyl, etc. Poultices and hot fomentations have a similar effect, as also irritants to the skin, such as mustard, etc. We term such agents *local vascular dilators*, and in reality they prove to be local circulatory stimulants.

4. **The Capillaries.**—We can act on capillary areas in a manner similar to that just described.

(*a*) The capillaries can be *dilated* and the blood-flow increased through them by the application of local heat, friction, and by rubefacients, such as mustard, etc. If the application be more severe, such as by the application of a vesicant, a process similar to that of inflammation will be brought about.

(*b*) The capillaries can be *contracted*, and the blood-flow through them diminished by the application of extreme cold, and also by astringents, such as lead and silver. Constringents have a similar effect, by constringing the connective tissue supporting the capillaries; *e.g.*, tannic and gallic acids, and vegetable substances containing these, such as catechu, kino, etc.

5. **The Veins.**—(*a*) *Directly*, we possess but little influence over the veins. We can dilate them by the application of heat, and contract them by cold; but the reaction will cause dilatation.

(*b*) *Indirectly*, by acting on the heart and arteries, we can increase or diminish the pressure in the veins. We can also, by acting on secretion and excretion, lessen blood pressure in the venous system. Thus hydragogue purgatives relieve the portal system, and saline diuretics relieve the renal veins.

III. Pathological Relations.

Briefly we may regard these under the headings of—

1. *Functional Disorders of the Heart.*
2. *Organic Diseases of the Heart.*
3. *Hæmorrhage and its Consequences.*

1. **Functional Disorders of the Heart** are of very common occurrence in all classes of our patients. It is essential that we must be careful to make a correct diagnosis in such cases, so as to distinguish the symp-

toms presented from those depending on organic disease of the heart, and also to ascribe such symptoms to their real causes, in order to treat these disorders in a rational manner.

We may divide these disorders of the heart and vessels into three classes, depending on their causes:

(*a*) *Those depending on nervous causes*, such as excitement in animals of a nervous temperament; also causes acting in a reflex manner through the nervous centres in the medulla, such as derangement of the digestive organs; or irritation from the presence of parasites in the stomach and intestines.

(*b*) *Those depending on changes in the quality and quantity of the blood*, such as in the conditions of anæmia, plethora, etc. The nervous centres in the medulla are disturbed, also the vessels and the nervo-muscular structures of the heart itself.

(*c*) *Those depending on contamination of the blood*, such as in cases of septicæmia, also in the specific diseases.

We may also remark that functional disorder of the heart may occur as a sequel to epizoötic diseases, such as influenza, the symptoms disappearing when the debility, which is present as a result of the disease, has passed off.

It is essential in all cases of functional disorders of the heart that a hasty diagnosis be avoided, as repeated examinations are often required before we can arrive at correct conclusions. It is often surprising what distressing symptoms may be present in cases depending on digestive derangements and the presence of parasites in the stomach and intestines, leading one to the suspicion that such symptoms may be due to organic disease of the heart unless careful observation be persevered in.

2. **Organic Diseases of the Heart** are far more common than would be imagined by the information gained from the clinical examination of patients. It is when making post-mortem examinations that we find many instances of well-marked organic disease which had not produced any appreciable symptoms during life, or that these symptoms had not been detected, or had been ascribed to diseases of other organs.

The most common organic disease of the heart found in horses and dogs is that of *fatty degeneration.* This affection is often met with in the case of aged animals in high condition and with insufficient exercise.

Of valvular affections we meet with disease of the mitral and aortic valves more often than of the others, the conditions of obstructive and regurgitant lesions being often found together in the latter. As acute affections of the heart we may mention endocarditis, often combined with pericarditis.

We may illustrate the effects of a valvular affection by taking the case of a lesion of the aortic valves; this will also afford valuable indications in the way of treatment. In disease of the aortic valves the course of the phenomena induced is progressive. The first effects are that the blood from the left ventricle is obstructed in its passage to the aorta during systole, and regurgitates from the aorta during diastole. In order to overcome this the heart has an extra amount of work to perform, and here we have an example of nature's efforts to combat disease, as a condition of hypertrophy of the muscular wall of the heart occurs, in order to enable it to perform the extra work. This is termed *compensation;* but after a time, in consequence of the increased demand for nutrition to supply the extra muscular force, this nutrition becomes insufficient, with the result that *com-*

pensation fails, and then grave symptoms set in. The contraction of the ventricle fails to completely empty the cavity, it becomes overdistended with blood during diastole, its walls become stretched, and as a result the cavity is dilated. Other conditions now occur: the mitral valve becomes incompetent, and during systole blood regurgitates into the left auricle, the pulmonary circulation becomes distended, and by this means the right ventricle, and afterwards the right auricle, become impeded in their function. As a result the systemic veins become distended and the circulation in the viscera is interfered with, leading to the occurrence of dropsy, intestinal hæmorrhage, and also to the presence of albumin in the urine. Respiration is interfered with, and also the supply of arterial blood to the system, so that the various complications cause a fatal termination.

3. **Hæmorrhage and its Consequences.**—Hæmorrhage produces certain effects in the system due to the loss of blood, and also to the fall in the blood pressure. If sufficient in amount, a condition termed *syncope*, or *fainting*, will occur. This depends on inability of the heart to supply a sufficient amount of blood to the brain, the result being loss of consciousness and of the power of maintaining the standing position, the anæmia of the brain producing a condition of general muscular paralysis. The same effects are produced by any causes of cardiac failure. In veterinary practice syncope is not a condition of common occurrence. We meet with it in cases of internal hæmorrhage, such as uterine hæmorrhage, and hæmorrhage as the result of wounds (accidental or after operations). It may also occur by the accidental entrance of air into the jugular vein during the operation of venesection.

IV. Natural Recovery.

There are many compensating mechanisms in the circulatory system which tend to bring about a return to a normal condition whenever this is possible. Thus, we have the reserve force in the heart, the power of compensating hypertrophy, the depressor mechanism, etc. Also the methods by which the fluid portions of the blood are removed by the kidneys and bowels, and relief given to the distended vessels.

All these are important considerations for the therapeutist, as they give him valuable indications in the way of treatment.

In the case of valvular lesions, when nature fails to give aid, all our efforts can only afford to give temporary relief, and to treat complications as they arise.

In the case of horses affected with far-advanced valvular disease, we have to consider that, in consequence of the nature of their work, it is impossible to give that rest which is absolutely necessary, and also that such animals are dangerous to their owners by reason of their liability to die suddenly when at work, so that in many instances it may not be practicable to advise treatment. In the case of dogs, however, such considerations do not apply.

V. Therapeutics.

1. **Functional Disorders of the Heart.**—Obviously the first step in the treatment of functional disorders will be to ascertain the cause, and then to apply remedies calculated to overcome it. If depending on digestive derangements, treatment must be directed accordingly; if the presence of parasites be the cause, these must be expelled from the system. If depending on an abnormal condition of the blood, appropriate means must be adopted

to restore the vital fluid to a normal condition; and if existing after debilitating diseases, general tonics will be indicated.

2. **In Organic Diseases** treatment can only be palliative, and, as previously remarked with reference to horses, it may not always be advisable to commence a course of treatment with them.

In the treatment of valvular lesions, the chief aim should be the *prevention and removal of dilatation of the ventricle.* Various means are adopted for this purpose, of which the following may be noted:

(*a*) *Avoidance of exertion* as much as possible, so as to lower the intraventricular pressure.

(*b*) *By increasing the Cardiac Power.*—This can be accomplished by the administration of direct cardiac stimulants, such as digitalis, strophanthus, alcohol, ammonia, etc. At the same time, strict attention should be paid to the digestive system, so as to avoid derangements of it, which are a source of danger to the heart. The quantity and quality of the blood is also of importance, in order that a proper nutrient supply through the coronary arteries be maintained to the cardiac walls.

(*c*) *By increasing the Time of Cardiac Rest.*—By this means we endeavour to increase the power of contraction of the ventricle, and to prevent over-distension of it, and also to afford a certain amount of rest to the heart.

In drugs such as digitalis, strophanthus, etc., we possess valuable agents in this respect. These, besides acting as direct cardiac stimulants, also stimulate the inhibitory apparatus in the heart and medulla; they lengthen the time of filling the heart, and thus favour the venous flow into it; the arterial pressure is also raised, as the aorta is more completely filled, and the vaso-motor nerves are stimulated. We can thus clearly see how they act beneficially in the different conditions which exist as a result of lesions of the aortic valves already described.

It is obvious that such drugs will be contra-indicated during the compensation period, but will be of the greatest service when this commences to fail and dilatation results.

(*d*) *By Treatment of the Symptoms.*—These are usually cardiac distress and pain, also pulmonary distress, dropsy, and visceral congestions.

In the treatment of cardiac distress, with oppression and pain, cardiac sedatives, such as opium and chloral, may be indicated; but in the use of these agents great discrimination and judgment is necessary, as they may also act as dangerous cardiac depressants. Locally, hot fomentations and rubefacients to the region of the heart, or the application of belladonna, often give relief.

In pulmonary distress stimulant expectorants, such as ammonia, are useful; but our chief reliance in combating this symptom and relieving the pulmonary engorgement should be on agents which act on the heart itself, such as digitalis.

This agent, acting also as a diuretic, relieves the dropsy which may be present, in a manner which will be described under the heading of *The Kidney.*

In certain cases purgatives will be indicated to relieve the visceral congestions.

3. **The Treatment of Hæmorrhage.**—The treatment of external hæmorrhage belongs to the domain of *Surgery*. The effects will, however, engage our attention under the heading of *Syncope.*

In internal hæmorrhage, a condition of very great danger, the therapeutist has to bring different agents to his aid.

Briefly speaking, internal hæmorrhage occurs from the stomach, intestines, lungs and uterus. In the case of the stomach, intestines, and lungs, medicinal agents termed *hæmostatics* are made use of. These agents, also termed *styptics*, may be classed according to the structures upon which they act.

(*a*) Those acting on the blood, by increasing its power of coagulation or precipitating albumin. By this means hæmorrhage from the part may be subdued.

Examples.—Tannin and substances containing it, such as catechu, galls, logwood, etc.; also salts, such as alum, acetate of lead, persalts of iron, etc.

(*b*) Those agents producing contraction of the broken vessels, such as acetate of lead, ergot, the local application of cold or of heat, such as water at 110° to 120°.

(*c*) Those agents which act on the perivascular tissues, constringing them, and thus compressing and closing the bleeding vessels. These include the substances just mentioned, viz., acetate of lead, persalts of iron, tannin, and substances containing it, etc.

In addition to the use of hæmostatics in internal hæmorrhage, we find it of advantage to administer cardiac and general sedatives with careful judgment, so as to reduce the *force* but not the *power* of the heart, and also to ensure perfect rest. For these purposes opium in its different preparations is especially useful.

In cases of cerebral hæmorrhage, hydragogue purgatives are useful, by dilating the mesenteric vessels, and thus relieving the cerebral vessels, and also withdrawing a certain amount of fluid from the blood.

In some cases of hæmorrhage from the stomach, due to portal congestion, we employ purgatives in a cautious manner for a similar purpose.

4. **Syncope.** — In veterinary practice, as previously

stated, syncope, or fainting, is not often seen except in cases of uterine hæmorrhage, or as a result of excessive hæmorrhage from wounds, etc.

In its treatment the chief indication will be to restore the suspended action of the heart by the employment of both direct and indirect cardiac stimulants. The recumbent position also favours the restoration of the blood and blood pressure in the cardiac centre iu the medulla.

As direct stimulants to the heart, ammonia, in the form of spts. ammon. aromat., and alcohol are useful. In urgent cases the hypodermic injection of ether must be employed.

As indirect stimulants, we may mention the application of cold to the cranial region, flagellation with wet towels, the solution of ammonia held to the nostrils, etc.

In concluding the subject of the therapeutics of the circulatory system, we may give a passing notice to the therapeutical value of *venesection*.

As is well known, this measure was at one time indiscriminately employed in the treatment of all affections, and although rarely practised by some veterinary surgeons in the present day, there is no disputing the fact that in suitable cases it is of the greatest benefit.

In cases of pulmonary congestion in horses in high condition, the result of over-exertion when the animals are not in a fit state to undergo it, a moderate abstraction of blood relieves the pressure in the pulmonary vessels and the engorgement of the large veins and right side of the heart, and thus changes the character of the pulse, which, as a result of the conditions mentioned, we find to be small, indistinct, and oppressed.

Other affections in which venesection is found of benefit are meningitis, phrenitis in the early stages, and also in that form of brain affection due to reflex action from the stomach known as stomach staggers.

It is obvious that in all cases characterized by debility, or those which tend to assume this character, such as epizoötic affections, etc., and also in the second stages of the affections mentioned above, venesection is contra-indicated, and cannot act but in a detrimental manner.

Local venesection is largely made use of in the form of scarification of locally inflamed areas. It is also availed of by some practitioners in the treatment of laminitis by bleeding at the toe in the affected feet, or at the coronets, though this is a measure as to the beneficial effect of which there is a divergence of opinion.

CHAPTER XI.

THE RESPIRATORY SYSTEM.

I. Physiological Relations.

The fuuction of the respiratory system is to supply oxygen to the blood, and to carry off by expiration the carbonic acid, water, heat, etc., formed in the tissues.

The acts of respiration are governed by the respiratory centre, which is situated in the medulla close to the deep origin of the pneumogastric nerves. This centre is affected by impressions carried to it by afferent nerves, not only from the respiratory passages and lungs, but also from all parts of the body by which its activity is modified, and by reflex action the respiratory movements are influenced.

The quality of the blood circulating through this centre affects it considerably, a deoxidized condition leading to stimulation of the centre, and increasing the respiratory activity. The manner in which the changes in the blood produce these effects is not yet definitely known; at one time they were ascribed to excess of carbonic acid in the blood.

The vagus is the special afferent nerve of respiration, and carries impressions from the whole surface of the respiratory passages to the centre. If these impressions be excessive, they also reach the cerebrum, causing sensations of distress, oppression, or irritation, which are referred more or less to the respiratory organs.

An important point to consider is that in a condition of diminished oxygenation of the blood, not only is the respiratory centre stimulated, but also the cardiac and vaso-motor centres, leading to a slowing of the action of the heart, and an increase in the arterial resistance. We have also to consider that the bronchi are under the control of the medulla, by reason of the motor filaments of the vagus which originate in the respiratory centre supplying the muscles regulating the calibre of the bronchi. By this means impressions originating in the respiratory passages produce an effect on the bronchi.

With reference to the mechanism of respiration, it may be stated that in the horse, under ordinary circumstances, only the last ten pair of ribs take any share in respiration, as the eight true ribs are covered by the scapula; but when dyspnœa occurs from any cause, the elbows are turned out, and thus other muscles act as auxiliaries, and a certain number of the true ribs assist in respiration.

II. Pharmaco-dynamics.

We can influence the respiratory system in various ways, which can be conveniently studied under the following heads :

1. **The Air.**—By paying attention to the details of ventilation, we can ensure a proper amount of oxygen in the air surrounding the animal; and by artificially regulating the atmosphere, we can ensure a proper temperature of the respired air. We can also, by the use of inhalations, medicated or otherwise, of steam from hot water, produce effects on the respiratory passages.

2. **By influencing the Blood and Circulation.**—The red corpuscles, being the carriers of oxygen, are important agents in modifying respiratory activity; so that by acting on these by means of food, drugs, natural influences, etc., we can produce beneficial effects on the respiratory system. The circulation also is of importance in modifying the respiratory functions.

3. **By influencing the Lungs and Air-passages**—(*a*) *By acting on the Afferent Nerves of the Respiratory Organs, either stimulating or depressing them.*—These nerves are stimulated by ammonia, and depressed by opium, chloral, chloroform, and ether. They are soothed by warm and moist air, and by hot applications to the walls of the chest, and to a slight extent by demulcents. Abnormal sensations connected with the respiratory organs may be modified by these nerve depressants.

(*b*) *By acting on the Circulation of the Vessels of the Bronchi.*—The circulation can be *increased* by stimulants to the general circulation, also by digitalis and aromatic oils. The bronchial circulation can be *depressed* by heat, by general vascular depressants, such as aconite, ipecacuanha, alkalies, etc.

(*c*) *By acting on the Bronchial Glands.*—We can *increase* the bronchial secretion by alkalies, especially by ammonia; also by iodine, sulphur, antimony, ipecacuanha, scilla, and also by the group of volatile oils, oleo-resins, and balsams, such as camphor, benzoin, etc. The bronchial secretion can be diminished by belladonna and hyoscyamus.

(*d*) *By acting on the Nervo-muscular Structures of the Bronchi and Larynx.*—These can be *stimulated* by those agents which stimulate the afferent nerves of the respiratory organs. The nervo-muscular structures can be *depressed* directly, and the bronchial walls thereby relaxed so that the respiratory movements are favoured, by such agents as belladonna, hyoscyamus, opium, chloral, and by the inhalation of warm moist air, such as by the inhalation of steam.

4. **By acting on the Respiratory Centre.**—(*a*) We can act directly on the respiratory centre, either stimulating or depressing it. It can be *stimulated*—that is, the force of nervous impulses proceeding from it may be increased—by ammonia, belladonna, strychnine, and by alcohol, ether, and chloroform in their primary effects. It can be *depressed* by the full action of alcohol, ether, and chloroform, also by opium, aconite, veratrine.

(*b*) The respiratory centre can be affected by impressions reaching it through other nerves than the vagus. It may be *stimulated* by the inhalation of ammonia, which irritates the fifth cranial nerve. It can be also stimulated by rousing the nerves of the skin, such as by flicking with towels, the application of extreme heat; also by the application of counter-irritants, such as mustard, etc. On the other hand, a *sedative* influence may be exerted on the respiratory centre by the application of warm poultices and fomentations to the walls of the chest; also by applying local anodynes, such as belladonna and soothing liniments, to the same situation.

5. **We can act on the Tracts of the Efferent Impulses from the Respiratory Centre, on the Spinal Centres of the Respiratory Muscles, and on the Nervo-muscular Apparatus of the Chest and Larynx.**—These can be *stimulated* by strychnine, which acts both reflexly and directly by increasing the vigour of the spinal centres. Electricity applied to the nerve trunks, such as to the phrenics, intercostals, or directly to the muscles, also stimulates the same regions. These regions can be *depressed* by opium, which has the effect of depressing the whole efferent mechanism. The movements of the chest may be controlled directly by the application of suitable bandages to the chest walls, a matter of importance in connection with wounds and injuries of this region.

Expectorants increase the amount of the natural secretions of the respiratory passages, and also modify their character so as to facilitate their expulsion. In horses and cattle these agents do not appear to have as beneficial an action as in human beings, the best results being obtained from the use of medicated inhalations. In dogs, however, expectorants are of great therapeutical value. Expectorants may act upon the bronchial glands, upon the muscular structures of the bronchi, upon the bronchial circulation and the respiratory centre. According to their action on the circulation, we may divide these agents into

1. *Stimulant Expectorants.*
2. *Sedative Expectorants.*

1. *Stimulant Expectorants* include ammonia, scilla, gum-resins, balsams, etc., demulcents and warm liquid food.

2. *Sedative Expectorants* include alkalies, iodides, ipecacuanha, the inhalation of steam, and hot applications to the walls of the chest.

In view of their special actions, we may form other groups of expectorants as follows:

3. *Expectorants with a Sedative Effect on Nerves.*—These are generally formed by combining expectorants, such as camphor, ipecacuanha, ammonia, etc., with opium, and are of advantage in the treatment of some respiratory affections characterized by irritation and cough.

4. *Expectorants which have a Special Action on the Sputa.*—(*a*) Those which increase the water of the bronchial mucus, and thus the liquidity of the sputa; these include saline expectorants, iodine, etc.

(*b*) Disinfectant expectorants include aromatic oils, balsams, etc.; these are absorbed by the pulmonary mucous membrane, and then excreted from it; they produce an increased flow of mucus, and exert an antiseptic, deodorant, and disinfectant effect both on the secretion and also on the surface of the mucous membrane.

The oil of eucalyptus is of special value in this respect, being given internally as well as employed as an inhalation. Disinfectant inhalations can also be made with such agents as carbolic acid, creolin, etc., and are of the highest therapeutical importance, not only promoting the discharge from the bronchial tubes in cases of bronchitis, but reducing irritation, and rendering the discharge aseptic.

III. Pathological Relations.

The diseases and disorders of the respiratory system include a large number of abnormal conditions, to which a passing notice can only be given. We may divide them into two great classes:

1. Those depending on changes in the blood and circulation, which have been already noticed in Chapters VIII. and IX.

2. Those depending on changes in the nervo-muscular apparatus, of the respiratory system, also in the lungs and air-passages, the respiratory centre, and the afferent and efferent nerves of communication.

In affections of the respiratory organs, such as bronchitis, pulmonary congestion, pneumonia, pleurisy, etc., we have circulatory, inflammatory, and degenerative changes occurring as predominant conditions, varying according to the stage and severity of the disease, and producing certain anatomical changes in the parts. Thus, in pulmonary congestion we have the pulmonary vessels engorged with blood; in bronchitis, the bronchial tubes become obstructed by inflammation of their mucosa and swelling, and by the presence of catarrhal products, which may be retained, causing irritation of the nerves and vessels.

In pneumonia, the condition of consolidation renders that portion of the lung incapable of performing its function, while gangrene may result from different causes.

In specific affections of the lung, such as tubercle, marked degenerative changes also occur. It is clear that in all such affections the efforts of the practitioner must be directed to the relief of the symptoms, *i.e.*, the effects of the morbid changes, as he has very little power in acting directly on the seat or cause of the disease. Amongst these effects, the following will demand attention:

1. **Dyspnœa.**—Disturbed respiration varies in degree,

and is a natural effort to increase the oxygenation of the blood when from any cause this process is interfered with. The condition is due to stimulation of the respiratory centre, which is brought about in two ways:

(*a*) By the blood circulating through it being deficient in oxygen.

(*b*) By exaggerated impressions coming to it from the lungs and air-passages.

These two causes are usually combined, as the morbid changes already mentioned interfere with the proper aëration of the blood in the lungs, and also cause irritation of the pulmonary branches of the vagus.

2. **Cough** is a very common symptom of respiratory affections, and has already been noticed in Part I., under the heading of *The General Symptoms of Disease*.

3. **Expectoration.**—In horses the products of the respiratory passages in disease are discharged through the nostrils in the later stages, but in the earlier stages a large proportion passes into the mouth, and is swallowed. The process of expectoration is a most important one to the therapeutist.

4. **Pain, Irritation, and Oppression**, resulting from abnormal conditions of the respiratory organs, are symptoms demanding all possible relief.

IV. Natural Recovery.

There are, perhaps, no affections which give us clearer indications of the efforts of nature to overcome disease than those of the respiratory system, and it is of the highest importance for the practitioner to recognise these efforts, so as to afford them every possible aid, and to avoid any line of treatment likely to interfere with them.

The condition of dyspnœa, to a certain extent, is an effort of nature to increase the oxygenation of the blood by increasing the force and frequency of the respiratory movements. We must, however, consider that this condition soon tends to aggravate the distress instead of affording relief. Nature endeavours to remove the effects of the morbid influence by removing the excessive secretions by expectoration.

Vicarious action is another method by which nature endeavours to afford relief—thus, in dyspnœa, auxiliary muscles are called into action along with those of respiration, and the healthy portions of the lung tissue take on increased function.

V. Therapeutics.

In the treatment of respiratory affections hygienic and dietetic measures are of first importance. Pure air, a proper temperature of the surroundings, an allowance of easily-digested nutritive food, and careful nursing of the patient, are details which never should be lost sight of. No hard and fast rules can be laid down as regards medicinal treatment, seeing that we cannot act directly on the organs affected, so as either to remove the cause or cut short the course of the inflammatory action, if such be present. The strength of the patient will demand attention, the condition of the pulse indicating the use of stimulants or otherwise. The excretory organs should be kept in as normal a condition as possible by acting gently on them, such as helping the skin to perform its functions by the use of clothing and diaphoretics, the kidneys by the administration of saline diuretics, and the bowels, should their action become torpid, by the allowance of small doses of sulphate of magnesia and the use of enemata if necessary. The temperature, as indicating the degree of fever present, is a symptom of great importance, and will require appropriate attention by the administration of antipyretics. Above all things, no measures calculated to depress the patient should be adopted, and excessive interference should be avoided.

In the treatment of dyspnœa we must carefully inquire into its cause. If depending on acute bronchitis in the first stages, saline expectorants will be of service in liquefying the bronchial secretions ; while the inhalation of warm, moist air, such as steam, will help to overcome the dryness and extreme vascularity of the bronchial tubes. After the early stage is passed, stimulants, such as ammonia with camphor, etc., are indicated, which, besides their expectorant action, sustain the action of the heart and strengthen the respiratory centre. Inhalations medicated with disinfectant agents and aromatic oils are of the greatest service, favouring expectoration, and preventing the discharges from becoming putrid or purulent. The external application of heat by means of woollen rugs wrung out of very hot water, and applied in a proper manner to the walls of the chest, gives great relief in cases of this kind.

In Dyspnœa from Diminished Respiratory Area, such as occurs in acute pneumonia from consolidation of the lung, we find that the air and the blood cannot come into mutual contact, so that increased respiratory movements occur, with acceleration of the cardiac action, the results being that the air is constantly changed and the blood constantly renewed. These are efforts of nature to provide for the aëration of the blood, and the practitioner must endeavour to assist them. Thus, the general system will require to be sustained, and the action of the heart carefully watched, so that stimulants may be administered when necessary, and everything possible secured for the comfort of the patient, the accompanying fever being combated by measures which are not depressing.

In Dyspnœa with Spasm, commonly termed 'Asthma,' which is an affection due to spasm of the circular muscular fibres of the bronchial tubes, depending on some irritation of the vagus or respiratory centre, by which reflex impressions pass out to the bronchial muscles, we employ direct depressants to the nervo-muscular structures of the bronchi, such as belladonna, hyoscyamus, etc. This affection in the horse is by some authorities classed with that disease known as 'broken wind,' but others either regard it as a distinct affection or as an early stage of the latter. In dogs asthma is of comparatively frequent occurrence, and often gives rise to very distressing symptoms. Inhalations of steam often give relief, while hot applications to the walls of the chest are useful; in severe cases counter-irritation may be required. Internally, diffusible stimulants and antispasmodics give relief, such as spirits of ether or chloroform in small doses, or a mixture of carbonate of ammonia, spirits of ether, with an aromatic, is a useful combination. Powerful respiratory depressants, such as opium, etc., are to be avoided in cases with threatening asphyxia, as they are likely to increase that condition.

Cough, depending on respiratory affections, is in some cases an effort of nature to remove some obstruction from the respiratory passages, but often proves a most distressing symptom demanding relief. As far as possible, powerful depressants of the respiratory centre, such as narcotics, are to be avoided in the treatment of respiratory diseases, and in distressing cough other means should have the preference.

In affections such as laryngitis it may be dangerous, if not impossible, to administer remedies in the usual manner, as violent fits of coughing are produced, during which the medicinal agent (if a fluid) may pass in part into the trachea, causing suffocation or mechanical bronchitis; if the agent be in the solid form, such as a bolus, it is quickly returned to the mouth. In such cases we find *electuaries* of great service; they can be placed between the molar teeth, and are then gradually dissolved and swallowed. They produce beneficial effects by their soothing action on the throat, which also extends to deeper-seated parts, such as the bronchi. Electuaries for the relief of cough may contain belladonna, chlorate of potash, etc., made up with honey or syrup. Warm liquid foods should be allowed, and inhalations of steam given without distressing the patient.

Pain and Distress, in connection with respiratory affections, are to be treated by external applications to the walls of the chest, such as the application of heat, as already stated. In the early stages of such affections as acute bronchitis and pleurisy, moderate doses of opiates are of great service; but when the diseased processes are established, we should avoid as far as possible the use of direct respiratory sedatives.

The therapeutical value of counter-irritants in the treatment of respiratory diseases is a point on which great difference of opinion exists among eminent authorities; this subject will be discussed under the heading of *Counter-Irritants* in Chapter XV.

CHAPTER XII.

THE NERVOUS SYSTEM.

ALTHOUGH to the veterinary therapeutist the nervous system is not so important as to the practitioner of human medicine, still, it is a system which deserves careful attention with reference to the action of drugs and the treatment of various diseases.

The physiology of the nervous system is a very extensive subject, as its distribution is universal throughout the body, and the student is referred to the excellent manual on 'Veterinary Physiology,' by Professor F. Smith, for a consideration of the chief points in connection with it.

For our present purpose, it will be sufficient to notice those portions which are of interest in the therapeutical relations of the system, such as the higher nervous centres, representing sensation, consciousness, and voluntary motion.

I. Physiological Relations.

Nervous tissue possesses the power of displaying or discharging force when acted on by certain influences. This power or property is termed *irritability*. The influence which produces it is termed *an irritant*, and the act of producing it is termed *irritation*.

If the result of the influence be the display of more force than ordinary, we term it a *stimulant*, and the action *stimulation*. If the result be the display of less force than ordinary, we term the influence a *depressant*, and the action *depression*.

For practical purposes we may arrange the nervous system on the following plan :

1. *The Terminal Nerve-endings on the Surface of the Body and in the Organs.*
2. *The Afferent Nerves.*
3. *The Spinal Cord.*
4. *The Cerebrum, or Brain Proper.*
5. *The Efferent Nerves.*

In addition to this arbitrary plan, we may add the nervous mechanism of the viscera, which is a portion of great importance. We find that most of the viscera are governed by centres in the medulla, spinal cord, or cerebrum, and that this mechanism is partly reflex; also that the efferent nerves between these centres and the viscera are intimately connected with the sympathetic nervous system, and that, in addition, the viscera possess intrinsic ganglia, by which their automatic action is chiefly carried on.

The following physiological points are of interest with regard to the actions of drugs on the parts named:

The Brain consists of motor centres, presiding over the movement of the limbs, and also for the mastication of food, etc. It also consists of sensory centres for the special senses of sight, taste, and hearing, and others for general sensation. These different functions are in addition to the function of the organ as the centre of consciousness, intelligence, etc.

In the domestic animals the cerebrum is of small size compared with the posterior parts of the brain and the size of the spinal cord, while in the human being the cerebrum is well developed. As a result of these facts, we find that certain drugs acting on the cerebrum, such as opium, produce marked soporific effects in man, while in the domestic animals such agents produce less depression of brain function, and frequently cause deranged motor function and convulsions.

The Spinal Cord possesses three important functions, viz., *conduction*, *reflex action*, and *origination of nervous force*. It transmits sensory impulses to the brain and medulla, and from the latter organs it conveys motor impulses to the muscles, glands, etc.

The Medulla contains various centres essential to life, such as the respiratory centre, the cardiac centre, etc., which renders this organ one of the most important in the body.

Before proceeding to notice the influences which we can bring to bear on the different portions of the nervous system, we have to consider the following physiological states or conditions:

1. **Sensation.**—This is the result of an impression carried to the cerebrum by an afferent nerve, generally commencing at the periphery, and referred thereto.

All organs and tissues in the normal state are sensitive; but actual sensations do not proceed from them. When, however, they are disturbed by any cause, perception is aroused, and a condition of *pain* may be the result. We term the constant existence of sensation in a quiescent state *common sensibility*.

2. **Motion.**—The act of movement is generally regarded as due to an impulse originating in a nervous centre, and being conveyed by an efferent or motor nerve to muscles or muscular organs. Muscular contraction may be produced by stimulation of any part of the efferent or motor nerve-tracts. It may also originate in a reflex manner by stimulation of some portion of the sensory nerve-tract, being reflected through the centres.

3. **Consciousness** is a physiological state partly depending on the presence of perceptions, and partly associated with the intellect and the will. Generally speaking, it will depend on a perfect state of the whole sensory apparatus, but for our present purpose we may regard it as residing in the cerebral convolutions, over which we can exert influence by means of certain drugs.

4. **Sleep.**—The real nature of healthy sleep is a matter which is not yet clearly understood. It is generally supposed to depend on diminished metabolism of the

gray matter of the cerebrum, either due to a deficient supply of blood, or an impaired quality of it, or to diminished activity of the tissues following exhaustion.

II. Pharmaco-dynamics.

This portion of the subject, if considered in detail, would assume very large proportions, as the system is such an extensive one, and the actions of drugs on its different portions are many and diverse.

For practical purposes, it will suffice to give an outline of the action of drugs and other measures on the chief portions of the system, giving preference to those which are of use to the therapeutist.

It is needless to remark that as the physiology of the nervous system is not yet clear in all portions, so the diseases of it still require further investigation, and as a result the actions and uses of drugs are yet far from being clearly understood.

We will first consider the power which we possess over—

1. **Sensation.**—This will include common sensibility, as well as that of the special senses.

(*a*) *Local stimulants* have the power of increasing common sensibility, also the sensation of a part, which may even give rise to pain. Most act directly on the nerve fibrils in the tissues, and some may act primarily on the vessels, exciting the circulation as well as the nerves.

As examples of local stimulants, we have the application of extreme heat, extreme cold (temporarily), iodine, volatile oils such as oil of turpentine, and irritants such as mustard, and cantharides in its primary effects. Alcohol and ether, when their vapour is confined, also act as local stimulants; and certain metallic salts, if applied in solution sufficiently strong, have the same effect, such as silver, copper, zinc, etc., acting as caustics or astringents.

It is necessary to understand that the sensations produced by local stimulants are in reality *central*, although they may be referred to the periphery. The higher centres are stimulated, and the impulses, while being carried to the cerebrum, also act partly on the spinal and medullary centres, producing reflex impulses which may act on muscles and the viscera.

Thus we see that sensory impressions, especially irritating ones, stimulate not only consciousness, but also the vital centres in the medulla, and through them some of the important viscera. For example, the cold douche rouses consciousness, and also excites the respiratory centre, causing increased respiratory movements.

It will thus be seen that *local stimulants may become general stimulants.*

(*b*) *Local anæsthetics* reduce the sensibility of the terminal nerve-endings, and finally remove their power of receiving impressions. When used for the relief of pain, they are termed *local anodynes.* Some agents directly depress the nerve fibrils, such as belladonna, aconite, cocaine, opium; others, such as alcohol, ether, volatile oils, etc., have a similar effect when their action is prolonged. Moderate cold, such as that produced by the evaporation of ether, acetic acid, etc.—also certain saline solutions, such as that of chloride of ammonium—possess an anæsthetic effect on the parts to which they are applied; while extreme cold will cause absolute anæsthesia of the part. Moderate heat reduces the irritability of nerves, while extreme heat prolonged destroys it.

We employ certain agents, such as *poultices*, to act as local anodynes, which effect they bring about by combining the properties of heat and moisture. The heat relieves the pain by acting on the bloodvessels, dilating and relieving them, promoting osmosis and the migration of corpuscles, an effect which is assisted by the presence of moisture.

(*c*) *We can act on the trunks of the afferent nerves.* By the use of certain drugs, such as opium, we can interfere with the carrying of impressions from the periphery to the sensory centres by depressing the nerve-trunks themselves.

We may mention a familiar surgical operation—viz., neurotomy—which relieves pain and lameness by section of the nerve, thus preventing painful impressions being carried to the sensory centres from the diseased part.

(*d*) *We can act on the sensory and perceptive centres themselves* by that group of agents termed *narcotics;* these include general anæsthetics and general anodynes, which will be noticed presently under the head of *Consciousness.*

Among the group of narcotics, we find some agents, such as opium, which interfere with the afferent impressions from all portions of the system—that is, at their formation, in the course of their conduction, and at their entry to the sensory centres.

2. **Motion.**—We possess more power over that portion of the nervous system presiding over motion than over sensation, because we can act on motor parts both directly and also in a reflex manner—viz., by local irritants producing muscular movements, and local depressants arresting them.

We find that different drugs act on different portions of the motor apparatus.

(*a*) *Motor stimulants* may act on the *motor convolutions* of the cerebrum.

Examples.—Alcohol in moderate doses, and chloroform and ether in their primary stages.

They may act on the *medulla.* Thus, ammonia, belladonna, and strychnine excite the movements of the respiratory muscles by acting on the respiratory centre, and ether and chloroform in their primary stages have a similar effect.

They may act on the *motor centres of the spinal cord.* Thus, strychnine produces convulsions by powerfully stimulating these centres.

Local motor stimulants act on the *terminations* of the nerves, the *terminal apparatus*, and the *muscles* themselves. As examples, we have the employment of hand-rubbing to parts, the cold douche, etc., which rouse the local circulation, and increase muscular nutrition and activity. Electricity is also in use as a local motor stimulant, and strychnine possesses a similar action.

(*b*) *Motor Depressants.*—Large doses of alcohol, ether, and chloroform depress and finally paralyze the *motor convolutions* of the cerebrum, and thus completely arrest all voluntary movements.

The motor functions of the medulla are depressed by opium, aconite, chloral, etc., and by large doses of alcohol and chloroform, which ultimately produce paralysis of the respiratory centre, and cause death by this means.

The motor centres in the spinal cord are depressed by physostigmine and other drugs, the result being paralysis of the limbs when large amounts are administered.

The motor nerves themselves are depressed by conium and other drugs, which cause paralysis through these channels when administered in sufficient amount.

The motor nerve-endings are depressed by belladonna and its allies, this effect being more marked in the case of involuntary muscles.

3. **Consciousness.**—Consciousness is readily acted on by various influences, but for practical purposes it is only necessary to refer to three means which we possess by which we are enabled to bring about desired results in connection with it:

(*a*) *We can rouse consciousness* by powerful and also by painful impressions, such as the use of the cold douche, or the application of an irritant, such as mustard, to the surface; also by the inhalation of ammonia.

(*b*) *We can reduce consciousness* by the use of cerebral depressants, such as by the bromides, which diminish reflex excitability, and give the nervous centres a certain amount of rest.

(*c*) *We can remove consciousness* by the use of *general anæsthetics.* These agents directly depress the nervous tissue of the convolutions, arresting their functions, removing sensibility and consciousness.

General anæsthetics belong to a group of drugs termed *narcotics.* Narcotics possess a very complex action, influencing both sensory and motor portions of the nervous system, and also acting on most of the viscera.

All narcotics, pushed to a certain extent, produce a condition of unconsciousness; but they do so in such a different manner that we are enabled to select some out of the number which have been proved by experiment and experience to be safe for use as general anæsthetics.

This selection is made as a result of our knowledge of the precise action of these agents, and of the manner in which they involve the different portions of the nervous system.

We may divide narcotics into two classes for this purpose:

1. Those which act primarily on the convolutions of the cerebrum, first stimulating, then depressing, and finally arresting their functions, producing the condition of unconsciousness. The vital centres in the medulla are also depressed, but until consciousness is completely removed, no serious depression in the vital centres occurs. Chloroform and ether act in this manner, and are hence the agents most commonly used for the purpose of general anæsthetics.

2. Those agents which involve the cerebrum and the vital centres in the medulla at the same time, so that before the condition of unconsciousness is produced there is dangerous depression of the centres of respiration and circulation in the medulla.

As examples of such agents we may give opium and chloral. It is needless to remark that such drugs are not used for the purpose of removing consciousness, but are frequently employed, and are of great importance when prescribed in suitable doses, as general anodynes. For such purposes we employ them to arrest perceptions of pain, to induce sleep, and to soothe and prevent pain in the great vital organs of the body when such are disordered or diseased.

Hypnotics are agents which promote or produce sleep, and include narcotics, such as opium, chloral, etc., also bromides. They do not act so readily on animals as on man, in consequence of the cerebrum of the former not being so well developed as in the latter.

We may remark that certain nervous depressants, such as aconite, paralyze the medulla before they remove consciousness, and consequently are daugerous agents, never employed for general anæsthetic purposes, and requiring great care in their use as nervous sedatives.

III. Pathological Relations.

In considering the pathological relations of the nervous system, it will be sufficient for our purpose to notice the principal *symptoms* to which the varied morbid conditions give rise.

1. **Disturbances of Sensation—Pain.**—We are aware that the condition termed *pain* will depend on a great variety of causes, and may arise from different sets of organs, and may be due directly to the part to which it is referred, and where it originates, or by reflex action affect other regions. Briefly we may state that whatever tissues or organs are affected, giving rise to the condition of pain, we may regard it as originating in the nerve-supply, connecting the periphery with the sensory centres in the cerebrum.

Severe pain produces very serious effects if allowed to go on unchecked. It is a powerful depressant of the nervous centres and of vital organs; and such actions, taken in connection with the morbid condition on which the pain depends, will clearly show the student the great importance of pain as a general symptom of disease.

2. **Paralysis.**—This is a symptom depending on various morbid conditions of the nervous system. Paralysis may affect different portions of the body: thus, we may have paralysis of the posterior extremities, paralysis of the intestines, paralysis of the bladder, etc.

We find this condition in a large variety of diseases, of a diversified nature. Thus, we have inability to rise in that affection termed *azoturia* in horses, also in injuries to the spinal cord. In cattle we find it in cases of milk-fever; and in dogs we find paralysis of the hind extremities in some cases of impaction of the intestines, also in the later stages of rabies.

3. **Excessive Motor Activity.**—Under this heading are included conditions such as spasm, convulsions, etc.; also disturbed movements of the viscera may be included.

The conditions may occur in a large number of affections, and depend on various causes, being due in some to a morbid state of any part of the motor tract from one extremity to the other, and in others to some disturbance of the sensory area, which produces effects by acting reflexly through the centres.

4. **Disturbances of Consciousness.**—These include the conditions of—

(*a*) *Unconsciousness*, which may depend on direct injuries to the head; on interference with the blood supply to the cerebrum, such as is seen in fainting due to hæmorrhage; on organic diseases of the brain, and as a result of narcotic poisons.

(*b*) *Delirium and excitement*, which are conditions found to occur in many diseases, and leading to a state of exhaustion. Many poisons also produce these conditions.

IV. Natural Recovery.

Many disorders of the nervous system not depending on organic changes have a tendency to disappear when the cause is removed either by natural means or when these are aided by the therapeutist.

As it is difficult in many instances to ascribe the symptoms presented to their real cause, it is clear that under such circumstances our efforts can only be directed to the alleviation of the conditions placed before us.

One important point never to be lost sight of is that severe pain should always be checked as early as possible, no matter what it depends on.

V. Therapeutics.

In considering this portion of the subject we will follow the headings laid down in the previous section, which, as we have stated, deal only with a view of the principal symptoms.

1. **Disturbances of Sensation—the Use of Anodynes.**—Pain, as the chief indication of disturbances of sensation, must be rationally treated by first ascertaining its cause as far as this is possible. As we have already remarked, pain acts as a powerful depressant of the centres and viscera, and hence the aim of the therapeutist should be to relieve this distressing symptom as speedily as possible, taking care, however, to accomplish this by means which will not act in a manner detrimental to the general system, or in a manner likely to increase the gravity of the affection on which the pain depends.

In veterinary practice we have to consider that not only is the relief of pain necessary from its depressing effects on the vital systems, but also that the patients may seriously injure themselves by rolling about in a reckless manner in their endeavours to obtain relief; besides, there is the danger to the attendants from the latter, and also the impossibility of administering medicinal agents.

Pain is exhibited by animals in a variety of ways, depending on the species and the individual temperament of the patient. In the horse excitement generally prevails, either rolling about violently or walking round his stall, and lying down carefully, various postures being assumed depending on the nature of the affection.

Clinical observation and experience alone will enable the student to discriminate between the varieties of pain exhibited, and to ascribe the symptoms to their true cause. He must be careful to distinguish between the manifestations of pain depending on abdominal affections and those due to affections of other organs, such as of the kidneys, pleuræ, brain, etc.

Correct diagnosis in such cases must be made by paying attention to the general symptoms presented, and also to the history of the case, and to special symptoms, which, if not present at the time of examination, may become apparent as the disease is developed. The conditions of delirium, excitement, etc., depending on affections of the brain, whether of its substance or of its coverings, must be distinguished from similar effects due to other causes.

It is needless to say that such distinctions are by no means clear when we consider, for instance, that affections of the stomach may, by reflex action, produce marked disorder of the brain, causing a combination of the evidences of pain and delirium.

Then, again, we have in certain affections, such as azoturia, the occurrence of violent convulsive movements, in severe cases continued until the patient becomes worn out, evidently due to some morbid cause acting on the nervous system. Whether pain really occurs or not in such cases we cannot definitely say, because our patients do not possess the power of speech.

Chronic degenerative diseases of the kidneys will also, in some cases, produce various degrees of pain, evidenced by the peculiar postures assumed by the patients.

In cases of volvulus and intussusception of the intestines the most violent struggles are often witnessed, the pain becoming so intense that the patient seems incapable of controlling his actions.

In cases of brain affections, whether occurring as primary affections or due to reflex irritation from the stomach, the horse becomes so violent in the first stages that it is impossible to approach him or to administer medicines.

In cattle we also find the evidences of pain either shown in great excitement, with excessive motor movements, or by great dulness accompanied by a grunt or low moan frequently repeated.

In dogs pain is manifested either by low moans or by shrieks, depending on severity. Different postures are also assumed.

The alleviation of pain leads us to inquire into the use of **Anodynes.** These are agents prescribed for the relief of pain. To make use of anodynes in a scientific manner it is necessary to arrive at a correct diagnosis—that is, to ascertain the cause of the pain and to remove it, and to act on the effects which remain. The student will clearly see that in all cases this will not be possible, especially so when we have to depend on objective symptoms for a diagnosis.

Nevertheless, there are certain conditions where pain exists, and where we can remove it by the employment of what are termed *indirect anodynes;* these attack the cause of the pain, while they do not act directly on nervous tissue. For example, in the case of local affections characterized by pain, such as an abscess or a foreign body in a part, we make use of surgical means of relief, also of poultices, warm fomentations, etc. But even local affections sometimes require the use of either local direct anodynes or general anodynes. Again, we find that local irritants, such as mustard, etc., may become local anodynes, supposed to be due to certain actions, such as exhaustion of the irritability and conductivity of local nerves and to dilatation of the vessels, etc., effects which will be described in the chapter on *Counter-Irritation.*

Purgatives may act as indirect anodynes in some cases, such as in impaction of the stomach or in spasmodic colic due to the presence of irritating ingesta; these agents remove the cause. But it is often necessary to combine with them anodynes in order to remove the effect—*i.e.*, the pain.

Local Anodynes are employed to reduce the irritability of nerves by local means; such are belladonna, opium, cocaine, and also the hypodermic injection of morphia, which acts both locally and generally.

General Anodynes are a most important group of medicinal agents in veterinary therapeutics. They relieve pain, no matter from what source, by depressing the sensory centres in the cerebrum, or by diminishing the conductivity of the sensory nerves, or by a combination of both methods. Some such as chloral hydrate act as pure and powerful *hypnotics*—that is, cause sleep, and prevent the perception of pain by their action on the sensory centres of the cerebrum. Others, such as opium, and its active principle, morphine, produce a paralyzing effect on the sensory nerves of all organs, and also act as hypnotics in some animals.

As we shall see, however, when treating of the special therapeutics of opium and its alkaloids in the majority of cases in horses, instead of a hypnotic effect, these drugs produce excitement, and act as cerebro-spinal stimulants, even when administered in large doses; and as such effects are productive of harm by reason of their depressing action on the nervous system at a time when it requires rest, we have to depend on another drug—viz., cannabis indica—which possesses the properties of acting as an efficient anodyne, both by producing direct hypnotic effects as well as depressing the sensory nerves. A pure hypnotic, such as chloral hydrate, although producing sleep by its action on the convolutions of the cerebrum, has little effect on the peripheral sensory nerves; hence, when the patient awakes from the sleep the pain may not be relieved, and suffering may continue as before.

We may also refer to the use of *General Anæsthetics* in surgical operations; these will be considered under the *Special Therapeutics of Chloroform, Ether, etc.*, in Part III.

2. **Paralysis.**—Paralysis must be treated according to the nature of the affection on which it depends. In veterinary practice it is well to bear in mind that if there is no reasonable prospect of a return to a normal condition, by which the patient will be enabled to be of practical use, treatment is of no avail, as a paralyzed animal is of no value. Paralysis occurs most commonly in animals in the form of *paraplegia*, generally depending on some affection of the spinal cord, producing a defect or loss of power in all parts posterior to that affected. It may depend on various causes, such as injury or fracture of the vertebræ, and also in reflex or functional causes, such as in that affection of horses termed *azoturia*, and in dogs in some cases of intestinal obstruction and impaction. General paralysis may occur from lesions of the cerebrum or of its coverings.

As an example of *local paralysis* in the horse, we may mention that of the branches of the facial nerve, producing difficulty in prehension and mastication.

In cases affecting the spinal cord and nerves, nerve tonics, such as strychnine, are indicated, local treatment being also of value.

In cases depending on cerebral affections, treatment must be adopted according to the nature of the lesions, stimulants being indicated in some instances, and cerebral sedatives in others.

3. **Excessive Motor Activity.**—Spasms, convulsions, etc., are also rationally treated according to their cause. We meet in young dogs cases of convulsive fits due either to teething or to the presence of parasites in the intestinal canal. Such cases are treated by aperients and stomachics, and by anthelmintics, according to the cause.

Cases of epilepsy are met with in dogs, in which instances the administration of the bromides is often of service.

In affections such as *tetanus*, in which the correct pathology is not yet discovered, various means of treatment are adopted; but it cannot yet be said that the use of one drug gives better results than another.

In cases of *convulsions* the exact cause of which we cannot determine, it may be necessary to prescribe drugs such as opium, chloral hydrate, cannabis indica, etc., to abate the violence of the symptoms.

In cases of such affections as *azoturia*, where the convulsions depend on some deleterious agent acting on the nervous system, it is of the greatest importance to ensure the action of the various excretory organs, such as the bowels, the skin, and the kidneys, by the use of purgatives, diaphoretics, and diuretics when necessary, avoiding narcotic agents as much as possible until the other means fail.

4. **Consciousness.**—In cases where delirium is a prominent symptom, cerebral depressants, carefully regulated, are indicated, such as chloral, bromides, etc.

In *loss of consciousness*, we must clearly inquire into the nature of the case. If the condition be due to injuries of the head, our attention should be directed to the state of the heart and the respiratory system, which may become depressed along with the convolutions of the cerebrum, the centres of respiration and circulation being involved by the injury. In such cases restorative measures must be employed, including cardiac stimulants and artificial respiration if necessary. But in cases of loss of consciousness, where the vital centres are not seriously depressed, we should avoid stimulants as much as possible, as they are likely to increase the existing injury to the brain by stimulating the circulation through it, when it should remain in a state of quietude.

CHAPTER XIII.

THE KIDNEYS.

ALTHOUGH organic affections of the kidneys are by no means so freqnent in our patients as in human beings, still, a consideration of these important organs is necessary, as, independent of chronic diseases, there are many abnormal states met with which demand the attention of the therapeutist. Also, the kidneys, being very important organs of excretion, can be availed of as auxiliaries in the removal of deleterious materials, depending on affections of other organs.

I. Physiological Relations.

The function of the kidneys is to remove from the blood and from the system the waste and poisonous products of the body, the excretion thus formed being termed the *urine*. Briefly, the urine may be stated to arise from two portions of the kidney.

1. **The Bulk of the Water of the Urine** is removed from

the blood by means of the Malpighian bodies, the blood pressure in which is always high, because the efferent vessels are smaller than the afferent. The watery portion then transudes into Bowman's capsule, and thence into the tubules.

2. **The Solid Portions of the Urine**, viz , the urea, uric acid, hippuric acid, and many salts, dissolved in a small amount of fluid, are separated from the blood by the cells of the convoluted tubules. These epithelial cells separate from the capillary vessels which surround them the organic and inorganic materials mentioned, and these join the water which is passing through the tubules derived from the Malpighian bodies.

According to Ludwig, there is a partial reabsorption of the water, which is excreted by the Malpighian tufts. The renal vessels are under the control of the vaso-motor system of nerves, and there are no recognised secretory nerves of the kidneys.

The Secretion of Urine consists of a *filtration theory*, *i.e.*, the existence of a difference in pressure between the blood in the Malpighian bodies and the tubules; and also on the *elective power* possessed by the epithelial cells of the tubules, which remove the organic and inorganic matters from the same blood.

The Amount of Urine depends on the nature of the food, the quantity of fluids taken, and the activity of the bowels and skin. The secretion of urine is *increased*, during the period of digestion, by cardiac stimulation, and also by contraction of superficial bloodvessels, such as by the action of cold on the skin. The organic matters are increased by nitrogenous food, and the activity of the renal epithelium will depend on the activity of the circulation and on the quality of the blood.

The following points are also of importance:

The Quantity of Urine secreted by the horse is about $8\frac{1}{2}$ pints for the twenty-four hours. In cattle the amount is 21 to 28 pints for the same period.

Carnivora excrete by the kidneys the major portion of the water they drink, while herbivora excrete the greatest part by the lungs.

The Reaction of the Urine in herbivora is alkaline, the alkalinity being due to the presence of carbonate of potash. In carnivora the reaction is acid.

According to Professor Smith, uric acid does not occur normally in the urine of the horse, and he regards uric acid in herbivora as replaced by hippuric acid.

II. Pharmaco-dynamics.

We can act on the urinary excretion by means of agents termed *diuretics.*

Diuretics may be defined as agents which act on the kidneys and increase the secretion of urine. Obviously, from what we have just noticed with regard to the physiological relations of the kidneys, their functions can be increased in a variety of ways, which, for convenience of description, we may classify as follows:

1. **Agents which increase the Volume of the Urine**—that is, the amount of water excreted from the glomeruli. Evidently this will be accomplished through the circulation.

2. **Agents which affect the Excretion of the Urinary Solids.**—These will act chiefly through the blood itself.

1. **The Agents which increase the volume of the Urine** produce their effects in different ways, as follows:

(*a*) *By raising the blood-pressure in the general arterial system*, including the renal arteries, without affecting the pressure in the veins.

This can be accomplished by increasing the amount of fluids ingested, which increases the amount of water in the system; also by the administration of cardiac stimulants, such as alcohol, digitalis, ammonia, etc. Such agents are termed *cardio-vascular diuretics.*

The action of cold on the surface of the body will produce a similar effect by constricting the peripheral vessels.

(*b*) *By Agents which dilate the Renal Arteries.*—These cause increased quantity of blood in the renal arteries, while the general arterial pressure and that in the renal veins remains unaltered. These act locally on the vasomotor nerves of the kidney, causing depression, and consequently dilatation of the renal arteries. They include digitalis in the second stage of its action, spirits of nitrous ether, volatile oils and resins, such as turpentine, camphor, etc.; also agents such as alcohol, belladonna, etc.

The action of cold on the surface of the body produces reflex dilatation of the renal vessels.

All these agents are termed *local vascular diuretics.*

By combining agents in classes (*a*) and (*b*), a more profuse volume of urine will be the result.

2. **The Agents which affect the excretion of the Urinary Solids** may be divided into two classes. Both influence the activity of the renal epithelium, and hence the excretion of solids and a certain amount of water.

(*a*) *Those which affect the Renal Epithelium through the General Composition of the Blood.*—General measures, which include the composition of the food, the perfection of the process of digestion, the action of the liver, etc., and the causes producing such normal performance of functions, all have an effect in altering the composition of the urinary solids. The chemical reaction of the urine is not affected by the administration of the mineral acids, as the majority are excreted in the form of neutral salts. The vegetable acids, such as citric, tartaric, and acetic acids, combine with alkaline bases, and are excreted as alkaline carbonates.

The administration of alkalies produces an alkalizing effect on the urine—that is, in the case of carnivora. Ammonia has not this effect, as it is broken up in the system.

(*b*) *Those Agents which act in a Special Manner on the Renal Epithelium.*—Potash stimulates the renal epithelium, and is excreted as the carbonate. Soda in certain of its salts, such as the phosphate, has a similar effect, but in a far less degree. Magnesia and calcium are also special stimulants of the renal epithelium.

All these salts mentioned, while acting as special stimulants of the renal epithelium, also carry with them a certain amount of fluid from the venous plexus around the tubules, and thus produce a condition of diuresis.

Such agents are termed *saline diuretics*, and are of great importance to the therapeutist. We do not recognise them as directly affecting the renal circulation, but as acting indirectly by their influence on the venous plexuses around the tubules, thus producing effects on the renal circulation, and especially on the blood pressure in the veins.

In addition to saline diuretics, we possess a group of medicinal agents in the aromatic oils, oleo-resins, and balsams, which have a special effect on the renal epithelium. These are excreted by the renal epithelium in part, either unchanged or altered by decomposition during their passage. They also carry away a certain amount of water. This action varies according to the agents employed.

Some, such as turpentine in large doses, may in some cases diminish, in others increase, the bulk of the urine, and may even produce hæmorrhage from the glomeruli.

3. **Renal Sedatives or Depressants** diminish directly the activity of the renal epithelium, producing their action by their influence through the blood. We may mention opium and its alkaloid, morphine, as possessing this power in a marked degree.

III. Pathological Relations.

Chronic affections of the kidneys are rare in veterinary practice, and acute inflammatory affections of these organs cannot be said to be of common occurrence. There are, however, disorders of the renal functions commonly met with, characterized by changes in the character, composition, and volume of the urine. As examples of these, we may give azoturia, or hæmoglobinuria, and diabetes insipidus in horses, and that affection termed 'red water,' or hæmo-albuminuria, in cattle.

As cases of chronic inflammatory affections of the kidneys are sometimes met with both in horses and dogs, it is necessary to study the pathological relations of this system as briefly as possible on the following lines:

1. **Disorders of the Fluid Portion of the Urine depending on Changes in the General Blood Pressure.**—These may be referable to—

(*a*) *Diminution of the General Arterial Pressure.*—This condition may be due to disease of the heart—*e.g.*, dilatation—by which the arterial pressure is lowered and the venous is raised; so that, as regards the kidney, the pressure is lowered in the afferent vessel of the glomerulus, and raised in the efferent vessel. The result is passive congestion of the kidneys. The urine is *lessened* in amount, both of fluid and also of the total amount of solids; it may contain albumin, and blood derived from the engorged veins.

(*b*) *Increase of the General Arterial Pressure.*—This condition occurs in that form of chronic disease of the kidney known as the *granular* or *contracted kidney.* In such a case, the left ventricle of the heart is hypertrophied, and the arterial tension high at first, succeeded by dilatation of the heart. The results are: The urine is greatly *increased* in volume, light in colour, and of low specific gravity, and may contain traces of albumin. There is a constant condition of diuresis.

2. **Disorders of the Fluid Portion of the Urine depending on Changes in the Local Blood Pressure.**—These may be referable to—

(*a*) *Certain Nervous Conditions.*—These disturb the blood pressure in the kidney by acting on the renal vessels, and thus influencing the fluid portion of the urine. As examples, we may give hysteria, characterized by alternate profuse and deficient secretion of the urine. Also diabetes insipidus, in which there is disordered innervation, probably depending on defective assimilation, due to improper food; the vaso-motor centres become disordered, the renal vessels dilated, the result being that there is an excessive amount of urine secreted, pale in colour, and of low specific gravity; great thirst is also a prominent symptom in this affection.

(*b*) *Morbid Conditions of the Renal Bloodvessels.*—These may affect either the glomeruli, the arteries, or the veins; they are found to occur as one of the pathological conditions of that affection termed *Bright's disease.* The results as regards the volume and constitution of the urine will depend on the portions involved, and on the severity of the diseased process.

We may also refer to another cause acting on the renal bloodvessels—viz., the presence of abdominal enlargements. These may cause pressure on the trunks of the renal vessels, and thus interfere with the renal circulation, resulting in the presence of albumin, blood, etc., in the urine, or in some cases there may be suppression of urine.

3. **Morbid Conditions of the Secreting Epithelium of the Kidney.**—These are among the lesions also found in cases of Bright's disease. The cells lose their function, becoming diseased; they obstruct the tubules, and press upon the venous plexus, causing interference with the circulation of the blood, and also with the filtration of the fluid portion of the urine through the glomerulus. The results are: The urine becomes lessened in volume, and of high specific gravity. It contains albumin, probably derived from the venous plexus, and blood, either from the latter or from the glomerulus; and also casts of diseased cells, fibrin, etc.

The following serious results may occur: The urea accumulates in the blood, the general circulation is interfered with, the heart becomes affected, and the fluid portions of the blood escape into the tissues and serous cavities, constituting dropsy. These are some of the phenomena met with in that form of Bright's disease known as the *large white kidney.*

The student should compare the character of the urine with that described in subsection (*b*)—*i.e.*, the contracted kidney, which is another form of Bright's disease.

4. **Renal Affections depending on Abnormal Conditions of the Blood.**—The urinary secretion may become deranged by influences other than changes in the kidneys themselves. Thus, the blood may be in an abnormal state as the result of dyspepsia or from hepatic disorder, and the urinary secretion may be greatly modified as regards its composition and reactions.

We may refer to the following disorders as examples of cases of this nature:

(*a*) *Oxaluria*—an affection met with in horses, consisting of debility, loss of flesh, and the presence of oxalate of lime in the urine, which is clear and pale in colour, frequently passed, and acid or neutral in reaction. The causes are: Irregularities in feeding, improper diet, and impaired digestion as a result. It is also said to be produced by food containing an excess of saccharine materials, such as turnips, carrots, etc.

(*b*) *Azoturia*—a condition characterized by spasms of the large muscles of the posterior part of the body and of the limbs. The urine is dark-coloured, of high specific gravity, and containing a large amount of urea, and sometimes albumin in small amount. The chief cause is the allowance of food too rich in nitrogenous materials, with insufficient exercise, and the affection is mostly seen when the animal is put to work after a period of idleness.

(*c*) *Hæmo-albuminuria*, also known as *red water*—occurring in cattle. In this disease the urine is dark-coloured, containing albumin, and the colouring matter of the blood in a disintegrated condition. The causes are chiefly dietetic, the food being inferior in quality, resulting in an impoverished condition of the blood. The albumin, being unfit for nutrition, is excreted by the kidneys along with a portion of the hæmoglobin, which becomes broken down, giving the characteristic colour to the urine.

We may also draw attention to a condition of the urine in which a large amount of phosphates are present These have a tendency to become precipitated in the mucous membrane of the bladder or urethra, giving rise to irritation, or in some instances to the formation of calculi. The causes are also dietetic errors.

IV. Natural Recovery.

If the renal disorder depends on derangement of the blood, or of other important organic functions, it is obvious that natural recovery will follow when these become changed to a normal condition. If, however, organic changes occur in the kidney, the skill of the therapeutist will be severely taxed in order to prolong vitality, in consequence of the serious results which follow and the implication of other vital organs. We must, however, recognise that the kidney possesses many provisions which tend to a natural recovery whenever this result is possible.

Thus, increased work is met by increased functional activity; also, if one kidney be diseased, the other endeavours to perform its work, a condition of compensating hypertrophy occurring in the healthy organ.

The condition termed *vicarious compensation* is also an important one. Thus, we find that the skin and the bowels endeavour to carry off the effete products which are normally excreted by the kidneys, but which are apt to be retained in renal diseases. This effort of nature is taken advantage of by the therapeutist by stimulating the bowels and skin to action by purgatives and diaphoretics, and thus preventing the accumulation of effete materials in the system, and also giving the kidneys a temporary rest in cases where such is desirable.

V. Therapeutics.

Under this heading we can only draw attention to some important general principles in the treatment of renal affections.

1. **The Use of Diuretics** is not confined to the treatment of affections of the kidney, as in other disorders we find these agents of great therapeutical value. Thus,

in cases of dropsy connected with cardiac disorder, agents such as digitalis, by acting as cardio-vascular diuretics, remove the excessive fluid, and also relieve the heart and general circulation.

Also in cases of rheumatic disorders diuretics hasten the expulsion of the morbid poison from the system. In all such instances a combination of diuretics will be found useful, such as of the cardio-vascular with the saline, etc. In acute inflammatory affections of the kidneys, diuretics—especially those of an irritating nature—should be avoided, and the bowels and skin should be stimulated, so as to carry off the effete products. Saline purgatives are especially useful, and their effect may be kept up by small repeated doses.

In chronic affections, such as the *large white kidney* of Bright's disease, great discrimination is necessary in prescribing treatment, especially with reference to diuretics.

From what we have already considered, it is obvious that in this affection there is constant danger of deficient excretion of urea, by reason of the epithelial cells being diseased, so that the indications are to relieve these cells by diverting the excrementitious products to other channels, and avoiding excess of nitrogenous food. Thus, hydragogue purgatives are indicated, also diaphoretics, etc.

Although renal stimulants, such as saline and special diuretics, may be considered as contra-indicated in such cases, nevertheless there are instances in which they prove useful, by clearing out the tubules when they are blocked by cellular and inflammatory products. This is accomplished by the diuresis induced.

2. **Urinary Derangements depending on Nervous Disorder.**—These will be rationally treated by prescribing

remedies directed to the nervous system, depending on the nature of the affection.

In diabetes insipidus, the first step in treatment will be attention to the food. Then mild aperients and the administration of iodine or iodide of potassium prove of service. In severe cases opium acts beneficially.

In that affection termed *diabetes mellitus*, or *glycosuria*, which is of rare occurrence in the horse, but is met with in the dog, the pathology is obscure. It is generally believed that the liver is the chief organ involved, although the prominent symptom is a profuse secretion of urine containing glucose, with excessive thirst. The treatment will consist in avoiding starchy and saccharine articles of food and the administration of small doses of opium with mineral tonics.

3. **In Renal Affections depending on Abnormal Conditions of the Blood** it is clear that the first indication will be to bring about a return of the vital fluid to a normal condition. This will be accomplished by acting on the bowels and skin, and paying special attention to dietetics.

In azoturia it is essential that the bowels be acted on by a purgative, and the skin by diaphoretics, so as to remove as expeditiously as possible the effete materials which exist in the blood, and which give rise to the characteristic and serious symptoms. If the urinary secretion be deficient, diuretics will be indicated, those being selected which have an effect on the solid portions of the urinary secretion.

In 'red water' in cattle it is of great importance to promote the action of the bowels; but our endeavours should also be directed to restore the blood to a normal condition by the allowance of nitrogenous food and agents which have a special action on the blood, such as chlorate of potash.

In oxaluria and conditions of excess of phosphates in the urine, the bowels should be acted on, the diet attended to, and dilute mineral acids with vegetable tonics administered, such as the dilute nitro-muriatic acid, with tincture of nux vomica and gentian.

CHAPTER XIV.

THE BODY HEAT AND ITS REGULATION; THE SKIN.

I. Physiological Relations.

THE heat of the body is the result of changes occurring in the tissues. The largest source is the oxidizing of carbon into CO_2; but many other changes occurring in the system also result in the formation of heat, such as muscular contraction, etc.

The normal temperature of the body is the result of a certain amount of heat being produced, portion of which accumulates in the system, and portion of which is lost. The bulk of loss of heat is due to evaporation by the skin, the heating of inspired air, food, etc., a small proportion being due to radiation.

The production of heat in the system varies at different periods, as also does the external temperature, so that it is necessary that some means of regulating the body temperature should exist. This we find is a complex and sensitive nervous mechanism, consisting of governing centres, afferent nerves from parts capable of receiving impressions, and efferent nerves carrying impressions to active organs.

The Skin occupies a most important position with reference to the regulation of the body temperature, and also as an excretory organ. It contains important glands, termed *sudoriparous or sweat glands*, which secrete an albuminous fluid termed *sweat*, consisting of organic and inorganic matters of the nature of an excretion. The skin also possesses a respiratory function, CO_2 being passed out and oxygen passed in; but this process is not very active in the higher animals.

The skin is highly endowed with sensory nerves, and also with bloodvessels; it is a bad conductor of heat, this being assisted by the subcutaneous layers of fat, and also by means of the hair growing from the skin.

The afferent nerves originating in the skin carry impressions of temperature, whether of heat or cold, to the brain and cord. These impressions are received by the cerebrum, becoming sensations of temperature, also by the sweat centres in the medulla and cord, and many other centres, such as the vaso-motor, cardiac, respiratory, etc.

The efferent impulses proceed from the sweat centres to the sudoriparous glands, either stimulating or depressing them, according to their nature. They also proceed from the other centres, producing effects on the cutaneous circulation, the general circulation, the renal secretion, etc.

The sudoriparous glands of the horse are not easily acted on by drugs; and, according to Professor Smith, we possess no drug which can excite the secretion of sweat in the horse; he has proved by experiment that pilocarpine has no effect on the sweat-glands of this animal, although it produces a profuse salivary flow.

Cattle possess very rudimentary sweat-glands, not easily acted on. They are believed to perspire principally in the muzzle; while in the dog the skin practically does not sweat, except in the foot-pads. In this animal the respiratory passages are supposed to assist in this function, and also in the regulation of the body temperature, exemplified by the panting observed in hot weather and after exercise.

In connection with the temperature of the surroundings of animals we have to draw attention to the effects produced when this is either raised or lowered.

(*a*) **If the Temperature be raised**, the regulating nervous mechanism is called into action, and the following effects occur:

1. *Increased loss of heat* by the evaporation of the perspiration, by the cooling of the blood in the dilated cutaneous vessels, and also in the lungs.

2. *Diminished production of heat* in the muscles, glands, etc. In muscular exercise there is increased metabolic activity, causing a rise in the internal temperature, the cutaneous vessels are dilated, perspiration occurs, respiration and circulation are increased, and the activity of metabolic organs, such as the liver, is temporarily lowered.

(*b*) **If the Temperature be lowered**, two effects are produced in a reflex manner through the medium of the nervous system:

1. *Diminished loss of heat*, due to contraction of cutaneous vessels, arrest of perspiration, and reduced activity of circulation and respiration.

2. *Increased production of heat* in internal organs, especially the muscular, digestive, and circulatory.

II. Pharmaco-dynamics.

Under this heading we will refer to the power we possess over the regulation of the body heat and the skin.

1. **By Means of acting on the Cutaneous Circulation.**—These comprise a power of withdrawing heat from the body by modifying the amount of blood and the rate of flow in the cutaneous vessels.

(*a*) The blood can be cooled by causing *dilatation of these vessels*, accomplished by increasing the surrounding temperature, also by the use of the hot bath, and by the administration of diffusible stimulants, such as alcohol, spirits of nitrous ether, etc.

(*b*) Similar effects are produced by *increasing the flow of blood through the cutaneous vessels*, accomplished by cardiac stimulants of all kinds.

2. **By acting on the Sweat-Glands by Agents termed 'Diaphoretics' or 'Sudorifics.'**—These increase the amount of perspiration, and include a variety of means and agents acting in different ways:

(*a*) *By stimulating the afferent cutaneous nerves* by means of the surrounding temperature being raised, as in the Turkish bath, also by means of warm clothing, and stimulants, such as moderate doses of alcohol, etc.

(*b*) *By acting on other afferent nerves* which stimulate the sweat-glands reflexly, such as by aromatic drinks, which act on the nerves of the mouth, throat, and stomach.

(*c*) *By acting on the sweat centre in the medulla directly.* These include narcotics which produce this effect by increasing the venous condition of the blood, such as opium, chloroform, etc., also by measures which iucrease the flow of blood through the centre, such as hot drinks, etc.

(*d*) *By stimulating the terminations of the nerves in the sweat-glands*, and also the secreting cells of these glands, such as by pilocarpine, which produces profuse and rapid diaphoresis; also by dilating the vessels, and thus increasing the flow of blood to the glands.

Some agents, such as acetate of ammonia, cause diaphoresis in a complex manner. This agent is supposed to both stimulate the secreting cells and to be excreted from them along with an increased amount of water. Other drugs acting in a manner not perfectly clear are camphor and also ipecacuanha in the form of Dover's powder.

We find that some diaphoretics act in more ways than one; thus, alcohol dilates the cutaneous vessels, increases the rate of blood-flow, and stimulates the afferent nerves and sweat centres.

We may here notice a group of agents which have an opposite effect to diaphoretics; these are termed *anhydrotics*. These diminish the amount of perspiration, and they produce this effect by acting in different ways:

(*a*) *By depressing the sweat centre*, acting indirectly by stimulating the cardiac and respiratory centres, and thus overcoming the venous condition of the blood, which in weakness and exhausting diseases frequently produces sweating of that peculiar nature termed *cold sweating.*

Examples.—Alcohol, ammonia; nerve tonics, such as strychnine, iron, etc.; while proper attention to food, air, etc., cannot be overlooked as auxiliaries.

(*b*) *By depressing the terminations of the secretory nerves of the sweat-glands.*

Examples.—Belladonna and its alkaloid, atropine, hyoscyamus and its alkaloid, hyoscyamine. These agents have a very marked effect in diminishing or checking excess of perspiration.

3. **We can act on other Excretory Organs for the purpose of reducing the Heat of the Body.**—Purgatives and diuretics cause a direct loss of heat by abstracting an increased amount of warm excretions from the body, through the medium of the bowels and kidneys. This

effect is assisted in the case of purgatives by the reflex dilatation of cutaneous vessels which accompanies purgation; but we shall find that in most febrile conditions which we have to treat, strong purgatives will be contra-indicated, although laxatives will be of great service.

4. **We can act on the Heat-forming Tissues** in the body by the use of certain drugs which possess the power of diminishing tissue change. Such agents are termed *antipyretics*, and are represented by quinine, salicylic acid, antipyrin, etc. These interfere with metabolism, and lessen the amount of heat formed, by reducing the activity of the tissues; they have little effect on healthy animals, this being attributed to the normal mechanism of regulation of temperature. Other drugs, such as alcohol, reduce temperature by diminishing tissue waste, but do so in a different manner from quinine. Alcohol becomes oxidized in the tissues, thus sparing them to some extent; and although generating a certain amount of heat, its action in the circulation is such that a diminution of temperature is the total result.

Other drugs, such as aconite, probably reduce temperature by their effects on the circulation.

III. Pathological Relations.

As we have already shown that the normal temperature of the body is the balance between the production and the loss of heat, both of which are under the control of the nervous system, we have now to consider the effects of disturbance or disorder of these relations, leading to that abnormal condition of the system termed *pyrexia*, or *fever*. The chief characteristic in fever is elevation of the body temperature; but there are many concomitant phenomena which also require consideration, consisting of derangement of vital functions and a condition of general depression. Briefly speaking, the following may be taken as the most common causes of the condition of pyrexia:

1. **Interference with the Refrigerating Function of the Skin.**—This is generally due to the effect of exposure to cold, or sudden changes of the temperature of the surroundings, producing what is popularly known as a *chill*. The impression of cold on the afferent nerves leads to interference with the nervous mechanism presiding over temperature, the cutaneous vessels become contracted, the perspiration arrested, rigors or shivering fits occur, and heat being thus retained in the system causes elevation of the temperature.

2. In those febrile affections which we believe to depend on the presence of *specific organisms* in the system, or to be associated with them, we have good grounds for stating that the life of such orgauisms, the processes of fermentation associated with them, and the destruction of tissues produced by them, are all factors in causing elevation of temperature.

3. **Pyrexia** may depend on a combination of the causes mentioned; for example, in the case of a wound in which pus may become decomposed and be absorbed, a general systemic disturbance occurs, the skin, lungs, and circulation become disordered, and temperature is raised.

The Increased Production of Heat in Fever depends on increased activity of metabolism, which fact is proved by the rapid emaciation, by the increased amount of the products of oxidation of tissues, viz., urea and other excretions.

The following conditions also occur in fever, along with the elevation of temperature:

The Skin in the first stages is hot and dry; if the fever be ushered in by a *chill* or *rigor* the cutaneous vessels are contracted, and the surface of the body is cold, especially the extremities.

The Nervous System is depressed, but in some instances restlessness and delirium may be present; these, however, are not often met with in our patients as compared with man.

The Pulse becomes altered in character, and the *respirations* accelerated, depending on the degree of the rise of temperature, and on the organs involved in the affection of which the fever is an accompanying condition.

The Digestive System becomes disordered, evidenced by dryness of the mouth, thirst, loss of appetite, and constipation of the bowels.

The Urinary Secretion is scanty, high-coloured, and its solid constituents are both relatively and absolutely increased.

Nutrition is interfered with, shown by general emaciation, the degree of which depends on the intensity and duration of the febrile affection.

We must regard fever as one of the prominent symptoms found in those affections which are usually accompanied by it, rather than as a distinct condition. There is, however, a form of fever met with termed *febricula*, or *simple fever*, which appears to arise independent of serious complications, and tends to a quick recovery. We have already alluded to this form in Part I., p. 20.

The occurrence of fever often precedes the advent of the special changes in organs induced by the various diseases; at least, those changes which we can detect by an examination of the patient and an observation of the symptoms.

We regard the recognition of fever as a very important item in therapeutics; although we may not immediately be able to determine the exact nature of the disease which is likely to follow, still, we can adopt treatment which will be beneficial in the early stages. The height of temperature is of importance during the course of a febrile affection; but although a high temperature is a very serious condition, still, we must take into consideration the state of the vital organs of the body at the same time in estimating the dangers of a febrile attack. The state of the pulse, of the respirations, of the nervous and digestive systems, must be taken into account.

The depressant effect of the high temperature will greatly depend on the previous condition of the organ which is invaded by the disease—whether it is weakened by the effects of previous disease or not; and also the influence of the surroundings, whether hygienic or otherwise, must not be lost sight of. Thus, if a horse suffering from an attack of pneumonia, although showing a high temperature, has a fair appetite and a pulse not likely to cause alarm, and if in addition we are able to place him in hygienic surroundings and have him properly nursed, we would be far more confident of his recovery than in a case where, although the temperature is lower, we find the pulse is frequent, small, and compressible, the appetite poor, and the surroundings unhygienic.

We have to notice a variety of fever termed *inflammatory fever*, in which the rise of temperature follows the inflammatory action in parts or organs, and is thus said to be *secondary*. We find this condition occurring in surgical practice, and in affections of abdominal organs, such as enteritis, peritonitis, etc. The intensity of the fever will be modified according to the nature of the parts involved by the inflammatory action at the commencement, and we find that the fever is not always proportional to the size or importance of the part inflamed. In traumatic peritonitis, a leading symptom in addition to the fever and the pain is a small thready pulse, an effect of the great depression which exists, which quickly tends to death from failure of the heart's action.

Another form of fever is termed *chronic fever*, in which a constant rise of temperature exists. It is met with in cases of specific diseases, such as tuberculosis and chronic glanders, and in the latter disease is a symptom of great importance as an aid to diagnosis.

Disorders of Perspiration.—These we may refer to two classes, viz.: (1) *Excessive sweating*; (2) *deficient sweating*.

We find *excessive sweating* to occur in such cases as azoturia, etc. Horses out of condition from various causes are likely to sweat excessively, even when at moderate exercise. Severe pain also causes *profuse perspiration*.

Deficient sweating occurs at the beginning of most febrile affections, the skin being dry; it also occurs in some diseases and disorders of the urinary functions.

IV. Natural Recovery.

In disorders of the body heat, as well as in the phenomena which accompany them, there is a natural tendency to return to the normal, and the aim of the therapeutist should be to assist nature as much as possible, and avoid undue interference. Febrile affections generally run a definite course, and cannot be cut short by any line of treatment; so that attention to the vital functions, and careful nursing and hygienic surroundings, form the chief details of rational treatment, in connection with the use of agents to reduce the pyrexia.

V. Therapeutics.

It is clear that remedies can only rarely reach the actual cause of febrile disorders, so that our treatment will be chiefly symptomatic.

1. In cases depending on interference with the functions of the skin in regulating body temperature, the indications are to increase the cutaneous circulation, and to gently stimulate the secretions of the body. For these purposes we prescribe *diaphoretics*, and apply suitable clothing. Agents thus employed are liq. ammonii acetatis, spiritus ætheris nitrosi, and moderate doses of alcoholic stimulants in case of the occurrence of rigors.

2. In cases of high temperature depending on general increase of metabolism, agents such as quinine, salicin, phenol derivatives, etc., are indicated. In cases which we believe to depend on the presence of micro-organisms in the system, we employ *disinfectant antipyretics* in order to destroy, if possible, these organisms and their life processes. Such agents are represented by quinine, salicin, etc.

3. It is clear that as fever may depend on a combination of causes, so our treatment of it must vary according to circumstances, and a combination of agents may be desirable. It is important that the functions of the skin, kidneys, bowels, etc., be kept regular, taking care, however, to avoid any measures likely to depress the patient. If the heart be weak, indicated by the condition of the pulse, stimulants will be required, of which alcohol will in many instances be found a most useful agent. It stimulates the cutaneous circulation and the sweat-glands; it spares tissue waste, acts as a food to the system, besides acting as a cardiac stimulant and an antiseptic antipyretic. But, like all other medicinal

agents, it requires to be used with caution and judgment, in properly regulated doses, and in suitable cases. The kidneys and bowels are kept regular by the allowance of salines in the drinking water, such as sulphate of magnesia with nitrate of potash. In cases where the temperature runs high, the use of quinine will be indicated, a large dose being given at first, followed by smaller quantities as required. In cases depending on traumatic causes, abdominal affections, etc., anodynes to relieve the pain must be administered along with febrifuges, and other means adopted as the special demands of the cases require.

Disorders of Perspiration are treated according to their nature and causes. The excessive sweating which is found in many cases of azoturia is evidently an effort of nature to remove the excess of deleterious materials from the system, and is to be encouraged by diaphoretics and warm clothing. In cases where horses sweat on the slightest exertion, nervine tonics are indicated, with strict attention to hygiene and dietetics.

Anhydrotics, the most powerful of which are belladonna and hyoscyamus, may be indicated. Briefly speaking, these may act by diminishing the activity of the sweat-glands, also by lessening the excitability of the sweat centres, or by acting on the circulation and stimulating the respiratory centre, and in this way overcoming that venous condition of the blood which is apt to occur in cases of debility, and which is a cause of the abnormal sweating accompanying such a condition of the system.

CHAPTER XV.

THE THERAPEUTICS OF THE SURFACE OF THE BODY.

From our knowledge of the physiological relations of the surface of the body, we can easily appreciate the importance of this portion of our subject to the therapeutist.

The skin is highly endowed with sensitive nerves, and is also very vascular, so that it is very susceptible to external influences, not only those acting on it through the medium of the surrounding temperature, but also those which we can apply for certain therapeutical purposes.

By acting on the surface of the body we can produce effects on distant parts, such as the nerve centres, the general circulation, and even the entire system. Such effects are produced by means of the nerves, which have extensive relations throughout the system, and also by the cutaneous vessels.

We must remark, however, that the *modus operandi* of the measures which we adopt is by no means so simple as might be imagined, as in many instances it will be found to be complex as well as obscure.

I. Pharmaco-dynamics.

The measures which we adopt may be conveniently considered under the following heads :

1. *Counter-irritants.*
2. *Baths and Allied Measures.*
3. *Surgical Applications.*

Counter-irritants are those agents which when applied to the skin cause either stimulation or inflammation of it, depending on the strength of the application. By reflex action they also produce effects on remote parts.

Counter-irritants are arranged according to the degree of their action into the following classes:

(*a*) *Rubefacients* produce a degree of redness and congestion of the skin. The alteration in colour of the skin is not always visible in veterinary patients. These agents are represented by hot water, mustard applied in moderation, solutions of ammonia, volatile oils, such as camphor, turpentine, etc.

(*b*) *Vesicants or Epispastics.*—These are more active agents; they cause at first reddening of the skin, with increased heat, and a sensation of smarting. In a variable time, depending on the strength of the application, the papillæ of the skin become raised and vesicles form; these enlarge and coalesce, forming blisters of various sizes; they contain an albuminous fluid, and generally fibrin. After a variable time they either dry up or a muco-purulent fluid is exuded, which becomes hard, forming a scaly covering to the part; this gradually falls off as new skin becomes formed.

Examples.—Cantharides, strong applications of mustard, boiling water.

(*c*) *Suppurants or Pustulants.*—These cause inflammation of the deep-seated portions of the skin, and the formation of pustules. They are represented by biniodide of mercury, croton-oil, tartar emetic, etc. Vesicants applied very strong and repeatedly have a similar effect.

There are other forms of counter-irritants besides the medicinal agents mentioned, such as the *actual cautery* and *setons*.

The General Action of Counter-irritants.—It will be readily seen that the general action of counter-irritants is a very complex one, although the measures adopted are simple in their application.

In order to understand the theory of the therapeutical value of these agents, it is essential that we study carefully not only their local actions, but also their effects on the different portions of the vital system. For the purpose of description we may divide the action of a counter-irritant into three stages:

1. The effect on the skin is stimulant; the cutaneous vessels become dilated by a direct action on their nerves, and the local circulation becomes more free, the sensory nerves are irritated, and pain is produced of a smarting character.

The effect on the general system is that of a stimulant, this being accomplished by reflex action. There is a similar effect produced on the individual organ over which the counter-irritant is employed. Reflexly the heart's action is accelerated, the blood-pressure raised, respiration is quickened, and the cutaneous vessels become contracted. The painful impression rouses the higher nerve centres. After a certain period the cutaneous nerves become depressed, and pain subsides.

2. If the application of the counter-irritant be prolonged, the second stage is reached, viz., that of *vesication*. Local pain is now induced, and if the process be extensive, there is depression and innervation of vital organs, the amount of serum withdrawn from the vessels being an important factor in the production of these effects.

3. If the degree of counter-irritation be still more severe, pustules are formed, and the remote effects are greater than in the stage of vesication.

The Theory of Counter-irritation in Therapeutics.—Perhaps in the whole range of therapeutics there is not more difference of opinion existing, not only as to the *modus operandi* of counter-irritants in the treatment of the affections for which they are recommended, but their beneficial action is questioned altogether by competent authorities. We need only refer to standard works on veterinary medicine, and also to professional literature, to become aware that while one authority definitely states as the result of actual experience that counter-irritation is of signal benefit in the treatment of pulmonary affections, another authority, quite as eminent, condemns the practice as not only useless but harmful to the patients.

Those who believe in the beneficial effects of counter-irritants to the walls of the chest in cases of pneumonia, pleurisy, or bronchitis, base their views on the following actions which these agents are capable of producing:

(*a*) That by acting on the skin over the region of a part or organ, we can produce certain effects on the nutrition of the latter, as well as the functions.

(*b*) That by this power we can influence internal morbid processes by creating external irritations.

These are based on the idea that we possess influence over:

1. The circulation of parts in immediate vascular connection with the area of skin irritated.

By means of rubefacients and vesicants it is believed that the circulation will be attracted to the area of skin, that the plasma will be drained off, and thus internal congestions or inflammations will be diminished.

This is also explained by the fact that, in congestion of the brain or of its coverings, the administration of a drastic cathartic proves beneficial by diverting the blood to the intestinal canal, and thus affording relief to the affected organ.

2. It is believed that we can influence deep-seated parts by irritating the cutaneous nerves, which, acting in a reflex manner through the centres in the brain and

cord, will modify the circulation and nutrition of the parts beneath the area to which the counter-irritant is applied.

3. By counter-irritation we can affect the trophic and vaso-motor centres in the brain and cord, which preside over the area of skin irritated; and in a reflex manner a neighbouring trophic centre may be influenced, which will induce a change in the nutrition of the tissues in the neighbourhood of the irritated area of skin.

As examples of pathological conditions explaining these phenomena, the following are quoted by Dr. Wood: 'The formation of a duodenal ulcer as the result of a burn of the skin, especially of the abdominal wall. Sympathetic ophthalmia, caused by the presence of a diseased tooth.'

The above illustrate some of the views held as to the theory of counter-irritation.* We have now to inquire as to the pathological conditions in which counter-irritants are indicated and prove of benefit. We find most authorities agreeing as to their beneficial action in cases of subacute or chronic inflammations of joints, tendons, etc., also in cases of rheumatism affecting different portions of the body, in phlebitis, and other diseased conditions. But when we come to consider the question of the value of counter-irritation in thoracic affections, we find the most striking differences of opinion to exist among authorities. Those who are in favour of counter-irritation state, as the result of considerable experience, that they have found morbid conditions of the lungs and thoracic organs benefited by moderate vesication applied to the chest-walls. They note favourable results in from twelve to twenty-four hours, consisting in an improvement in the pulse, temperature, and respiration. On

* For further information on this subject, see 'Therapeutics and Materia Medica,' by Dr. H. C. Wood, p. 475.

the other hand, we find authorities who are opposed to counter-irritation bringing forward strong evidence that the practice in such cases is not only useless, but actually productive of harm to the patient, raising the temperature, causing restlessness, and increasing instead of modifying the morbid processes in the organs involved by the disease.

Without adhering to either of these opinions, we may safely state, as the result of clinical experience, that the indiscriminate use of strong counter-irritants to the chest-walls in cases of thoracic affections is both irrational and harmful in practice. A moderate amount of counter-irritation is of the greatest benefit in some cases, while in others it can be entirely dispensed with. Hot applications to the chest-walls we have found of great service, but when improperly applied, they are productive of more harm than good, and hence the application of a moderate counter-irritant must always have the preference where the satisfactory adoption of the other measure is impossible.

No hard and fast rule can be laid down as to the employment of counter-irritation or otherwise, but this fact we must lay stress on, that it is clearly wrong practice to apply severe and prolonged irritation to the thoracic walls, causing extensive and deep-seated structural changes in the skin, with the hope of relieving the diseased process in internal organs.

In the primary stages of thoracic affections, where a high temperature is a prominent symptom, and if, in addition, the animal is excitable, it would be clearly irrational to apply counter-irritants where rest, pure air, and attention to the diet, with simple medicinal agents, will of themselves bring about a return to the normal state. But there are cases where counter-irritation proves of great benefit, when it is properly and carefully carried out.

In cases of acute congestion of the lungs we have seen the most favourable results from the application of moderate stimulation to the thoracic walls, in conjunction with other important details of treatment. Again, there are instances in the course of pulmonary affections where the usual treatment is not attended with that change in the condition of the patient which we are anxiously watching for. In popular language, the case is 'hanging fire,' and we find the application of a moderate counter-irritant to the thoracic walls to be productive of very satisfactory results. Among other diseased conditions where counter-irritation is of signal benefit we may mention cases of laryngitis, pharyngitis, etc.; also in cases of strangles, by causing the maturation of the submaxillary abscess.

We find that although the beneficial effects of counter-irritation are generally admitted in cases of chronic lameness depending on affections of bones, cartilage, tendons, or ligaments, still there is great difference of opinion existing as to the manner in which these results are brought about. Experiments by authorities have given totally different results, the main point at issue being whether the inflammatory action produced by the counter-irritant extends below the skin and subcutaneous tissues, or otherwise. The bulk of evidence would go to demonstrate that the beneficial effects produced in such cases are due to the counter-irritant exciting a process of reparative inflammation in the diseased parts, which overcomes the original diseased process, or, in other words, assists nature in the process of repair.

Take the case of a horse lame from bone spavin, which has resisted the usual treatment by line firing and blistering. Now, if when the part has been deeply fired with a sharp-pointed iron, and when a long rest has been allowed, the animal goes sound, surely we are not going to believe that the inflammatory process induced did not extend beyond the skin and subcutaneous tissues.

We are fully aware that in performing the operation we pierce the exostosis with the cautery, and we are justified in concluding that the beneficial results produced were due to the reparative process set up, which assisted nature to cause anchylosis of the opposing surfaces of the diseased bones, and thus removed the pain and lameness, and as an auxiliary to which we must regard rest as very important.

2. **Baths and Allied Measures.**—In veterinary practice we do not make use of baths, either hot or cold, to the same extent as in human medicine. The large extent of the skin of horses and cattle, and the difficulty in overcoming the evil effects of excessive reactions, are among the circumstances which prevent the general adoption of baths. Hot baths are of the greatest benefit in canine practice, and are employed for a variety of diseased conditions. Great care is, however, necessary in order to avoid the injurious effects of reaction, and to guard against the danger of chills, etc. The patients should be carefully dried, and kept in kennels maintained at a proper temperature.

The Turkish Bath, as a therapeutic agent, is one of great value and importance, and no veterinary infirmary is complete without a properly fitted bath of this kind. In cases of chills, rheumatism, laminitis, renal affections, etc., the Turkish bath is of benefit in the early stages; but we must be careful not to cause excessive reaction, and also to see that the animal is properly clothed, and not afterwards exposed to cold. We may also refer to the value of the Turkish bath in affections of the skin extending over a wide area, whether in horses or dogs. The action of the hot air softens the cuticle, and enables applications to have the desired effect.

The Effects of Cold and Hot Applications.—The effect of the application of cold to a part for a time is to cause contraction of the afferent arteries by reflex action, and, as a result, the amount of blood going to the part is lessened. Heat dilates the capillaries, reduces tension and relaxes tissues, soothes the nerves of the part, and thus relieves pain.

Fomentations are composed of hot water, either medicated or otherwise. They are applied to inflamed parts for the purpose of lessening tension and pain, and require care in their use, so as to avoid the effects of reaction. Their application should be continued for a considerable time, with water at the required temperature; the parts should be well clothed afterwards, and a stimulating liniment applied, so as to prevent chilling.

Poultices are applications composed of substances such as linseed-meal, bran, oatmeal, boiled carrots or turnips, spent hops, etc. Their uses are various in cases where heat and moisture are beneficial either in soothing the nerve endings in inflamed parts, or in favouring the maturation of abscesses. In cases of punctured wounds of the feet in horses, after the judicious use of the knife to provide proper drainage, poultices are very useful. It is necessary to remark, however, that poultices require to be employed with discretion, so as to avoid their use in the case of wounds where we may, by dry antiseptic dressings, induce more favourable results. They should not be continued for too long a period, as they are apt to produce a softened, unhealthy condition of the part and excessive granulations, which interfere materially with the reparative process. In many instances it is necessary to medicate poultices; thus, in wounds of the feet associated with much pain, local anodynes, such as belladonna, are very useful. In every case we should endeavour to render poultices applied to open surfaces antiseptic by the addition of agents, such as carbolic acid, creolin, etc., in proper proportions. It is also necessary to remember that poultices should be changed at least twice a day, to avoid putrefactive changes. When wounds become greatly inflamed, and great pain and irritability exist, the beneficial effects of poultices judiciously applied are beyond question.

The selection of either hot or cold applications for therapeutical purposes is very often a question of taste, and depends much on the nature of the case. As a rule, we may state that where pain and tension are prominent symptoms the use of heat is indicated; this acts beneficially by soothing the peripheral nerve-endings, relieving the tension of the vessels, and softening the skin.

There are many instances, especially of unhealthy conditions of the joints, ligaments, and tendons of horses, where the application of cold, such as that produced by a continuous stream of cold water over the parts, is productive of great benefit. As examples, we may mention cases where it is necessary to reduce existing heat or inflammation prior to the application of a counter-irritant; also in cases of open joint the continued application of cold relieves the pain, and checks the inflammation in the synovial membrane.

3. **Surgical Applications.**—These properly belong to the domain of surgery, so that only a brief mention can be made here of the therapeutical agents employed in

this respect; these agents will, however, receive attention under their respective heads in Part III.

(1) *Antiseptics.*—These agents either prevent the entrance of organisms into a wound or destroy them, and arrest the processes giving rise to fermentation and decomposition. They are represented by carbolic acid, creolin, boracic acid, iodoform, perchloride of mercury, etc.

(2) *Disinfectants* are for the most part similar materials to antiseptics, but are employed in a much stronger form, and are also used for the purposes of preventing the spread of infectious and contagious diseases. They destroy micro-organisms and their products, and are employed in cases of putrid wounds, etc. They are represented by strong solutions of carbolic acid, chloride of zinc, chloride of lime, sulphurous acid, etc.

(3) *Deodorants.*—These possess the power of absorbing gases and neutralizing foul odours, and are represented by charcoal, solutions of permanganate of potash, etc.

(4) *Astringents* coagulate or precipitate albuminous discharges, and contract or constringe the vessels of a part, thus limiting the process of exudation. For surgical purposes they are employed to lessen excessive discharges, and to check granulations, thus imparting tone to wounds. They are represented by solutions of the acetate and subacetate of lead, sulphate of zinc, alum, etc.

(5) *Stimulants* are employed in surgical therapeutics to check excessive granulations in a wound, and to hasten the healing process when this is tardy. They are represented by mild applications of a caustic, such as nitrate of silver.

(6) *Styptics* are agents employed for the purpose of arresting hæmorrhage from injured vessels or surfaces, either the result of accident or from surgical wounds.

They are astringents, and act either by coagulating albumin, and thus plugging the bleeding vessels, or they cause contraction of capillary vessels. Styptics are represented by persalts of iron, benzoin, tannic acid, acetate of lead, hazeline, etc. Pressure, such as with tow or lint, acts as a mechanical styptic.

(7) *Caustics and Escharotics.*—Caustics possess the power of destroying living tissue with which they come in contact. They combine with the water and albumin of the tissues, and when they produce an extensive slough are termed *escharotics.* Caustics are employed for destroying virus in wounds, for removing warts and unhealthy growths, and for promoting the healing process in sinuses and fistulæ. They are useful in suppressing exuberant granulations and in hastening the healing process wheu this is slow, probably by stimulating the trophic nerves and the capillary vessels of the part.

(8) *Vesicants* are sometimes employed in cases of ulcerating surfaces which tend to become chronic, and are difficult to heal. They stimulate the local circulation, and promote the reparative process, cantharides being the agent usually employed for this purpose.

(9) *Anodynes* are employed in cases of wounds characterized by persistent pain and irritation. They are applied locally as well as administered internally, the preparations of opium and belladonna being most useful in this respect.

Before concluding the subject of general therapeutics, we may refer to the actions of medicinal agents on the eye.

Local anæsthesia of the eye is produced by the application of a solution of cocaine.

The iris is dilated by belladonna and its alkaloids, also by hyoscyamus, etc.; such agents are termed *mydriatics*, and produce their effect whether applied locally or given internally in sufficient amount.

The iris is contracted by Calabar bean and its alkaloid, physostigmine, by opium, pilocarpine, etc.; such agents are termed *myotics*.

PART III.

SPECIAL THERAPEUTICS.

CHAPTER I.

INTRODUCTORY.

WE have now to consider the actions of the various medicinal agents, and their uses, founded on our knowledge of their actions.

New remedies are ever on the increase, and as our knowledge of pathology advances, so will our efforts to discover new means to combat disease be continued. As a rule, new remedies or methods of treatment, when first brought forward, are eagerly sought after. Some stand the test of practical usefulness; others, after a brief existence, are ignored because they have not acted up to the expectations of their introducers.

The number of drugs employed for therapeutical purposes is very large, but it is clear that there are many which from want of precise knowledge concerning their actions, and of clinical data concerning their therapeutical value, cannot be accorded more than a passing notice in a work of this kind.

There are certain drugs which have been proved by both experimental and clinical evidence to be of definite therapeutical value, and these of necessity will require a more detailed consideration at our hands.

As previously remarked, we must not be too hasty in according all beneficial results in our treatment to the action of the drugs employed, seeing that, in the majority of instances, rational treatment consists in aiding the efforts of nature to overcome the diseased condition existing in our patients.

In the treatment of a case we must keep this point clearly in view, so as to have a proper perception of what we expect the mediciual agents employed to bring about.

A combination of different drugs, with a vague notion of what their result in the system of the patient shall be, is irrational both in theory and in practice.

The effects of a drug must be carefully watched during the course of an affection, remembering that patients are not alike susceptible to its actions. Of course the preference for special drugs in certain affections, by different practitioners, is due to the fact that they have obtained beneficial results from their use, and it is only natural to expect that, when a line of treatment proves successful, the practitioner is likely to continue it in cases of a similar character. Nevertheless we must admit that a departure from the beaten track is often of benefit, and it is rational to believe that in the future the science of pharmacology will advance and change as our knowledge of pathology extends.

In the classification of drugs various methods are adopted. Some authors arrange the medicinal agents in alphabetical order. Others classify them according to their actions, but as many drugs are entitled to be placed under different headings by reason of possessing more actions than one, this plan is not a satisfactory one.

The plan which we shall follow is that adopted by Dr. Mitchell Bruce in his work on 'Materia Medica and

Therapeutics.' It consists in arranging the drugs according to their natural order—that is, according to their source, whether derived from inorganic or from organic materials.

By subdividing these we can group together many medicinal agents possessing similar actions, and thus conveniently compare these actions when necessary.

The following is the sketch of the plan to be adopted :

Part I.—The Inorganic Materia Medica.

GROUP I.—*Alkalies and Alkaline Earths.*
GROUP II.—*The Metals.*
GROUP III.—*The Non-Metallic Elements.*
GROUP IV.—*Acids.*
GROUP V.—*Water.*
GROUP VI.—*The Carbon Compounds.*

Part II.—The Organic Materia Medica.

GROUP I.—*The Vegetable Kingdom.*
GROUP II.—*The Animal Kingdom.*

We have previously drawn attention in Part I., under the heading of the *Actions of Medicines*, to a convenient method of tracing the actions of a drug in the system, and whenever possible this plan will be followed.

It consists in arranging the actions under four distinct heads—that is, supposing the drug to be administered by the mouth :

(1.) *The Immediate Local Action.*
(2.) *The Action in or on the Blood.*
(3.) *The Specific Action.*
(4.) *The Remote Local Action.*

Having followed the drug in its course through the system and noted its actions therein, we can then consider its *medicinal uses*, founded on a knowledge of these actions, and also note any *contra-indications* to its employment.

There does not exist as yet any recoguised Veterinary Pharmacopœia, so that in the following chapters the preparations of the agents described are those of the British Pharmacopœia, unless when for special purposes stronger preparations than those of the latter are mentioned.

Preparations. — The majority of the agents of the Materia Medica possess such characters in the crude state that it is necessary to prepare them for administration.

The following are the chief kinds of preparations in use:

Aquæ (Waters) are very weak simple solutions of volatile oils in distilled water.

Decocta (Decoctions) are made by boiling vegetable substances in water, straining, and adding more water.

Infusions are solutions prepared by digesting vegetable substances in water.

Essentiæ (Essences) are solutions of volatile oils in four parts of rectified spirit; they are ten times the strength of spirits (spiritus).

Extracta (Extracts) are obtained by evaporating either the expressed juice of fresh plants or the soluble constituents of dried drugs.

Green extracts are prepared from fresh plants.

Alcoholic extracts are prepared by the action of rectified spirit or proof spirit on dry drugs, and then evaporating.

Liquid extracts are prepared by macerating the drug in water, evaporating, and adding spirit to prevent decomposition.

Glycerina (Glycerines) are solutions of substances in glycerine.

Pulveres (Powders) are prepared by reducing drugs by trituration to a state of fine division.

Spiritus (Spirits) are solutions of colourless substances or oils in rectified spirit. They are termed Complex when prepared in a special manner, *e.g.*, Spiritus ætheris nitrosi.

Syrupi (Syrups) are fluid preparations, containing a large proportion of sugar.

Tincturæ are solutions of active substances in spirit, either alone or combined with other solvents.

Vina (Wines) are solutions of drugs in sherry, such as vinum ipecacuanhæ, or in orange wine, *e.g.*, Vinum quiniæ.

Misturæ (Mixtures) are made by dissolving various substances in water. They are frequently compound.

Linimenta (Liniments or Embrocations) are preparations for external application, by friction, anointing, or painting.

Lotiones (Lotions or Washes) are solutions or mixtures for external use by washing or applying in lint.

Unguenta (Ointments) are mixtures of active substances with lard, vaseline, lanoline, etc.

Alkaloids are active principles, found in various plants, probably resulting from the metamorphosis of the albuminoid constituents; they are alkaline in reaction, forming salts with acids, and in form they are usually crystalline solids. All contain nitrogen, and they may be regarded as compounds of ammonia. Some plants contain a number of alkaloids which may differ in their actions from one another, but chemical analysis affords little or no indication of such difference.

For example, among the alkaloids of opium we find the *anodyne* morphine and the *emetic* apomorphine, the difference between the chemical formulæ being only two atoms of hydrogen.

Alkaloids have the terminal 'ine' or 'ina,' and in the older works the terminal 'ia' is given.

Examples. — Morphine, atropine, quinine, cocaine, physostigmine, pilocarpine.

Neutral Organic Principles are concentrated active agents, also derived from vegetable drugs.

They contain carbon, hydrogen and oxygen, and occur sometimes as bases, sometimes as acids.

They are distinguished from the alkaloids by having the terminal 'in,' and are represented by aloin, digitalin, santonin, salicin.

CHAPTER II.

I.—THE INORGANIC MATERIA MEDICA.

GROUP I.—ALKALIES AND ALKALINE EARTHS.

Of these the most important are: **1. Potassium**; 2. **Sodium**; 3. **Ammonium**; 4. **Calcium**; 5. **Magnesium.**

General Remarks on Alkalies.—Alkalies possess the power of dissolving the nitrogenous constituents of animal tissues. This solvent power is in proportion to, yet distinct from, their affinity for water. The caustic alkalies, having a great affinity for water, possess a more destructive action on the tissues than the other members of this group.

On the Stomach.—Alkalies given before feeding increase the secretion of gastric juice, but if given soon after feeding they neutralize the acid of this secretion, and retard digestion.

In cases of excessive acidity, with acid eructations, the administration of an alkali, such as the bicarbonate of soda, proves beneficial, but its action must be regarded as only palliative. Alkalies exert a sedative effect on the stomach, and relieve gastric pain; they also neutralize the toxic effects of acids.

On the Blood.—Alkalies, by reason of their diffusion-power, readily pass into the blood, so that only a small portion of them reach far into the small intestine. On entering the blood they undergo various changes, depending on their composition, the majority being probably converted ultimately into carbonates. They are quickly eliminated by the kidneys, so that it is probable they do not increase the alkalinity of the blood to any great extent; in fact, after their conversion into carbonates, but little is known of their precise action on the vital fluid. Acting as diuretics, they are excreted chiefly by the kidneys.

1. POTASSIUM AND ITS MEDICINAL SALTS.

Sources.—From woodashes, from cream of tartar, and from the native nitrate.

GENERAL ACTIONS OF POTASSIUM SALTS.

The actions of the different salts of potassium vary according to their nature, some, as the hydrate, being irritant and caustic; others, as the nitrate and acetate, being diuretic; while others, as the iodide and bromide, exhibit the action of their acid or salt radical.

(1) IMMEDIATE LOCAL ACTION.

In the mouth potassium temporarily checks the secretion of saliva. In the stomach, if given before feeding, it acts as a dilute alkali, stimulates the gastric follicles, increases the flow of gastric juice, and also acts as a sedative to the gastric nerves. If given after feeding it neutralizes the acidity of the contents of the stomach.

(2) ACTION ON THE BLOOD.

Potassium quickly enters the blood in the form of salts; it increases the natural alkalinity of the plasma, in a transient manner, however, and also increases the number and quality of the red corpuscles.

(3) SPECIFIC ACTION.

In larger doses potassium salts depress the *muscular*, *nervous*, and *cardiac tissues*. In the dog large doses are expelled by the act of vomition.

(4) REMOTE LOCAL ACTION.

Potassium salts are very rapidly excreted from the system, chiefly by the kidneys, to a less extent by the skin, respiratory passages and bowels, increasing the amount and the alkalinity of the excretions, their diuretic effect being generally due to their influence on the renal epithelium.

The Medicinal Uses will be described under the heading of each salt.

Potassii Carbonas—CARBONATE OF POTASSIUM.
Potassii Bicarbonas—BICARBONATE OF POTASSIUM.

Preparation.—The *Carbonate* is obtained from pearl-ash, the product of lixiviation of woodashes by solution and crystallization. The *Bicarbonate* is prepared by saturating a strong aqueous solution of the carbonate with carbonic acid gas, and recrystallizing.

Doses of the Bicarbonate.—Horses, ℥ss. to ℥i.; cattle, ℥i. to ℥i.ss.; sheep and pigs, ʒss. to ʒi.; dogs, grs. x. to grs. xl. Twice daily, properly diluted.

General Actions.—The carbonates differ only in the degree of their action.

The carbonate in sufficient amount and concentrated form acts as an irritant corrosive poison. The bicarbonate does not possess this action, being less of an alkali and more of a saline, and is the salt preferred for internal use. It is antacid, also stomachic, soothing the gastric nerves. It increases the alkalinity of the blood and urine, and acts as a mild diuretic and diaphoretic.

Externally both salts, in dilute solution, act as antacids to the skin, besides stimulating and cleansing when used in the familiar form of soap.

Medicinal Uses—*Internally.*—In cases of *dyspepsia* the bicarbonate is prescribed shortly before feeding to increase the flow of gastric juice when this is deficient; at the same time it acts as a sedative to the gastric nerves. The bicarbonate of soda is, however, more commonly employed for this purpose.

In rheumatism, acute and chronic, the bicarbonate is employed to neutralize the excess of acid in the blood, to increase the flow of urine, which it renders alkaline.

In uric acid deposits occurring occasionally in dogs, the administration of bicarbonate tends to cause their removal.

In calculi and deposits, occurring in the bladder and urethra of highly-fed rams, and chiefly consisting of the ammonio-magnesian phosphate, the administration of the bicarbonate freely diluted and in repeated doses often acts beneficially.

In *cystitis* and in irritable conditions of the bladder, the bicarbonate is prescribed in combination with belladonna or hyoscyamus.

Externally.—In the early stages of *eczema* in dogs, characterized by weeping and great irritation, dilute solutions of the carbonates in combination with glycerine often act in a beneficial manner.

In chronic skin affections in the dog, the carbonate of potash, in combination with sulphur, in the form of ointment such as the *unguentum sulpho-alkalinum*, as recommended by Professor Williams, is a very useful and efficient application.

In parasitic skin affections of all animals, the addition of carbonate of potash to the active ingredients applied is of great value in softening the cuticle, and enabling the remedy to penetrate to a greater depth, also neutralizing the acid excretion. An emulsion of carbonate of potash, olive-oil and water forms an excellent application for use after blisters, when the part becomes hard and scaly, possessing the advantages of allaying undue irritability, and not causing excessive softening of the parts, such as is apt to ensue after the use of oleaginous substances.

Liquor Potassæ—SOLUTION OF POTASH.
Potassa Caustica—CAUSTIC POTASH.

Preparation.—*The Liq. Potassæ* is prepared by boiling slaked lime in a solution of the carbonate and decanting. *Caustic Potash* is prepared from the liquor potassæ by boiling it down quickly in a silver vessel and pouring into moulds.

Caustic potash is a penetrating caustic seldom employed in practice. Liquor potassæ possesses similar actions to the carbonate, but the latter, being milder, is prescribed instead.

Potassii Iodidum—IODIDE OF POTASSIUM (see *Iodum*, p. 293).

Potassii Bromidum — BROMIDE OF POTASSIUM (see *Bromum*, p. 299).

Potassii Nitras—NITRATE OF POTASSIUM, NITRE, SALTPETRE.

Prepared from the native salt by crystallization from solution in water.

Doses.—Horses, ʒii. to ℥ss. ; cattle, ʒi. to ʒi.ss. ; sheep and pigs, ʒss. to ʒi. ; dogs, grs. x. to grs. xx. Twice daily.

Specific Actions.—*Externally* it is stimulant and refrigerant, and when concentrated is an irritant to mucous surfaces.

Internally.—In excessive doses it is a gastro-intestinal irritant, besides paralyzing the heart and nervous centres.

In medicinal doses it is very soluble and diffusible, and quickly enters the blood. Its precise action in the blood is not clearly understood, but when added in large amount to blood drawn from the body it retards coagulation. It is excreted by the kidneys chiefly, also from the bronchial glands and the skin, increasing the functions of these organs.

It is a powerful *diuretic*, producing this effect by acting as a local vascular stimulant to the kidneys, thus differing from other potassium salts in this respect.

Medicinal Uses.—As an *alterative and febrifuge*, nitrate of potassium is prescribed in febrile conditions and catarrhal affections, to promote the bronchial, cutaneous and urinary secretions, and to assist in the elimination of effete products.

It is given either alone or with sulphate of magnesia, and is readily taken dissolved in the patient's drinking-water.

As a diuretic it is employed in febrile affections, and for hastening the removal of effusions from serous cavities. In cases of renal disease its use requires care because of its action on the renal bloodvessels, other salts, such as the acetate and acid tartrate, being preferred when it is desired to increase the secretion of water and urea, by stimulating the renal epithelium, without disturbing the renal vessels. It is also useful in œdematous conditions of the limbs, lymphangitis, etc., in horses, and in such cases is often combined with other diuretics.

In acute rheumatism, in combination with other remedies, it produces beneficial effects; but these cannot be ascribed to any special action on the blood.

Externally, in combination with sal ammoniac, it forms a refrigerating lotion, which is useful in reducing local inflammatory action.

Potassii Chloras—CHLORATE OF POTASSIUM.

Prepared by passing chlorine gas into a mixture of carbonate or chloride of potassium and slaked lime, boiling, evaporating, and separating the chlorate of potassium by recrystallization.

Doses.—Horses, ʒii. to ℥ss.; cattle, ℥ss. to ℥i.; sheep and pigs, grs. xx. to grs. xl.; dogs, grs. v. to grs. xv. These doses must be modified according to circumstances, and may be administered in the food or drinking-water.

Specific Actions.—In the mouth it increases the salivary flow; also acts as a stimulant to the different portions of the respiratory mucous membrane, thus being a *saline expectorant.* If administered in excessive doses, it acts as an irritant to the stomach and intestines. Its action on the blood is not clearly understood. If it be added to blood drawn from the body, it increases the power of coagulation, and causes firmness of the coagulum. It does not, as was once believed, yield up its oxygen to the blood, as it is eliminated chiefly by the kidneys in an unchanged condition, and its soluble power is slight.

In toxic doses it disintegrates the red corpuscles, and causes the colouring matter and albumin, with a few corpuscles, to appear in the urine.

Medicinal Uses.—*As an internal antiseptic*, the chlorate of potash is a very valuable agent; although we are not able to explain the manner in which it produces its beneficial effects in cases of septicæmia, still, experience has proved its utility.

In cases of *purpura hæmorrhagica* it produces most beneficial results, either alone or in combination with preparations of iron; it is advisable to prescribe at first a large dose, and to follow this with smaller amounts. It is evident that this drug possesses some special action on the blood, judging from the results obtained.

In *hæmo-albuminuria, or 'red water,'* in cattle, after attending to the bowels, the chlorate of potash in combination with albuminous substances gives excellent results, probably by improving the quality of the blood.

As a sialagogue and saline expectorant chlorate of potash is useful in cases of laryngitis, pharyngitis, bronchitis, etc. Where there is difficulty in swallowing, it may be used in the form of gargle, or as an electuary in combination with extract of belladonna. For wounds or injuries of the mouth, tongue, and in aphthous eruptions and ulcerations, it is useful in the form of a mouth-wash or collutorium.

Potassii Acetas—Acetate of Potassium.

Prepared by saturating acetic acid with carbonate of potassium, evaporating, and solidifying.

Doses.—The same as those of the nitrate.

Actions and Uses.—These are similar to those of the nitrate, but the diuretic action is brought about in a different manner, as already stated. It enters the blood as a carbonate, and is chiefly excreted by the kidneys, causing profuse diuresis. It is prescribed in cases of dropsy depending on renal disease, where the use of the nitrate would be contra-indicated.

Potassii Tartras Acida—Acid Tartrate of Potassium, Cream of Tartar

is a mild *laxative* and *diuretic* occasionally prescribed in veterinary practice.

Potassii Permanganas—Permanganate of Potassium.

Prepared by evaporating a mixture of black oxide of manganese, chlorate of potassium, and solution of caustic potash.

The most important use of this salt is as a *disinfectant* and *deodorant.* It is employed in solution, and readily evolves oxygen, but is superseded to a great extent by more efficient disinfectants. It is still employed by some practitioners as an injection for the uterus in cases of metritis, etc. The popular disinfectant known as Condy's Red Fluid is a solution of permanganate of potassium and sodium.

2. SODIUM AND ITS MEDICINAL SALTS.

Sources.—The chloride, the native nitrate, and native borax.

GENERAL ACTIONS OF SODIUM SALTS.

The salts of sodium resemble in their actions the salts of potassium; but there are important differences to be noticed:

(1) They have not the depressing effect on muscles and nerves, consequently they are far less poisonous when administered in full doses.

(2) The salts of sodium are much less diffusible than those of potassium; thus, they are more slowly absorbed and excreted, and in some instances act as saline purgatives by passing into the small intestines.

(3) The salts of sodium, compared with those of potassium, are less useful for the purpose of increasing the alkalinity of the blood in diseases such as rheumatism, as they are slowly absorbed, and when administered in full doses tend to pass off by the bowels.

Sodii Bicarbonas—Bicarbonate of Soda.

Prepared by saturating the carbonate of potassium with carbonic acid gas, or by the reaction of chloride of sodium and bicarbonate of ammonium.

Doses.—Horses, ʒii. to ℥ss.; cattle, ℥ss. to ℥i.; sheep and pigs, grs. xx. to grs. xxx.; dogs, grs. x. to grs. xx.

The carbonate only differs in its degree of action from the bicarbonate, and the latter is the salt generally employed.

General Actions.—Bicarbonate of sodium possesses the actions of sodium in general on all parts of the body. Administered before feeding, it increases the secretion of the gastric juice; given after or with the food, it prevents excessive acidity, and undue fermentation of food. It also acts as a diuretic, increasing the water and solid constituents of the urine, and neutralizing the acidity of the same; but these actions are less powerful than the corresponding salts of potash.

Medicinal Uses.—The bicarbonate of soda, being less irritant than the corresponding salt of potassium, is preferred in cases of indigestion, for which purpose it is generally combined with vegetable bitters, tonics, and aromatics. A combination with nux vomica and gentian is very useful in cases of indigestion depending on a want of tone in the stomach with a tendency to fermentation of the contents and flatulence; this may be administered along with the food or after feeding.

As a stomachic this salt is very useful in stimulating the flow of gastric juice. When this secretion is deficient, a portion of the salt at the same time is converted into the chloride, which assists the digestion of albumin. It also tends to liquefy mucus of a tenacious nature, which is found to exist in the gastric mucosa in cases of dyspepsia, and thus enables the gastric juice to reach the food without difficulty.

Sodii Sulphas—SULPHATE OF SODIUM, GLAUBER'S SALTS.

Prepared by adding carbonate of sodium to the residue left after the manufacture of hydrochloric acid.

Doses.—As a purgative for cattle, lb. i. to lb. i. ss.;

sheep, ℥ii. to ℥iv.; as a cholagogue and alterative for horses, ℥ii. to ℥iii., dissolved in the drinking-water.

General Actions.—Sulphate of sodium is a *saline purgative*, resembling in its actions other purgatives of this nature, such as sulphate of magnesium. It possesses an immediate local action on the intestines, also stimulates the intestinal glands, and is constantly being absorbed and excreted by the intestinal vessels in its course along the intestine, causing purgation in the manner described at p. 85.

It is also a *direct cholagogue* or true *hepatic stimulant*, acting directly on the hepatic cells, and *increasing* the secretion of bile, besides removing bile which is lodged in the duodenum. Given in small doses freely diluted, it is excreted almost unchanged by the kidneys.

The phosphate of sodium has similar actions.

Medicinal Uses.—It is prescribed for both horses and cattle in cases where we wish both to stimulate the liver and to act on the bowels. Unless in large doses, it has no purgative effect on the horse, and even then is uncertain in its action. Nevertheless, in moderate doses it has a laxative effect, and is useful in cases of congestion of the liver. In cattle, compared with sulphate of magnesia, it is slower in its action as a purgative, and both drugs are occasionally combined. As a cholagogue in the dog, it is seldom suitable, because of the great irritability of the stomach which is generally present in hepatic disorders of this animal.

Sodii Hyposulphis—Hyposulphite of Soda.

Prepared by passing sulphurous acid gas into a solution of carbonate of soda with sulphur.

Doses.—Horses and cattle, ʒii. to ℥ss.; dogs, grs. v. to grs. x., repeated twice or three times daily.

General Actions.—Hyposulphite of soda is absorbed as the sulphate, and is not decomposed into the sulphite or free sulphur in the system, such as was once supposed. As an internal antiseptic it has not acted up to the expectations of those who suggested it for this purpose, and other drugs are far more satisfactory and reliable. Clinical experience, however, proves its value in cases of distemper in dogs, given in doses of from two to six grains, according to the size of the dog, and combined with quinine it modifies very considerably the virulence of the affection.

Sodii Chloridum—Chloride of Sodium, Common Salt.

Source.—Native.

General Actions.—This agent is necessary in the system of all animals for the maintenance of health. It promotes digestion and assimilation, and natural instincts compel animals to seek for it when there is a deficiency of it in foods or pastures.

Internally, in moderate doses, the chloride of sodium is stomachic. In toxic doses it acts as an irritant, while in full doses is cathartic, and acts as an emetic in those animals capable of the power of vomition. Cases are recorded of the toxic effects of salt in pigs, causing gastro-enteritis and lesions of the nervous system.

Medicinal Uses.—As conducive to health, it is always well to allow a piece of rock-salt in the manger of the horse, and convenient to cattle and sheep. Salt increases the secretion of saliva and of gastric juice, thus acting as a stomachic, being as necessary for animals as for human beings.

As a cathartic it is more soluble and more rapidly absorbed than sulphate of magnesia, hence it is sometimes combined with the latter, half a pound of each

15

being given as a dose dissolved in a proper proportion of water.

It is also prescribed in various parasitic affections of the alimentary canal of young animals in combination with tonic agents, and is popularly employed as an emetic for the dog.

Externally it is sometimes used in the form of a refrigerating lotion in combination with nitrate of potassium and chloride of ammonium, in the proportions of one of each to thirty of water, which produces a lotion of very low temperature.

Sodii Biborate—Borax (see *Acid. Boricum*, p. 319).
Sodii Bromidum (see *Bromum*, p. 299).
Sodii Iodidum (see *Iodum*, p. 293).
Sodii Salicylas.
Sodii Hypophosphis.

3. AMMONIUM AND ITS MEDICINAL COMPOUNDS.

Sources.—All the medicinal preparations and compounds of ammonium are derived directly or indirectly from the chloride, which is obtained from ammoniacal gas-liquor.

GENERAL ACTIONS OF AMMONIUM SALTS.

These resemble to a certain extent those of potassium and sodium, but are much more volatile, quicker in their action, and more powerful.

(1) IMMEDIATE LOCAL ACTION.

Externally ammonia acts as a *stimulant* to the cutaneous nerves and structures, causing a sensation of pain, and dilating the vessels. If the application be prolonged and the vapour confined, vesication may result, otherwise it acts as a *rubefacient*.

Internally, when inhaled by the nostrils, ammonia acts as a powerful general stimulant, producing in a reflex manner excitation of the vaso-motor centre, and raising blood-pressure.

In the stomach a large dose, such as of the carbonate of ammonia, well diluted, acts in the dog as an emetic. Medicinal doses act as *carminatives and reflex general stimulants*, besides possessing an *antacid* effect if given after feeding. If given before feeding it stimulates the secretion of gastric juice, being generally employed in the form of an alkaline stomachic mixture.

On the intestines, in medicinal doses, ammonia does not appear to have any appreciable immediate local action.

(2) ACTION ON THE BLOOD.

Ammonia is rapidly absorbed into the blood; it diminishes the tendency to coagulation, and increases the alkalinity of the plasma.

(3) SPECIFIC ACTION.

It is a general *stimulant*, acting on the central nervous system, the spinal cord, the respiratory centre, the heart, and general blood-pressure. It increases the production of urea, in part by its own decomposition with carbonic acid in the liver.

In toxic doses the effects vary with the preparation employed; but all after primary stimulation cause paralysis of the spinal cord, motor centres, and cerebrum.

(4) REMOTE LOCAL ACTION.

Ammonia is excreted by the *kidneys*, also by the mucous membranes, especially by the *respiratory mucous membrane*. It is changed to the form of nitric acid, and probably also as urea, and thus increases the amount of urea in the urine, while it tends to render the excretion acid as well as increasing its volume, the chloride of ammonium possessing these actions more fully. It increases the *bronchial secretion*, thus acting as an expectorant.

On the skin it has a diaphoretic effect, most marked in the acetate of ammonium.

On the Intestines.—Ammonia remotely increases the secretions of the intestinal glands, and, if given in large doses, will cause purgation.

The medicinal uses will be described under the heading of each preparation of ammonium.

Liquor Ammoniæ Fortior—Strong Solution of Ammonia, Spirits of Hartshorn.

Water containing 32·5 per cent. of gaseous ammonia.

Liquor Ammoniæ—Solution of Ammonia.

Water containing 10 per cent. of gaseous ammonia.

General Actions.—These possess the chief actions of ammonia.

The liq. ammoniæ fort. is a topical irritant, and unless largely diluted it causes violent irritation of the mouth, throat, and mucous membrane of the stomach. Mistakes have occasionally arisen in administering this preparation instead of the milder forms of ammonia.

Professor F. Smith, in experimenting with this drug, injected into the jugular vein of a mule half an ounce of the strong solution, followed shortly after by another half-ounce, with no apparent effect. Another half-ounce was injected, and in forty minutes from the first injection there were symptoms of colic manifested, the animal looking towards the sides, rolling, and pawing frequently. There was quivering of the muscles of the sides and flanks, and the animal made constant attempts, as if wishing to urinate. The symptoms became modified, and had disappeared next morning. It was destroyed, and there was found extensive phlebitis from the seat of injection to the chest, with discoloration of the muscles around the injection.

In cases where the strong solution of ammonia has been administered by mistake, the most effectual *antidotes* are dilute acids, such as vinegar, and a free allowance of demulcents and diluents.

Medicinal Uses.—The strong solution of ammonia is not used internally. The liquor ammoniæ is employed as a powerful stimulant in cases of narcotic poisoning in doses of from ʒss. to ℥i. for horses and cattle, and from ♏ xx. to ʒss. for dogs.

It is necessary here to state that all preparations of ammonia should be properly diluted with water before administration, or, better still, mixed with cold gruel or mucilaginous substances, so as to avoid the danger of irritating the mucous membrane of the mouth and throat.

The liq. ammoniæ fort. gives off strong fumes, which are occasionally used as an inhalation to overcome shock, or to act as a general stimulant in cases of narcotic poisoning in dogs.

The liquor ammoniæ is prescribed in cases of *tympanitis* in horses and cattle, neutralizing the gas present, acting as an antacid, and stimulating the stomach and intestines to healthy action.

Externally the strong solution of ammonia is largely employed in the form of liniments as a stimulant and mild counter-irritant in cases of rheumatic affections of muscles and joints, in laryngitis and pharyngitis; and to prevent fomented surfaces, such as the chest walls, becoming chilled; also as an application for the irritation caused by the stings of insects.

Ammonia should not be used strong enough to act as a vesicant, as its action is likely to leave a blemish on the skin if prolonged.

The following form convenient liniments for the purposes of mild counter-irritation:

℞ Liq. ammon. fort., ℥i.
Ol. terebinthæ, ℥i.
Ol. olivæ, ℥vi.
M. Ft. lin.

For dogs the following is a useful liniment in cases of strains, bruises, etc., also for muscular strains in horses after hot fomentations have been applied:

℞ Tr. arnicæ, ℥iv.
Tr. camphoræ, ℥iv.
Liq. ammon. fort., ℥ss.
Sapo mollis, ℥ii.
Aqua ad Oi.
M. Ft. lin.

Spiritus Ammoniæ Aromaticus—Aromatic Spirit of Ammonia, Sal Volatile.

Prepared by dissolving the strong solution of ammonia and the carbonate of ammonia in water and rectified spirit, in the proportion of four ounces of the carbonate and eight ounces of the liq. ammoniæ fort., to six pints of spirit and three pints of water, and flavouring with oil of nutmeg and oil of lemon.

Doses.—Horses and cattle, ℥ii. to ℥iv.; dogs, ʒss. to ʒi., repeated at intervals as required.

Medicinal Uses.—The aromatic spirit is a convenient preparation of ammonia.

As a carminative and reflex general stimulant we employ it in cases of dyspepsia, both in horses and dogs. It is also useful, in combination with other agents, such as the oil of turpentine, in cases of tympanitis, in both horses and cattle, administered in raw linseed-oil.

As an antacid it is prescribed in combination with other agents possessing this property, in the form of alkaline stomachic mixtures, administered after feeding.

As a general stimulant it is useful in cases of milk-fever in cows, where stimulant effects are indicated in the secondary stages.

The effects being transient, it is essential that the doses be repeated at intervals, and alcohol is often prescribed in addition, with advantage.

Similar remarks refer to the irritating effect of this preparation of ammonia on the mucous membrane of the mouth as of the liq. ammoniæ, it being necessary to have it properly diluted before administration.

Ammonii Carbonas—CARBONATE OF AMMONIA, SESQUICARBONATE OF AMMONIA.

Prepared by subliming a mixture of chloride of ammonium and carbonate of calcium.

Doses.—Horses, ʒii. to ℥ss.; cattle, ℥ss. to ℥i.; dogs, grs. iii. to grs. viii., either given in the form of bolus or dissolved in gruel, and repeated at intervals as required.

Medicinal Uses.—The carbonate being more permanent in its effects than the other preparations of ammonia, is preferred as *a stimulant* in certain respiratory and cardiac affections.

As an antacid and diffusible stimulant it is prescribed in cases of atonic dyspepsia, such as we meet with in cattle, manifested by recurring attacks of tympanitis. For this purpose it is combined with a vegetable tonic, such as gentian, and a carminative, such as ginger, and administered twice daily in warm ale.

As a stimulant expectorant it is indicated in cases of bronchitis, as it promotes bronchial secretion and expectoration, being especially useful when the secretion is thick and scanty in the secondary stages, and the heart's action weak, with general debility of the system. In addition it stimulates the heart and respiratory centre. For such purposes it is combined with camphor and chlorate of potash, and a bitter tonic such as gentian, and administered in the form of bolus twice daily.

As a stimulating emetic it is sometimes prescribed in canine practice, combined with ipecacuanha in cases of bronchitis.

Ammonii Chloridum—Chloride of Ammonium, Sal Ammoniac.

Prepared by neutralizing ammoniacal gas liquor with hydrochloric acid.

Doses.—Same as the carbonate.

Medicinal Uses.—*Internally.*—*As an expectorant* the chloride of ammonium is sometimes prescribed in the second stages of bronchitis, also in cases of chronic bronchitis.

As a cholagogue it acts directly on the liver, and is occasionally prescribed in cases of chronic torpidity of this organ, and also in chronic hepatitis.

Externally it is prescribed as a refrigerating lotion in combination with nitrate of potassium and chloride of sodium, dissolved in a proper proportion of water.

Liquor Ammonii Acetatis Fortior—STRONG SOLUTION OF ACETATE OF AMMONIUM.

Prepared by neutralizing carbonate of ammonium by acetic acid, and adding water.

Liquor Ammonii Acetatis—Mindererus' Spirit.

Prepared by adding one part of the strong solution of acetate of ammonium to five parts of water.

Doses of the Strong Solution.—Horses, ℥ii. to ℥iii.; dogs, ♏xx. to ʒi. Of the weaker solution twice or three times these doses are required. The strong solution is the best preparation for horses, taking up less bulk.

Medicinal Uses.—The acetate of ammonium acts as a *feeble stimulant* compared with other preparations of ammonia.

It is prescribed as a *diaphoretic*, *febrifuge*, and *a mild diuretic and expectorant* in febrile affections and acute respiratory disorders, and is generally combined with the spts. æth. nit., and a saline such as the nitrate of potash, and repeated at intervals of two or three hours. Its diaphoretic effect in the horse is aided by the use of warm clothing and a proper temperature of the surroundings, with frequent administration of the drug.

In the dog the acetate of ammonium acts as a diuretic instead of a diaphoretic, and is a useful agent in distemper and in catarrhal affections, being combined with other medicinal preparations as the circumstances of the case may indicate.

A useful febrifuge mixture for the dog is prepared with the acetate of ammonium, and the spts. æth. nit., while if there be irritation of the larynx or bronchii present, the tincture of camphor and chlorate of potash may be added with advantage. The effects of these diffusible stimulants being transient, it is necessary to prescribe them so as to have the doses repeated at stated intervals.

Ammonii Bromidum (see *Bromum*, p. 299).

4. CALCIUM AND ITS MEDICINAL SALTS.

Sources.—The chief sources are carbonate of lime, the native sulphate and bone-ash.

Calcii Hydras—Slaked Lime.

Prepared by slaking lime with water.

Preparations.

Liquor Calcis—Lime-water.

Prepared by shaking up slaked lime with distilled water and decanting. Each fluid ounce contains half a grain of lime.

LINIMENTUM CALCIS.

Prepared by mixing equal parts of lime-water and olive-oil. Also termed carron oil.

Actions and Uses.—*Externally* lime in the form of the hydrate is *caustic*, but is seldom used for this purpose; it attracts the water of the part, and combines with the albumen.

In the form of the *linimentum calcis* it is a valuable application to scalds and burns, and is often useful in cases of extensive eczema in dogs, with profuse weeping discharges, acting as an *astringent and desiccant.*

Internally the immediate local action is *antacid and astringent*, it being administered in the form of the liquor calcis.

In the stomach and intestines it combines with the free acids of the contents, and prevents the formation of coagulated masses of casein occurring in young animals, especially those artificially fed on milk, about one-fourth lime-water being added to the milk.

It also acts as a *general gastric sedative*, depressing the glands of the stomach, and is hence prescribed in cases of vomiting in dogs depending on a condition of acid dyspepsia, in the form of the *saccharated solution of lime*, which is prepared by digesting slaked lime and sugar in water, and decanting, in the proportion of an ounce of the former with two ounces of the latter to a pint of water, and administered in doses of from twenty to sixty minims mixed with milk.

On the intestines the *astringent* action is due partly to the antacid property, and partly to a sedative effect on the intestinal glands, and for this purpose the liquor calcis is administered in cases of diarrhœa in calves and lambs in doses of two ounces for the former, and half an ounce to one ounce for the latter, combined with tincture of gentian and ginger. Lime-water may be employed as an *antidote* for poisoning by the mineral acids and oxalic acid.

Creta Preparata—Prepared Chalk.

Prepared from the native carbonate of calcium by elutriation and drying.

Incompatibles.—All acids and sulphates.

Doses.—Horses, ℥i. to ℥ii.; cattle, ℥ii. to ℥iv.; sheep and pigs, ʒii. to ʒiv.; dogs, grs. x. to ʒi.

Actions and Uses.—Prepared chalk possesses all the actions of the liquor calcis just described, but it is less soluble, and retains its antacid properties for a longer period in the alimentary canal, thus being more efficacious as an *antacid* and *astringent* throughout the intestines.

It is prescribed in cases of diarrhœa, combined with other astringents, and is believed to soothe the irritable mucous membrane, and to leave a protecting film of the carbonate thereon.

In severe cases of diarrhœa in all patients it is combined with antispasmodics, such as opium or chlorodyne, with very beneficial effects. Attention, however, must be directed in such cases to ascertain, if possible, the *cause*, which, if depending on the presence of an irritant, will require appropriate treatment, as previously referred to.

Calx Chlorinata—Chlorinated Lime.

A compound directly of lime and chlorine.

Actions and Uses.—This compound is not used internally. Its chief use is as a *disinfectant* and *deodorizer*, producing its effects by decomposing substances such as ammonia, sulphuretted hydrogen, etc., being ultimately converted into the chloride of calcium. It also prevents the development of germs, and is employed for the purposes of disinfecting stables and cowsheds, shaken about as a dry powder; but other agents are more reliable, and not possessed of its disagreeable properties.

Calcii Phosphas—Phosphate of Calcium.

Prepared by dissolving bone-ash in hydrochloric acid, and adding water and solution of ammonia, is sometimes prescribed in cases of malnutrition and anæmia in young animals, also in cases of rickets, and other bone affections.

Calcii Hypophosphis (see *Phosphorus*, p. 276).

Calx Sulphurata (see *Sulphur*, p. 302).

5. MAGNESIUM AND ITS MEDICINAL SALTS.

Source.—All the medicinal preparations are derived directly or indirectly from the sulphate of magnesia, which itself is prepared from magnesian limestone or dolomite, by solution in sulphuric acid and purification.

Magnesii Sulphas—SULPHATE OF MAGNESIA, EPSOM SALT.

Incompatibles.—Alkaline carbonates, lime-water.

Doses.—*As a purgative for cattle:* Adults, lb. i.; calves, two or three months old, ℥iii. to ℥iv.; sheep and pigs, ℥iv.

It is given dissolved in ten to fifteen parts of warm water, with a carminative such as an ounce or two of powdered ginger, and a pound of treacle, which both assists the purgative action and also conceals the nauseous taste. The chloride of sodium is combined with the sulphate of magnesia by some practitioners in half doses of each.

As a febrifuge and alterative ℥i. to ℥ii. is prescribed for *horses*, generally combined with the nitrate of potash; for *cattle*, ℥ii. to ℥iv.

General Actions.—Given in sufficient amount the sulphate of magnesia acts as a saline hydragogue cathartic, causing little stimulation of the muscular coat of the intestines.

In the stomach it is slowly absorbed, the chief action being in the intestines.

In the intestines it has a low diffusing power, is slowly absorbed, and produces its characteristic hydragogue action in three ways:

(1) It causes an increased flow of fluid from the blood into the intestinal canal.

(2) It retards the absorption of the fluid present in the canal.

(3) It stimulates the intestinal glands, and causes great increase of the intestinal secretions.

The total result is the free evacuation of a large quantity of fluid by the intestines; there being also a slight amount of increased peristalsis, the major portion of the drug is removed by the intestine, and thus excreted, a certain amount being carried off by the kidneys.

As a purgative, it is more rapid iu its action in cattle than sulphate of soda. In small doses sulphate of magnesia is likely to be retained longer in the intestines, being then absorbed into the blood, and excreted chiefly by the kidneys, causing more or less *diuresis*, rendering the urine more alkaline, and dissolving uric acid.

On the Liver.—According to the results of experiments, the sulphate of magnesia does not directly increase the flow of bile, thus differing from the sulphate of soda, which is a direct cholagogue. It has, however, a beneficial action in clearing away unabsorbed bile in the duodenum, and thus preventing its reabsorption.

Medicinal Uses.—*As a purgative* the sulphate of magnesia is not used in the horse, as its action in this animal is uncertain, sometimes causing violent purgation, and at other times causing considerable diuresis. In the dog, the purgative effect is irregular, and its nauseous bitter taste is apt to induce vomition in this animal.

For ruminants, however, experience proves that it is a very valuable purgative, generally acting in from twelve to fifteen hours, and is prescribed in the manner already mentioned.

It is necessary to remark, however, that the practice of administering large and repeated doses of this drug to cattle is irrational, and productive of injurious results when the cause of the loss of intestinal action is due to a paralyzed condition of the intestinal walls, or to gastric inflammation. In such instances we find the result to be a tympanitic state of the alimentary canal, with great depression of the system, effects which tend to aggravate the already existing condition. If a dose of proper strength does not succeed after a reasonable time, then we should prescribe oleaginous aperients, and adopt a line of treatment best calculated to overcome the cause of the arrested action of the intestines.

As a febrifuge and alterative the sulphate of magnesia is a very useful therapeutic agent in all patients. It improves the appetite, maintains a healthy action of the bowels, removes excrementitious matters from the blood, lessens abnormal temperature, and is prescribed in febrile affections, combined with other salines, such as the nitrate of potash, given dissolved in the drinking-water, and left in the stall convenient to the patient, so that he can drink at pleasure.

Two ounces of sulphate of magnesia and half an ounce of nitrate of potash, given twice daily in this manner, prove very useful in cases of influenza and acute respiratory affections.

In atonic torpidity of the bowels in cattle, two or three ounces of sulphate of magnesia, with one drachm of powdered nux vomica and one ounce of powdered gentian, administered twice daily, forms a very useful prescription.

As a diuretic it is prescribed in small doses in chronic affections of the kidneys, and in cases of dropsical effusions.

As an antidote to poisoning by salts of lead, the sulphate of magnesia is very effectual, converting them into insoluble sulphates, and also promoting the action of the bowels, which are apt to lose their tone as a result of the toxic agent.

Magnesii Carbonas Ponderosa—HEAVY CARBONATE OF MAGNESIA.

Magnesii Carbonas Levis — LIGHT CARBONATE OF MAGNESIA.

Preparation.—These two salts only differ as regards their physical properties. Both are prepared by mixing solutions of sulphate of magnesia and carbonate of sodium. In the case of the former salt the solutions are mixed when *boiling*, in the latter *cold dilute solutions* of both are employed.

Actions and Uses.—The carbonates of magnesia neutralize excessive acidity of the stomach and intestines, forming salts which have a laxative action, and yielding carbonic acid. They increase the alkalinity of the blood, and are prescribed as *laxative antacids* in cases of acidity and flatulence in foals, calves, and dogs, given with the spts. ammon. aromat. between the hours of feeding, in doses of from ʒii. to ℥ss. for foals and calves, and grs. x. to ʒss. for dogs.

As antidotes for the mineral acids, oxalic acid, mercurial, arsenical and copper salts, they form comparatively insoluble or innocuous compounds, and in large quantities prevent the absorption of alkaloids by rendering the contents of the stomach alkaline.

CHAPTER III.

INORGANIC MATERIA MEDICA—*Continued.*

GROUP II.—THE METALS.

For convenience of description, according to their actions and uses, we may subdivide the metallic elements into sub-groups as follows :

1. **Plumbum ; Argentum ; Zincum ; Cuprum ; Aluminium.**
2. **Ferrum.**
3. **Hydrargyrum.**
4. **Arsenium ; Antimonium ; Bismuthum ; Phosphorus.**

(Phosphorus is a non-metallic element, but is included under this heading because of a similarity in its actions to antimony and arsenic.)

Sub-Group I.

PLUMBUM—LEAD, AND ITS MEDICINAL SALTS.

GENERAL ACTIONS OF LEAD SALTS.

(1) IMMEDIATE LOCAL ACTION.

Externally the salts of lead possess certain definite actions of importance to the therapeutist.

Applied to wounds or exposed mucous surfaces, the following phenomena occur :

(*a*) They precipitate the albumen in the fluids found either covering the surface or flowing as a discharge.

(*b*) They coagulate the protoplasm of the young cells of the superficial layers of the part.

(*c*) They act on the local circulation of the part, causing active contraction of the small arteries and veins, diminishing the blood-flow, and preventing the escape of plasma and blood-cells through the walls of the vessels.

(*d*) They depress the local nerve endings in the part.

The total effects of these actions are, *astringent*, *sedative*, and *desiccant*.

Internally they act as *astringents* on the mucous membrane of the mouth and throat.

In the stomach and intestines the secretions are diminished, the vessels contracted, and the peristaltic movements retarded, the salt being converted into an albuminate.

(2) ACTION ON THE BLOOD.

Lead salts are absorbed as albuminates; they pass rapidly through the blood, and if administered for some time are said to render the vital fluid more watery, and to diminish the number of red corpuscles.

(3) SPECIFIC ACTION.

Lead is taken up by the tissues freely from the blood, and retained firmly in the form of an albuminate, chiefly by the liver and kidneys, also by the central nervous system, and in the bones. Certain **toxic effects** are produced as a result of the presence of lead in the tissues, the condition being termed *plumbism*.

The chief symptoms of this condition are dyspepsia, constipation, colicky pains, cramps of the muscles, especially the extensors, terminating in paralysis; the pulse is full, tense and infrequent, the blood-pressure raised, the urinary excretion disturbed, the central nervous system is first irritated, evidenced by convulsions, and succeeded by paralysis. The appearance of a blue line at the edges of the gums is often observed.

Whether the effects produced are due to the irritant action of lead on the involuntary muscular tissue of the alimentary canal and bloodvessels, or to its primary action on the central nervous system and nerves, and secondarily on the muscles, bloodvessels, etc., is a question on which authorities are not agreed.

(4) REMOTE LOCAL ACTION.

Lead is slowly excreted by the kidneys, liver, skin, and milk. In the intestine the portion which is excreted by the liver is reabsorbed, again excreted, and is finally removed from the body in the form of the black sulphide of lead.

Antidotes to Lead Salts.—In cases of acute poisoning in dogs, emetics should be administered. In chronic poisoning, sulphate of magnesia or potassium iodide convert the lead in the system into insoluble salts, and should be prescribed daily at intervals, the use of occasional doses of linseed-oil hastening their removal from the system.

Plumbi Oxidum—Oxide of Lead, Litharge.

Prepared by roasting lead in a current of air.

Medicinal Uses.—The oxide of lead is not prescribed internally.

Externally it is used in the form of the oleate of lead, or lead plaster, prepared by combining it with olive-oil and water.

This plaster is employed for the purpose of bringing the edges of small wounds together, or for giving support to sutures in the case of extensive wounds.

The oxide of lead is sometimes used locally as a *desiccant* and *astringent.*

Plumbi Acetas—ACETATE OF LEAD, SUGAR OF LEAD.

Prepared by heating oxide of lead in acetic acid and water.

Doses.—Horses and cattle, ʒss. to ʒi.; dogs, gr. i. to grs. iv.

Liquor Plumbi Subacetatis—GOULARD EXTRACT.

Prepared by boiling together acetate of lead 5 parts, oxide of lead $3\frac{1}{2}$ parts, and water 20 parts, filtering, and adding water.

Incompatibles.—All vegetable astringents, preparations of opium, alkalies, lime-water, iodide of potassium.

Medicinal Uses—*Internally* the acetate of lead is prescribed as a powerful *hæmostatic* to check hæmorrhage from the stomach and intestines, and also from the lungs.

As an astringent it is prescribed in cases of obstinate diarrhœa and dysentery, being usually combined with opium, its beneficial effects in this respect being referable to its local action on the alimentary canal.

Externally the acetates of lead are extensively employed as astringents and local sedatives. Goulard's extract is preferred for external application, being more soluble, and not crystallizing.

In cases of eczema in dogs, with raw surface, copious weeping and intense irritation, the careful use of a lotion consisting of liq. plumbi diacetatis, ℥ii., glycerinum, ℥ii., aqua, ℥iv., is often productive of benefit; but it is necessary to be aware of the danger of the animal licking the parts.

In cases of *mud fever* and *grease* in horses, a liniment consisting of the liquor plumbi subacetatis with glycerine and olive-oil, in the proportion of one to four parts, is a very useful application.

In strains, superficial inflammations, etc., the acetate of lead mixed with spirits and water forms a refrigerating astringent lotion.

It is sometimes prescribed as a lotion in catarrhal inflammations of the eye, but is contra-indicated when there is any abrasion of the cornea present, as tending to form an insoluble lead albuminate, causing an opacity difficult to eradicate.

Solutions mixed with the tincture of opium, although chemically incompatible, form useful lotions in cases of bruises, contusions, etc. A weak lotion of the same is of benefit in the first stages of *canker* in the ears of dogs.

Acetate of lead and sulphate of zinc, dissolved in water, in the proportion of 1 part of the former and $\frac{3}{4}$ part of the latter to 30 of water, forms the time-honoured *White Lotion*, so extensively used in veterinary practice.

This preparation is chemically incompatible, acetate of zinc being formed in solution, and sulphate of lead being thrown down as a precipitate; but experience proves it to be a valuable astringent, cooling lotion in cases of collar and saddle-galls, irritated surfaces, unhealthy wounds, ulcers, etc.

Plumbi Carbonas—Carbonate of Lead, White Lead.

Prepared by exposing lead to the vapour of acetic acid, and simultaneously to air charged with carbonic acid.

Medicinal Uses.—It is not used internally. Externally, it is occasionally employed as an *astringent* and *desiccant*.

Mixed with linseed-oil it makes a valuable application in cases of burns, and also in local blood-poisoning the result of septic matter entering a wound. Painted on, it forms a protective covering, and diminishes the extreme pain existing in the part, by depressing the nerve endings.

Plumbi Iodidum—Iodide of Lead.

Prepared by mixing solutions of nitrate of lead and iodide of potassium, and drying the precipitate.

Medicinal Uses.—In the form of an ointment (1 to 7) the iodide of lead is sometimes used as an absorbent application to enlarged joints, glandular swellings, etc., the effects being referable to the iodine, probably assisted by the lead.

ARGENTUM—SILVER.

The salt of silver used in veterinary practice is the nitrate.

Argenti Nitras—Nitrate of Silver, Lunar Caustic.

Prepared by dissolving silver in dilute nitric acid.

General Actions.—*Externally* the nitrate of silver acts as a caustic when applied in the solid form or in strong solution.

Solutions of a moderate strength, when applied to the broken skin or a mucous membrane, form an albuminate which coats the surface with a thin layer, also coagulating the protoplasm of the young cells.

The arteries, veins and capillaries of the part are actively contracted, and in animals with skins of a light colour the superficial layers are stained black, being previously of an opaque white at the point of application.

Internally the nitrate of silver combines with the albuminous fluids and chlorides in the mouth, and when properly diluted acts as an *astringent.*

In the *stomach*, in medicinal doses, it is decomposed by the acid present. It enters the blood in the form of an albuminate, being slowly absorbed, and retained in the metallic form in all the connective tissues, staining exposed parts of a permanent blackish-brown colour.

Toxic doses cause irritation of the stomach and intestines, with prostration, convulsions, and paralysis, these latter effects being probably central in origin. The best *antidote* is common salt, which forms the insoluble and inert chloride of silver.

Medicinal Uses.—As a *tonic and astringent* it is sometimes prescribed in canine practice, in chronic nervous diseases, or in chronic diarrhœa and dysentery, in doses of $\frac{1}{6}$ to $\frac{1}{3}$ grain in pills.

Externally it is the *caustic* most universally employed, as its effects are limited to the area of application, and it is less irritating than others.

As a *stimulant* to indolent wounds and ulcers the nitrate of silver is very useful, promoting healthy growth, and suppressing excessive granulations, besides forming a protecting covering to the part.

In *conjunctivitis* a solution of the nitrate of silver containing from half a grain to two grains to the ounce is very useful; a few drops inserted into the eye three times daily promotes a healthier action in the membrane, and relieves irritation.

In *opacity of the cornea* a solution containing four to six grains to the ounce of distilled water, carefully applied daily with a camel's-hair brush, often succeeds in rendering the part clear.

It is recommended in *erysipelas*, applied two or three times to the inflamed surface, and extending a few inches beyond it, in the form of a strong solution containing 80 grains to 4 drachms of water.

In cases of *chronic inflammation of the larynx and pharynx*, sometimes met with in dogs, a solution of the nitrate of silver applied to the part by means of a probang or brush produces beneficial results.

The best *solvent* for the nitrate of silver is nitrous ether, as this dissolves the fatty matters of the skin, and enables the solution to produce a uniform action over the surface, instead of running into drops. This solution acts much more strongly than an aqueous one, and hence requires to be made of less strength.

ZINCUM—ZINC, AND ITS MEDICINAL SALTS.

General Incompatibles of Zinc Salts.—Alkalies and their carbonates, lime-water, acetate of lead, nitrate of silver, astringent vegetable preparations.

GENERAL ACTIONS OF ZINC SALTS.

(1) IMMEDIATE LOCAL ACTION.

The salts of zinc resemble those of lead, silver, and copper in their local actions; they act as *caustics* in their stronger forms, and as *astringents* in their weaker forms.

The difference in degree of the actious of zinc salts depends on their diffusion-power and affinity for water, and on their solubility. Thus, the chloride of zinc acts as a *caustic*, applied in sufficient strength locally, while the sulphate acts as an *astringent* and *stimulant*.

Internally the effect of zinc on the stomach is that of a *local irritant*, acting as a *direct emetic*, in those animals capable of the act of vomition. In the intestines, in large doses, zinc acts as an *irritant*, but in medicinal doses it has an *astringent* effect.

(2) ACTION ON THE BLOOD, AND SPECIFIC ACTION.

Zinc is slowly absorbed, probably as an albuminate. We possess no knowledge concerning its action on the plasma or corpuscles which is of any therapeutical value.

In the tissues of the body it does not become fixed, but acts as a *direct depressant to the nerve-centres* when administered in continued doses.

(3) REMOTE LOCAL ACTION.

Zinc is excreted by the kidneys in small quantities, also by the mucous surfaces and skin.

It produces a *remote astringent* effect on those parts by which it leaves the system.

Zinci Oxidum—Oxide of Zinc.

Prepared by heating the carbonate.

Medicinal Uses.—The oxide of zinc is *astringent* and *desiccant*, and is used in cases of eczema in which there is a raw indolent surface, either in the form of a dusting powder or as an ointment.

It is also useful in mild cases of grease and cracked heels, in the form of unguentum zinci, prepared with the oxide of zinc 1 part, benzoated lard $5\frac{1}{2}$ parts.

A similar ointment is also prescribed in cases of canker of the ear in dogs.

Zinci Carbonas—Carbonate of Zinc, Calamine—is similar in its actions and uses to the oxide.

Zinci Sulphas—Sulphate of Zinc, White Vitriol.

Prepared by the action of dilute sulphuric acid on granulated zinc.

Doses.—As an astringent and tonic: horses, ʒss. to ʒi.; dogs, gr. i. to grs. iii.

As an emetic for dogs, grs. x. to grs. xxx. dissolved in two ounces of warm water.

Medicinal Uses.—*As an emetic* the sulphate of zinc is safe, prompt, and effectual for the different purposes for which emetics are indicated. It acts with little prostration or nausea, producing its effect by its local irritant action on the stomach, thus being a *direct emetic.*

It is sometimes prescribed as a *tonic* and *astringent*, but is inferior to other drugs in these respects.

In nervous affections, such as chorea, epilepsy, etc., it is prescribed in canine practice, often with beneficial results, the doses being gradually increased.

Externally the sulphate of zinc is very useful as a *stimulant* and *astringent* application in cases of ulcers, unhealthy wounds, etc., limiting the amount of discharge, checking excessive weak granulations, and promoting a tendency to reparative action. For these purposes it is dissolved in 30 to 60 parts of water.

In inflamed conditions of the conjunctiva, after the acute stage has passed, a weak solution of the sulphate of zinc dropped into the eye a few times daily often proves of service.

As an astringent injection it is prescribed in cases of discharges, either acute or chronic, from the genito-urinary passages, such as leucorrhœa.

Combined with the acetate of lead in solution, it forms the white lotion of Professor Dick.

Zinci Acetas, which is the active constituent of this lotion, resembles in its actions the sulphate of zinc, but is seldom used as a separate agent.

Zinci Chloridum—Chloride of Zinc.

Prepared by the action of hydrochloric acid on granulated zinc.

Medicinal Uses.—The chloride of zinc is not given internally.

Externally, applied without dilution, it is a powerful *caustic*, possessing great affinity for water, and coagulating albumin. It is sometimes employed as an application to unhealthy ulcerations, fistulas, etc. It is a powerful *antiseptic* and *disinfectant*, and even in dilute solution is a poison to low forms of life. Burnett's disinfectant contains 25 grains of chloride of zinc to each fluid drachm.

CUPRUM—COPPER.

The salt of copper employed in veterinary practice is the sulphate.

Cupri Sulphas—Cupric Sulphate, Sulphate of Copper, Blue Stone, Blue Vitriol.

Prepared by heating copper with sulphuric acid.

Incompatibles.—Alkalies and their carbonates, lime-water, mineral salts (except sulphates), iodides, and most vegetable astringents.

General Actions.—The actions of copper resemble those of zinc and silver.

Externally it produces no effect on the unbroken skin, and is not absorbed therefrom. Applied to wounds, ulcers, and delicate mucous membranes freely, it acts as a *caustic.*

It unites with soluble albuminous substances on the surface, forming insoluble albuminates, condenses the structures, and constringes the bloodvessels, and hence is an *astringent* in solutions of moderate strength.

Internally, in large doses, it acts as a *direct emetic* in the dog; in toxic doses it is an *irritant poison,* causing gastro-enteritis, etc.

In the intestines, given in medicinal doses, it has an *astringent* effect. Sulphate of copper is slowly absorbed, and is supposed to possess some tonic effect on the nutrition of the central nervous system. It is excreted by the liver chiefly, also in the urine and saliva.

In poisoning by sulphate of copper, the *suitable antidotes* are albuminous substances, such as white of egg, milk, etc., which form insoluble albuminates with the salt.

Medicinal Uses.—*As an emetic* the sulphate of copper is sometimes prescribed in canine practice, in doses of from grs. vi. to grs. x., for acting quickly in cases of narcotic poisons; but a more reliable agent is found in the hypodermic injection of apomorphine. As a *tonic* and *astringent* it is occasionally prescribed in doses of ʒi. for horses, and gr. $\frac{1}{4}$ to grs. ii. for dogs. It is an *antidote* to phosphorus-poisoning by combining with the element, and rendering it inert.

Externally the sulphate of copper is extensively employed as a *stimulant, astringent,* and *mild caustic,* in cases of exuberant granulations, unhealthy surfaces, ulcers, etc.

It, however, possesses no advantages over the nitrate of silver for such purposes, and the latter agent is preferred by many practitioners.

It is a valuable *stimulant* and *astringent* in certain affections of the feet of horses, such as canker, etc., and is recommended as a dressing, combined with the sulphate of zinc and iron. As an injection for cases of *quittor* the following, known as 'Villate's Injection,' is recommended by Professor Macqueen: Cupri sulph., ℥ii.; zinci sulph., ℥ii.; acid. acet. dil., ℥xxxv.; liq. plumbi diacet., ℥iv.

In cases of *foot-rot* in sheep, the sulphate of copper is also a useful application in combination with other agents, such as tarry substances, etc.

ALUMINIUM.

The most important salt of this metal is **alumen**, or **alum.**

Alumen—Alum, Aluminium and Potassium Sulphate.

Prepared from alum schist and sulphate of potassium.

Incompatibles.—Alkalies, lime, acetate of lead, mercury, and substances containing tannin.

General Actions.—*Externally.*—Alum locally applied is *astringent* and *styptic;* it absorbs water, and if the skin be broken acts as a *mild caustic.* It coagulates albumin, condenses the tissues, and constringes the bloodvessels.

Internally it causes dryness of the pharynx by coagulating the mucous secretions of the part, producing a similar effect on the mucous membrane of the stomach and intestines. In large doses it is *emetic*, *irritant*, and *purgative.* It is absorbed into the blood as an albuminate, and is excreted chiefly by the kidneys.

Medicinal Uses.—The chief use of alum is as a *topical astringent*, in the form of a lotion, for aphthous ulcerated conditions of the mouth; it is also applied in the form of dry powder to indolent surfaces with exuberant granulations. It is sometimes prescribed internally in cases of hæmorrhage from the kidneys, with the idea that during its excretion the form of albuminate is redissolved, and that the salt will have a styptic effect.

Alum is frequently administered to cows to arrest the secretion of milk, when it is desired to stall-feed them.

In cases of emergency alum may be employed in strong solution as a *styptic*.

SUB-GROUP II.

FERRUM—IRON AND ITS MEDICINAL SALTS.

(1) IMMEDIATE LOCAL ACTION.

Externally the soluble preparations of iron, such as the persalts, act as *astringents* and *constringents* when applied to the broken skin or to mucous surfaces. They coagulate the albuminous tissues and the blood, contract the bloodvessels of the part by compressing the tissues, and thus act as *hæmostatics* or *styptics*.

Internally the salts of iron have an *astringent* effect on the mucous membrane of the mouth and contiguous parts. *In the stomach* all the salts are converted into the chloride, thus differing from those of some other metals which combine with the acid albuminates. If the agent be administered in excess, or if the organ be empty, the digestive fluid is decomposed, and the iron acts as an *irritant* and *astringent* to the mucous membrane.

In the duodenum iron is converted into an alkaline albuminate, and is absorbed in this form, the unabsorbed portion being excreted as the sulphide.

(2) ACTION ON THE BLOOD.

The preparations of iron have important effects *on* the blood, acting on the red corpuscles, increasing their number, and the amount of hæmoglobin present, being combined with the latter. Iron enters the circulation very slowly, being absorbed along the alimentary canal as the chloride and alkaline albuminate.

There is a difference of opinion among authorities as to the manner in which iron is absorbed into the blood. Evidently but a small amount is absorbed, as a large proportion is excreted with the fæces, and if it is injected into the blood much of it passes away in the urine.

As the result of experiments, it is stated that in health iron does not increase the number of red corpuscles, but that it does produce this effect in cases of anæmia. According to Dr. Wood, iron increases the ozonizing power of the red corpuscles, and is also a stimulant to the source which produces them, thus acting as a *hæmatinic* or *blood tonic*.

(3) SPECIFIC ACTION.

The specific action of iron is on the red corpuscles of the blood, and it is said that the temperature is slightly raised as the result of the increased oxidation.

(4) REMOTE LOCAL ACTION.

Iron is excreted chiefly by the whole length of the intestines, also by the liver, kidneys, skin, and saliva, and the various mucous surfaces. It possesses remote *astringent* effects, which are of importance.

On the Bowels.—It causes constipation; certain salts, such as the perchloride, having greater astringent effects than others. It gives a characteristic black appearance to the fæces, due to the conversion of the metal into the sulphide and tannate, resulting from the action of the food and sulphuretted hydrogen of the intestines.

On the Kidneys.—It is excreted by the cells, not by the glomeruli; it reduces the volume of urine, but increases the amount of urea and other solids, and the acidity of the excretion. It acts as a *remote astringent* to the mucous surfaces, and as a hæmostatic.

Incompatibles of Preparations of Iron.—Alkalies and their carbonates, lime-water, magnesia and its carbonate, tannic and gallic acids, all astringent infusions, such as those of digitalis, cinchona, etc.

GENERAL VIEW OF THE DIFFERENT PREPARATIONS OF IRON.

For convenience of description we may classify the preparations of iron as follows:

1. Those possessing the Hæmatinic Actions of Iron, with but little Astringency.

Examples.—*The oxides and carbonates*, comprising ferrum redactum, ferri carbonas saccharata, liquor ferri dialysatus, ferri peroxidum hydratum.

All these preparations possess the hæmatinic action of iron, with but little astringency, and are hence employed in cases where we wish to avoid an astringent effect on the bowels, or any tendency to interfere with the process of digestion. The question of the solubility in water of an iron salt is not one of importance as regards absorption, as the solid preparations become soluble in the stomach.

Ferrum Redactum—Reduced Iron, Metallic Iron, with a variable amount of Oxide.

Prepared by adding a dilute solution of ammonia to a dilute solution of the perchloride, drying the precipitate, and exposing it at a white heat to the action of hydrogen.

Medicinal Uses.—This preparation is the least astringent of the iron salts, and is employed in canine practice in cases of anæmia in delicate dogs, and in convalescence from debilitating affections, in doses of from 2 grains to 5 grains. It does not derange digestion or cause constipation, and is administered in the form of pills twice daily.

Ferri Carbonas Saccharata—Saccharated Carbonate of Iron.

Prepared by adding a solution of carbonate of ammonium to one of sulphate of iron, and rubbing the precipitate with sugar. The sugar prevents the oxidation of the carbonate.

Medicinal Uses.—This is also a mild preparation of iron, and is prescribed in canine practice in doses of from 5 grains to 20 grains in the form of pills.

Liquor Ferri Dialysatus—Solution of Dialysed Iron.

Prepared by dissolving ferric hydrate, freshly prepared, in a strong solution of the perchloride of iron, and washing with water in a dialyser to remove acidulous matter. 100 grains contain 5 grains of iron.

Doses.—Horses, ℥ss. to ℥i.; dogs, ♏x. to ♏xxx.

Medicinal Uses.—This is a very useful preparation of iron, and is extensively employed as a *general tonic*, combined with quinine. It does not produce the irritating or astringent effects of the sulphate of iron, and can be prescribed in cases where the latter would be inadmissible.

Ferri Peroxidum Hydratum—PEROXIDE OR SESQUIOXIDE OF IRON.

Prepared by precipitating a diluted solution of the persulphate of iron with solution of soda and drying.

Medicinal Uses.—The chief use of this salt is as an antidote to poisoning by arsenic. It should be freshly prepared in a soluble form, and in cases of emergency is best made by mixing three ounces of the solution of perchloride of iron with oue ounce of carbonate of soda, or with solution of ammonia, if the latter is not at hand. It converts the arsenious acid into an insoluble compound, which is a basic arsenite of variable constitution. As it requires twelve parts to neutralize one of arsenious acid, the preparation should be administered in large amounts every five or ten minutes, such as half-ounce doses to the dog and an indefinite quantity to the horse, followed up by doses of magnesia.

2. Preparations of Iron characterized by their Corrugating and Astringent Action.

These comprise the compounds with the mineral acids, such as the sulphate of iron and the liquor ferri perchloridi with its medicinal preparations.

Ferri Sulphas—SULPHATE OF IRON, FERROUS SULPHATE, GREEN VITRIOL, COPPERAS.

Prepared by dissolving iron wire in sulphuric acid and water, crystallizing, and drying.

Ferri Sulphas Exsiccata.

Prepared by heating the sulphate to 212° Fah., removing six-sevenths of its water and powdering; $2\frac{1}{2}$ grains are equal to about 4 grains of the crystalline sulphate.

Doses.—Horses, ʒss. to ʒii.; cattle, ʒi. to ℥iv.; dogs, gr. i. to grs. v. repeated twice daily.

The dried sulphate is prescribed in half the above doses, and is preferred in consequence of its convenient form for dispensing.

Medicinal Uses.—This salt is extensively employed in veterinary practice as a *mineral tonic*, but, in consequence of its astringency and liability to irritate the gastric mucous membrane, certain precautions are necessary in prescribing it, and these will also apply to the preparations of the perchloride presently to be noticed:

(1) That moderate doses should be given, so as not to disorder digestion.

(2) That these preparations should not be employed when gastric derangement is present.

(3) That they must be prescribed either along with the food, or administered after feeding.

(4) That it is of advantage to combine them with laxatives, such as small doses of sulphate of magnesia or sulphate of soda, in order to avoid their constipating effects.

The sulphate of iron is prescribed as a *general tonic* in *nasal gleet* accompanied by a debilitated condition of the system, being combined with arsenic and bitter tonics, such as nux vomica, in such cases. It is believed to act as a *vermicide*, and is hence employed for the destruction of intestinal parasites in combination with other remedies.

It is also prescribed in cases of *diabetes insipidus*, in combination with the iodide of potassium and gentian. As a *hæmatinic* it is useful in cases of purpura hæmorrhagica, combined with the chlorate of potash.

In convalescence from debilitating affections, such as influenza, it is prescribed with vegetable tonics, but we often find that the bland forms of iron succeed better in cases of this kind, such as dialysed iron, combined with quinine. In canine practice the milder forms of iron are preferred, such as the saccharated carbonate.

Externally the sulphate of iron is used as an astringent preparation in combination with other astringents of a similar nature, as previously mentioned. It also acts as a disinfectant, and mixed with sulphates of lime and alumina, it forms Tuson's Disinfectant Powder, which gives off, when moistened, *sulphurous anhydride*.

Liquor Ferri Perchloridi Fortior—Strong Solution of Perchloride of Iron.

Prepared by dissolving iron wire in hydrochloric acid and water, adding hydrochloric acid, pouring into nitric acid, evaporating, and diluting.

(*a*) **Liquor Ferri Perchloridi**—Medicinal Solution of Perchloride of Iron.

Prepared by adding one part of the strong solution to three of water.

Doses.—Horses and cattle, ℥ss. to ʒi.; dogs, ♏v. to ♏xx, given properly diluted.

(*b*) **Tinctura Ferri Perchloridi**—Tincture of Perchloride of Iron, Tincture of Steel.

Prepared by mixing one part of the strong solution with one of spirit and two of water.

Doses.—Same as the medicinal solution of the perchloride.

Medicinal Uses.—The strong solution of the perchloride is not used internally, but externally acts as a powerful *styptic*. It possesses, however, a very corrosive action on the tissues, and is hence only to be employed in cases of severe hæmorrhage, such as may occur in wounds of the feet, etc., where its action will not be productive of serious damage to the parts.

The medicinal solutions of the perchloride and the tincture are extensively employed as *hæmatinics* and *general tonics*. In consequence of their irritant and astringent actions, they must be given properly diluted and in suitable doses, so as not to irritate the mouth, interfere with digestion, or cause constipation of the bowels. Some horses possess individual peculiarities to the action of astringent preparations of iron, which even in moderate doses cause interference with digestion. In such cases the milder preparations should be employed.

In cases of *purpura*, the preparations of the perchloride produce beneficial results, and are prescribed with the chlorate of potash or the oil of turpentine.

In cases of hæmorrhage from the stomach, bowels, kidneys or bladder, the preparations of the perchloride are prescribed with benefit as astringents.

In cases of *erysipelas*, frequently repeated doses of the perchloride are highly recommended.

In *anæmic, debilitated patients*, with a relaxed condition of the mucous membrane of the alimentary canal, moderate doses of the perchloride, judiciously administered, are useful in producing a tonic effect on this membrane, besides improving the quality of the blood and exerting a beneficial influence on the tissues.

In cases of *chronic affections of the kidneys* the preparations of the perchloride are sometimes prescribed as chalybeate diuretics, also in cases of hæmorrhage from the kidneys or bladder, and as remote astringents in cases of chronic discharges from the genito-urinary mucous membrane, such as leucorrhœa.

Externally the chief use of the perchloride is as a powerful *styptic*. It contracts the bloodvessels and condenses the tissues, besides causing the blood to form a firm clot on the surface of the wound. In consequence of its corrugating and irritant action on wounds, it should not be used except in cases where the hæmorrhage cannot be otherwise arrested.

In cases of flooding of the uterus after delivery, the injection of a solution of the perchloride is highly recommended in the proportion of four ounces of the medicinal preparation to twelve ounces of water, which is to be slowly injected into the uterus with a long tube, a free outlet of the fluid being allowed, and the introduction of air avoided.

3. Compounds of Iron with Other Active Bodies.

These include ferri iodidum, ferri arsenias, ferri phosphas, and ferri et quininæ citratis.

These preparations are intended to combine the hæmatinic and tonic properties of iron with the specific action of the constituents with which they are combined.

Ferri Iodidum—Iodide of Iron.

Prepared from iodine, iron wire, and distilled water, heated together; the solution, being filtered and evaporated, is prescribed in cases of *diabetes insipidus* in horses, also in *nasal gleet*, in glandular enlargements, and as a *general tonic* in the treatment of scrofulous diseases.

Doses.—Same as the sulphate.

Ferri Arsenias—Arseniate of Iron.

Prepared by mixing arseniate of sodium, sulphate of iron, and bicarbonate of sodium together.

This preparation is sometimes prescribed in treating certain forms of skin affections, such as psoriasis, chronic eczema, etc., in doses of grs. v. to grs. x. for horses, and $\frac{1}{16}$ to $\frac{1}{2}$ gr. for dogs.

Ferri Phosphas—Phosphate of Iron.

Prepared from phosphate of sodium, sulphate of iron, and bicarbonate of sodium.

This salt is chiefly used in canine practice, in cases of rickets, and also in dogs recovering from distemper and other debilitating affections, in doses of from grs. iv. to grs. viii. It is conveniently administered in the form of Parrish's Syrupus Ferri Phosphatis Comp., which contains in each drachm $\frac{1}{2}$ grain of phosphate of iron and $\frac{4}{5}$ grain of phosphate of calcium, with small amounts of the phosphates of potassium and sodium.

Easton's syrup is also a useful preparation, consisting of 1 grain of phosphate of iron, 1 grain of phosphate of quinine, and $\frac{1}{32}$ grain of strychnine in each fluid drachm, this quantity being the average dose for the dog, repeated twice daily.

Ferri et Quininæ Citras—Citrate of Iron and Quinine.

A preparation of citrate of iron and quinine, containing 16 per cent. of quinine, is prescribed in canine practice, in doses of from grs. iv. to grs. x.; as a general tonic it combines the actions of both agents.

Sub-Group III.

HYDRARGYRUM—MERCURY.

All salts and preparations of mercury are derived directly or indirectly from the metal itself.

GENERAL ACTIONS.

(1) IMMEDIATE LOCAL ACTION.

Externally.—Most preparations of mercury have but little action on the unbroken skin unless applied for some time, but certain salts possess marked *caustic* and *counter-irritant* properties, such as the solution of the nitrate and the biniodide; all are capable of absorption from the skin. On mucous surfaces and on abraded tissues there are, however, definite effects produced, depending on the preparation employed. Thus, some, such as the red oxide, the diluted nitrate, and weak solutions of the perchloride, are *astringents,* and *stimulants* locally. Others, such as stronger solutions of the perchloride and the nitrate, are *caustics.*

All preparations are *antiseptics* and *disinfectants*, especially the perchloride.

Internally the local action of mercury also depends on the preparation employed and its strength. All preparations produce certaiu effects on the mouth, gums, and salivary glands, resulting in *salivation* when administered in full amount and for a period of time, these effects, however, being due to the excretion of the drug from the system, and not to the local action.

In the stomach the salts of mercury combine with the chloride of sodium present in the secretions, and become converted into a double chloride of sodium and mercury; this, again, combines with albumin, forming a complex substance. It is precipitated at first, then becomes soluble in excess of chloride of sodium and albumin, and is in this form diffusible and easily absorbed. In large or concentrated doses an irritant effect is produced in the stomach. *In the duodenum* an irritant action is produced, resulting in *purgation;* that is, speaking of certain preparations.

This effect is probably a local one, the intestinal glands being stimulated to increased secretion, and the mucous membrane irritated so as to produce an increased flow of fluid from the vessels, with more active peristalsis. The contents of the small intestines are thus evacuated, along with any bile present in the duodenum.

(2) ACTION ON THE BLOOD.

Only a small amount of a medicinal dose enters the blood from the intestines, as the major portion passes off with the fæces as a sulphide, unless combined with opium, which delays its passage through the bowel. The combination which mercury forms in the stomach and intestines becomes decomposed on entering the blood by combining with oxygen and albumin, an oxy-albuminate of mercury being the result.

We are not aware of any *direct* action of mercury on the blood, but large doses cause impoverishment of both plasma and corpuscles, resulting in a watery condition of the blood and a diminished power of coagulation.

(3) SPECIFIC ACTION.

The specific action of mercury is not exerted through the blood, but by a *direct action* on the tissues themselves. It leaves the blood quickly and enters the tissues, being slowly excreted therefrom. It is found most abundantly in the liver, but remains in every organ of the body, and a point worthy of note is that even in cases of chronic poisoning by the drug no definite anatomical changes have been found in the organs containing it. The influence of mercury on nutrition is supposed to depend on its power of interference with the growth or life of germinal cells, and this may be termed an alterative influence.

When mercury is administered in small doses for a considerable period, a condition termed *mercurialism* or *hydrargyrism* is produced, characterized by the following train of symptoms, viz., salivation, tenderness of the mouth and gums, impaired appetite, dyspepsia, anæmia, and in some instances eczematous eruptions and bone affections.

(4) REMOTE LOCAL ACTION.

Mercury is removed from the system by all the secretions, the chief channel of escape being the kidneys. During its excretion it stimulates many of the glands, especially the salivary glands, acting as a powerful *sialagogue*. It has only a slight diaphoretic effect, and does not increase the volume of the urine, but combined with diuretics, such as digitalis, it assists their action. It is excreted in the fæces as the sulphide, derived partly from a considerable amount of the unabsorbed portion of the dose administered, and partly from the portion excreted from the liver, pancreas and intestinal glands.

It is apparent that we cannot place any therapeutic value on the remote local action of this drug.

The Actions and Medicinal Uses of the Different Preparations of Mercury.—For convenience of description it will be of advantage to classify the preparations of mercury as follows :

1. *Metallic Mercury and its Preparations.*
2. *The Perchloride of Mercury and its Preparations.*
3. *The Subchloride of Mercury and its Preparations.*
4. *A Complex Group, consisting of the Oxides, Iodides, Ammoniated Mercury.*
5. *Acid Solution of Nitrate of Mercury.*

1. Metallic Mercury and its Preparations.

Metallic mercury is not given internally except in the finely divided form in which it exists in the pilula hydrargyri and the hydrargyrum cum creta.

Pilula Hydrargyri—Blue Pill.

Prepared by mixing two parts mercury, three of confection of roses, and one of liquorice.

Medicinal Uses.—Blue pill is sometimes employed in canine practice as a *purgative* and *indirect cholagogue*, in doses of from grs. iii. to grs. v., generally combined with a similar amount of the compound colocynth and hyoscyamus pill.

Hydrargyrum cum Creta—Mercury with Chalk, Grey Powder.

Prepared by triturating together one part of mercury with three of prepared chalk.

Medicinal Uses.—In cases of bilious indigestion, with diarrhœa, occurring in young calves and foals, the hydrargyrum cum creta is useful as a *laxative antacid* and *alterative* in small doses, such as from grs. v. to grs. xv. repeated twice daily. In canine practice small doses are useful in dyspepsia due to hepatic irregularities, especially if there is gastric irritability. It is also useful in cases of diarrhœa in young dogs depending on indigestion, in which the food acts as an irritant in the alimentary canal. It restores the natural colour to the fæces, and reduces the irritability of the intestinal mucous membrane. For such purposes it should be administered in small repeated doses, from gr. ½ to grs. iii., according to the size of the patients.

Unguentum Hydrargyri—Blue Ointment.

Prepared by mixing mercury with lard and suet in the proportion of one to two.

Uses.—The blue ointment is not employed in veterinary practice to produce constitutional effects. If applied with friction it produces vesication, and in sufficient amount becomes absorbed, producing the specific effects of mercury in the system. For this reason the ointment has to be cautiously applied. It is sometimes employed as an absorbent application to reduce swelling of joints, and is useful in some cases of obstinate *psoriasis.*

Linimentum Hydrargyri—Mercurial Liniment.
Oleatum Hydrargyri—Oleate of Mercury.

Both these preparations possess similar actions, being *diffusible*, *penetrating*, *absorbent* agents. The liniment is prepared by mixing equal parts of mercurial ointment, solution of ammonia, and camphor liniment together. The oleate is a mixture of the yellow oxide of mercury in oleic acid. They may be used in cases of persistent scaly skin diseases, in tinea and favus, and as absorbent applications to enlarged glands, and to cases of induration of the mammary gland in cattle.

2. **Hydrargyri Perchloridum**—Perchloride of Mercury, Corrosive Sublimate, Mercuric Chloride.

Prepared by triturating a mixture of persulphate of mercury, chloride of sodium, and black oxide of manganese together and subliming.

Incompatibles.—Alkalies and their carbonates, iodide of potassium, lime-water, nitrate of silver, acetate of lead, albumin, soaps.

Actions and Uses.—Corrosive sublimate, containing twice as much chlorine as calomel and being very soluble, acts as an *irritant corrosive poison* in sufficient quantities, hence it is of importance to distinguish between the two salts of mercury in prescribing and dispensing.

If administered in strong solution it causes gastro-enteritis, producing a bluish-gray appearance of the alimentary mucous membrane, with patches of inflammation and sloughing in severe cases. It is not prescribed internally.

The Antidotes consist of the free administration of albumin, which forms an insoluble mercuric albuminate. For such purposes eggs, flour, milk, etc., should be freely given.

Externally strong solutions of corrosive sublimate act as *caustics* and *escharotics.* The most important use of corrosive sublimate is founded on its antiseptic properties. It is one of the most active of antiseptic agents, and in the proportion of 1 part to 1,000 of water is capable of destroying bacilli and their spores. It is extensively employed as an antiseptic dressing for wounds in the proportions stated, and also used to render cotton-wool or wood-wool aseptic for surgical uses. The danger of absorption from strong applications of the perchloride must not be lost sight of.

3. **Hydrargyri Subchloridum**—Subchloride of Mercury, Calomel, Mercurous Chloride.

Prepared by triturating a mixture of persulphate of mercury, mercury, and chloride of sodium, subliming, and washing.

Doses.—As an alterative: Horses and cattle, grs. x. to grs. xx.; dogs, gr. i. to grs. ii. *As a purgative and cholagogue:* Horses, ʒi., generally combined with aloes; cattle, ʒi. to ʒii., combined with other purgatives; dogs, grs. ii. to grs. v., combined with jalap or colocynth.

Actions and Uses. — Calomel, being very insoluble, possesses mild actions compared with other salts of mercury. It must be rendered soluble before being absorbed, consequently the effects will depend to a certain extent on the amount which is made soluble. In proper doses it is a *purgative* in all animals, besides acting as an indirect cholagogue and a diuretic. Its purgative action is a purely local one, probably by stimulating the intestinal glands and irritating the mucous membrane, causing the outpouring of fluid from the vessels.

The *cholagogue* action is one on which some difference of opinion exists. Experimentally, it has been demonstrated that calomel does not increase the secretion of bile, but that corrosive sublimate possesses this action. In purgative doses it is believed that calomel acts as an *indirect cholagogue* by clearing away the bile present in the duodenum, and preventing its reabsorption. However, some authorities state, as the result of clinical experience, that in some affections calomel does increase the flow of bile, as small doses of the drug restore the colour to the fæces which had become pale as the result of liver derangement.

Calomel is a very useful agent as a *cathartic* and *indirect cholagogue* in cases where such a combination is desirable, such as congestion of the portal system and liver. It assists the action of other purgatives with which it is combined, and is thus employed in all cases where a full purgative effect is desired, such as tetanus, brain affections, lymphangitis, etc. In former times calomel was extensively employed as an alterative and febrifuge in all febrile and inflammatory affections, either combined with opium or otherwise; in the present day, however, in consequence of our improved knowledge of the pathology of these affections, we avoid agents likely to depress the patient, of which calomel is one. In alterative doses it is sometimes prescribed in cases of gastric irritation, intestinal catarrh, and bilious diarrhœa, but the hydrargyrum cum creta is to be preferred for such purposes.

Externally calomel is desiccant, stimulant, and astringent. In the form of ointment (1 to 8) it is employed to allay the severe itching of certain skin affections, such as eczema, pityriasis, etc. In that affection of the frog of the horse's foot termed 'thrush,' calomel is a most useful agent, combined with equal parts of iodoform, and applied thoroughly to the cleft of the frog, the part being kept as dry as possible.

4. The Oxides, Iodides, and Ammonio-Chloride of Mercury.

There are two oxides of mercury, viz.:

Hydrargyri Suboxidum—Black Oxide of Mercury.
Hydrargyri Oxidum Rubrum—Red Oxide of Mercury, Red Precipitate.

Both these salts possess similar actions, viz., *stimulant* and *astringent*, when locally applied; they are not used internally. A modification of the red oxide, but of similar composition, is the yellow oxide, which is non-crystalline.

The *therapeutic value* of these oxides consists of their presence in two useful lotions, viz.:

Lotio Hydrargyri Nigra—Black Wash.

Prepared by mixing 30 grains of calomel in 10 ounces of lime-water (1 to 146), the black oxide of mercury being precipitated.

Lotio Hydrargyri Flava—Yellow Wash.

Prepared by mixing 18 grains of corrosive sublimate with 10 ounces of lime-water (1 to 243), the yellow oxide of mercury being precipitated.

Both these lotions are used as applications to ulcers, unhealthy surfaces, chronic scaly skin eruptions, etc., the yellow wash being the most active. In collar and saddle galls, which are slow in healing, the yellow wash is a useful stimulant and astringent.

Hydrargyri Iodidum Rubrum—Red Iodide of Mercury, Biniodide of Mercury.

Prepared by mixing hot solutions of perchloride of mercury and iodide of potassium, washing and drying the precipitate.

Actions and Uses.—The presence of iodine in this salt renders it more soluble, and hence more quickly absorbed. It is seldom prescribed internally, except in the combination with arsenic known as the liquor arsenii et hydrargyri iodidi, or Donovan's solution, prepared by dissolving equal parts of iodide of arsenic and red iodide of mercury in water, in the proportion of 1 per cent. of each salt. This is recommended as an alterative in chronic scaly skin affections, in doses of ℥i. to ℥ii. for horses, and ♏x. to ♏xxx. for dogs, repeated twice daily.

Externally the red iodide of mercury is extensively employed as a *counter-irritant* and *absorbent* in cases of diseases of joints and the various forms of exostoses. Applied sufficiently strong, it penetrates deeply, and acts as a suppurant. It is used in the form of an ointment in the proportion of 1 part to 8 of the basis, which should be preferably of *lanoline*. This increases greatly the penetrating and absorbing powers of the agent.

When it is desired to produce severe counter-irritation, equal parts of the ointment of the red iodide and of cantharides are mixed together. A very severe blister is prepared by a mixture of the red iodide of mercury and iodide of potassium, dissolved in methylated spirit along with cantharides. For the purposes of a slow absorbent application in cases of capped hocks, etc., it is recommended to dissolve 1 drachm of the red iodide with a sufficiency of iodide of potassium in 12 ozs. of water, and to apply this daily until the part gets scaly and tender, when it is discontinued for a time and then reapplied.

Hydrargyrum Ammoniatum—AMMONIATED MERCURY, WHITE PRECIPITATE.

Prepared by precipitating a solution of perchloride of mercury with diluted solution of ammonia, washing and drying.

Medicinal Uses.—It is not used internally. Externally it is employed as a stimulant application to chronic skin diseases, especially to those troublesome affections of the posterior portion of the knee and anterior portion of the hock known as *mallenders* and *sallenders* in horses, in the proportion of 1 to 10 of simple ointment. It often succeeds for this purpose when other agents fail.

(5) **Liq. Hydrargyri Nitratis Acidus**—Acid Solution of Nitrate of Mercury.

Prepared by dissolving mercury in nitric acid and water, and boiling.

Unguentum Hydrargyri Nitratis—CITRINE OINTMENT.

Prepared by mixing a hot solution of mercury, nitric acid, lard, and olive oil together. This ointment, mixed with 2 parts of soft paraffin, forms the unguentum hydrargyri nitratis dilutum, or dilute citrine ointment.

18

Actions and Uses.—The acid solution of the nitrate of mercury is a strong caustic, and may be employed for this purpose in malignant growths, canker in the feet of horses, etc. The dilute citrine ointment is very useful in cases of *eczema* in dogs, especially in the stage of desquamation ; its efficacy is greatly increased by the addition of creolin, combined with lanoline. In irritable and discharging conditions of the eyelids, with chronic inflammation and ulceration of the hair follicles, a careful application of weak citrine ointment is productive of much benefit. In chronic cases of *grease* in horses' heels, citrine ointment is a very useful application, and in deep fissures of the same parts, with little tendency to heal, the addition of iodoform to this ointment often produces beneficial results.

Mercury and Zinc Cyanide—A DOUBLE CYANIDE OF MERCURY AND ZINC.

This has been strongly recommended by Sir Joseph Lister as an antiseptic dressing for wounds; and is best prepared in the form of an antiseptic gauze, which should be dipped immediately before use into a 1 to 4,000 solution of perchloride of mercury. Experiments with this salt have demonstrated that half the strength is requisite to prevent putrefaction in serum and corpuscles as compared with corrosive sublimate. It is stated that the double cyanide of mercury and zinc is feeble as a germicide, but admirable in preventing the growth of microbes ; hence it is recommended to treat the gauze before using with a solution of corrosive sublimate or carbolic acid.

Sir Joseph Lister states that this salt tends to cause healing by first intention, and that granulating wounds heal in a satisfactory manner by a gradual process of cicatrization, while the dressing is quite unirritating to the skin.

SUB-GROUP IV.

PHOSPHORUS.

A non-metallic element obtained from bones. The chief therapeutic interest in this substance depends on the hypophosphites of sodium and calcium which are derived from it, and possessing similar actions, are the forms in which it is usually prescribed.

(1) IMMEDIATE LOCAL ACTION.

Phosphorus is a local irritant and caustic, both externally and internally. In toxic doses it causes gastro-enteritis, with intense thirst, and in dogs produces vomiting of a dark green or black substance, with the odour of garlic, and sometimes phosphorescent.

As a poison it is peculiar in the comparative slowness of its action, and the variable duration of its effects in acute cases. It causes catarrh of the small biliary ducts, and as a consequence jaundice, and generally diarrhœa; also a fall of temperature and fatty degeneration of different organs and tissues. Post-mortem examination shows general inflammation of the glandular structures of the stomach and intestines, the mucous membrane being thickened and of a whitish colour.

The antidotes are oil of turpentine, which forms an inert compound with phosphorus, and sulphate of copper, which forms an insoluble phosphide. Milk, oil, eggs, etc., should be avoided, as they render the poison more soluble.

(2) ACTION ON THE BLOOD.

Phosphorus enters the blood, and is partly oxidized into phosphorous or phosphoric acid, by the oxygen derived from the red corpuscles.

(3) SPECIFIC ACTION.

It acts specially on the glandular and nervous systems. It can be traced in the tissues in its unchanged form, as it is only partly oxidized in the blood. The agent has special effects on metabolism, especially when given in full doses. These consist of increase of the nitrogenous products, such as urea, etc., a reduction of the formation of glycogen in the liver, a diminution of oxidation, and of the volume of oxygen absorbed, resulting in fatty degeneration of the epithelial, glandular, and muscular tissues of the body. In small doses, continued for a length of time, phosphorus has a special effect on the structure of bone, which has been proved experimentally, converting the spongy texture into firm, compact substance without altering its chemical composition.

(4) REMOTE LOCAL ACTION.

Phosphorus is excreted by the kidneys and lungs partly as phosphorous acid and partly unchanged, but not as phosphates.

Medicinal Uses.—As the hypophosphites of calcium and sodium act very much the same as phosphorus, but are not irritant, they are preferred for therapeutical purposes. As *tonics* and *alteratives* they are prescribed in cases of general debility and anæmia in foals and dogs; they increase appetite and digestion, and overcome weakness. They are also prescribed in cases of rickets, bone softening, and chronic malnutrition in doses of 10 to 20 grs. for foals and 1 to 5 grs. for dogs, repeated twice daily.

The **Phosphate of Calcium**, which conjoins the actions of calcium and phosphorus, is prescribed in cases of debility, malnutrition, and rickets, and is sometimes combined with iron.

Doses.—Horses, ʒii. to ʒiv.; dogs, grs. v. to grs. x.

Phosphate of Sodium.—This salt acts as a moderate cholagogue, increasing directly the secretion of bile; in full doses it is a saline purgative.

ARSENIUM—ARSENIC.

All preparations of this agent are derived from white arsenic.

Acidum Arseniosum—Arsenious Acid. Arsenicum Album—White Arsenic.

Source.—Obtained by roasting arsenical ores, and purified by sublimation. It is an anhydride and not a true acid.

Incompatibles.—Salts of iron, magnesium, lime-water.

Doses.—Horses and cattle, grs. ii. to grs. v.; sheep, grs. ss. to grs. ii.; dogs, $\frac{1}{60}$ to $\frac{1}{12}$ gr., administered either along with the food or immediately afterwards, repeated twice daily.

Liquor Arsenicalis—Fowler's Solution.

Prepared by boiling arsenious acid and carbonate of potash in water, and colouring with compound tincture of lavender; contains about $4\frac{1}{2}$ grs. to the ounce (1 to 100). The carbonate of potash renders the arsenic soluble.

Doses.—Horses and cattle, ʒii. to ℥i.; dogs, ♏ii. to ♏viii.

Liquor Arsenii et Hydrargyri Iodidi—Donovan's Solution (see *Hydrargyrum*, p. 272).

GENERAL ACTIONS.

(1) IMMEDIATE LOCAL ACTION.

Externally.—Arsenious acid is *irritant, caustic*, and *antiseptic*. It is not absorbed from the unbroken skin, but on wounds, ulcers, etc., it excites very active inflammation, and is liable to become absorbed, unless, indeed, the process of inflammation is so severe that the part loses the power of absorption. It is an escharotic, slowly corroding and destroying the tissues with which it comes in contact.

Internally.—In medicinal doses, on reaching the stomach, it does not form an albuminate like other members of this group, but is changed into a soluble form and absorbed into the blood. It is believed that if food be present the drug is absorbed by the lacteals and conveyed to the blood, while if the stomach be empty, it is absorbed by the veins and passes on to the liver. It stimulates the gastric nerves and vessels, increases the power of digestiou, and sharpens the appetite. In large doses it causes *irritation* of the gastric and intestinal mucous membrane, producing nausea and diarrhœa, while toxic doses are corrosive and irritant; these effects, however, being also due to the excretion of the agent as well as to the immediate local action.

(2) ACTION ON THE BLOOD.

Arsenic is quickly absorbed from the alimentary canal, also from any mucous, serous, or skin abraded surface. We are not aware of any special effect of the agent on the blood; it can be detected in this fluid as well as in most organs of the body.

(3) SPECIFIC ACTIONS.

Arsenic enters all tissues and organs; it does not form albuminates therein, and is more quickly eliminated than other metals. It manifests a special affinity for the *mucous membrane of the alimentary canal*, producing effects thereon, no matter by what chaunel it enters the system. It also produces special effects on the *nervous system*, on *metabolism*, and on the *skin*. Medicinal doses, as already mentioned, act as stimulants to the alimentary mucous membrane; large doses cause *irritation*, while a toxic dose acts as an *acute irritant poison*. It causes *gastro-enteritis* in all animals, the post-mortem appearances varying with the severity and duration of the case. There is generally acute inflammation of the stomach, often in patches; sometimes spots of ecchymosis are present, and less commonly ulcerations.

Inflammation of the lower portion of the œsophagus, also of the intestines, may be present.

Mr. Gresswell ('Manual of Equine Medicine') records some important cases of arsenical poisoning in horses in which the post-mortem examinations showed several small patches of redness in the cuticular portion of the stomach, with erosion of the wall in one case, at its junction with the villous portion. The villous portion was intensely inflamed, of a dark brownish-red hue, and covered in parts with a film of coagulated lymph; patches were blackened, and in some places there was much erosion, while in one case there were two almost complete perforations through the walls. The small and large intestines were acutely inflamed in patches. An important lesion noted was the presence of inflammation of the endocardium of the left ventricle, with patches of ecchymosis thereon, showing the special effect of arsenic on this membrane. In animals poisoned by arsenic, the carcases usually resist decomposition to a great extent.

On the nervous system arsenic possesses specific effects. It diminishes the sensibility and reflex-irritability of the centres of the spinal cord, and afterwards depresses the motor nerves and muscles, in toxic doses causing general paralysis. Some authorities conclude as a result of their experiments that sensation and reflex action persist as long, or longer, than voluntary power; also that arsenic is a protoplasmic poison, destroying the functional activity, first of the central nervous system, next of the nerves, and last of the muscles (Dr. Ringer, 'Handbook of Therapeutics').

It is important to remember that in some cases of arsenical poisoning the usual symptoms of gastro-enteritis may be absent, and the animal may die in a state of *profound coma*, the post-mortem examination not revealing any signs of inflammation of the alimentary mucous membrane. In such cases the chief effect of the poison is on the nervous system.

On the heart and circulation experiments prove that in toxic doses arsenic arrests the action of the heart by a direct effect on all its structures—nerves, ganglia, and muscle. It lowers the arterial tension, first accelerating and then decreasing the action of the heart, also influencing vaso-motor nerves.

On the respiratory system it first stimulates slightly the respiratory centre and the pulmonary terminations of the vagi. In toxic doses it paralyzes the respiratory centre.

On metabolism it reduces the amount of glycogen in the liver, and interferes with metabolism by diminishing oxidation. The results are, an increased amount of nitrogenous materials in the urine, a rise in temperature, and if the action of the drug be long continued there occurs an excess of the fatty products of albuminous decomposition in the system which are not excreted, and a condition of fatty degeneration of different tissues and organs is brought about.

On the skin arsenic possesses a specific action. It produces desquamation of the superficial layer of the skin, and experiments on frogs prove that this effect is due to a direct action on the skin and the epidermic cells, in which, by a form of stimulation, there is a peculiar destructive change in the metabolism of these cells. In medicinal doses this stimulation of the epidermis is found to occur in cases of chronic scaly skin diseases, and is an action of importance to the therapeutist.

We may briefly enumerate the important symptoms of poisoning by arsenic, and will first remark that in the various species of animals, and also in individuals of the same species, the symptoms will vary greatly as regards severity, and the amount of the drug necessary for a toxic dose is not definite, the soluble preparations being most active.

In the horse the toxic dose is liable to great variation, which fact has been demonstrated by experiments. In some instances even medicinal doses produce serious effects. All animals acquire a tolerance of it, if the drug be administered regularly, and after a time their systems are enabled to resist the effects of large doses. The severity of a toxic dose will depend to some extent on the amount of food present in the stomach. The period of time which the drug takes before manifesting acute symptoms in the horse varies from half an hour to three or four hours, and cases are recorded where death occurred within an hour.

The symptoms are—violent purging, extreme tenesmus, violent colicky pains, pulse weak, irregular and thready, gradually becoming imperceptible; respirations greatly accelerated, temperature variable, from 101° to 105° Fahr., extremities cold; death occurring with a comatose condition, or with tetanic spasms. (Mr. Gresswell, 'Manual of Equine Medicine.')

Cattle are less susceptible to the action of arsenic, and a longer period elapses before symptoms are developed, in consequence of the arrangement of the stomach, which renders its absorption slow. In cases recorded, poisonous symptoms appeared in twenty hours, consisting of acute abdominal pain, purging, staggering gait, etc.

In sheep there are many cases recorded of arsenical poisoning from the use of arsenical dipping mixtures. In such instances it results from too large a proportion of arsenic being present in the dip, and by allowing the sheep to wander over the pastures and to graze thereon: the drippings from the fleece fall on the grass, and thus the drug is taken into the system. It is believed, and experiments bear it out, that arsenical sheep dips are not absorbed through the sound skin.

The symptoms recorded are—dulness and nausea, frothing at the mouth, colicky pains, accelerated respiration, and in some instances death occurs rather suddenly.

In dogs, which are usually very susceptible to the action of arsenic, the symptoms are nausea, vomiting, pain, pulse quick and wiry, purging with dark-coloured evacuations, and convulsions with death in a space of from six to thirty hours.

Chronic arsenical poisoning may occur in certain districts where tin and copper smelting-furnaces are worked, the usual symptoms being indigestion, thirst, swelling of joints, and gradual emaciation.

In the horse, cases of both acute and chronic arsenical poisoning have been recorded as the result of the administration of the drug by the attendants with the idea of improving the condition of the animal, and Mr. Gresswell ('Manual of Equine Medicine') relates an interesting case of this description, in which an irregular pulse, with great distress of breathing during moderate exercise, were the results of repeated small doses of arsenic, continued for a long period.

When arsenic is long-continued in medicinal doses, certain symptoms occur which the practitioner should carefully watch for, so as to avoid them by diminishing the amount given, but *not* by suspending it altogether. These are first noticed in the eyes and stomach, consisting of a slight œdematous condition of the eyelids, resulting in slight conjunctivitis, either followed or preceded by irritation of the stomach, evidenced by indigestion and diarrhœa; and in dogs thirst and vomition may occur.

The antidotes and treatment of arsenical poisoning consist of the prompt administration of emetics in the dog; while in all animals the most reliable chemical antidote is the *hydrated sesquioxide of iron*, which can be prepared in cases of emergency by adding a solution of ammonia to the perchloride of iron solution, washing the precipitate with warm water, and administering it moist in repeated doses at intervals of ten minutes. A mixture of carbonate of soda with a solution of the perchloride acts in a similar manner; also dialyzed iron —the action of these iron preparations being to convert the arsenic into an inert insoluble substauce.

Hydrated magnesia, prepared by precipitating a solution of sulphate of magnesia with caustic potash, is also useful in diminishing the solubility of arsenic; while mechanical antidotes—such as oils, demulcents, milk, etc.—have a similar effect, besides reducing the irritation of the gastro-intestinal mucous membrane, the addition of a preparation of opium being of advantage in this respect.

In chronic cases, oleaginous laxatives, tonics, and diuretics are employed to hasten the elimination of the poison.

(4) REMOTE LOCAL ACTION.

Arsenic is eliminated chiefly in the urine in the form of arsenious acid; also by the gastro-intestinal mucous membrane, the liver, and skin. As previously mentioned, its irritant effects are due to its excretion as well as its immediate local action.

Medicinal Uses.—*Internally.*—As a *gastric tonic*, arsenic is prescribed in some cases of gastric dyspepsia. It produces beneficial effects by stimulating the nerves and vessels of the stomach, and is administered either along with the food, or immediately after feeding, in the form of the liquor arsenicalis; and here we may remark that for all purposes this preparation of arsenic is preferable, being more soluble and less liable to cause irritation.

The form of dyspepsia in which arsenic is indicated is characterized by excessive peristaltic action of the stomach and intestines, resulting in the passage of imperfectly digested food into the intestines, and the occurrence of purging after feeding. The arsenic may be combined with antacids, and some authorities recommend that it be given in small doses shortly before feeding; but this is rarely necessary.

As a *general tonic* and *alterative, or modifier of nutrition*, it is prescribed in various affections, such as general debility, anæmia, chronic nasal catarrh, nasal gleet, etc., and in such cases is usually combined with a preparation of iron.

In nervous affections—such as chorea, epilepsy, etc.—in dogs, its administration is often productive of beneficial results, which are believed to depend partly on its power of diminishing sensibility and reflex irritability of the nerve centres, and partly on its alterative actions.

In spasmodic asthma in dogs, and in that affection in horses known as *broken wind*, it is a very valuable palliative remedy, and is combined with other agents, such as aconite, digitalis, etc.

It is also useful in cases of *chronic cough*, and in such respiratory affections its beneficial effects must be ascribed to its action on the nerves, as well as its action on the digestive organs, a large proportion of such cases depending on reflex irritability from the stomach.

In affections of the skin it is most serviceable in those affecting the more superficial parts, such as psoriasis, and chronic scaly skin eruptions.

It is also useful in *chronic eczema* in dogs, and cases of *chronic grease* in horses.

Its effects in such cases must be ascribed in part to its specific action on the superficial layers of the skin, and also to its action as a general alterative; but, generally speaking, it is contra-indicated in acute cases.

Precautions in the Administration of Arsenic. — As already stated, all patients are not affected alike by medicinal doses of arsenic, so that in prescribing this drug it is always advisable to commence with a minimum dose, and to gradually increase it as the system becomes accustomed to its effects.

In some affections a long period of time is required before beneficial effects are produced, and although we should avoid the production of the physiological action of the drug, still, it requires to be pushed to a proper extent, especially in skin affections and nervous disorders. It should be given along with the food, or immediately afterwards, so as to avoid its free contact with the gastric mucous membrane.

It is *contra-indicated* in cases of gastric irritability, and during the acute inflammatory stages of eruptions.

Externally.—As a caustic and escharotic, arsenic is seldom employed, in consequence of the severity of its action, and the danger of its being absorbed. It is sometimes mixed with corrosive sublimate, a small amount of arsenious acid and the latter being mixed in tissue paper, and introduced into the sinus of a quittor in order to form a slough, and produce a healthy action of the part; but the use of the knife in such a case gives safer and better results.

As an anti-parasitic, arsenic is largely employed in sheep-dips, and with proper precautions can be used with safety. The following is a safe dip: Take 2 lb. of arsenious acid, 2 lb. of carbonate of potash, 2 lb. of sublimed sulphur, and 4 lb. of soft soap; dissolve in 10 gallons of boiling water, and add cold water to make 100 gallons. This will be sufficient to dip about 100 sheep, and the following precautions should be attended to—viz.: The sheep should be kept in the dip about a minute, with the head carefully kept away from the fluid. The animal is then placed on a sparred apparatus over another receptacle, and the wool squeezed as dry as possible with a scraper, especial care being taken not to allow the animal on pasture immediately afterwards.

ANTIMONIUM—ANTIMONY.

All the medicinal preparations are derived from antimonium nigrum, black antimony, which is obtained from the native sulphide. The chief preparations in use are:

Liquor Antimonii Chloridi—Terchloride of Antimony, Butter of Antimony.

Prepared by dissolving purified black antimony in hydrochloric acid.

Antimonium Tartaratum—TARTARATED ANTIMONY, TARTAR EMETIC.

Prepared by mixing oxide of antimony and acid tartrate of potassium with water, boiling, evaporating, and crystallizing.

THE ACTIONS OF ANTIMONY PREPARATIONS.

(1) IMMEDIATE LOCAL ACTION.

The **chloride of antimony** is a powerful *escharotic*, and unless cautiously applied it produces a sloughing of the part which is not disposed to heal.

Tartar emetic, applied to the skin in the form of solution or of ointment, causes an eruption which is first papular and then pustular, and thus acts as a severe *counter-irritant.* It is absorbed from the broken skin and mucous surfaces.

Internally.—In the dog this agent acts as an *emetic* in doses of one to three grains. This effect is produced both directly and indirectly—*directly*, by its irritant action on the terminations of the nerves of the stomach; and *indirectly*, by stimulating the vomiting centre in the medulla. Its action is slow, fifteen minutes or longer being required. It produces this emetic action when injected into a vein, but more slowly; and its effects are prolonged, much nausea and depression resulting, showing that the drug is excreted by the gastric mucous membrane.

In horses and cattle, except in very large amounts, it produces no effects, and even then only a slight degree of nausea and uneasiness is found to result.

(2) ACTION ON THE BLOOD.

Antimony enters the blood, and does not combine with the albumen of the plasma. We are not aware of any action which it produces under this head.

(3) SPECIFIC ACTION.

As already mentioned, it produces no effects in the horse in ordinary amounts.

In the dog it produces specific actions as follows:

On the heart and circulation it is *depressant.* It acts directly on all the tissues of the heart, and partly in a reflex manner from the stomach; it also acts on the vessel walls.

On the respiratory system it diminishes and disturbs the respiratory movements.

On the nervous system it causes *depression,* both directly and also through the circulation.

On metabolism the effects of antimony resemble those of arsenic and phosphorus, in large amounts causing deficient oxygenation, increase of nitrogenous products, and fatty degeneration of organs.

On the skin it acts as a stimulant to the superficial layers, resembling arsenic to a certain extent in this respect. In man it acts as a diaphoretic; but this effect is not observed in animals.

Toxic Effects.—*In the horse,* except when administered in very large amounts, no appreciable effects are produced. The results of experiments go to prove that this animal resists the action of antimony in a remarkable manner. In a few instances symptoms of nausea and uneasiness are recorded after large doses, the *post-mortem* appearances showing slight softening and vascularity of the intestines, while in some cases no lesions could be discovered. The drug is stated to produce more definite actions when administered intravenously, some experimenters recording purging and salivation, acceleration of the pulse and respirations, as the results of one drachm administered in this manner.

In cattle the drug also produces little physiological effect, the result of the administration of large doses being to cause purgation in some cases.

In the dog the drug acts as a powerful *depressing emetic*, in large doses producing gastro-enteritis, purging, and intense prostration.

(4) REMOTE LOCAL ACTION.

Antimony is excreted by all the mucous surfaces; also by the liver, kidneys, and skin. During its excretion by the stomach, it produces a remote emetic effect in the dog. It is also excreted by the respiratory mucous membrane, and acts as a *sedative expectorant*.

The Antidotes consist of the administration of substances containing tannin, such as strong tea or coffee, or decoction of oak bark; these form an insoluble compound, and prevent absorption. The vomiting should be encouraged within safe limits, and demulcents given freely to allay the gastric irritation.

Medicinal Uses.—The chloride of antimony is sometimes employed as a caustic application in cases of canker, foul in the feet of cattle, and foot-rot in sheep; but in consequence of the severity of its action it must be used with great caution, and other agents are safer, while being quite as effectual.

Tartar emetic is still occasionally prescribed in veterinary practice. As we are aware, it produces no effects in medicinal doses in horses and cattle; it is difficult to understand how it can be of any therapeutical value.

It is believed to improve the condition of horses by its action on the skin, and hence is employed in alterative and condition powders, in combination with other agents, but probably it is to the latter that the beneficial effects are really due.

As a vermicide it is also prescribed, but we have no evidence of its action in this respect to justify its use.

It may be given in doses of from 1 to 4 drachms.

In the dog this drug can safely be dispensed with.

It is to be avoided as an *emetic*, in consequence of its nauseating and depressing effects.

As a *sedative expectorant* for similar reasons it should be avoided, as our aim in the treatment of affections requiring the use of sedative expectorants should be to sustain the strength of the patients, by encouraging the appetite and digestion, and avoiding any agent likely to irritate or nauseate.

Tartar emetic is not employed *externally*.

BISMUTHUM—BISMUTH.

The chief salt of bismuth employed in veterinary practice is the *subnitrate*.

Bismuthi Subnitras—Subnitrate of Bismuth.

Prepared by dissolving purified bismuth in diluted nitric acid, heating, concentrating, washing with water, and drying.

Doses.—Horses, ʒiv. to ℥i.; dogs, grs. v. to grs. xx. Administered every two hours as required, in the form of emulsion.

(1) IMMEDIATE LOCAL ACTION.

Externally this salt has no effect on the unbroken skin. On inflamed or ulcerated surfaces it acts as a *mild sedative* and *astringent*, and a similar effect is produced on accessible mucous membranes.

Internally it is insoluble in the stomach, and produces *sedative* and *astringent* effects, either by acting on the gastric nerves and local circulation, or, by acting in a mechanical manner, soothing and protecting the mucous membrane.

On the *intestines* it also produces *sedative* and *astringent* effects.

(2) ACTION ON THE BLOOD, SPECIFIC ACTION, AND REMOTE LOCAL ACTION.

Bismuth enters the blood in very small amount, and passes through the tissues very slowly. There are no specific effects recognised, and the drug is excreted by the kidneys, also by the intestines and respiratory mucous membrane, milk, etc.

The subnitrate is partly converted into the sulphide in the intestines, causing the fæces to assume a leaden-gray colour.

Medicinal Uses.—Bismuth is chiefly prescribed in canine practice in cases of *gastric* catarrh with obstinate vomiting, due to dyspepsia. It may be combined with the bicarbonate of sodium, dilute hydrocyanic acid, or with opium, if there be much pain present. It is also useful in cases of diarrhœa in foals, and young dogs, and may be combined in such instances with Dover's powder. As a rule, large doses are required to produce therapeutic effects.

Thioform.

A basic bismuth salt of dithio-salicylic acid.

CHAPTER IV.

INORGANIC MATERIA MEDICA—*Continued.*

GROUP III.—THE NON-METALLIC ELEMENTS.

We may subdivide the non-metallic elements into three divisions, as follows:

1. **Chlorum; Iodum; Bromum.**
2. **Sulphur.**
3. **Carbo.**

SUB-GROUP I.

CHLORUM—CHLORINE GAS.

Prepared by heating common salt and black oxide of manganese with sulphuric acid.

Actions and Uses.—Chlorine is a *disinfectant*, *antiseptic*, and *deodorizer*. Its action depends partly on its power of destroying the organisms which produce putrefaction, and partly on its chemical actions. It possesses great affinity for hydrogen, and seizes upon this element in organic and inorganic substances, altering their properties, and setting free nascent oxygen, which exerts active oxidation.

Chlorine gas dissolved in water acts as a powerful *irritant* to the skin, and in dilute solutions in the stomach it becomes converted into hydrochloric acid and chlorides.

If the gas be inhaled, it causes local irritation of the respiratory passages. The chief use of chlorine in medicine is as a *disinfectant* and *deodorizer*, for the purpose of disinfecting sheds, buildings, etc.; but other agents are to be preferred. It is sometimes employed as an inhalation for parasitic affections of the bronchial tubes in calves and lambs, but other remedies are more effectual and less irritant.

The combination of chlorine with lime has already been noticed under the heading of Calcium.

IODUM—IODINE.

Under this heading we will notice iodine and its combinations with potassium and sodium.

Prepared from kelp, the ashes of seaweed.
Incompatibles.—Ammonia, metallic salts, mineral acids, vegetable alkaloids.
Doses.—Horses, grs. x. to grs. xxx.; dogs, gr. i. to grs. ii. Given in the form of bolus or pill.

Preparations.

Tinctura Iodi—Tincture of Iodine—1 in 40; iodine, ½; iodide of potassium, ½; spirit, 20 parts.

Liquor Iodi—Solution of Iodine—1 in 20; iodine 10; iodide of potassium, 15; water, 200 parts.

Unguentum Iodi—1 to 8; iodine 1; iodide of potassium, ½; lanolin, 4 parts; vaseline, 4 parts.

Potassii Iodidum—Iodide of Potassium.

Prepared by dissolving iodine in liquor potassæ, evaporating, mixing the residue with wood charcoal, and fusing.
Doses.—Horses, ʒi. to ʒii.; cattle, ʒii. to ʒiv.; dogs, grs. ii. to grs. x. Repeated twice daily.

ACTIONS OF IODINE AND ITS PREPARATIONS.

(1) Immediate Local Action.

Externally pure iodine acts as a *stimulant* to the skin, and if applied of sufficient strength is an irritant and *vesicant.* It stains the epidermis in light-coloured animals a deep-brown colour, and may be absorbed from the skin into the blood. It also possesses powerful *antiseptic* and *disinfectant* properties.

The *iodide of potassium* is devoid of local irritant effects when applied to the unbroken skin, and is not absorbed, but is readily taken up from exposed mucous membranes.

Internally iodine acts as an *irritant* in the stomach and intestines, the iodides of potassium or sodium rarely producing this effect. It is gradually converted into the iodide or iodate of sodium; the iodide of potassium is also decomposed in the stomach, the sodium salt and albuminate being formed. If inhaled, it produces irritating effects, giving rise to cough, dyspnœa, etc.

(2) ACTION ON THE BLOOD.

Iodine is quickly absorbed into the blood from the stomach and mucous surfaces, and at first exists in the form of the iodide of sodium. The chemical or physical changes produced on the blood are not definitely ascertained, the results of experiments going to prove that the iodine is temporarily set free, and if administered in large amount it seems to break up some of the red corpuscles, causing hæmaturia and hæmorrhagic effusion and discharges. Some authorities state that it increases the coagulating power of the blood.

(3) SPECIFIC ACTION.

Iodine passes rapidly from the blood into the tissues, being specially attracted to *lymphatic glands and vessels.* It quickly leaves the tissues, to be excreted by the kidneys aud mucous secretions generally, and its effect on metabolism is to *accelerate tissue change* and promote absorption. Its action on *lymphatic glands* is to reduce their size.

Certain poisons, such as lead and mercury, which have the power of associating themselves with the albuminous structures are disengaged and removed from the system by the administration of the iodide of potassium.

We have no evidence of the effects of iodine in medicinal doses on the heart, vessels, or temperature, the depressing effects noted as the results of large doses of the iodide of potassium being probably due to the action of potassium.

Toxic Effects.—Iodine and iodide of potassium, given in large doses, and for a prolonged period of time, act specially on the mucous covering of the eyes, and that of the nostrils and throat, the latter effects being chiefly due to the excretion of the agent by the respiratory mucous membrane.

A series of symptoms termed 'Iodism' results, consisting of loss of appetite, dyspepsia, an irritable catarrhal condition of the mucous membrane of the nostrils, eyes, throat, etc., these effects being rarely noticed in veterinary patients as compared with human.

Professor Dick's experiments with iodine on the horse demonstrate that in some instances the only effect produced was the total refusal of water by the animal.

In the dog iodine in large doses causes vomition and gastro-enteritis, with hæmaturia, and hæmorrhagic discharges from the intestines. According to Binz, it paralyzes the cerebral centres by direct action on the nervous structures, and proves fatal by this action on the respiratory centre.

Antidotes.—In acute poisoning and iodism, starch should be administered, which converts any unabsorbed iodine into the insoluble starch iodide.

(4) REMOTE LOCAL ACTION.

Iodine is rapidly excreted, appearing in the urine, the mucous secretions of the air-passages, the perspiration, saliva, bile, and milk.

In full doses, the iodide of potassium acts as a *diuretic;* but this action is uncertain in different individuals, and is probably due to the alkali rather than to the iodine.

The remote local action of iodine during its excretion by the respiratory mucous membrane is of therapeutical importance, as it increases and liquefies bronchial secretion, thus acting as an *expectorant.*

Iodine is also excreted by the skin, causing stimulation of the epidermis, and sometimes the appearance of a papular or vesicular eruption, if administered in full doses.

Medicinal Uses.—The iodide of potassium being more soluble than iodine itself, is preferred for internal administration; it is also less liable to cause gastric derangement. The iodide of sodium possesses similar actions.

As a promoter of absorption iodine is prescribed in subacute and chronic inflammations of various kinds, such as exudations or effusions in serous cavities, and in some forms of pulmonary consolidation it probably promotes absorption by stimulating the local nutrition.

In cases of pleuritic effusions, and in the secondary stages of pneumonia, it is prescribed twice daily in combination with tonics.

As an expectorant it is useful in cases of chronic bronchitis, and may be combined with the chloride of ammonium. Such a combination at first increases the amount of expectoration, but renders it less viscid and tenacious.

The iodide of potassium has been extensively employed in the treatment of *actinomycosis*, and with evident success. It is administered in doses of 90 grains in a pint of water once a day for eight or nine days.

Recently it has been demonstrated that one of the troublesome sequels of castration, termed *scirrhus cord*, or *champignon*, depends on the presence of a fungus, and a long course of the iodide of potassium has resulted in the disappearance of the morbid growth without operation. The method adopted consists in the administration of 75 grains of the iodide of potassium twice daily, injections of iodine being also made into the scrotal fistula. After a period of administration from one to two months the growth gradually disappears.

The iodide of potassium has been employed in the treatment of *chronic rheumatism*, but its value in this respect is not superior to other remedies.

In glandular enlargements, such as bronchocele, and in cases of abdominal tumours met with in canine practice, the iodide of potassium is employed with benefit.

In *diabetes insipidus* or polyuria, iodine is especially useful, allaying the excessive thirst and reducing the large amount of urine excreted. The manner in which it brings about these favourable results cannot be satisfactorily explained. The pure drug acts best in some cases given in doses of half a drachm, along with the sulphate of iron and gentian in bolus once a day; but in severe cases it may be administered twice daily, care being taken to ensure a complete change of food at the same time.

As a cutaneous stimulant and alterative iodine is prescribed in persistent cases of *psoriasis*, in combination with arsenic and mercury in the form of the liquor arsenii et hydrargyri iodidi, as recommended by Professor Williams ('Veterinary Surgery,' p. 695).

In cases of *purpura hæmorrhagica* in horses, especially in those characterized by difficulty in deglutition, Professor Dieckerhoff and other German authorities recommend the intra-tracheal injection of a solution of iodine and iodide of potassium prepared with one part of iodine, five parts of iodide of potassium, and one hundred parts of water, the dose being in ordinary cases three to nine fluid drachms of this solution, slowly injected into the lumen of the trachea twice a day with an ordinary hypodermic syringe. In severe cases this quantity may be greatly increased without producing any unfavourable local effects.

As an antidote in chronic cases of lead or mercury poisoning, the iodide of potassium is employed; it disengages these agents from the tissues, and renders them capable of being excreted from the system.

In prescribing iodine it should, if possible, be given a few hours after feeding, so as to diminish the chances of a portion of it being converted into the insoluble iodide of starch, as starch forms such a large proportion of the food of herbivora.

Externally iodine is applied to glandular enlargements, bursal distensions, etc., as a *stimulant* and *absorbent.*

As a parasiticide it is employed in certain skin diseases, such as ringworm, and for such purposes may be combined in the form of ointment, with wood-tar oils, sulphur, creolin, etc.

As a stimulant antiseptic and promoter of adhesion, a dilute solution of iodine is injected into cysts, etc., from which the fluid has been withdrawn.

In bursal and synovial enlargements, such as capped hocks in horses, a useful application consists of equal parts of tincture of iodine, spirits of tar, and soft soap well mixed together, and applied with a brush once daily, being discontinued when the parts get tender, and re-applied when necessary.

The ointment of iodine is best prepared with one ounce of iodine, half an ounce of iodide of potassium, and eight ounces of lanoline, heating the constituents together.

BROMUM—BROMINE.

The preparations of bromine employed are—*bromide of potassium, bromide of ammonium, bromide of sodium.*

Bromine, a liquid element, is obtained from sea-water and from some saline springs, by heating the natural magnesium compound with oxide of manganese and sulphuric acid. The salt in general use is:

Potassii Bromidum—Bromide of Potassium.

Prepared from bromine, liquor potassæ, and charcoal.

Doses.—Horses and cattle, ʒss. to ℥i. ; dogs, grs. v. to grs. xx.

(1) IMMEDIATE LOCAL ACTION.

Externally, pure bromine acts as a topical irritant to the skin, but the bromides possess no local irritant action unless in highly concentrated solutions, and are not absorbed from the unbroken skin.

Internally, the bromides have little effect of an irritant nature on the stomach or intestines. Given in full doses they are said to diminish the sensibility of the fauces, so that reflex movements, such as swallowing, cough, etc., are not easily excited.

(2) ACTION ON THE BLOOD.

The bromides are rapidly absorbed, and the bromide of potassium is believed to enter the blood unchanged, and to be then converted into the sodium salt by the presence of chloride of sodium. It may be temporarily set free in the blood, but we are not aware of any special action which it exerts thereon.

(3) SPECIFIC ACTION.

It seems probable that the bromides pass through the organs and tissues, as the bromide of sodium, and the specific action, generally speaking, is one of *depression.*

On the nervous system they produce most important effects. They reduce the activity of the nervous centres in the brain and spinal cord, and also depress the peripheral (sensory) nervous filaments, the result being that after the administration of full doses, there is a *loss of reflex excitability* in connection with the sentient surfaces of the body.

On the cerebrum they lessen activity, and diminish cerebral excitement by reducing the activity of the reflex portions of this region. They are thus *indirect hypnotics*, producing a condition of the brain favourable to sleep, and as yet we cannot determine whether this effect is due to a special action on the nerve-cells or on the cerebral blood-vessels.

On the vital centres of the medulla they act as depressants.

On the spinal centres, spinal nerves, and muscles, they cause depression, and so act as physiological antagonists to strychnine in this respect.

On the heart they cause slowness of its action and weakness, chiefly by depressing its nervo-muscular substance, partly by depressing the cardiac centre in the medulla.

On respiration they weaken and slow the respiratory movements by depressing the respiratory centre in the medulla.

On the blood-vessels the direct effect is not known in a definite manner; probably the tension in the vessels is reduced.

Toxic Effects.—Given in continued large doses the bromides cause a condition termed *bromism*, consisting of cerebral depression, feebleness, anæmia, and the occurrence in some instances of an eruption resembling acne.

(4) REMOTE LOCAL ACTION.

The bromides are quickly eliminated, chiefly by the kidneys, also by the salivary glands, skin, and all mucous surfaces. In their passage through the excretory organs they set free bromine, which exerts certain effects, when they are given continuously, such as irregular disturbance of the urinary constituents, an eruption on the skin, and sometimes conjunctivitis.

Medicinal Uses.—The bromide of potassium is the salt most frequently used.

In *epileptic convulsions* in dogs the bromide of potash often gives favourable results as a palliative remedy. It is also useful in *chorea*, and in both these affections is combined with the liquor arsenicalis with benefit. The bromide of ammonium is recommended by some practitioners in the early stages of pneumonia in horses, when the affection is accompanied by nervous excitement.

In milk fever in cows, it is recommended in combination with chloral hydrate, but many practitioners prefer the latter drug administered alone.

In strychnine poisoning it is inferior as an antidote compared with chloral hydrate or chloroform.

In tetanus it is sometimes prescribed in combination with belladonna, but does not appear to be of any special value in the treatment of this intractable affection.

SUB-GROUP II.

SULPHUR.

Source.—Crude sulphur is chiefly obtained from the native sulphur, occurring as a product of volcanic action in Sicily and Italy. It is the source of all the preparations, with the exception of calx sulphurata.

Sulphur Sublimatum—SUBLIMED SULPHUR—'FLOWERS OF SULPHUR.'

Prepared from crude sulphur by subliming in large chambers.

Doses.—As a laxative: Horses, ℥i. to ℥iv.; cattle, iii. to ℥vi.; sheep and pigs, ʒiv. to ℥i.; dogs, ʒi. to ʒii.

As an alterative, one-fourth of these doses is prescribed.

Sulphur Præcipitatum—Precipitated Sulphur—'Milk of Sulphur.'

Prepared by boiling sublimed sulphur with slaked lime in water, precipitating the filtrate with dilute hydrochloric acid, washing and drying.

Doses.—Same as those of sublimed sulphur.

Sulphuris Iodidum—IODIDE OF SULPHUR.

Prepared by fusing sublimed sulphur with iodine.

Unguentum Sulphuris Iodidi.—1 in 15½ lanolin and vaseline.

Calx Sulphurata—SULPHURATED LIME.

Prepared by heating a mixture of sulphate of calcium with wood-charcoal.

Acidum Sulphurosum—SULPHUROUS ACID.

Prepared by burning sulphur in air.

ACTIONS OF SULPHUR AND ITS PREPARATIONS.

(1) IMMEDIATE LOCAL ACTION.

Externally, sulphur applied to the skin in its dry form has little or no local action. Applied in the form of ointment, it becomes partially converted by contact with the acid products of the skin into sulphuretted hydrogen and sulphides, which exert special local actions. It acts as a *vascular stimulant* and *nervous sedative*, and an alterative to the superficial layers of the skin, by stimulating epithelial cells, and increasing movements of cilia.

Internally it undergoes no change in the *stomach*, and possesses no appreciable action on the organ. It is carried to the intestines, and is in part converted into *sulphides* by the action of the bile, producing mild purgation when given in full doses by stimulating the glandular structures, and also probably by increasing peristalsis. A considerable amount of sulphuretted hydrogen becomes generated in the intestines, and portion of the sulphur escapes unabsorbed in the fæces, either unchanged or as sulphides of hydrogen, or combined with alkalies met with in the bowel.

(2) ACTION ON THE BLOOD.

A certain proportion of sulphur enters the blood in the form of sulphides of hydrogen and the alkalies. We are not aware of any action which it possesses on the physical or chemical constitution of the blood. It is believed that portion becomes oxidized, appearing in the urine as a sulphate.

Sulphuretted hydrogen, if inhaled by an animal, acts as a powerful blood poison, reducing the oxyhæmoglobin of the red corpuscles, and converting the carbonates and phosphates of the white corpuscles into sulphides, sulphites, and sulphates.

(3) SPECIFIC ACTION.

Sulphur in the form of hydrogen and alkaline sulphides enters the tissues from the blood, and in excessive doses acts upon the central nervous system, causing depression, and finally paralysis of the centres of respiration and circulation, besides giving rise to inflammation of the stomach and intestines, as proved by the experiments of Moiroud and Hertwig.

In medicinal doses we believe that sulphur possesses the effect of modifying nutrition, and thus acting as an *alterative*.

(4) REMOTE LOCAL ACTION.

Sulphur is excreted by the kidneys, by the skin, the lungs and the bronchii, and by the intestines.

By the kidneys it is excreted in the form of sulphates, and if in excess as sulphides also; the constituents of the urine are not altered, with the exception of the increase of the sulphur compounds.

By the skin it is excreted in the form of sulphides and sulphuretted hydrogen, giving a characteristic odour to the perspiration, increasing slightly the amount of the latter, and acting as a *mild cutaneous stimulant* and diaphoretic.

By the lungs and bronchii it is excreted in the form of sulphides, and is believed to act as a *mild expectorant*.

By the intestines it acts as a *purgative alterative*.

Medicinal Uses.—*Internally.*—*As an alterative* sulphur is extensively prescribed in affections of the skin, such as acne, eczema, etc.; also in dry, scurfy conditions of the skin, and general want of condition. It is given either in the sublimed or precipitated forms, or in the form of the sulphide of calcium.

As a laxative it is sometimes employed in cattle practice, and frequently in canine practice; its action as a laxative as well as an alterative rendering it an agent of great value in the latter, and being almost devoid of taste it is readily taken in the food.

As an expectorant it is seldom prescribed, and its action in this respect appears to be slight.

Externally.—As a parasiticide it is extensively employed in the treatment of *mange* in all species of animals. It is used in various combinations, in the form of liniments, ointments, etc. Experiments and practical experience prove that the efficacy of sulphur for such purposes is greatly increased by combining it with an alkali, such as the carbonate of potassium. It is believed that the parasites on which mange depends are destroyed by the formation of sulphuretted hydrogen and other toxic sulphides, the combination of the sulphur with the alkali increasing the production of these compounds, besides tending to soften and remove the crusts and scales on the skin. Two parts of sublimed sulphur and one part of carbonate of potassium, dissolved by the aid of gentle heat, in eight parts of lard or oil, make a useful application for such cases, the addition to this of one part of the oil of tar rendering it more efficacious.

Before being applied, the parts should be thoroughly washed with soft soap and warm water, so as to enable the application to act directly on the parasites. It should be allowed to remain on for two days, and then be washed off, and reapplied if necessary.

As a dip for sheep, sulphur is highly recommended in the form of the sulphide of calcium, prepared as follows: Boil one part of quicklime with two of sublimed sulphur in ten parts of water until the sulphur and lime combine, let the solution stand, and pour off the clear portion.

A sufficient amount can be prepared in similar proportions to the above.

As a *cutaneous stimulant and alterative*, sulphur in various forms of combinations is employed as an application to affections of the skin, such as chronic eczema, psoriasis, etc., stimulating epithelial cells, hastening desquamation, and thus promoting a healthier action in the parts. The ointment composed of sublimed sulphur and carbonate of potash, already mentioned, is very useful for such purposes.

The iodide of sulphur, in the form of ointment (1 to 8) acts very beneficially in some forms of chronic scaly skin affections, and also in cases of ringworm.

Sulphurous acid is employed as a disinfectant for stables and premises, the gas being evolved by burning sulphur mixed with one-fortieth part of finely-divided charcoal. It is sometimes used as an inhalation for destroying bronchial filariæ in calves and lambs.

Sub-Group III.

CARBO—CARBON.

Two forms of carbon are recognised, viz.:

1. **Carbo Animalis.**
2. **Carbo Ligni.**

(1) Carbo Animalis—Animal Charcoal.

Prepared by exposing bones to a red heat, excluding air, and powdering the residue. The purified animal charcoal is prepared by digesting the agent in diluted hydrochloric acid, and thus removing the salts therefrom.

(2) **Carbo Ligni**—Wood Charcoal.

Prepared from wood charred by exposure to a red heat, and excluding air.

General Actions.—*Externally* charcoal acts as a *desiccant*, *disinfectant*, and *deodorant*. It possesses the property of absorbing and condensing many gaseous bodies and vapours, it absorbs but little hydrogen, although it will take up a considerable amount of oxygen, and large quantities of sulphuretted hydrogen and ammonia. Its action on noxious gases is believed to depend on the oxygen which it retains decomposing and deodorizing them. Some authorities state that it has the power of absorbing and condensing the noxious gases in its pores.

Internally, charcoal given in sufficient amount has the power of checking fermentative changes while passing through the alimentary canal, and by virtue of this action it will prevent the occurrence of flatulence. It possesses the power of attracting alkaloids from their solutions in the stomach, and rendering them inert; hence animal charcoal has been recommended by Dr. Garrod as an antidote in cases of poisoning by morphia, aconite, strychnia, etc.

Charcoal is removed from the system entirely by the intestines, and not being absorbed, it does not exert any specific action on the body.

Medicinal Uses.—As an agent to check the formation of gases due to fermentative changes in the alimentary canal, charcoal is sometimes prescribed in cases of flatulence in doses of ℥ss. to ℥ii. for horses and cattle, and grs. xx. to ʒi. for dogs.

Externally.—It is occasionally employed as a *deodorant* and *disinfectant* to unhealthy ulcers or foul wounds, being applied directly in the dry form; but as it possesses no action as an antiseptic, other agents are to be preferred.

CHAPTER V.

INORGANIC MATERIA MEDICA—*Continued.*

GROUP IV.—ACIDS.

For convenience of description, we may arrange the official acids in common use under two headings :

1. INORGANIC ACIDS.

Sulphuric ; Nitric ; Hydrochloric ; Nitro-hydrochloric ; Boric ; Chromic.

2. ORGANIC ACIDS.

Acetic ; Citric ; Tartaric ; Hydrocyanic ; Carbolic ; Gallic and Tannic ; Salicylic.

Of the organic acids, only the first three will be noticed in this chapter, as the actions and uses of the remainder are but slightly connected with their properties as acids.

We shall first briefly notice the general actions of *acids* before proceeding to a consideration of the actions and uses of each acid separately.

(1) IMMEDIATE LOCAL ACTION.

Externally.—The strong acids—such as sulphuric, hydrochloric, and nitric—are *caustic* and *irritant*, and in concentrated form are powerful corrosives. They produce these effects by their affinity for the bases and water of the tissues, and in a lesser degree for the organic substances therein. Properly diluted, they act as astringents when applied to the skin, mucous membranes, etc., causing a direct condensation of the tissues, and thus checking hæmorrhage from small vessels and capillaries.

Internally.—In the mouth they act as *sialagogues*, being powerful stimulants of salivary secretion, this action depending on an impression reflected through the cerebro-spinal nerves supplying the salivary glands. They are in part neutralized by the alkaline secretion from the salivary glands, the resulting salts exerting some astringent effects.

In the stomach—acids act directly upon the contents of this organ; the free acids quickly unite with bases in the digestive tract, and form neutral salts. Hydrochloric acid increases the acidity of the gastric juice when given after feeding, thus acting as a digestive adjuvant.

In the duodenum acids increase the acidity of the chyme, stimulate the intestinal glands and muscular coat of the intestine, and also stimulate the liver and pancreas. The dilute sulphuric acid acts as an intestinal astringent.

(2) ACTION ON THE BLOOD.

Acids on entering the blood combine with part of the alkali of the liq. sanguinis, and thus render the blood *less alkaline;* but even when given in toxic doses they do not produce an *acid* reaction in this fluid. We are not aware of any further effects which they are capable of producing on the blood. The vegetable acids, when administered as salts of the alkalies, have a deoxidizing effect on the blood.

(3) SPECIFIC ACTIONS.

On the different tissues and organs of the body each of the acids possesses a specific action of its own. There are, however, some important actions which acids exert on the salivary and digestive secretions, and of these we shall now give a brief notice:

On the salivary secretion they act as powerful sialagogues; the impression from the acid is conducted to the nerve centres, and is then reflected through the cerebro-spinal nerves supplying the salivary glands.

On digestion—dilute acids taken into the stomach check or lessen the secretion of gastric juice; they also cause an increased flow of bile, probably by rendering the contents of the duodenum of an acid reaction, and increase the activity of the intestinal glands and muscles.

All these effects must be attributed to a law which is proved both by experiment and also by the employment of acids in therapeutics—viz., that acids check acid but increase alkaline secretions, while dilute alkalies stimulate acid secretions.

These facts are explained in an admirable manner by Dr. Ringer in his work on 'Therapeutics,' and they are most important in the treatment of the disorders of the digestive system, as indicating whether acids or alkalies should be prescribed.

Dr. Ringer supports these views by illustrations of the therapeutic employment of acids or alkalies, as follows:

1. Acids allay thirst by promoting the secretion of the alkaline saliva.

2. Acids given shortly before feeding generally check acidity.

3. Alkalies given shortly before feeding increase the secretion of the acid *gastric juice, and so promote digestion.*

Acids check fermentation, and the formation of gases and irritating organic acids in the intestines, and thus act antiseptically in this respect.

In toxic doses, and in concentrated form, acids are *corrosive irritant poisons*, nitric and sulphuric acids possessing these actions in a most marked degree.

The suitable antidotes are alkaline bicarbonates, calcium and magnesium carbonates, given with demulcents and diluents—such as oils, milk, linseed-tea—the addition of an anodyne—such as opium—being often required.

(4) REMOTE LOCAL ACTION.

Acids having entered into combination as neutral salts, or having been decomposed in the blood, are removed from the system, and during this process they exert very little local action. They are chiefly excreted by the kidneys, stimulating these organs by increasing the total amount of salts excreted; but they do not to any extent increase the free acidity of the urine.

Acetic, citric, and tartaric acids never reach the tissues unless given in large doses; they are decomposed in the blood, and excreted as carbonates. Given in excess, they escape unchanged by the kidneys.

INORGANIC ACIDS.

(1) **Acidum Sulphuricum**—SULPHURIC ACID, OIL OF VITRIOL.

Prepared by the combustion of sulphur, and the oxidation and hydration of the resulting sulphurous acid by means of nitrous and aqueous vapours. Contains 98 per cent. of real acid.

Preparations.

(*a*) **Acidum Sulphuricum Dilutum.**—Dilute sulphuric acid.—1 to about 11 of distilled water.

Doses.—Of the dilute acid: Horses, ʒi. to ʒii.; cattle, ʒii. to ʒiv.; dogs, ♏v. to ♏xx.—administered, freely diluted, twice daily, and combined with aromatics and bitters.

(*b*) **Acidum Sulphuricum Aromaticum.**—Prepared by mixing sulphuric acid, $1\frac{1}{2}$; spirit, 18; spirit of cinnamon, 1; strong tincture of ginger, 1. Contains 12·5 per cent. of real acid.

Doses.—Similar to those of the dilute acid.

Actions—*Externally.*—Strong sulphuric acid absorbs water with avidity from the tissues, and has also an affinity for their bases, and to a less degree for the organic substances themselves. For these reasons, when applied locally, it destroys the tissues to a considerable extent, producing a *brown* or *black* eschar and a powerful corrosive action.

Internally.—The dilute and aromatic preparations only are employed internally. These act as *tonics* and *astringents*, the tonic action probably depending on a stimulating effect upon the gastric and biliary functions, the astringent action probably on an astringent effect on the bloodvessels.

It must be remarked, however, that the acid is soon neutralized in the upper part of the small intestines, being converted into a sulphate, thus losing its astringency. It is excreted chiefly by the kidneys, increasing to a slight extent the amount of sulphates in the urine; it is probable that part escapes by the bowels as sulphates of sodium and maguesium, and a certain portion possibly by the skin.

Toxic Effects. — Sulphuric acid acts as a corrosive irritant poison, producing in concentrated form patches of erosion of a brown or black colour on the mouth, fauces, œsophagus, and mucous membrane of the stomach, with perforation of the latter in some instances. The throat becomes acutely inflamed, extensive swelling resulting, with rapid death from suffocation.

In dogs it causes immediately retching and emesis, the vomited matters being dark-coloured and blood-stained.

The antidotes are alkaline bicarbonates, chalk, or carbonate of magnesia, given in small quantities frequently repeated, with a liberal administration of demulcents.

Medicinal Uses—*Internally.—As a tonic and astringent*, the medicinal preparations are prescribed in chronic diarrhœa and dysentery, generally combined with a preparation of opium, carminatives, etc., and administered in starch gruel.

It is recommended by some practitioners in the treatment of purpura hæmorrhagica in horses, being prescribed with the sulphate of iron. It is an efficient antidote in cases of poisoning by lead and by alkalies. In pharmacy it is employed as a solvent in dispensing sulphate of quinine in the form of mixtures.

Externally.—Sulphuric acid is occasionally employed as a *caustic* to destroy some forms of malignant growths, being mixed with suitable substances for such purposes. It is recommended as an application to contract and remove umbilical herniæ, being applied either pure or mixed with linseed-oil.

(2) **Acidum Nitricum**—Nitric Acid, Aquafortis.

Prepared from nitrate of potassium by distillation with sulphuric acid and water. Contains 70 per cent. of real nitric acid.

Preparation.

Acidum Nitricum Dilutum.—1 to 4 of distilled water.

Doses.—Of the diluted acid: horses or cattle, ʒss. to ʒii.; dogs, ♏v. to ♏x. properly diluted.

Actions—*Externally.*—Nitric acid, not possessing so strong an affinity for water, and not readily redissolving precipitated albumin, is not so penetrating as sulphuric acid, and hence, when locally applied, destroys the tissues less extensively.

It stains the skin a characteristic *yellow* colour, due to the formation of picric acid. This colour is deepened by alkalies, and removed only by desquamation of the cuticle.

The action of nitric acid on the skin and tissues is comparatively speaking slow, but is usually very deep-seated, especially if close to the flexure of a joint, an extensive slough often resulting.

Internally the dilute nitric acid acts as a *cholagogue*, probably in part by its action on the mucous membrane of the duodenum, causing an increased flow of bile, by consequent contraction of the gall-bladder and bile-ducts; also, probably by the contents of the duodenum being rendered acid, the secretion of the alkaline bile is stimulated.

Nitric acid possesses similar actions to other acids on the alimentary canal and on digestion. It is believed to be partly decomposed in the system into ammonia, and during its excretion by the kidneys to diminish slightly the acidity of the urine.

Toxic Effects.—Nitric acid is a corrosive irritant poison, especially when in concentrated form. It causes yellow or brown stains in the mouth, pharynx, and œsophagus; but in the mucous membrane of the stomach these are usually rendered obscure by the acute inflammatory changes, often accompanied by extravasation of blood.

The antidotes are similar to those employed for the other mineral acids.

Medicinal Uses.—*As a hepatic stimulant* dilute nitric acid is prescribed after feeding, in cases of torpidity of the liver accompanied with intestinal dyspepsia. It is also useful in long-standing affections of the liver, such as chronic congestion and cirrhosis.

In cases of diarrhœa, especially in young animals, where the motions are greenish in colour, curdled, and mixed with mucus, small doses of dilute nitric acid are often of great benefit. Nitric acid should be given largely diluted with water, and is usually combined with aromatic bitters.

Externally nitric acid is employed for the removal of warts, fungous growths, etc. It should be carefully applied with a glass rod, precautions being taken to prevent the surrounding tissues being injured, and also to guard against its action extending too deeply.

(3) **Acidum Hydrochloricum**—Hydrochloric Acid, Muriatic Acid, Spirit of Salt.

Prepared by the action of sulphuric acid upon chloride of sodium and solution of the fumes in water. Contains 32 per cent. by weight of the gas dissolved in water.

Acidum Hydrochloricum Dilutum—Dilute hydrochloric acid—1 to $2\frac{1}{4}$ distilled water.

Doses.—Of the dilute acid : horses, ʒss. to ʒii. ; cattle, ʒii. to ʒiv. ; sheep, ♏xv. to ♏xx. ; dogs, ♏v. to ♏x. properly diluted.

Actions—*Externally.*—Hydrochloric acid is an active *caustic*, causing the formation of a *white* film on the tissues when applied in concentrated form. It is less corrosive in its action than nitric or sulphuric acid.

Internally.—In the mouth it is a *stimulant* and *sialagogue*, increasing the flow of saliva, and thus indirectly, as well as reflexly, of the gastric juice. In the stomach it increases the acidity of the gastric juice, and acts as a *digestive adjuvant*. It enters the tissues in the form of chlorides, possessing no appreciable specific action thereon. It is excreted chiefly by the kidneys, but does not increase to any extent the free acidity of the urine.

Toxic Effects.—These resemble those of the other mineral acids, but, independent of its irritant or corrosive effects, it is believed to destroy life by causing a fatal diminution of the alkali in the blood, resulting in paralysis of the respiratory centre.

Medicinal Uses.—*As a sialagogue*, hydrochloric acid, largely diluted with water, is sometimes prescribed in cases of fever accompanied with excessive thirst and a parched condition of the mouth. It relieves the throat by stimulating the secretion of saliva, and, besides, increases the appetite, and favours digestion by stimulating indirectly, as well as reflexly, the gastric secretion.

As a digestive adjuvant it is extensively employed, in consequence of its special action in digesting and rendering soluble the albuminous constituents of the food. It is important, however, to remember the influence of the time of administration as regards prescribing the acid before or after feeding.

Thus, in cases where the secretion of the gastric juice is scanty, and not sufficient to perform the function of digestion in a normal manner, the acid should be administered *after* feeding. When the gastric secretion is completed, the acid then makes up for the deficiency of that which should be secreted naturally. On the other hand, when there is an excess of acid secreted in the stomach, giving rise to a condition of undue acidity of the gastric contents, the administration of dilute hydrochloric acid *before* feeding will overcome this condition.

The rationale of this depends on the rule that acids check the production of acid secretions from the glands, while they increase the flow of alkaline secretions, the very reverse being the case with alkalies.

Acidity of the stomach, however, does not always depend on an excessive secretion of gastric juice; it is often due to an excessive or irregular fermentation in the contents of the organ, leading to the formation of large amounts of various acids, such as acetic, butyric, and lactic; and here also the administration of dilute hydrochloric acid checks this irregular fermentation. It is best combined with vegetable tonics and bitters for such purposes, care being taken not to continue the administration for too long a period, which would tend to induce the opposite condition to that for which it was employed in the first instance.

As alkalies administered before feeding increase the secretion of gastric juice, it becomes a question for the practitioner as to whether he shall prescribe an acid or an alkali in cases of dyspepsia depending on a scanty secretion of gastric juice.

Practical experience teaches that no hard and fast rule can be laid down. In some cases alkalies administered shortly before feeding give better results than acids administered after feeding; while in others the reverse holds good. It is evident that in cases of acidity of the stomach depending on excessive secretion, acids given after feeding would increase the abnormal condition and aggravate it.

In cases of *renal concretions,* also in cases characterized by the appearance of an excessive sediment in the urine, small doses of the dilute hydrochloric acid are recommended, as this agent possesses the power of dissolving the earthy carbonates, rendering them soluble, and capable of being removed in the urine.

Externally.—Hydrochloric acid is occasionally employed as a *caustic* in the removal of warty growths, etc., and also in combination with other agents as an application to *foot-rot* in sheep. In *superficial necrosis of bone* it is useful, properly diluted, removing the diseased portion and leaving a healthy surface to heal.

(4) **Acidum Nitro-hydrochloricum**—Nitro-Hydrochloric Acid, Nitro-Muriatic Acid.

Prepared by mixing one part of nitric acid and three of hydrochloric acid.

Acidum Nitro-Hydrochloricum Dilutum—Dilute Nitro-Hydrochloric Acid.

Prepared by mixing 3 ounces of nitric acid and 4 ounces of hydrochloric acid with 25 ounces of distilled water. It contains free chlorine, hydrochloric, nitric, and nitrous acids, with other compounds, dissolved in water, and should be prepared fourteen days before using.

Doses.—The same as those of dilute nitric acid, with similar precautions as to dilution and the avoidance of too prolonged use.

Actions—*Externally.*—The strong acid is corrosive and irritant. It is believed to produce a cholagogue effect locally as well as specifically, when applied as a compress wrung out of a solution of the acid over the hepatic region in the case of liver affections in dogs.

Internally.—It acts as a *direct cholagogue*, as demonstrated by the experiments by Dr. Rutherford; this action is also proved by the results of clinical experience. It resembles the other acids in its action on the stomach and intestines.

Medicinal Uses.—*As a cholagogue* it is prescribed in torpidity of the liver, in catarrhal jaundice, and in the early stages of cirrhosis, also in intestinal dyspepsia. It is contra-indicated in cases of jaundice depending on obstruction in the bile-duct, also in severe organic affections of the liver, and in acute hepatitis.

In that affection of horses termed *oxaluria*, characterized by debility, loss of flesh, stiffness in the loins, a dry scurfy condition of the skin, the frequent passage of pale-coloured urine, acid or neutral in reaction, and containing oxalate of lime, the nitro-hydrochloric acid, in combination with tincture of nux vomica and gentian, gives very beneficial results.

This affection depending on impaired digestion, due to dietetic errors, it is necessary that dietetic and hygienic precautions be adopted in addition to medicinal treatment.

The acid is not employed externally, except occasionally as a local application in dilute solution in some hepatic affections, as already mentioned.

(5) **Acid Boricum**—BORIC ACID, BORACIC ACID.

Prepared by the action of sulphuric acid on borax, or by the purification of native boric acid.

Doses.—Horses and cattle, ʒii. to ʒiv.; dogs, grs. v. to grs. xx.

Preparations.

(1) **Unguentum Acidi Borici**—Boric ointment—1 to 6 of hard and soft paraffin.

(2) **Boroglyceride** (not official) is prepared by heating 92 parts of glycerine with 62 parts of boric acid.

Borax—BIBORATE OF SODIUM.

Prepared by boiling together boric acid and carbonate of soda. It is also found native.

Preparations.

(1) **Glycerinum Boracis**—Borax, 1; glycerine, 4; water, 2.

(2) **Mel Boracis**—Borax, 2; glycerine, 1; clarified honey, 16.

Actions.—*Externally.*—Boric acid is *antiseptic* and *disinfectant.* In solution of 1 in 800 it is capable of destroying low organisms, but is not, however, destructive to all growths of this nature. It has little or no irritating effect on the tissues, in this respect differing from carbolic acid and other disinfectants.

Internally it checks fermentation in the alimentary canal; it is excreted in the urine, exerting an antiseptic effect on the urino-genital canal.

In **toxic doses** it acts as a gastro-intestinal irritant.

Borax possesses similar actions to those of boric acid.

Medicinal Uses.—Boric acid and borax are occasionally employed internally in cases of fermentative diarrhœa in foals, calves, and dogs, also in some cases of cystic catarrh, by reason of its remote local antiseptic action on this region.

In *aphthous* conditions of the mouth, in ulcerations of the mouth, tongue, and fauces, and in glossitis, it is employed in the form of a mouth-wash, in combination with the chlorate of potash, honey, or glycerine.

As an antiseptic dressing for wounds, boric acid is largely employed in the form of lotion, in the proportion of a 5 per cent. solution. It is also very useful in the form of dry powder, combined with a certain proportion of creolin.

In different forms it is in frequent use as an application to burns and ulcerated surfaces.

In erythema, in irritable conditions of the skin, and in eczema in dogs, the employment of boric acid in the form of ointment, as follows, often gives most satisfactory results: boric acid, 5 parts; lanoline, 5 parts; vaseline, 1 part.

In canker of the ear in dogs boric acid is successfully employed, either in the form of lotion or of the ointment just mentioned, combined with oxide of zinc. For a similar purpose the dusting powder, composed of boric acid and creolin, is also very useful.

In catarrhal and purulent conjunctivitis a lotion consisting of from three to six grains of boric acid to the ounce of aqua laurocerasi, applied three or four times daily, gives excellent results, lessening irritability and reducing the discharge. In severe cases this treatment may be alternated with atropine lotions.

(6) **Acidum Chromicum**—Chromic Acid, Chromic Anhydride (not a true acid).

Prepared from potassium bichromate.

Actions.—Chromic acid is a penetrating *caustic* and escharotic, also a *disinfectant* and *deodorant.* It coagulates albumin, and is a powerful oxidizing body, destroying the organisms and products of decomposition. It also decomposes ammonia and sulphuretted hydrogen.

Medicinal Uses.—It is not prescribed internally.

As an escharotic and *caustic* it is recommended by Professor Williams as an application to that intractable affection of the foot of the horse termed canker. For this purpose it should be sparingly applied, as in consequence of its great affinity for water a blaze of fire results from the intensity of the combination.

ORGANIC ACIDS.

Acidum Aceticum—Acetic acid contains 33 per cent. of real acetic acid by weight in water.

Prepared from wood by destructive distillation and purification.

Acidum Aceticum Dilutum—1 to 7 of distilled water.

Acidum Aceticum Glaciale—Glacial Acetic Acid—contains 99 per cent. of real acetic acid with water.

Prepared by distillation from acetate of sodium and sulphuric acid.

Acetum—Vinegar—contains 5·41 per cent. of acetic acid.

Prepared from a mixture of malt and unmalted grain by the acetous fermentation.

Actions.—Strong acetic acid is corrosive and irritant when applied to the skin; the medicinal acid acts as a *vesicant* and *stimulant* when applied in sufficient amount. Properly diluted, or in the form of vinegar, it is stimulant, astringent, and refrigerant. When administered internally, it reaches the blood and becomes decomposed, passing out of the system as carbonates, but when given in excess it escapes unchanged by the kidneys.

Medicinal Uses.—Acetic acid is not employed internally. It may be used as an antidote in cases of poisoning by alkalies and alkaline carbonates, and also when properly diluted, as an application to surfaces irritated by strong alkalies. The strong acid is frequently employed as a caustic in the destruction of warts. In the form of vinegar it is used as a cooling and astringent application to strains and contusions, either alone or combined with other agents. In pharmacy it is employed as a solvent for various drugs, as it is capable of dissolving their active principles, such combinations being termed *aceta*. *Example*—Acetum cantharidis.

Acidum Citricum—Citric Acid.

Acidum Tartaricum—Tartaric Acid.

Both these acids are devoid of irritant and poisonous properties, and are occasionally prescribed as cooling antipyretics; they relieve thirst, and, like other organic bodies, are excreted as carbonates, probably stimulating the kidneys and skin indirectly by increasing the total amount of salts excreted.

GROUP V.—WATER—AQUA.

Aqua Destillata—Pure Water obtained by Distillation.

(1) IMMEDIATE LOCAL ACTION.

Externally water acts chiefly as a means of applying cold or heat to the surface of the body, depending on the temperature which is employed, whether cold, temperate, tepid, warm, hot, etc., the effects of which have already been noticed in Part II., p. 203.

Internally it relieves thirst, improves digestion and intestinal action when allowed at proper times. In the dog, hot water acts as a *gastric sedative*, and warm water as an *emetic*.

(2) ACTION ON THE BLOOD.

Water readily passes into the blood, but this process varies according to circumstances. In cases where a large amount of fluid is removed from the system, water is quickly absorbed, while if there is a sufficient amount of this agent in the blood already, the absorption of a further quantity from the alimentary canal is diminished.

(3) REMOTE LOCAL ACTION.

Excess of water is eliminated by the kidneys, skin, lungs, bowels, but chiefly by the kidneys, acting as a *diuretic*. Administered warm, and combined with external heat, it acts as a *diaphoretic*.

(4) USES.

As a *diluent* and *febrifuge* cold water is liberally allowed in cases of febrile affections, the vessel containing it being left within reach of the animal, so that it can be partaken of at pleasure, and saline febrifuges dissolved in it give beneficial results. Cold water is contra-indicated directly after feeding, also when animals are in a heated condition after exertion. After the administration of a cathartic dose, and until the physic has ceased to operate, cold water should be studiously avoided, as it is likely to induce superpurgation, or spasm of the intestines.

Externally water is extensively employed, either hot, in the form of fomentations, or cold as a refrigerant. The employment of hot or cold applications is often a matter of choice with the practitioner. We must, however, draw attention to the beneficial effects of continuous irrigation in severe cases of broken knees, open joints, etc. (see p. 204).

CHAPTER VI.

GROUP VI.—THE CARBON COMPOUNDS.

ALCOHOL.

THE following forms of alcohol are those of chief importance in therapeutics:

(1) **Spiritus Rectificatus**—RECTIFIED SPIRIT.

Alcohol with 16 per cent. of water.

Prepared by distillation of fermented saccharine fluids.

(2) **Spiritus Tenuior**—PROOF SPIRIT.

Alcohol with 51 per cent. by weight of water.

Prepared by mixing 5 parts of rectified spirit with 3 parts of water.

(3) **Spiritus Vini Gallici**—BRANDY.

Contains from 48 to 56 per cent. by volume of absolute alcohol.

Prepared by distillation from French wines.

(4) **Spiritus Frumenti**—WHISKY.

Contains about 44 to 50 per cent. of absolute alcohol.

Prepared by distilling a thoroughly fermented solution of malt.

(5) **Vinum Xericum**—SHERRY.

Contains about 17 per cent. of alcohol.

Prepared from the fermented juice of the grape.

(6) **Gin—Hollands—Geneva.**

Contain from 40 to 50 per cent. of alcohol, and are *prepared* from fermented malt, with a small quantity of juniper berries.

(7) **Port and Madeira Wines.**

Contain from 14 to 18 per cent. of alcohol.

(8) **Ales and Porter.**

Contain from 4 to 8 per cent. of alcohol, and are *prepared* from malt, with hops and yeast.

(9) **Methylated Spirit.**

A mixture of 90 parts of rectified spirit with 10 parts of wood-spirit or impure methylic alcohol. It is chiefly used for pharmaceutical purposes.

The methylated spirit for retail use has the addition of 3 pints of petroleum oil to 100 gallons of the above.

THE ACTIONS OF ALCOHOL AND ITS PREPARATIONS.

(1) IMMEDIATE LOCAL ACTION.

Externally alcohol is a powerful *refrigerant;* it withdraws heat from the surface by its evaporation, lessens the local cutaneous circulation by vascular constriction, and produces a sensation of cold. If the vapour be confined and allowed to act on the tissues beneath, or if the agent be rubbed into the part, it acts as a *stimulant* and *rubefacient* by penetrating the epithelium and irritating the nerves and vessels of the cutaneous structures, the results being redness, heat, and pain, followed by local anæsthesia. It is *antiseptic* and *disinfectant* when employed as a constituent of lotions for wounds and ulcers, and possesses the power of hardening the epidermis. It can be absorbed by the unbroken skin.

Internally it has the property of coagulating albumin, and constringing to a small extent the mucous membranes of the mouth if it be retained in contact with them. It stimulates the flow of saliva, and gives an increased relish for food.

In the stomach alcohol, in a moderate dose, produces the following important effects:

(*a*) It mixes with the *contents of the stomach*, and is partly decomposed into aldehyde and acetic acid. It precipitates a portion of the pepsin, as well as of the peptones and proteids; thus, to a certain extent, it *retards digestion.*

(*b*) It stimulates the gastric mucous membrane, dilating the vessels, and increasing the blood-supply and the flow of gastric juice; the appetite is sharpened, and the movements of the stomach become more energetic, the total effect of a moderate dose thus being to *favour gastric digestion.*

(*c*) Alcohol produces important effects of a *reflex* nature from its action on the gastric walls. The heart is stimulated, and the general blood-pressure raised; the active organs are filled with blood, and their activity thus increased, the agent producing the characteristic effects of a *diffusible stimulant.*

(2) ACTION ON THE BLOOD.

Owing to its high diffusion-power alcohol passes readily into the blood. It enters either unchanged or as an aldehyde, and is distributed to the tissues and organs. The precise action of alcohol on the corpuscles of the blood is not yet accurately determined; it is supposed to have the effect of *binding the oxygen more firmly to the hæmoglobin*, with the result that oxygenation of the tissues occurs less freely and less extensively.

(3) SPECIFIC ACTION.

On the tissues and organs alcohol exerts several important actions, which we shall refer to under the following headings:

(*a*) **Alcohol as a Food.**—Given in moderate quantity alcohol becomes *oxidized* in the tissues, carbonic acid and water being produced, so that it resembles other carbo-hydrates, being a source of energy, and thus acting as a food. Given in large amounts, it may pass out of the system by the lungs, kidneys, etc., before oxidation has had time to take place.

Alcohol does not become an integral part of the living cells; it remains in the plasma surrounding the cells, where, being oxidized, it supplies an amount of energy to the active elements; thus, it can temporarily sustain life when, from some cause, a sufficient amount of food cannot be taken or assimilated.

(*b*) **Alcohol as a Nutritive Depressant.**—It has been demonstrated by experiments that alcohol *interferes with the metabolism or oxidation* of the tissue proteids or formed protoplasm of the cells, or, in other words, it spares the wear and tear of the tissues.

In experiments moderate doses of alcohol were given to animals, and the following deductions were arrived at: Firstly, *less oxygen was absorbed;* this is supposed to depend on the power of interference which alcohol possesses over the oxygenating function of the red corpuscles. Secondly, *the temperature fell*, and the albuminous tissues, while not wasting, tended to degenerate into fat, so that the whole system inclined to grow gross and fat. Thirdly, there was a diminution in the amount of urea, uric acid, carbonic acid, and salts excreted.

These effects are believed to depend on the readiness with which alcohol, when it reaches the tissues, seizes on the oxygen which is present, and thus deprives the fixed elements of their proper share, with the result that their decomposition is arrested at the middle stage of fat formation. We thus observe that alcohol has the property of *saving tissue waste.*

(*c*) **On the heart and circulation** alcohol acts as a *stimulant.* It increases the force and frequency of the heart's action, and causes dilatation of the peripheral bloodvessels, the total effect being *increased circulatory activity.* This effect depends both on *reflex* stimulation from the mucous membrane of the stomach, and on *direct stimulation of the nervo-muscular structures of the heart itself;* also of the *cardiac centre*, and of the *nervo-muscular tissue of the middle coat* of the vessels. Administered in large doses, this stimulant effect of alcohol on the circulation is followed by *depression*, both reflex and direct.

According to Dr. Ringer ('Handbook of Therapeutics'), alcohol in health dilates the arterioles, and makes the pulse larger and softer; while in disease, or when from other causes the arterioles are relaxed, it contracts them, rendering the pulse smaller, slower, less frequent, and more resistant; thus, it strengthens the pulse and reduces its frequency, and must be considered one of the most powerful *cardiac tonics*.

(*d*) **On the nervous system** the primary effect of alcohol in moderate amount is that of *stimulation.* The nerve-centres are stimulated, commencing from the highest to the lowest; but in animals, in consequence of the inferior development of the cerebrum, alcohol in full doses has the effect of disturbing motor functions rather than intellectual. In large amounts, the primary stimulant effects quickly give way to *depression* of all the nerve-centres, finally terminating in complete arrest of their function. The muscles become first ataxic and then paralyzed, so that the standing posture becomes difficult or impossible; the respiratory and circulatory centres may be depressed to such an extent as to cause stertorous breathing, failure of the circulation, and death.

The effects of alcohol on the nerve-centres are partly due to—(*a*) *Dilatation of the bloodvessels of the brain and cord*; (*b*) partly *to a direct action of the drug upon the nerve-cells.*

(*e*) **On Respiration.**—Alcohol acts partly through its influence on the respiratory centre, and partly through the respiratory muscles and the circulation. The respirations are first accelerated, then slowed and weakened, death occurring by asphyxia after excessive doses.

(*f*) **On the Body Temperature.**—Alcohol, as the result of the following actions, has the effect of *lowering temperature* when administered in full doses:

(1) By increasing the circulation through the dilated peripheral vessels.
(2) By diminishing metabolism.
(3) By increasing perspiration.

Very large doses lower the temperature to a great extent by causing general vital depression, vaso-motor paresis, and rapid refrigeration, especially in a low state of the external temperature. Moderate doses of alcohol in a temperate atmosphere cause a sensation of warmth by diverting the blood to the skin.

Toxic Effects.—In excessive doses alcohol acts as a narcotic poison, causing paralysis of the vital nerve-centres. The higher centres are first affected, causing a brief stage of excitement, soon terminating in profound narcosis, death resulting from paralysis of either the respiratory or cardiac centres in the medulla, or from both.

(4) REMOTE LOCAL ACTION.

In medicinal doses alcohol is almost entirely oxidized in the system, only about 3 per cent. passing out unchanged, the major portion by the lungs, the remainder by the kidneys and skin. This portion, however, includes ethereal and other complex bodies which are associated with alcohol in spirits and wines.

The major portion of the alcohol proper is excreted as carbonic acid and water. During excretion it acts as a diuretic, and fluids such as beer and gin possess this action in a marked degree. It has also a remote local action as a *diaphoretic*.

Medicinal Uses.—It is well known that alcohol is often prescribed indiscriminately in the treatment of diseases of the respiratory system, and much difference of opinion exists among authorities as to its beneficial effects or otherwise.

In judging of the value of stimulants, just as of counter-irritants, no hard and fast rule can be laid down; clinical experience alone can direct the practitioner when alcohol is indicated, and when its use can be dispensed with.

The state of the pulse and heart, the general strength of the patient, his appetite and powers of assimilation, should be the chief guides in the employment of this agent.

We are assured of the full effects of alcohol in our patients, which differ from human beings, in whom habit as regards this drug has a very decided influence on its actions. But we must not forget that, in some instances, when alcohol is prescribed for animals in a palatable form, more of the agent finds its way into the system of the attendant than into the patient, and that this can be effectually guarded against by mixing some harmless drug with the alcoholic liquor.

We shall notice the uses of alcohol under the following headings:

(*a*) *As a Stimulant.*—In threatening death from cardiac failure, as in cases of hæmorrhage, shock, etc., alcohol is especially indicated, being usually available, convenient, and rapid in its action. For such purpose either whisky or brandy should be administered to horses and cattle in full doses, varying from half a pint to a pint, slightly diluted with hot water, and combined with a rapidly-acting diffusible stimulant, such as a preparation of ammonia or sulphuric ether. For dogs from a quarter to half a wineglassful will be required, according to the size of the animal.

(*b*) In *fevers* and *acute diseases* characterized by exhaustion, alcohol judiciously employed is an agent of great therapeutic value. The indications in such cases are to prevent or make good the great waste of tissue, to sustain the heart and nervous system, which threaten to fail, to reduce the abnormal temperature, to aid digestion, and to supply a temporary food.

These indications are well summed up by Dr. H. C. Wood ('Therapeutics and Materia Medica') as follows: 'Alcohol enables the system to stand the drain upon its vital powers, and at the same time to check such drain.'

From our knowledge of the actions of alcohol, we see clearly that it fulfils all these indications, but we also infer that its indiscriminate use should be carefully avoided. It should be understood that alcohol is by no means essential in every febrile affection. If the appetite remain fairly good and the pulse of sufficient strength, we should rely on simple measures, with strict attention to nursing and to the details of hygiene.

Besides the evil effects of the indiscriminate use of the drug, we have to consider that the constant administration of drenches to the patient will tend to annoy him at a time when rest is urgently needed. At the same time, we ought to be careful not to delay prescribing alcohol until the system of the patient becomes weakened and debilitated by the disease.

If the pulse be frequent and weak, with excessive temperature, dryness of the skin, loss of appetite, etc., then alcohol will be indicated, and is likely to prove of benefit.

In pneumonia, bronchitis, etc., it is usually in the second stage that alcoholic stimulants are indicated when inflammatory products are being absorbed.

As respiratory affections in horses are mostly of an asthenic character, aggravated by enforced work during the primary stages and by unsanitary surroundings, we often find that at our first attendance alcoholic stimulants are indicated.

In cases of that affection termed 'influenza,' often characterized by total loss of appetite and great debility in the early stages, the judicious administration of alcohol causes a return of the appetite and an improvement in the general appearance of the patients.

In severe cases it is necessary to prescribe alcohol at intervals, as its effects are transient, the doses and the frequency of repetition being mainly determined by the condition of the patient. In some instances the doses must be repeated every two or three hours, and large amounts are tolerated apparently from the rapidity of oxidation of the drug in the system. From two to three glasses of whisky every three hours may be required, and in cases characterized by extreme debility and exhaustion the administration should be continued at intervals during the night, as much harm is often done by leaving a patient all night without stimulants or necessary nourishment when the demands of the system require both.

The amount of alcohol should be steadily decreased as there are signs of improvement in the patient, and during the period of convalescence we find it of advantage to change the stimulant to one containing a smaller percentage of alcohol, such as strong ale. This also acts as a valuable tonic, and may be administered in doses of a pint twice daily combined with either vegetable or mineral tonics.

In *canine practice* we also find alcoholic stimulants of great service. In cases of *distemper*, characterized by weakness, loss of appetite, etc., small doses of brandy, sherry, or port are indicated. In cases of *diarrhœa*, *dysentery*, etc., especially in young dogs, port wine is a valuable remedy, possessing both stimulant and astringent properties.

(*c*) *When a depressing agent exists in the system*, such as certain poisons—for example, aconite, etc.—alcohol is indicated as an arterial and nervous stimulant to overcome the effects of the depressing agent.

(*d*) *In chronic diseases*, attended by great debility and want of appetite, alcohol in small regular doses is indicated; also in chronic disease of the heart, when natural hypertrophy fails and dilatation ensues.

(*e*) In some forms of *atonic dyspepsia*, with a tendency to flatulence, alcohol is prescribed in different preparations; it increases gastric secretion, and also acts as a carminative and antispasmodic.

Contra-Indications.—In cases characterized by cerebral excitement, with high arterial tension, such as phrenitis, meningitis, etc., also in cases of shock or injuries to the brain, stimulants should be withheld.

External Uses.—As a *stimulant* and *refrigerant* a solution of alcohol is applied as a popular remedy to bruises and strains. It is largely employed as a *solvent* in pharmacy, also in the preparation of tinctures and extracts.

CHAPTER VII.

THE CARBON COMPOUNDS—*Continued.*

GENERAL REMARKS ON THE ACTION OF ANÆSTHETICS.

Before proceeding to a description of the actions of chloroform and ether on the different portions of the system, it will be of advantage to give a brief notice to the condition of *general anæsthesia.*

This is a state characterized by loss of consciousness, accompanied by loss of sensibility and of voluntary muscular action.

The vapour of various volatile substances, when inhaled, has the power of producing general anæsthesia; but in veterinary practice our knowledge is confined to the use of two drugs possessing this action, viz., **chloroform** and **ether**. Ether has been termed the sister anæsthetic to chloroform, because it possesses so many actions in common with the latter; we shall find, however, many important points of distinction with reference to the actions and uses of each as regards the production of anæsthesia.

Many theories have been advanced to explain the production of anæsthesia, but the only one compatible with our present knowledge is that which ascribes the effects to a direct action of the agents on the central nervous system, and on the various organs and tissues concerned.

One agent, however—namely, **nitrous oxide gas**—when inhaled, acts as au anæsthetic by *producing partial asphyxia,* as well as by a specific action, apparently by diminishing the amount of oxygen in combination with the red corpuscles without itself uniting with the hæmoglobin. It simply takes the place of the oxygen if the latter be excluded at the same time by administering the drug without the admixture of air; the blood is thus rendered partially venous, and the drug, entering the nerve-centres, exerts specific effects thereon, acting first as a stimulant, and speedily as an anæsthetic.

We are not aware of its successful employment in veterinary practice, but in human practice it is extensively used to produce anæsthesia during operations lasting a minute or less, such as in some dental operations. The effects are quickly produced, and as quickly disappear.

In considering the actions of chloroform and ether, we shall notice each drug separately, drawing attention to any special points of resemblance and distinction between them. The phenomena of anæsthesia will particularly merit our attention, also the methods of administering anæsthetics and the precautions to be observed.

Chloroformum—Chloroform, Pure Chloroform.

Prepared by distilling rectified spirit with chlorinated lime and slaked lime, purifying by washing with water and sulphuric acid, agitating with slaked lime and calcium chloride, redistilling, and adding 1 per cent. by weight of ethylic or absolute alcohol.

Methylated Chloroform.

Prepared in a similar manner to the above, but substituting methylated spirit for rectified spirit.

Preparations.

Spiritus Chloroformi—Spirit of Chloroform, Chloric Ether.

Prepared by dissolving 1 part of chloroform in 19 parts of rectified spirit.

Doses.—Horses and cattle, ℥i. to ℥iss.; dogs, ʒss. to ʒi.

Tinctura Chloroformi et Morphinæ—Chlorodyne.

This is prepared from different formulæ, and is extensively prescribed as an *anodyne*, *antispasmodic*, *sedative*, and *intestinal astringent*.

The following is a convenient formula:

Take 4 drachms of hydrochlorate of morphia, 1 ounce of hydrocyanic acid (Scheele's), 2 ounces of powdered gum acacia, 2½ drachms of powdered capsicum, 4 ounces of rectified spirit, 5 ounces of ether, 15 ounces of chloroform, 1 drachm of oil of peppermint, and 25 ounces of boiling water; add syrup or treacle sufficient to make 80 ounces.

Dissolve the morphia in boiling water, mix with the gum acacia, digest the capsicum in the rectified spirit and filter into a bottle, mix the other ingredients, and shake well for fifteen minutes.

Doses.—Horses and cattle, ʒss. to ℥ii.; dogs, ♏v. to ♏xx., according to requirements.

(1) IMMEDIATE LOCAL ACTION.

Externally, if applied and allowed to evaporate, chloroform acts as a *refrigerant*. It also acts as a *local anæsthetic* by depressing the terminations of the sensory nerves of the part, and thus reducing sensibility. If the vapour be confined, or the drug rubbed into the skin, it acts as an irritant, and may cause vesication.

Internally, if undiluted, it acts as a severe irritant to the mouth and neighbouring parts.

In small doses, properly diluted, it causes reflex salivation, and possesses a *carminative* effect on the stomach, and also acts as an *antispasmodic* and *anodyne*.

(2) ACTION ON THE BLOOD.

Chloroform enters the blood rapidly from the respiratory organs when inhaled, but may also reach it from the stomach and from the unbroken skin, as well as subcutaneously. It mixes with the blood chiefly unchanged, partly in the form of various products, but we are not aware of any definite actions which it exerts thereon, although certain changes have been noticed to occur in blood drawn from the body to which chloroform has been added.

(3) SPECIFIC ACTION.

The most important action of chloroform is exerted on the *central nervous system*, resulting in the occurrence of what we term the *phenomena* of *anæsthesia*. These should be carefully noted by the student, as on them depends the safe administration of the drug as an anæsthetic.

When administered in the form of vapour, chloroform reaches the central nervous system very rapidly, and its effects thereon may be conveniently divided into three stages:

(*a*) *First Stage.*—This is characterized by powerful *stimulation* of the cerebrum, due to a direct action of the drug on the convolutions, and probably, to a certain extent, by causing vascular disturbance.

This stimulation is accompanied by a certain amount of disorder and excitement, not, however, equally marked in all horses.

In some temperaments loud neighing results, with obstinate struggling; in others the stage of excitement is not well marked. The same phenomena occur in the case of dogs; but, as we shall see further on, this stage in these animals often passes imperceptibly into that of anæsthesia.

Accompanying the primary stimulation, or immediately afterwards, the *muscular centres* are roused, causing still greater struggling movements.

We have to consider that in horses and dogs the cerebrum is not developed to the same extent as in man, consequently the exciting effects of chloroform on the higher centres are not so well marked.

As horses are cast and secured prior to administration, it is clear that this process will tend to cause struggling, independent of the action of the anæsthetic, so that it is difficult to judge of the exact amount of excessive muscular action which should be ascribed to the latter.

In some horses we observe very little preliminary struggling, but in every instance the respirations become accelerated, due also in part to the animal being cast and secured.

After the stimulation of the cerebrum, the *medulla oblongata* is next affected. The centres of circulation and respiration are *stimulated*, causing frequency of the pulse and respirations; the blood-pressure is raised, and there is commencing dilatation of the pupils.

Other phenomena accompanying this stage in the horse are the occurrence of a distinct jugular pulsation, and frequent movements of the jaws, also constant movements of the eyes, the sclerotic coat being freely exposed and the pupils dilated.

(*b*) *Second Stage.*—This is the stage of *anæsthesia*—*i.e.*, that in which consciousness and sensibility are removed and muscular action lost. The period of time which is required to bring about this condition in horses varies greatly in different individuals. It also depends on the method of administration, and whether the vapour of the drug is properly diluted with air or otherwise.

In the former case the average time may be stated as from ten to fifteen minutes; in the latter a far shorter period will suffice.

The phenomena of chloroform anæsthesia depend on the secondary effect of the drug on the nerve-centres, which is that of *depression*. The functions of the same parts are first diminished and then arrested. Consciousness is removed, reflex excitability is first diminished and then lost.

In the horse, except under very profound anæsthesia, there is winking of the eyelids on touching the cornea, although reflex excitability may be lost all over the body, and the pupil remains dilated during the whole period of anæsthesia. The centres in the medulla and cord are also depressed, muscular tone becomes lost, and the voluntary muscles relaxed. The centres of circulation and respiration being depressed, the pulse falls in frequency, and the respiratory movements become slower and shallower.

This is the period required for the performance of surgical operations, the chief consideration being to keep this depression of the vital centres within safe limits by ceasing the administration of the drug when the proper stage is reached, and by inducing anæsthesia with as small an amount as possible, thus avoiding the commencement of the third stage.

(*c*) *Third Stage.*—The further action of chloroform is attended by *complete loss of all reflex excitability*. The pupils become widely dilated, the sphincters relaxed, the respiratory centre gradually becomes paralyzed, and the respiratory movements get shallower, irregular, weaker, and finally cease. The action of the heart is irregular and feeble, and at last stops in diastole, both from central and from direct nervo-muscular depression.

Numerous experiments have been made from time to time in order to determine accurately whether chloroform causes death by asphyxia or by syncope.

The results of the Hyderabad Commission on Chloroform certainly indicate that death usually occurs from asphyxia. Still, there are many instances in dogs where, during the administration for surgical purposes as well as for experiment, death occurs with such rapidity as to lead to the conclusion that it depends on syncope. It is highly probable, however, that in such cases some cardiac affection was present, and the means of restraint often adopted to overcome the primary struggling is a potent factor in hastening the fatal result.

In the horse, however, it is certain that, except in the case of advanced cardiac disease, asphyxia is the cause of death as a result of the toxic effects of chloroform.

I have made numerous experiments on this animal with chloroform, and in every instance found that death was due to asphyxia slowly induced, and that large amounts of the drug were required to bring about this result, and a considerable space of time was involved.

In one case of a very old pony, which was destroyed by the inhalation of chloroform, twelve ounces of the drug were administered by means of the Carlisle inhaler, which does not admit much air to enter, and after a period of half an hour of administration the respiratory movements became very shallow and irregular. A long inspiration would then occur, followed by an interval and a series of quick shallow inspirations, and a short time prior to death convulsive movements of both forelegs were noticed. A long interval elapsed between each shallow respiratory movement until respiration finally ceased, the pulse beating in a feeble and irregular manner for a short time afterwards.

In some instances I have observed the occurrence of oral breathing, with great stertor, where excessive amounts of the drug had been administered.

It may safely be stated that the horse is capable of resisting to a remarkable extent the toxic effects of chloroform as compared with the dog and with man. Still, this should not make us less careful during its administration, as deaths have occasionally been recorded during its employment in surgical operations, and alarming symptoms will sometimes manifest themselves.

The dog is very susceptible to the toxic effects of chloroform, so that great care is necessary during its administration in this animal, and, as a rule, ether is to be preferred for producing anæsthesia.

Analysis of Chloroform Anæsthesia.—As the result of knowledge gained by experiments and by experience in the administration of chloroform, we are enabled to obtain a fair idea of the analysis of the phenomena of anæsthesia as produced by it.

As already stated, the primary effects are due to the *stimulating* action of the drug on the cerebral centres, the functions of which are then depressed and finally removed, loss of consciousness being the result. The *lower cerebral* and *spinal* centres become affected later on, and as the spinal centres are no longer controlled by the cerebral, we have the occurrence of irregular movements of the limbs; as these centres become in turn depressed, the muscles become paralyzed.

It is evident that the loss of sensibility in general anæsthesia is due to a *central* and not a peripheral effect, as the peripheral nerves are the last to become affected.

In the third stage the vital centres in the medulla become seriously depressed; but this does not occur until the higher centres completely lose their function, hence the selection of chloroform as one of the agents for the safe production of general anæsthesia (see section on 'Consciousness,' p. 161).

It is probable that the muscles are affected directly as well as through the nervous system. The parturient uterus contracts freely in complete anæsthesia, but with a certain loss of vigour and regularity.

On the heart chloroform exerts a steady, powerful, depressing influence after primary stimulation. The increase of pulse occurring in the first stage is believed to be partly due to depression of the inhibitory centres. According to some authorities, there is a *progressive lowering of arterial pressure* from the commencement.

It has been demonstrated by experiments that there is a *reduction of temperature* during anæsthesia; this probably depends on the power of the drug to check tissue metamorphosis, and thus lessen the production of animal heat in a similar manner to alcohol.

The *dilatation of the pupil* in the first stage is probably due to stimulation of the sympathetic, and in the second and third stages to paralysis of the third nerve or its cerebral centre.

(4) SPECIFIC USES OF CHLOROFORM.

These may be considered under the following headings:

(*a*) *As a General Anæsthetic.*
(*b*) *As an Antispasmodic.*

(*a*) As a *general anæsthetic* chloroform is the agent adopted for this purpose in horses. The use of anæsthetics in veterinary surgery is rapidly on the increase, as prejudice and ignorance on the subject are being overcome. Various objections have been raised from time to time by those who hold that the employment of anæsthetics is not necessary, some asserting that there is danger of fatal results in the horse, that a long period of time is required to produce anæsthesia and to bring about a return to consciousness; others, that there are undesirable after-effects; and that operation wounds do not heal in a satisfactory manner. Experience in the use of chloroform will soon dispel such erroneous ideas, and demonstrate the enormous benefits of anæsthetics to veterinary surgery.

Apart from the question of humanity and our duty towards the lower animals, it is obvious that the absence of struggling and of muscular action are most important attributes to scientific surgery. The infliction of pain gives rise to struggling, often violent and prolonged, wearying to the patient and to the operator, rendering the employment of the knife and the manipulation of delicate parts difficult and dangerous; bleeding vessels cannot be secured with facility, and the risk of hæmorrhage is increased by the violent struggles of the animal.

When we consider that the safety of anæsthetics was first demonstrated on animals before their successful employment in human surgery, it certainly is a matter for surprise that in the latter the use of anæsthetics is general, and, as the result of constant employment and research, has now reached a high state of perfection; while in veterinary surgery, until recently, it was in a state of infancy, and much yet remains to be done before we can hope to claim a similar practical knowledge of the subject.

Briefly the circumstances under which chloroform anæsthesia may be employed are the following:

(1) *In operations attended by severe pain;* these need not be specified.

(2) *In operations where muscular action or spasm* has to be overcome, such as the reduction of herniæ and of dislocations.

(3) *In Parturition.*—In certain cases and conditions chloroform is employed, the primary stage of anæsthesia being often sufficient for the purpose required.

Method of Administration and Precautions to be observed in Chloroform Anæsthesia.—From our knowledge of the physiological action of chloroform, we are enabled to employ the agent in a safe and effectual manner. Clearly, our object should be to temporarily remove consciousness and the perception of pain without interfering materially with the vital functions of the medulla.

The change from *depression* of the vital centres to paralysis of the same is a gradual one in the horse, hence careful watching is necessary during the production of anæsthesia to avoid continuing the administration longer than necessary, also to avoid large amounts of the drug, and to ensure a proper admixture of air.

Experiments have proved that the horse is not very susceptible to the action of chloroform; indeed, the same remark holds good with reference to the action of all narcotics in this animal. However, this should not make us less careful during the administration, as, independent of the risk of a fatal result, we have to consider the effects of an overdose on the system, just as we should when employing any narcotic.

Chloroform may be administered to the horse by different methods. Thus, in the case of an emergency, we make use of a sponge, on which the chloroform is poured, this being placed in a towel and fixed over the nostrils. Different forms of apparatus are employed for the administration of chloroform, their object being to avoid waste of the drug and to judge accurately of the amount given.

It was at one time believed that, in order to produce anæsthesia in the horse in an effectual manner, it was necessary to administer the chloroform in a concentrated form by the use of an apparatus which admitted but little air. This method is still practised by many in the present day; those who uphold it stating that the preliminary stage of excitement is shortened and the quantity of the drug required is greatly lessened, while anæsthesia is more rapidly induced.

We must admit the more rapid induction of anæsthesia by this method, but feel convinced that it is at the risk of safety to the animal, because a certain amount of asphyxia is produced as the result of an insufficient supply of air. From our knowledge of the physiological action of chloroform we clearly see that such a condition should be carefully avoided, and that a proper supply of air should be allowed throughout the whole period of administration.

It is obvious that, in order to produce anæsthesia, it is necessary to have a certain amount of chloroform vapour in the blood circulating through the central nervous system, and it is now conclusively proved that such a condition can be induced in horses by a proper dilution of the chloroform vapour with air, just as in the case of dogs and human beings.

The most reliable and the safest apparatus for this purpose is made by Messrs. Krohne and Sesémann, Duke Street, Manchester Square, London. It is made on the same plan as the chloroform inhalers for human beings which have been invented by this firm, the principle consisting in diluting the chloroform vapour by means of passing a current of air through a graduated bottle containing the drug, the diluted vapour then passing through a rubber tube to the face portion.

For dogs an apparatus similar to that employed for human beings auswers very satisfactorily, the face-piece being changed for a muzzle, made either of leather or canvas, with air-holes beneath. The air is passed through the chloroform by means of a hand-bellows of india-rubber, with tubing to connect with the muzzle, and by means of a stop-cock, also by working the bellows slowly, we can regulate the amount of the vapour inhaled.

For horses a far more powerful apparatus is necessary, consisting of a foot-bellows, a large graduated bottle to hold the chloroform, a rubber tube connecting these, and another tube connecting with the muzzle.

The muzzle is very capacious, and on its lower surface the rubber tube enters; on this surface also the air regulator is inserted. By this method we can judge accurately of the amount of the drug administered, and ensure a proper dilution with air, besides avoiding any waste.

During the course of an operation it is not necessary to remove the muzzle, as plenty of air is allowed, and the administration can be continued when required by simply working the bellows, and can be immediately discontinued when requisite. This is far different from the other method, in which, when the anæsthesia has to be continued, the chloroform is poured on the sponge, and the pure vapour inhaled, the control of the latter being very inadequate.

It is necessary to cast the horse prior to administration, although some authorities state to the contrary. However, as we cannot judge of the exciting effect of the drug on some temperaments, it is far safer to adopt the former course.

The proper amount of chloroform being in the graduated bottle, the muzzle is fixed to the horse's head, making sure to have it air-tight above, and the air regulator open below. The bellows is then slowly worked at first, and as the drug is being inhaled the working can be increased, and the amount of air entering beneath slightly lessened.

As previously remarked, the stage of excitement varies greatly in different horses, but by this method it is reduced to a minimum. The mere fact of having the horse cast induces accelerated respirations, and it follows that a larger amount of the chloroform will be exhaled under such a condition than during quiet regular respiration, when more of the agent will be absorbed by the blood.

If a proper proportion of air is not allowed, a condition of semi-asphyxia will be produced, which also causes accelerated respiratory movements. Hence it is of importance to have respiration as regular as possible, and to avoid continuing the administration during the time the animal struggles. The capacious muzzle of this apparatus is of great advantage, as, besides allowing a sufficient supply of air, it acts as a reservoir for the mixture of air and chloroform vapour, including that portion which is exhaled in expiration. Hence in some cases we find it of advantage to cease working the bellows for a short time prior to the commencement of an operation, and to allow the animal to inhale the amount of the drug which is present in the muzzle.

The period of time which is required to produce anæsthesia varies according to the susceptibilities of different animals to the action of the drug. We must be careful to avoid undue haste, both in the administration and in commencing the operation before a proper stage of anæsthesia is induced. The average period of time is from ten to fifteen minutes.

The amount of chloroform necessary also varies in different animals, the average being from one ounce to two ounces. In short operations it is not necessary to induce full anæsthesia; indeed, such a condition is best avoided, as it is of advantage to have the animal return to consciousness as quickly as possible. But in severe operations it is necessary to have a proper stage of anæsthesia, and we usually find that in operations on the feet full anæsthesia is required.

The recognition of the condition of anæsthesia is a matter of great importance. It is best determined by catching hold of the limbs of the animal, or striking it on the quarters. If the muscular tone is lost, and the muscles are relaxed, and there are no movements excited by the above procedure, we may conclude that a proper stage of anæsthesia is induced. For the operation of castration we can always decide by grasping the testicles, which under anæsthesia have lost the power of retraction, and are flaccid to the touch. In this operation we often find that an involuntary struggle may occur when the non-vascular portion of the spermatic cord is being divided; this, however, does not call for a further supply of the drug.

During long and severe operations it is always necessary to keep up the proper stage of anæsthesia, and this is accomplished by working the bellows for the required time when there are any signs of returning consciousness. Above all things, it is necessary to avoid the administration of an excessive amount at any time. The respiratory movements should be carefully watched, and shallow breathing, especially if intermittent, is a condition of gravity demanding immediate attention. Stertorous breathing is also a sign of danger, especially if it be oral. On the appearance of these symptoms the tongue should at once be drawn forward, and plenty of fresh air allowed. Should the respiratory movements become shallow and intermittent, artificial respiration should be immediately resorted to, also moderate flagellation with wet towels, and cold affusions to the head.

The administration of stimulant drenches is dangerous, as they are apt to enter the trachea and cause greater interference with respiration. The hypodermic injection of ether has been recommended, and we have often found this of benefit, but *we must regard artificial respiration as the most important item in resuscitation.*

We frequently observe, after long operations, that a second period of anæsthesia occurs, even some time after the administration of the drug has been discontinued, and when we are anxiously watching for a return to consciousness. The respirations may become shallow and intermittent to an alarming extent, with stertor and oral breathing; we can ouly account for this by supposing that there is an excessive amount of the drug circulating in the blood, and still exerting its action on the nerve-centres. In such a condition it may be necessary to perform artificial respiration, and to adopt every means to assist respiration to return to the normal.

Here we may remark that our efforts at resuscitation should not be relaxed, even though a case may seem hopeless, as it is surprising to observe the effects of energetic efforts in this direction, where we would imagine that respiration had almost ceased.

The period of the return to consciousness varies according to the individual animal, and to the amount of the drug which has been inhaled. In favourable cases the average time is fifteen minutes, before which it is never safe to remove the hobbles, as the animal may attempt to rise, and, being in a semi-unconscious state, is liable to injure itself. Many cases show a tendency to sleep for a long period before an attempt is made to rise, and it is probable that, after severe operations, if it were practicable to allow the patients to sleep without being disturbed, much good would result. The animal should never be forced to rise before it regains consciousness, as it is liable to fall again and cause itself injury.

No solid food should be given for two hours after the operation, as some practitioners have observed that there is a danger of 'choking' after a prolonged period of anæsthesia. Fluid foods should be allowed, and, if necessary, after a severe operation a diffusible stimulant should be administered. The after-effects of the drug may be noticed in some cases, but, except after a long period of anæsthesia, we have not observed any interference with appetite or digestion in the horse.

It is important to note that anæsthesia is more rapidly induced when the stomach is as empty as possible, hence no solid food should be allowed for twelve hours previous to administration, the best time for operation being early in the morning.

Some practitioners recommend the hypodermic injection of morphine and atropine fifteen minutes prior to the administration of chloroform, stating that it diminishes preliminary excitement and intensifies the anæsthesia; having never tried this, we cannot speak of its advantages or otherwise.

Chloroform may be administered to **cattle** with similar precautions as in horses.

Dogs are very susceptible to the action of chloroform, and great care is necessary during administration. The safest apparatus is that made by Messrs. Krohne and Sesemann, already referred to, and plenty of time should be allowed during the administration, with a proper supply of air. Dogs generally struggle violently during the preliminary stage of excitement, and the means of restraint usually adopted often increases the risk of respiratory failure.

In these animals the percentage of chloroform vapour inhaled should not exceed 4 per cent. in the air, and it is well to commence the administration with 2 per cent. of vapour, and increase the quantity until 4 per cent. is reached; this can be accomplished by means of the regulator on the tube of the apparatus.

In the dog, death sometimes occurs so quickly that it would appear as if respiration and circulation ceased simultaneously, and the second and third stages of anæsthesia often succeed each other rapidly without being observed. On the first appearance of shallow breathing, artificial respiration should be immediately resorted to, and we have seen excellent results from the inhalation of the vapour of nitrite of amyl. Generally speaking, ether is to be preferred as an anæsthetic for the dog for reasons to be presently noticed.

(*b*) *As an antispasmodic and anodyne* chloroform is prescribed internally in the form of the spiritus chloroformi, or the tinctura chloroformi et morphinæ (chlorodyne). The latter is extensively employed in cases of *gastric irritation, intestinal spasm*, etc.; also in *diarrhœa and dysentery*, as an intestinal sedative and astringent, combined with creta preparata. It is also very useful in cases of spasmodic cough, and in the early stages of bronchitis.

Ether—ETHER, SULPHURIC ETHER.

Prepared by distilling rectified spirit and sulphuric acid, agitating with slaked lime and chloride of calcium in water, and redistilling.

Doses.—As a stimulant: Horses, ℥i. to ℥ii.; cattle, ℥ii. to ℥iii.; dogs, ♏xx. to ʒi.—administered properly diluted, and repeated when necessary. Where immediate results are required, as in cases of collapse, it is administered hypodermically.

(1) IMMEDIATE LOCAL ACTION.

Externally ether, applied to the skin and allowed to evaporate, acts as a powerful *refrigerant* and *local anæsthetic* by its rapid evaporation and consequent abstraction of heat, also by depressing the nerves of the part. Applied in the form of a spray, the part becomes frozen, and sensation is annulled. If the vapour be confined or the ether be rubbed into the skin, a *rubefacient* or *vesicant* effect is produced.

Internally ether causes local irritation in the mouth and reflex salivation. In the stomach it acts as a *stimulant* to the bloodvessels, nerves, and muscular coat, and also acts in a reflex manner from the gastric mucous membrane on the heart and respiratory organs as a powerful *systemic stimulant.* On the intestines it produces *antispasmodic* effects. By whatever method administered, its odour can be quickly detected in the patient's breath.

(2) ACTION ON THE BLOOD.

Ether is very rapidly absorbed into the blood, either when inhaled or when given by the mouth. We are not aware of any action which it possesses on the blood.

(3) SPECIFIC ACTION.

The specific action of ether resembles that of chloroform to a certain extent, with, however, important points of difference. Both drugs act first on the central nervous system as stimulants, then as depressants. The important distinctions are:

(*a*) Ether depresses the heart, the vessels, and the respiratory centre far less than chloroform.

(*b*) With ether the stage of stimulation is more protracted, excitement is more marked, and struggling more violent; the stage of anæsthesia is shorter and less profound, and there is a quicker return to consciousness.

(*c*) In order to produce anæsthesia with ether it must be administered nearly pure, about 70 per cent. of the vapour being required in the air inhaled. The more concentrated the vapour the more rapidly will anæsthesia be produced.

Ether causes a profuse secretion of ropy mucus from the mouth and excites the respiratory mucous membrane; it may even induce catarrh. The respiratory movements are greatly accelerated, and, according to some authorities, there is no material diminution of arterial pressure during ether narcosis until manifest failure of respiration has taken place.

The experiments of Sansom have demonstrated that the vessels of the foot of the frog can be seen to contract during the inhalation of ether, and this authority states that this contraction of the vessels is very permanent, and does not yield to passive dilatation until a fatal stage of anæsthesia has been produced.

We thus observe that of the two agents ether is by far the safest as a general anæsthetic; but as regards its use for this purpose in horses there are great drawbacks, which we shall presently notice.

(4) SPECIFIC USES OF ETHER.

These may be arranged as follows:

(*a*) **As a General Anæsthetic.**
(*b*) **As a Local Anæsthetic.**
(*c*) **As a Diffusible Stimulant and Antispasmodic.**

(*a*) *As a general anæsthetic* ether is not often employed in horses, in consequence of the excessive amount of struggling induced in the primary stages in many individuals, and also because of the large quantity of the agent requisite to produce anæsthesia, and the short duration of the latter.

In the *Veterinarian* of 1847 there are recorded some interesting experiments made by Messrs. Cherry, Henderson, and Mayhew, of the action of ether on horses and other animals. The drug was administered by means of different forms of inhalers, with the animals in the standing position, and from six to eight ounces were required to produce anæsthesia; in many cases very violent exciting effects were induced in the primary stages, the results at the time not being considered satisfactory.

I have only employed the drug once, the subject being an aged gelding; ten ounces was the amount required to produce anæsthesia, and a period of fifteen minutes, the vapour being administered in a concentrated form. There was intense preliminary excitement, with laboured respiratory movements; but the period of anæsthesia was of short duration.

In the dog it is generally admitted that ether is a far safer anæsthetic than chloroform, although it produces far more preliminary excitement. A period of time from five to ten minutes is usually required, the amount of the drug varying greatly, according to the susceptibility of the individual to it.

Ether may be administered by the rectum, a special apparatus being employed for this purpose.

Some practitioners recommend a mixture of chloroform, alcohol, and ether to produce anæsthesia, forming what is termed the 'A C E mixture.' This is stated to be safer in its actions than either chloroform or ether employed separately.

(*b*) *As a local anæsthetic* ether is employed in the form of spray, after the method introduced by Dr. Richardson. Its great disadvantages, however, in this respect are the risk of sloughing of the skin and the occurrence of pain when the part is returning to a natural condition.

(*c*) *As a diffusible stimulant and antispasmodic* ether is frequently employed. It is a powerful *systemic stimulant*, administered either by the mouth or hypodermically, and is indicated in cases of *collapse* depending on shock, hæmorrhage, or exhausting disease. As an *antispasmodic* it may be administered in cases of abdominal pain in conjunction with anodynes, and is especially useful in cases of gastric impaction in the horse.

There are other anæsthetics occasionally employed by human surgeons, such as bichloride of methylene, dichloride of ethidene, and bromide of ethyl. We are not aware of their successful employment in veterinary surgery.

Liquor Sodii Ethylatis—Solution of Ethylate of Sodium—

is a powerful *caustic*, and is recommended in the treatment of canker in the feet of horses.

CHAPTER VIII.

THE CARBON COMPOUNDS—*Continued.*

Chloral Hydras—Hydrate of Chloral.

Prepared by adding water to chloral. Chloral is made by saturating anhydrous alcohol with chlorine gas, and purifying.

Incompatibles.—All alkalies which decompose it.

Doses.—Horses and cattle, ℥i. to ℥ii.; dogs, grs. v. to grs. xx.—repeated every two or three hours as required, and administered in mucilage or syrup to avoid its irritating effects.

(1) IMMEDIATE LOCAL ACTION.

Externally, in weak solution, chloral hydrate is *antiseptic*, experiments demonstrating that it has the power of destroying micro-organisms. In concentrated solution it acts as a *topical irritant.*

Internally, in concentrated form, it acts as an irritant to the mouth and stomach. It has no specially sedative effect on the stomach or intestines like opium.

(2) ACTION IN THE BLOOD.

Chloral quickly enters the blood, and its composition is not altered therein, such as was at one time believed. We are not aware of any appreciable changes in the blood as the result of the agent.

(3) SPECIFIC ACTION.

The chief action of chloral is on the *nervous system*, resembling that of chloroform. In moderate doses, after a brief period of excitement, which is seldom noticed in the horse, it acts as a powerful *hypnotic*, causing sleep by a direct action on the nervous structure of the brain, and also, according to some authorities, by influencing the cerebral circulation, producing a condition of anæmia of the organ.

In large doses it depresses the lower nerve-centres, diminishing reflex excitability, and causing relaxation of the muscles. It depresses the three great medullary centres—viz., the respiratory, the cardiac, and the vaso-motor — the results being slow, irregular, and shallow respiration, weakening of the action of the heart, and general dilatation of the bloodvessels.

On the heart it first accelerates and then slows the action, both by a direct action on the intrinsic nervous ganglia as well as by its effect on the cardiac centre.

In *toxic doses* chloral is an intrinsic cardiac poison, diminishing the irritability of the cardiac ganglia, and finally arresting the heart in ventricular diastole.

According to Liebreich strychnine is an antidote to chloral.

On the bloodvessels it acts through the vaso-motor centre, causing dilatation of the vessels and a lowering of the blood-pressure, the latter effect being also due to peripheral paralysis of the walls of the vessels and weakened cardiac action.

On metabolism its exact effects are not clearly known. It *reduces temperature* chiefly by increased loss of heat through dilatation of the cutaneous vessels, and in a lesser degree probably by diminishing heat formation.

In large doses it acts as an *anæsthetic*, and is employed for this purpose by Continental practitioners.

(4) REMOTE LOCAL ACTION.

Chloral is excreted by the kidneys partly unchanged, but chiefly in the form of urochloral acid, causing a slight amount of diuresis. It is probable that portion of the drug escapes by the skin also.

Medicinal Uses.—*As a hypnotic* it is rapid in its action, and is prescribed to quiet irritability and cause sleep in cases characterized by the presence of pain. As its action is chiefly on the central nervous system, chloral only gives temporary relief in cases of pain depending on certain abdominal affections, for if sleep be induced by a powerful dose the patient wakes to suffering as before. It is thus inferior to other drugs, such as morphine and Indian hemp, as an anodyne; but when combined with morphine, it produces beneficial effects by overcoming the exciting action which this drug often exerts on horses, and the combination is very valuable.

In *tetanus* chloral has been employed with a varying degree of success, like many other medicinal agents.

In *chorea* and *epilepsy* in dogs, it is prescribed in combination with the bromide of potassium.

It has also proved successful in cases of equine *hysteria.*

It is stated by some authorities that when chloral is dissolved in a large amount of water it produces more satisfactory results.

As an *antidote to strychnine* it has proved of great value by antagonizing the severe convulsions produced by this poison. Chloral is also antagonistic to physostigmine.

In *parturient apoplexy*, or *milk fever*, in cows, chloral has been much employed of late years, and has given very satisfactory results. Mr. McConnell, M.R.C.V.S., Wigton, has used this agent with great success in the treatment of this disease (*vide* Report on Milk Fever, National Veterinary Association, 1893).

He recommends the early administration of chloral hydrate in a dose of from six drachms to one ounce, according to the size of the animal and the severity of the symptoms, along with one or two pounds of treacle. In two hours, if there is no improvement, half an ounce of the drug is given with one pound of treacle, and this amount is repeated in four or six hours, as often as necessary, the administration being ceased as soon as the cow can hold her head up quite steadily. The manner in which this drug brings about beneficial results cannot be explained satisfactorily, because we are not yet aware of the correct pathology of milk fever. Some practitioners report that its use has not been attended with success, and prefer to rely on the old treatment—viz., by the administration of purgatives and stimulants.

As an anæsthetic chloral is employed by French veterinarians. M. Cagny induces anæsthesia in the horse by injecting hypodermically two to three grains of morphine, with half a grain of atropine, and shortly afterwards administering one ounce of chloral in the form of an enema. In about an hour signs of anæsthesia appear, and a small amount of ether or chloroform is then given by inhalation. This authority states that chloral has the disadvantage of favouring the occurrence of hæmorrhage during surgical operations ('Précis de Thérapeutique Vétérinaire').

Chloral is *contra-indicated* in cases where organic affections of the heart are present.

Butyl Chloral Hydras—Hydrate of Butyl Chloral, Croton Chloral.

Prepared from dry chlorine and acetic aldehyde; resembles in its actions chloral hydrate, but is less powerful as a hypnotic and less depressant to the heart. It has a special power of paralyzing the trigeminus, or fifth nerve, and the parts supplied by it, but we are not aware of its employment in veterinary practice.

Chloralamid.

A compound of chloral anhydride and formamide; also acts as a hypnotic. It is said to be less effectual than chloral hydrate, and to produce less cardiac depression.

Paraldehydum—Paraldehyde.

A polymeric modification of aldehyde; is a pure *hypnotic* like chloral, but is believed to cause less depression of the heart. Its action is uncertain in animals, and the results of experiments do not justify its employment in therapeutics.

Sulphonal.

A complex solid of the methane series; acts as a *hypnotic* in dogs; but this effect is not observed in horses or cattle.

Amyl Nitris—Nitrite of Amyl.

Prepared by distilling nitric acid with amylic alcohol, sulphuric acid, and copper, purifying with caustic soda and carbonate of potassium.

Doses.—Horses, ♏xx. to ♏xxx., given hypodermically, or dissolved in rectified spirit; dogs, ♏ii. to ♏v. as an inhalation, ♏ss. to ♏ii. internally.

(1) IMMEDIATE LOCAL ACTION.

If applied directly to peripheral nerves it depresses or paralyzes them.

(2) ACTION ON THE BLOOD.

When administered by inhalation, the vapour of the drug instantly enters the circulation through the lungs; it converts a certain amount of hæmoglobin into methæmoglobin, changes both arterial and venous blood to a chocolate colour, and thus lessens the ozonizing property of the blood and the oxidation of the tissues.

(3) SPECIFIC ACTION.

The specific action of nitrite of amyl is chiefly on the *circulatory system*, the other organs being secondarily involved. It *accelerates* the heart, with but little increase of its force, probably by depression of the cardiac centre or of the vagus; it *dilates* the peripheral vessels either by relaxation of their muscular coat or influencing the vaso-motor nerves or vaso-motor centre. The result is that the *blood-pressure falls* in a marked degree, so that the left ventricle has less work to accomplish, and is thus relieved. It reduces the reflex irritability of the spinal cord, probably by *depressing the motor tracts*, but has no effect on the sensory tracts or centres, and does not produce unconsciousness. It lowers the body temperature by checking oxidation.

In *toxic doses* it causes laboured respiration, muscular weakness, unsteady gait, dilatation of the pupils, loss of reflex irritability, in some cases convulsions, and finally death from asphyxia. Experiments prove that the drug causes an increased amount of urine containing sugar.

Medicinal Uses.—In *angina pectoris*, an affection rarely met with in veterinary practice, the nitrite of amyl is a very valuable agent, and may be administered as an inhalation on cotton wool, or hypodermically.

In *tetanus* it has been employed in some cases with success, administered hypodermically twice daily, in gradually increasing doses, commencing at ♏xxx. (*vide Veterinary Journal*, March, 1881).

As an antidote to poisoning by strychnine its value has been proved experimentally by Dr. Richardson. It has also been employed with a certain amount of success as an antidote to carbolic acid poisoning. In cases of threatening death during chloroform anæsthesia in dogs, we have seen good results from the inhalation of amyl nitrite.

Sodium Nitrite.

Possesses similar actions on the blood, the heart, and the vessels to amyl nitrite, but its depressant action on the central nervous system is more marked. The effects are not so rapidly produced, but persist longer.

Nitroglycerinum—Nitroglycerine, Trinitrina.

Closely resembles in its actions amyl nitrite; it is more powerful, and its effects are less rapidly produced, but are more persistent.

Spiritus Ætheris Nitrosi—Spirit of Nitrous Ether, Sweet Spirit of Nitre.

A spirituous solution containing nitrous compounds, aldehyde, and other substances.

Prepared by distilling a mixture of rectified spirit, nitric acid, sulphuric acid, and copper, and dissolving the distillate in spirit.

Doses.—Horses, ℥i. to ℥iii.; cattle, ℥ii. to ℥iv.; sheep, ʒii. to ʒiv.; dogs, ʒss. to ʒi. These doses may be varied according to circumstances, and repeated at intervals as required, being properly diluted.

Incompatibles.—Iodide of potassium, sulphate of iron, gallic and tannic acids.

General Actions.—The spirit of nitrous ether is a *diffusible stimulant* and *carminative*, probably from the amount of alcohol it contains. On the blood it produces similar effects to other nitrites, acting on the red corpuscles, and diminishing oxygenation. (See Amyl Nitrite, p. 362.) Its chief action is on the circulation; it accelerates the heart, relaxes the peripheral vessels, and lowers arterial tension. It acts as a *diuretic* by relaxing the renal vessels and increasing the watery portion of the urine. It acts as a *diaphoretic* by dilating the cutaneous vessels and stimulating perspiration, and thus it increases the loss of heat from the skin.

Medicinal Uses.—As a *carminative* and diffusible *stimulant*, it is extensively prescribed in cases of indigestion, tympanitis, and colic, combined with anodynes and anti-spasmodics.

As a *general stimulant*, it is employed in all cases in which stimulants are indicated, and may be combined with alcohol in its different forms.

As an *anti-pyretic*, it is prescribed in febrile conditions, in combination with the liquor ammonii acetatis, diminishing heat-production by its action on the blood, and increasing the loss of heat through the skin and kidneys.

As a *diuretic*, it is useful when a free watery flow is desired, to wash out the tubules and passages of the kidneys, and relax spasm of the renal vessels, as in some cases of chronic renal affections with increased arterial tension. It should not be employed in acute inflammatory states of the kidney, in consequence of its action in dilating the renal vessels.

Acidum Hydrocyanicum Dilutum—Dilute Hydrocyanic Acid, Prussic Acid.

Hydrocyanic acid (HCN) dissolved in water, and constituting 2 per cent. by weight of the solution.

Prepared by distilling aqueous solutions of ferrocyanide of potassium and sulphuric acid, and diluting the product with water to the definite strength (B.P.).

Scheele's acid contains 4 per cent. of the anhydrous acid.

Doses.—Of the B.P. acid: horses and cattle, ♏xx. to ʒi.; dogs, ♏ii. to ♏v.—repeated three or four times daily according to the requirements of the case; of *Scheele's acid* half these doses are prescribed.

(1) IMMEDIATE LOCAL ACTION.

Externally, applied to mucous or skin surfaces, it diminishes or destroys sensation by depressing the sensory nerves. It is readily absorbed from abraded surfaces.

Internally, in medicinal doses, it acts as a *sedative* to the nerves of the stomach.

(2) ACTION ON THE BLOOD.

Hydrocyanic acid enters the blood rapidly from all parts of the body, but especially from the lungs.

In medicinal doses we are not aware of any special effects on the vital fluid, while in large amounts authorities differ as to the precise action of the drug thereon.

Experiments have demonstrated that it converts the blood of the veins first into a bright arterial colour, and then into a deep black, the results being an arrest of the oxygenating function of the corpuscles, and finally destruction of them.

(3) SPECIFIC ACTION.

Hydrocyanic acid enters the tissues rapidly, and acts as a *direct depressant* on the central nervous system. It acts first and chiefly on the *respiratory centre*, which is briefly excited, and then depressed, resulting in weak, irregular respirations, dyspnœa, convulsions, and finally death by asphyxia. It also depresses the afferent branches of the respiratory nerves, and arrests reflex respiratory actions.

The *vaso-motor* and *cardiac* centres are first temporarily stimulated, and then depressed, resulting in a fall of blood-pressure and weakened action of the heart, the nervo-muscular structures of the latter being depressed at the same time.

The *convolutions* are depressed, and the *spinal cord* is lowered in activity; the *motor* nerves and *muscles* are also depressed, while the peripheral sensory nerves are but slightly affected.

Hydrocyanic acid is one of the quickest and most fatal poisons with which we are acquainted. If given in a large dose to the dog, it may kill almost instantaneously, by both cardiac and respiratory arrest.

Usually asphyxia is readily produced, the heart continuing to beat in an irregular manner for several minutes after respiration has ceased.

The drug, being very diffusible and volatile, is quickly absorbed, and causes the animal to gasp once or twice and fall in convulsions, giving a few suppressed cries, asphyxia being rapidly produced.

In smaller amounts death occurs less quickly, staggering movements being first induced, with irregular respirations, followed by convulsions, depending on paralysis of the cerebro-spinal axis, and terminating in paralysis of the cardiac or respiratory centres.

Horses are less rapidly affected by toxic doses, and in some experiments large amounts were administered without causing death.

The medicinal acid, in consequence of its volatility, is apt to lose its strength, and this will probably account for the large amounts tolerated in some instances.

Antidotes.—Hydrocyanic acid is usually so rapidly fatal that antidotes are of little avail. Artificial respiration should be immediately resorted to, and inhalations of ammonia, with alternate affusions of cold and warm water to the head and neck, persevered in. The hypodermic injection of atropine is recommended in order to stimulate the respiratory and cardiac centres.

The *chemical antidote* consists of a mixture of a ferrous and ferric salt, administered with magnesia or carbonate of potassium ; this forms the insoluble Prussian blue, in combining with the poison, but is seldom of value in consequence of the rapidity of absorption of the latter.

Medicinal Uses.—(*a*) To allay irritation of the gastric nerves, to relieve gastric pain and arrest vomiting, the dilute hydrocyanic acid is very useful in cases of *gastritis, painful dyspepsia*, and reflex or other nervous disorders of the stomach, occurring in canine practice. It is prescribed in small doses repeated at intervals, in combination with bismuth, and often succeeds in relieving obstinate vomiting when other agents have failed.

(*b*) In cases of irritable chronic cough, both in horses and dogs, it is occasionally prescribed with benefit.

(*c*) In *tetanus* it has been employed in doses of one drachm given three times a day, with four drachms of bromide of potassium, given in the patient's drinking-water ; but its beneficial effects in this disease are not superior to those of the many other medicinal agents recommended from time to time.

(*d*) In the treatment of parasitic bronchitis of calves, due to the presence of the *Strongylus micrurus*, Professor Williams recommends ♏x. to ♏xx. of Scheele's hydrocyanic acid, combined with carbonate of soda and gentian, given twice daily, his experience being that it destroys the parasites and allays irritation.

Hydrocyanic acid is contained in the tinctura chloroformi et morphinæ (chlorodyne), see p. 338. It is also contained in aqua laurocerasi, see below.

Externally the dilute hydrocyanic acid is employed in the form of a lotion in cases of prurigo and skin affections characterized by excessive itching. The liability to absorption must not be forgotten, so that it should be applied with caution. For such cases the following lotion is recommended by Professor Williams:

℞ Liq. potassæ, ʒii.
Ac. hydrocyanici, P.B., ʒi.
Aqua, qt. i.
Ft. lotio. Sig. To be applied twice daily.

Aqua Laurocerasi.

Obtained from the leaves of the cherry laurel (*Prunus laurocerasus*) by distillation. Contains 0·1 per cent. of real hydrocyanic acid.

This preparation possesses the action of diluted hydrocyanic acid.

It is chiefly used as an eye-lotion, containing four or five grains of boric acid to the fluid ounce, and is very useful in cases of conjunctivitis (simple and purulent).

Acidum Carbolicum—Carbolic Acid, Phenic Acid, Phenol, Phenyl Alcohol.

Prepared from coal-tar oil by fractional distillation and subsequent purification.

Preparations.

(1) **Acidum Carbolicum Liquefactum**—Carbolic acid liquefied by the addition of 10 per cent. of water.

Doses.—Horses and cattle, ʒi. to ʒi.ss.; sheep, ♏v. to ♏x.; dogs, ♏i. to ♏iv. It should be administered properly diluted, so as to avoid local irritation, and the addition of glycerine is useful in this respect.

(2) **Glycerinum Acidi Carbolici**—1 to 4 by measure.

(3) **Unguentum Acidi Carbolici**—1 to 18 of soft and hard paraffin.

Zinci Sulphocarbolas—SULPHOCARBOLATE OF ZINC.

Prepared by heating a mixture of carbolic and sulphuric acids, saturating the product with oxide of zinc, evaporating and crystallizing.

Sodii Sulphocarbolas—SULPHOCARBOLATE OF SODA.

ACTIONS OF CARBOLIC ACID.

(1) IMMEDIATE LOCAL ACTION.

Externally.—Applied in a sufficiently concentrated form, carbolic acid acts as a local *irritant* to the skin or mucous surfaces; it causes *local anæthesia* of the part, coagulates albumin, and finally has a *caustic* effect with the formation of a hard white eschar, afterwards becoming brown.

This agent possesses important influences on fermentation and decomposition, apart from its action on animal tissues.

Solutions of carbolic acid deprive most of the *organized ferments* of their characteristic powers. These ferments are represented by yeasts, moulds, and bacteria. On *chemical ferments* (enzymes) it does not act so readily.

Its effect on the *spores* of vegetable organisms is far less energetic than that of other agents, such as corrosive sublimate, a 5 per cent. solution of carbolic acid being required to destroy them, while 1 part in 1,000 of the mercury salt will suffice for this purpose.

On fully-developed *microzymes*, however, carbolic acid acts energetically, as 1 per cent. aqueous solution destroys the anthrax bacillus, and 1 part in 1,000 is sufficient to prevent its growth. We thus term the drug an *antizymotic* (ἀντὶ, against; ζύμη, a ferment).

It is also an *antiseptic*, both as regards its action in septic diseases as well as on wounds. It destroys the *products of decomposition*, which are usually infective and of a foul odour, and is thus a *disinfectant* and *deodorant*.

The exact method by which carbolic acid exerts its effects on fermentative processes and organisms is not yet fully understood, but we are aware of the beneficial results of the agent as an antiseptic and disinfectant.

Internally.—Inhaled in the form of vapour, it is *stimulant* and *disinfectant* to the nasal passages, throat, and lungs. In moderate doses it arrests excessive fermentative changes in the gastric contents, and in large amounts acts on the stomach and intestines as a powerful *irritant poison*.

(2) ACTION ON THE BLOOD.

Carbolic acid is rapidly absorbed from the unbroken skin, mucous surfaces, wounds, subcutaneous tissues, respiratory passages, and stomach. It can be found for a considerable time in the blood unchanged, but steadily disappears by conversion into compounds, probably combining with the sulphates, forming sulphophenates, and is eliminated in the urine. Portion of it is lost in the system, being probably converted into oxalates and carbonates, and, according to some authorities, a certain amount undergoes oxidation.

(3) SPECIFIC ACTION.

In large doses carbolic acid acts as an *irritant* poison, besides producing special effects in the nervous system. It causes salivation, gastro-enteritis, and vomiting in dogs.

On the Nervous System.—It first *stimulates*, and subsequently *paralyzes, the medulla and spinal cord*, but produces these effects in a less marked degree on the cerebrum.

Convulsions may occur, depending, according to some authorities, on the action of the poison on the spinal cord, while others ascribe them to an effect on the central basal ganglia.

The voluntary muscles and sensory nerves are not seriously implicated.

On the Circulation.—It acts as a *cardiac depressant* after primary stimulation. The blood-pressure rises at first, and then falls.

On Respiration.—The respirations are increased in frequency in the primary stages, afterwards becoming shallow and gasping.

The *temperature* falls slightly after medicinal doses, but may rise in cases of absorption of excessive amounts from surgical dressings.

Death generally occurs from asphyxia, combined with collapse.

All animals are susceptible to the actions of this drug when incautiously employed as a surgical dressing over large surfaces, but dogs are especially so.

The symptoms in such cases are dulness, trembling, loss of appetite, a peculiar olive-green, brown, or gray discoloration of the urine, while excessive absorption may occasion fatal collapse.

Professor Williams ('Principles and Practices of Veterinary Surgery') records cases where a solution of carbolic acid was freely applied to considerable skin surfaces of dogs, and produced 'gradual failure of the heart's action' in one, while in others 'a state of marasmus was induced, with sunken eyes, fœtid breath, "tarry" fæces, and death in six to twelve days.'

In acute cases of poisoning by carbolic acid, a diagnosis can be arrived at by the odour of the drug from the mouth, and an examination of this region will show traces of white, hardened corrugated patches on the mucous membrane, if the agent has been administered in a concentrated form.

The *post-mortem appearances* will show, in addition, patches of inflammation in the stomach and intestines, and if death has occurred within twenty-four hours after the poison has been taken, the characteristic phenol odour will be detected throughout the body.

The *antidotes* are the saccharate of lime, which is stated to control the action of the poison, and sulphate of soda, which neutralizes it, forming a sulpho-carbolate, which is excreted by the kidneys. The pharyngeal and gastric irritation should be allayed by the free administration of olive-oil and demulcents.

(4) REMOTE LOCAL ACTION.

Carbolic acid and its products are rapidly excreted, chiefly in the urine and to a less extent by the saliva. Only a minute portion can be recovered unchanged, various products being formed. The peculiar colour of the urine is due to one of these products.

This change in colour of the urine bears no definite relation to the amount of carbolic acid in the system, nor to the risk of toxic effects occurring.

Medicinal Uses—*Internally.*—Carbolic acid has been prescribed for all the purposes of an *internal antiseptic,* in cases of pyæmia, septicæmia, pulmonary gangrene, etc. Its poisonous nature, however, must not be lost sight of, and other antiseptics are preferred by many practitioners.

In *flatulent colic* in the horse and obstinate cases of tympanitis in cattle, it acts beneficially, being directly introduced into the colon of the horse and the rumen of the cow by means of Toope's trocar and cannula, in doses of 1 to 2 drachms, combined with 2 to 4 ounces of glycerine, and a pint of tepid water.

As an *inter-tracheal injection,* it is prescribed in cases of parasitic bronchitis in calves, combined with tr. opii or chloroform, as follows: Ac. carbolic., ♏xx.; tr. opii, ʒi.; ol. olivæ, ʒii.; or ʒss. of chloroform may be substituted for the tr. opii.

As an inhalation it is largely employed, in the form of vapour, in cases of respiratory affections with unhealthy discharges, acting as a *disinfectant* inhalation on the respiratory passages.

The drug should not be administered to dogs, for reasons already mentioned.

Externally.—Carbolic acid is extensively used as an *antiseptic* in the treatment of wounds, etc., in the form of a $2\frac{1}{2}$ per cent. watery solution.

Creolin, being non-poisonous, is preferred by many practitioners in the present day, and is largely gaining in favour.

At one time the familiar carbolic oil was a favourite dressing for wounds, but as its influence on germs is believed to be slight, if any, and as dry antiseptic dressings give better results, the oily compound is now being discarded, except as a popular application.

As a local anæsthetic, in the form of a strong solution, carbolic acid does not give satisfactory results, in consequence of its after-effects on the part.

Carbolic acid is employed in sheep-dips, and also as a *general disinfectant.*

Sulphocarbolate of zinc, in the proportion of from 2 to 3 grains to the ounce of water, is recommended in cases of *leucorrhœa*, and foul discharges from the vagina or uterus, and as a urethral injection (4 grains to the ounce) in gonorrhœa in bulls.

Resorcin.

A derivative of carbolic acid by various processes; is an *antiseptic* and *disinfectant* externally, and internally it reduces the temperature and pulse temporarily in febrile conditions.

Naphthalin, Naphthol—β Naphthol, Iso-Naphthol.

These are products of the distillation of coal-gas, and are powerful *antiseptics* and *disinfectants*.

Naphthalin has been used as an *intestinal antiseptic* in cases of diarrhœa and dysentery, in doses of ʒi. to ʒii. for horses, and grs. ii. to grs. viii. for dogs, administered in mucilage.

β **Naphthol** is applied in the form of ointment or solution (5 to 15 per cent.) in some diseases of the skin; it resembles tar in its actions, and is antiseptic and antiparasitic.

Creolin.

A coal-tar product obtained from the creosote-containing fractions of certain kinds of coal; it is freed from poisonous constituents, and specially treated to render it soluble and suitable for use. In contains only the higher homologues of phenol in the form of soluble salts.

Actions—*Externally.*—Creolin is antiseptic, deodorant, and disinfectant.

As an *antiseptic*, it has been proved by experiment to be far more active in the destruction of micro-organisms than carbolic acid, as well as in arresting their growth, a 2 per cent. solution being stronger than a 5 per cent. solution of carbolic acid for such purposes. In a 5 per cent. solution it destroys all pathogenic micro-organisms.

Properly diluted, it is devoid of irritating action on the skin, and is an effectual deodorant in the case of foul, unhealthy wounds.

As a general disinfectant, it is employed in the less refined form known as Jeyes' fluid. Its value in this respect has been amptly proved by experience, and being non-poisonous, it possesses great advantages over carbolic acid, besides being cheaper and capable of more dilution than the latter.

Medicinal Uses—*Internally.*—Creolin is administered as a *gastric disinfectant* in cases characterized by excessive fermentation. It is also useful in checking undue fermentation in the intestines, and in lessening the fœtor and acridity of the excretions.

As an internal antiseptic, it is an agent of great value, and is preferred to carbolic acid, being non-irritating and non-poisonous.

It may be administered to horses and cattle in doses of ʒii. to ʒvi., properly diluted, or given in mucilage, repeated two or three times daily, according to the requirements of the case; and for dogs, from ♏x. to ʒss. may be administered most conveniently in the form of capsules.

Externally.—Creolin is extensively employed as an antiseptic surgical dressing in cases of wounds, etc.

It forms a reliable antiseptic solution in the proportion of 1 to 80 of water (ʒii. to Oi.), and in this form may be used for rendering the hands, instruments, and field of operation aseptic.

As a uterine injection, it is very valuable in cases of metritis, and for washing out the uterus after a decomposing placenta has been removed; for such purposes a 1 to 40 solution may be employed.

As an inhalation it is employed in respiratory affections with benefit.

In *affections of the skin*, both parasitic and non-parasitic, it acts beneficially, and is highly recommended.

For mange in dogs the following ointment is recommended: creolin, ℥i.; sapo mollis, ℥iv.; lanoline ointment, ℥viii.; creta prep., ℥ss. Mix.

In chronic eczema the following application is useful: creolin, ℥i.; sapo mollis, ℥i.; methylated spirit, ℥ss. Mix.

In cases of *severe burns* and *scalds*, creolin gives favourable results, and may be employed in the form of ointment, the basis being of lanolin, containing 5 per cent. of creolin. This ointment forms an excellent antiseptic application for many purposes.

Creolin is employed in the dry antiseptic treatment of wounds in the form of a dusting powder, composed of boric acid containing 10 per cent. of creolin, and used in a similar manner to iodoform.

Pyoktanin.

A chemical preparation belonging to the class of aniline colours, introduced as an antiseptic by Stilling of Strasburg. It is produced in two forms:

Pyoktaninum Aureum—Auramin.

Pyoktaninum Cœruleum—Methyl Violet.

Methyl violet is the form most commonly employed. It is stated to be capable of killing germs and arresting their development in a higher degree than any of the hitherto known antiseptics, and to be non-poisonous and non-irritating.

It is used in the form of solution of 1 to 1,000, or in powder containing 1 or 2 per cent, or in the form of small crayons. It is very diffusible, penetrating living textures rapidly, and is quickly eliminated therefrom; it causes even in weak solutions an intense violet coloration of the tissues, and for this reason may be objected to as an antiseptic in operations and wounds.

In wounds already infected this agent is highly recommended as an antiseptic dressing.

In cases of suppurating ulcers it is advised to sprinkle pyoktanin in substance on the parts, or to apply it in the form of crayon.

In the form of injection (1 to 300) it is recommended in the treatment of mammary tumours in the dog, and melanotic tumours in the horse, injected deeply into the bases and substance of the growths.

In diseases of the eye it is employed by German practitioners. In conjunctivitis (simple and purulent) it is applied in the strength of 1 to 1,000. In ulceration of the cornea, in iritis, and panophthalmia it is also recommended.

Phenazonum—PHENAZONE, 'ANTIPYRIN.'

A crystalline substance obtained from phenyl hydrazine.

Doses.—Horses, ʒii. to ʒiv.; dogs, grs. x. to grs. xx.; may be repeated every one or two hours in acute cases until results are obtained. It is soluble in water.

Actions and Uses.—Phenazone is a powerful *antipyretic*, and a *general nervous sedative* and *anodyne*. It has little effect on the temperature of healthy animals, but in febrile cases is said to reduce the abnormal temperature, usually within half an hour, the effects continuing for two hours. The antipyretic action is believed to depend on diminished production of heat, less oxygen being taken in, while less urea and carbonic acid are excreted. Some authorities do not agree with this, but ascribe its action to increased radiation by dilatation of the cutaneous vessels. Large doses in dogs caused primary excitement, followed by paralysis of the central nervous system, muscular weakness, serious lowering of temperature, and general paralysis in some cases.

Antipyrin has been employed in cases of *influenza* characterized by very high temperature. It is not extensively used, and in our experience quinine gives far more reliable results.

In acute rheumatism it has been recommended, but is greatly inferior to the salicylate of soda in the treatment of this affection, as it only temporarily lowers the temperature, and on discontinuing it the pyrexia returns. Its use is contra-indicated in cases where cardiac complications are present.

Acetanilidum—Acetanilide, 'Antifebrin.'

A crystalline substance obtained by the action of glacial acetic acid on aniline, and subsequent purification.

Doses.—Horses, ʒi. to ʒii.; dogs, grs. iii. to grs. x., repeated every second hour in critical cases. Being very insoluble in water, it may be dissolved in alcohol for administration.

Actions and Uses.—Acetanilide is an *antipyretic,* and also a *nervous sedative.* It is said to be more powerful than antipyrin, and more lasting in its effects. It may be employed in febrile affections characterized by a very high temperature, and its use is said to be unaccompanied by any detrimental after-effects. It should be avoided in cases where there is weakness of the heart's action, as it tends to cause depression of this organ.

Phenacetinum—Phenacetin.

A crystalline substance produced by the action of glacial acetic acid on paraphenetidin, a body obtained from phenol.

Actions and Uses.—Phenacetin is *antipyretic*, anodyne and hypnotic. It resembles antipyrin and antifebrin in its actions, which are less rapid, but more prolonged. It may be employed in similar cases in doses of ʒii. to ʒiv. for horses, and grs. v. to grs. x. for dogs, dissolved in alcohol, as it is sparingly soluble in water.

Chinoline or Quinoleine.

An oily liquid obtained from aniline and allied substances.

Kairin.

A crystalline substance derived from chinoline.

Thallin.

A crystalline substance also derived from chinoline.

These agents resemble each other in their actions as antipyretics. They belong to a large group of allied substances, and are not as yet in general use in veterinary practice. Thallin is regarded by some authorities as a reliable antipyretic, and its value in this respect has been demonstrated on veterinary patients by Kaufmann and Friedberger. It is used in the form of a sulphate, and is stated to cause neither digestive nor nervous disturbance, and to reduce temperature quickly, this effect appearing to depend on diminished oxidation. It is given to horses in doses of ʒii. to ʒiii., and to dogs in doses of grs. ii. to grs. iv.

Salol.

A compound of salicylic acid and phenol. Insoluble in water.

Actions and Uses.—It is *antiseptic* and *antipyretic*, also *disinfectant*. It resembles salicylic acid in its action in cases of acute rheumatism, but is less effectual.

It is stated to exert beneficial effects in cases of intestinal diarrhœa, given in doses of ʒii. to ʒiv. to horses, and grs. iii. to grs. x. to dogs.

It is recommended by Kaufmann as a substitute for iodoform in surgical cases.

Ichthyol.

A brown, tarry liquid obtained by the dry distillation of a bituminous quartz found in the Tyrol, and is probably a residual product of fossilized fish. It contains about 18 per cent. of sulphur, and is capable of combining with alkalies and metals; the ammonium and lithium ichthyol compounds are given internally, while the former is usually employed for external use. It mixes readily with oils, fats, lanolin, etc.

Actions and Uses.—Ichthyol is *antiseptic*, *stimulant*, and *antiparasitic*.

According to Dr. Cranstoun Charles, it is very oxidizable, draws oxygen from the tissues, thus being a reducing agent; it also produces an invigorating and antiseptic influence throughout the body, and an astringent effect on the vessels. It is said to be specially useful in diseases associated with hyperæmia, as it limits the spread of inflammation and tends to prevent vesication.

In *affections of the skin*, especially eczema, psoriasis, pityriasis, it is highly recommended in the form of ointment, such as 1 to 10 of lanolin.

In *chronic rheumatic affections* of joints and muscles, a 50 per cent. ointment, applied with friction, is said to produce favourable results.

In *acute rheumatism* a 30 per cent. lotion is applied to the inflamed joints, which are then covered with cotton wool and oiled silk.

In *parasitic skin affections* ichthyol is employed by French and German practitioners in the form of ointment.

The drug is also given internally in doses of grs. i.ss. to grs. iii. in the form of pills for cases of the above affections in canine practice.

In *burns and scalds* an ointment of from 2 to 10 per cent. is recommended for reducing the smarting effects and allaying irritation.

Dr. Klein advises a 50 per cent. ointment of ichthyol in cases of *erysipelas*, which should be rubbed into the skin of the affected part two or three times a day.

Creasotum—Creasote.

A product of the distillation of wood tar.

Dose.—For dogs, ♏i. to ♏iii., administered in mucilage or milk.

Actions and Uses.—Creasote resembles carbolic acid in its actions. The most important use of creasote internally depends on its power of arresting fermentation, while not interfering with the action of pepsin or the digestive processes; hence it is prescribed in cases of *obstinate vomiting* in dogs due to indigestion and excessive fermentation, or to dilatation of the stomach.

In cases of *parasitic bronchitis* it is sometimes substituted for carbolic acid, in the form of inter-tracheal injection. (See p. 374.)

Externally, creasote is highly recommended in the treatment of *follicular mange* in dogs, by Mr. Hunting, F.R.C.V.S., London.

After shaving the affected parts, the following dressing is applied twice a week, and when the skin gets soft and tender longer intervals are allowed :

℞ Creasoti, ʒiv.
Liq. potassæ, ℥i.
Ol. olivæ, ʒvii.
Ft. lin.

Iodoformum—Iodoform.

Prepared by heating iodine with carbonate of potassium, alcohol, and water, and allowing the crystalline deposit to settle. It contains about 90 per cent of iodine.

Actions and Uses.—Iodoform is an *antiseptic* and *disinfectant*, also a powerful *deodorant*. Applied locally it produces little or no irritation, but acts as a *local anæsthetic*. In veterinary patients it is not likely to become absorbed as in human beings, in whom it produces constitutional symptoms ; dogs, however, may by licking the dressed surfaces be affected by the drug, which causes gastric derangement, vomiting, etc., and sometimes nervous symptoms. Iodoform is seldom prescribed internally ; its effects resemble, to a certain extent, those of iodine. Its chief use is as an antiseptic dressing for wounds, ulcerated surfaces, etc.

It appears to have little influence on bacteria outside the body, and, according to Behring, it produces beneficial effects not by acting directly upon the bacteria, but by inducing chemical changes in their toxic products, which render the latter harmless.

Iodoform may be applied in the dry form, or as iodoform wool and gauze, containing 10 per cent. of the agent. In the case of fresh wounds it should be judiciously employed, as it tends to induce excessive granulations.

It may be applied to unhealthy wounds in the form of an ointment, as follows: Iodoform, ʒi.; ol. eucalyptus, ℥i.; vaseline, ℥v. Mix.

In *canker of the ear* in the dog it acts very beneficially, being applied directly in the form of dry powder.

In cases of *thrush*, equal parts of iodoform and calomel form an efficient application, which should be introduced carefully into the cleft of the frog, until the discharge therefrom ceases.

In cases of *ozæna, chronic nasal catarrh*, etc., iodoform is introduced directly into the nasal cavities by means of an insufflator once a day, and often gives satisfactory results.

Iodol.

A powder obtained by precipitating a moderately pure pyrrhol with iodo-iodide of potassium. This resembles iodoform in its actions and uses, but is devoid of odour, and non-toxic when applied to wounds.

Aristol.

A compound of iodine and thymol, resembles iodoform in its actions, but is said to be non-toxic.

Paraffinum Molle.—Soft Paraffin, Vaseline.

A semi-solid mixture of the softer or more fluid members of the paraffin series of hydrocarbons, usually obtained by purifying the less volatile portions of petroleum.

Uses.—Vaseline is not oxidizable, and hence cannot become rancid or irritant to the skin. It is extensively employed *as a basis* for ointments instead of lard, and is also useful as a lubricant and emollient application.

CHAPTER IX.

II.—THE ORGANIC MATERIA MEDICA.

GROUP I.—THE VEGETABLE KINGDOM.

The vegetable kingdom supplies a large number of medicinal agents, some being of great importance; others, in consequence of their actions not being understood, are but seldom employed. To the latter only a passing notice will be given, while those agents whose value has been demonstrated by practical use in the treatment of disease will be considered at length.

We shall endeavour, as far as possible, to group together those drugs which possess a similarity of actions, and compare them whenever necessary, and thus assist the student to remember their indications and uses. This plan is preferable to arranging the agents according to their natural orders, or alphabetically.

Aconiti Radix—Aconite Root.

The dried root of Aconitum Napellus (monk's-hood).

Aconiti Folia.

The fresh leaves and flowering tops of Aconitum Napellus.

Preparations of Aconite Root.

Tinctura Aconiti (B.P.)—Tincture of aconite (British Pharmacopœia), 1 in 8 of spirit.

Doses.—Horses, ʒss. to ʒi.; cattle, ʒi.; sheep, ♏v. to ♏x.; dogs, ♏ii. to ♏v. Small doses should be repeated at intervals of one or two hours, combined with salines or diaphoretics.

Fleming's Tincture of Aconite is about four times as strong as the above, the doses for horses being ♏v. to ♏x.; cattle, ♏x. to ♏xx.; sheep, ♏ii. to ♏iii.; dogs, ♏ss. to ♏ii.

Aconitina—Aconitine.

An alkaloid obtained from aconite root. It is not given internally, but externally is sometimes employed in the form of unguentum aconitinæ—1 to 55 of benzoated lard.

Pulvis Aconiti (Folia)—Powdered Aconite.

Dose.—Horses, ʒi. to ʒii.

ACTIONS OF ACONITE.

(1) IMMEDIATE LOCAL ACTION.

Externally, aconite applied to the skin or exposed mucous membranes depresses the peripheral endings of sensory nerves, and subsequently paralyzes them. It can be absorbed by the skin.

Internally, full doses have a topical irritant effect on the stomach, causing slight pain and nausea, followed by vomition in dogs. It subsequently depresses the gastric nerves.

(2) SPECIFIC ACTION.

Aconite is rapidly absorbed from the stomach, and entering the blood, it passes quickly into the tissues.

Medicinal doses given in close succession have a special action on the heart, the circulation, respiration, and temperature.

They reduce the *frequency*, *force*, and *tension of the pulse* by acting on the nerves, and also by a direct action on the nervo-muscular structure of the heart itself.

The *blood-pressure* is lowered, partly from cardiac, and partly from vaso-motor, depression.

Respiration is slowed, both from reduced circulatory force as well as direct depression of the respiratory centre.

The *skin* is stimulated, perspiration is slightly increased, and *temperature is lowered* steadily.

The *kidneys* are stimulated, and the fluids and solids of the urine are increased in amount.

On the nervous system the specific action of aconite is that of a *depressant*. Authorities do not agree as to the exact manner in which the different portions of the nervous system are affected by this drug. Some state that it first depresses, then paralyzes, the sensory centres of the spinal cord, the peripheral nerve-endings being next affected, and finally the nerve-trunks.

Others believe that the sensory nerves are affected from the periphery inwards, the spinal cord being secondarily acted on. The motor nerve-endings and nerve-trunks also become depressed, but the influence on these is less than on the sensory nerves. The brain is not directly affected, and even large doses do not remove consciousness, but may disturb it.

Toxic Effects.—Aconite in toxic doses causes great disturbance of respiration, muscular weakness, and vascular depression; the cardiac action becomes frequent, irregular, and gradually feebler, tending to cease in diastole. Death may occur from asphyxia, depending on paralysis of the respiratory centre; but a very large dose may kill by syncope, due to sudden paralysis of the heart-muscle. Convulsions may precede death in some instances.

In the horse, large doses cause frothing from the mouth, nausea, attempts at swallowing, followed in a variable period by attempts at vomition, accelerated respirations, and feeble pulse.

Professor F. Smith, in experimenting with this drug, gave a pony 4 ounces of the tincture of aconite undiluted. In ten minutes there was slight frothing from the mouth, a gulping sound from the throat, as if making attempts to swallow, pulse weak and very compressible, and, judging from the sound proceeding from the abdomen, there were increased peristaltic movements of the intestines. In forty minutes the animal was pawing with one fore-leg, and in one and a quarter hours from the commencement there were distinct attempts at vomition, which were continued for three and a half hours after receiving the dose. The animal commenced to recover, and was in a normal condition in five and a half hours.

Aconitine is a very active poison, even $\frac{1}{48}$ grain injected hypodermically producing serious symptoms in the horse.

In horses destroyed by this alkaloid, the prominent symptoms noted were excessive salivation, grinding of the teeth, indications of pain, and violent tetanic convulsions.

No alteration of temperature, nor any increased secretion from the skin, bowels, or kidneys, was noted.

In dogs, large doses of aconite generally cause in five minutes painful vomiting and continuous retching, muscular exhaustion, and paralysis of the hind extremities. In some instances death occurs with great rapidity.

Antidotes.—Iu the dog, if seen immediately after the poison has been taken, emetics should be administered.

Alcoholic or ammoniacal stimulants should be freely given, and ether used hypodermically, every means being adopted to assist in maintaining cardiac and respiratory action.

(3) REMOTE LOCAL ACTION.

Aconite is excreted by the kidneys, increasing the solid and fluid portions of the urine. It probably also leaves the system by the skin.

Medicinal Uses.—*In acute febrile affections* in sthenic patients, aconite judiciously prescribed is a valuable agent, acting as a *vaso-motor sedative*, reducing cardio-vascular excitement, and lowering abnormal temperature.

In the early stages of respiratory affections, it is prescribed in carefully regulated doses, in combination with the liquor ammonii acetatis, and repeated every two or three hours.

It is **contra-indicated** in cases characterized by debility, weakness of pulse, and in cardiac affections.

Being a powerfully depressing agent, its effects require to be carefully watched, and, generally speaking, its use is not indicated in that affection termed *influenza*, as the system is in an already depressed condition.

In laminitis, aconite is indicated, and gives very beneficial results in the early stages, combined with salines, such as the nitrate of potassium, and, administered at intervals of one or two hours, it tends to relieve pain, and reduces excessive cardiac action and temperature.

In enteritis, it was recommended in combination with opium and camphor by the late Professor Robertson ('Equine Medicine').

In acute rheumatism, it relieves pain and reduces the pyrexia, being combined with salines.

In tetanus, it has been prescribed with variable success in the earlier stages, in the form of hypodermic injections of Fleming's tincture in from ♏v. to ♏x. doses.

In chronic cough and broken wind, it acts as an efficient palliative remedy, combined with arsenic, strict attention being also given to dietetics. For such purposes it may be administered in the form of powders, such as the pulvis aconiti folia, or in the form of the tincture, combined with the liquor arsenicalis.

Externally, aconite is used as a *local anodyne* in rheumatic affections and swollen, painful joints, in the form of liniment, combined with a small proportion of chloroform. The ointment of aconitine may be similarly employed.

The external use of aconite demands special care in consequence of the danger of absorption.

Veratrina—Veratrine.

An alkaloid or mixture of alkaloids, obtained from the dried ripe seeds of Cevadilla or Sabadilla—a Mexican plant. It is also present in small amounts in Veratrum album, popularly known as white hellebore, and in Veratrum viride, or green hellebore, both of which are allied to veratrine in their physiological actions.

Doses.—Horses, grs. i.ss. to grs. ii.; cattle, grs. ii. to grs. iv. By hypodermic injection.

Actions.—*Externally,* veratrine applied to the skin or mucous surfaces acts as a powerful irritant, and then depresses the nerves and vessels, terminating in loss of sensibility and vesication.

Internally, full doses cause salivation and painful vomiting in dogs, violent purging, great muscular prostration, slow, feeble, or irregular pulse, shallow respiration, a lowering of temperature, spasmodic twitching of muscles, and finally collapse, death occurring from asphyxia.

In horses, 5 or 6 grains administered caused salivation, profuse sweating, muscular trembling, and violent contractions of the gastro-intestinal muscles, with efforts at vomition (Kaufmann).

On the nervous system veratrine exerts a slight depressing influence, but has no marked action on the brain or spinal cord.

The muscles are the structures chiefly acted on by the drug. It produces a remarkable lengthening of their contraction, and increases their force, so that the muscles appear to be in a state of tetanus; but this condition really depends on a single contraction, and not on a series of simple spasms. In larger amounts it causes weakness of the muscles, and finally paralysis.

On the heart it produces similar effects as on the voluntary muscles; it lengthens the contractions of the organ, thus *reducing its frequency*, larger doses causing irregularity, feebleness, and finally paralysis.

The blood pressure is first raised, and then falls.

Respiration is first accelerated, and then slowed, being finally arrested through the centre, the muscles, and the vagus.

The temperature is lowered, probably depending on circulatory depression.

Medicinal Uses.—Veratrine has been recommended as an *antipyretic* for the same conditions as aconite, viz., acute febrile affections in sthenic subjects; but its depressing influence on the system does not render its use either safe or advantageous.

According to M. Cagny ('Précis de Thérapeutique Vétérinaire'), this drug has the power of stimulating the functions of the stomach in cattle, and is an agent of great value in cases of impaction, by causing the removal of a large portion of the gastric contents. It is administered in doses of 2 to 3 grains hypodermically, and may be repeated if necessary.

This authority also states that veratrine resembles, to a certain extent, eserene, but that it has less action on the intestinal secretions, as compared with its influence on the peristaltic movements, and he recommends a combination of veratrine, eserene, and pilocarpine in the treatment of impaction of the colon in the horse.

Staphisagriæ Semina—Stavesacre Seeds.

The ripe seeds of Delphinium staphisagria, or larkspur. Contains several alkaloids, the most important being delphinine and staphisagrine.

Actions and Uses.—Delphinine resembles aconitine in its actions, but is even more depressant to the vessels.

Stavesacre is only used as a *parasiticide*, for the destruction of pediculi and acari. For such purposes one part of the bruised seeds is boiled for two hours with twenty to thirty parts of water, making up the latter to the original quantity.

Strong preparations too freely applied, or absorbed from abraded surfaces, or licked by dogs, are liable to produce nausea and prostration.

As an application for mange in the horse, Professor Williams recommends the following formula :

℞ Pulv. delphini staphisagriæ, ℥ii.
Adipis vel ol. palmæ, ℥viii.
Ol. olivæ, ℥i.

Mix and digest at 100° in a sand-bath, and strain.

For the destruction of lice, a decoction of stavesacre is very efficient, composed of one ounce of the powdered seeds to a pint of water, care being taken that the animals do not lick themselves for some time after the remedy is applied.

Colchici Cormus—Colchicum Corm.

The fresh corm of Colchicum autumnale, or the autumn crocus, dried and powdered for use.

Doses.—Horses, ʒss. to ʒi. ; cattle, ʒi. to ʒii. ; dogs, grs. ii. to grs. viii. Repeated twice daily in combination with salines.

Colchici Semina—Colchicum Seeds.

Preparation.

Tinctura Colchici—Tincture of colchicum—1 to 8 proof spirit.

Doses.—Horses, ℥i. to ℥i.ss. ; cattle, ℥ii. ; dogs, ♏x. to ♏xxx.

Actions.—The physiological action of colchicum is not clearly understood, hence its use in medicine is somewhat empirical, and founded on the results obtained in the treatment of certain diseases. Given in a large dose it causes *gastro-intestinal irritation*, purging, cardiac depression, and an increase of the biliary secretion, its actions resembling to a certain extent those of veratrine. Its alkaloid, colchicine, enters the blood and tissues, and acts as a depressant on the central nervous system, large doses producing loss of sensibility and consciousness, and diminishing reflex excitability; the peripheral sensory nerves become paralyzed, while motor nerves and muscles are unaffected.

On the Kidneys.—It is said by some authorities to diminish the *amount* of urine, but to increase the quantity of urea and uric acid.

Medicinal doses act as *diuretics* and *cholagogues*. While large amounts may lessen the quantity of urine excreted, moderate doses increase both the flow and the solid constituents, a fact which is proved by clinical experience.

Medicinal Uses.—In subacute *rheumatism*, colchicum is prescribed with benefit in combination with saline diuretics, its effects probably being due to its power of assisting the excretion of the morbid material through the kidneys.

In *lymphangitis* it is also useful in combination with other agents, in virtue of its diuretic and cholagogue actions.

In *azoturia*, when the urinary excretion is deficient, colchicum is indicated, and may be given with sweet spirits of nitre.

In the secondary stages of *pleurisy*, and in *rheumatic pericarditis*, it is prescribed with iodide of potassium, and gives favourable results in many instances.

CHAPTER X.

THE VEGETABLE KINGDOM—*Continued.*

Opium.

THE juice obtained by incision from the unripe capsules of Papaver somniferum, the white poppy (grown in Asia Minor), inspissated by spontaneous evaporation (B.P.).

The best variety of opium is the Smyrna, Turkey, or Levant; this yields 10 *to* 12 *per cent. of morphine.*

Preparations.

(1) **Pulvis Opii**—Powdered Opium.

Doses.—Horses, ʒi. to ʒii.; cattle, ʒii. to ʒiii.; sheep, grs. x. to grs. xxx.; dogs, grs. ss. to grs. iii.

These doses must be modified according to sizes and requirements.

(2) **Extractum Opii**—Aqueous—2 in 1.

Doses.—Half the above.

(3) **Pulvis Ipecacuanhæ Compositus**—Dover's Powder—Opium, 1; ipecacuanha, 1; sulphate of potassium, 8 (1 in 10).

Doses —Horses and cattle, ʒii. to ʒiv.; dogs, grs. v. to grs. xv.

(4) **Tinctura Opii**—Tincture of Opium, Laudanum—Opium, 1½; proof spirit, 20. Contains 1 grain in 14½ minims, or nearly 33 grains to the ounce.

Doses.—Horses and cattle, ℥i. to ℥iii.; sheep and pigs, ʒii. to ʒiv.; dogs, ♏v. to ♏xxx. Modified according to requirements.

(5) **Tinctura Camphoræ Composita** — Camphorated Tincture of Opium, 'Paregoric'—Opium, 40 grains;

benzoic acid, 40 grains; camphor, 30 grains; oil of anise, $\frac{1}{2}$ fluid drachm; proof spirit, 20 fluid ounces (1 in 240).

Doses.—Similar to those of the tincture of opium.

(6) **Unguentum Gallæ cum Opio**—Opium, 32 grains; ointment of galls, 1 ounce (1 in $14\frac{2}{3}$).

Incompatibles of Opium and its Preparations.—Acetate and subacetate of lead, salts of zinc, copper and arsenic, all astringent vegetable preparations, fixed alkalies and their carbonates, alkaline earths, and ammonia.

Opium contains a large number of constituents, among which are many alkaloids and two organic acids. The most important *alkaloids* are *morphine*, *codeine*, *thebaine*.

The chief organic acid is meconic acid, an agent of no therapeutical importance.

The alkaloid *morphine*, in consequence of its insolubility, is employed in the form of different salts; it is obtained from opium by complex chemical processes, the various salts depending on the acid which is used in the preparation of each.

Morphinæ Hydrochloras—Hydrochlorate of Morphine—

is prepared by precipitating morphine by ammonia, diffusing in water, dissolving in hydrochloric acid, and crystallizing out. It is the salt most commonly employed.

Solubility.—1 in 24 of water, readily in spirit.

Incompatibles.—The alkaline carbonates, lime-water, salts of lead, iron, copper, mercury and zinc, liquor arsenicalis, and all astringent vegetable preparations.

Doses.—Horses and cattle, grs. iv. to grs. x.; sheep, gr. i. to grs. ii.; dogs, gr. $\frac{1}{8}$ to gr. $\frac{1}{2}$.

For *hypodermic injection*, which is the most effective, the minimum doses mentioned should be employed at first, the agent being rendered in a soluble form, as follows:

Liquor Morphinæ Hydrochloratis (B.P.)—4½ grains in 1 fluid ounce of a mixture of spirit, water, and dilute hydrochloric acid (1 in 100). Dose for dogs: ♏ v. to ♏ x., hypodermically.

For horses and cattle a stronger solution is more convenient, and may be prepared of the strength of 2 grains of morphine hydrochlorate to each 25 minims of solution.

Tinctura Chloroformi et Morphinæ—Chlorodyne.
See p. 338.

Morphinæ Acetas—Acetate of Morphine.

Solubility.—1 in 2½ in water, readily in spirit.

Doses.—Similar to those of the hydrochlorate.

Morphinæ Sulphas—Sulphate of Morphine.

Solubility.—1 in 24 of water, sparingly in spirit.

Doses.—Similar to the above.

Codeina—Codeine—

is prepared from the ammoniacal liquors from which morphine has been obtained; it is present in opium in the proportion of ¼ to 1 per cent.

Doses.—About four times those of morphine.

ACTIONS OF OPIUM.

These depend chiefly on morphine, and any differences in the actions of each will be noticed afterwards.

(1) IMMEDIATE LOCAL ACTION.

Authorities differ as to the action of opium on the unbroken skin, some stating that morphine cannot be absorbed therefrom, and hence that the local effect is slight, if any.

Others believe that it acts as a *local anodyne* when applied in the form of liniment or fomentation, made from the tincture and other preparations.

Opium and morphine are readily absorbed from wounds, ulcers, and exposed mucous surfaces, acting as local anodynes thereon.

Internally.—In the mouth opium *diminishes the secretions*, and is quickly absorbed from the mucous membrane. It causes dryness of this region, and a degree of thirst.

On the Stomach.—Opium produces brief irritation of the nerves, and may cause nausea in the dog, but sensibility is quickly reduced, and appetite, gastric secretion, and digestive activity are diminished.

On the Intestines.—Opium exerts a *distinct sedative effect.* It diminishes or arrests the sensible and insensible impressions from the mucous membrane, and lessens the secretions. It renders the peristaltic action slower, or completely arrests it by *stimulation of the splanchnics*, which are the inhibitory nerves of the intestinal walls. In large doses opium is stated by some authorities to cause paralysis of the splanchnics, and thus to increase peristalsis.

(2) ACTION ON THE BLOOD.

Morphine does not enter the circulation as quickly as some other alkaloids, although traces of it are rapidly discovered in the blood.

The full action of opium is thus comparatively slowly developed, and its local effects continue to be exerted even in the colon, where the morphine is gradually being absorbed.

It is said that the red corpuscles are reduced in size indirectly, probably through depression of the circulation and a deficiency of oxygen.

(3) SPECIFIC ACTION.

The principal action of morphine is exerted on the *nervous system*, although it has a physiological effect on all organs.

On the cerebrum its effects vary greatly in individuals of the same species, as well as in those of different species. In man, where the cerebrum is highly developed, opium usually causes brief excitement of the convolutions, followed by depression and the occurrence of sleep.

In the horse, where there is less development of the higher brain-centres, but relatively more development of the loco-motor centres, and of the reflex centres of the spinal cord, opium exerts its primary stimulant effects on these lower centres, and in many instances, instead of producing sleep, it causes restlessness, involuntary movements, pawing with one foot persistently, and continuous walking round in one direction ; in large doses it may cause delirium, accompanied with frequent neighing, etc. In such instances even large amounts of the drug will fail to produce sleep, but rather tend to increase the excitement.

In some cases opium in medicinal doses will exert anodyne and hypnotic effects, these differences probably depending on the susceptibilities of individual animals.

According to Dr. H. C. Wood, the restlessness induced in some horses by opium and morphine is due to delirium, and not to spinal excitement.

Ruminants are usually affected by opium in a similar manner to horses.

Dogs may show a preliminary period of excitement, but depression usually follows, and sleep occurs, not, however, profound, but may be accompanied by muscular twitchings and evidences of disturbed dreams.

The effects of opium on the cerebrum are probably due to a *direct action of morphine on the nerve-cells*, and not on the cerebral vessels. In those instances in which it exerts hypnotic effects, the perceptive and sensory centres become depressed earlier and more profoundly than the vital centres in the medulla, this being a matter of great therapeutical importance with reference to the safety of the drug.

The motor centres in the brain and spinal cord are stimulated by morphine, and reflex excitability is increased; these effects are well marked in the horse in those instances where the exciting action of the drug predominates.

When cerebral depression occurs, muscular weakness of central origin sets in, the *motor nerves* become paralyzed from the centres outwards, but muscular irritability is never completely lost.

The sensory nerves of all organs of the body are depressed by opium. The sensory *nerve-terminations* have their functions lowered or arrested, so that common sensibility is reduced and pain cannot be originated. This peripheral anodyne effect, however, is secondary both in time and degree to the action of the drug on the sensory centres.

The sensory nerve-trunks have their power of conductivity diminished, this effect still further preventing painful impressions being conveyed inwards.

The hypodermic injection of morphine possesses a local anodyne effect on the peripheral sensory nerves and the nerve-trunks, as well as a central effect.

On the vital centres of the medulla opium acts as a *depressant.*

On the *cardiac centre* it causes primary excitation, followed by depression.

On the Heart and Circulation.—The heart is *temporarily accelerated* by opium, partly through the cardiac centre, and partly through an effect on its intrinsic ganglia. In fuller doses its action is slowed by stimulation of the vagus in the medulla, and in the heart itself.

The *cardiac vagus* is next depressed or paralyzed; but in consequence of the intrinsic cardiac ganglia being simultaneously depressed, acceleration of the heart is impossible, so its action becomes infrequent and feeble. Death rarely occurs from sudden cardiac failure.

The *vessels* become dilated through the vaso motor centre, but they are not directly influenced by the drug either in their muscular coats or their peripheral nerves.

On Respiration.—Opium is a *powerful depressant;* the respiratory centre is depressed, and the respiratory movements become sup rficial and irregular; the afferent nerves of breathing—*i.e.*, the pulmonary branches of the vagus—are also depressed, so that reflection is dulled at its origin, and cough, spasm, and other reflex respiratory acts are rendered less liable to occur, or may be altogether arrested. The bronchial secretions are diminished by the action of the drug on the glands.

In toxic doses the respiratory centre becomes paralyzed, and death occurs from asphyxia.

On the Liver.—Opium interferes with the biliary and glycogenic functions, and in that affection termed *diabetes mellitus* it diminishes the amount of sugar in the urine to a marked extent. It reduces the activity of hepatic and general metabolism, and diminishes the amount of urea, and probably of carbonic acid, excreted.

The *temperature* temporarily rises, and then falls, apparently varying with the blood-pressure.

The *pupil of the eye* is *dilated* in the horse, probably from some effect of the drug on the basal ganglia ; in the dog it is contracted while the animal is asleep, or narcotized as a result of the action of the drug.

(4) REMOTE LOCAL ACTION.

Morphine leaves the system by most of the secretions, but especially in the bile. Its excretion commences rapidly, but may not be completed for a considerable period; it is found in the urine, mainly unchanged. It *diminishes* the quantity of urine, and in large doses may suspend the action of the kidneys.

Morphine in passing through the skin is said by some authorities to act as a diaphoretic; but this effect is not observed in medicinal doses. It is also excreted in the milk, which necessitates caution in prescribing the drug to animals nursing their young.

ACTIONS OF THE PRINCIPAL ALKALOIDS OF OPIUM.

1. **Morphine.**—As already mentioned, the action of opium depends chiefly on morphine, so that the description just given will apply to both; there are, however, a few points of difference which must be noticed.

(*a*) Morphine in its pharmacopœial preparations is more readily absorbed, and acts quicker, than opium, while the effects of opium are more lasting, and its immediate local action on the intestines is more marked.

(*b*) Morphine is of definite composition, while the crude drug is often variable. It can be readily administered by hypodermic injection, while dyspeptic and constipating effects are less marked than in the case of opium.

(*c*) Morphine has a more sedative influence than the entire drug, as several of the constituents of the latter possess, more or less, convulsant action, such as thebaine, codeine, narcotine.

As a rule, morphine is preferred to opium, except in cases of intestinal affections, such as diarrhœa, dysentery, etc., where the latter reaches the bowel directly, and exerts its immediate local action thereon.

2. **Codeine** is generally believed to excite the spinal cord more than morphine, and to depress the convolutions less. It reduces the amount of sugar in *diabetes* to a marked degree. According to M. Cagny ('Précis de Thérapeutique Vétérinaire), codeine is an anodyne less narcotic than morphine, and does not cause so marked a period of excitation in its action on nervous horses. He prefers codeine to morphine for the various purposes of an anodyne.

3. **Thebaine, or Paramorphine,** present to the extent of one half per cent. in opium, stimulates the motor tract of the spinal cord, and acts like strychnine, producing muscular rigidity and convulsions. We are not aware of its employment for therapeutical purposes.

Toxic Effects of Opium and Morphine.—*Horses* resist the toxic effects of opium and morphine to a great extent.

In the majority of instances large doses produce excitement, restlessness, muscular tremors, dilatation of the pupils, continuous walking in a circular direction, shaking of the head, profuse sweating, delirium; these effects may continue for a long period, and are usually succeeded by profound depression and nausea.

According to Dr. H. C. Wood ('Materia Medica and Therapeutics'), 100 grains of acetate of morphine killed a horse with convulsions in three hours.

In the dog large doses of opium or morphine generally cause nausea, staggering, unsteady gait, muscular twitching, clonic spasms, stertorous breathing, stupor, and death from asphyxia due to paralysis of the respiratory centre.

Antidotes.—In the dog emetics should be resorted to, and preparations of ammonia prescribed to promote cardiac and respiratory action.

In all animals the occurrence of coma should be prevented by artificial respiration and keeping the patient moving about.

Small doses of atropine, administered by hypodermic injection, in a judicious manner, are recommended to maintain the cardiac and respiratory functions.

Comparison of the Actions of Opium and Belladonna.—As morphine and atropine are frequently combined as anodynes in the form of hypodermic injections, it will be necessary to briefly compare their actions. In some respects the action of morphine is opposed to that of atropine. Thus, atropine in medicinal doses has a sedative effect on the cerebral convolutions. It stimulates the respiratory centre, and by depressing the inhibitory branches of the splanchnics causes relaxation of the intestines.

By combining the two agents we find that one may prevent or relieve certain effects of the other when employed as anodynes. Thus, atropine prevents the nausea, depression, dyspepsia, and constipation which are apt to occur after the administration of morphine.

Medicinal Uses.—*As an anodyne* opium and its alkaloid morphine are frequently employed in cases where the relief of pain is the primary indication of treatment. Such cases are very numerous, and depend on various pathological conditions.

In the horse, as we have already noticed, opium and morphine act as excitants to the nervous system in many instances, and hence do not produce anodyne effects in as satisfactory a manner as in dogs or human beings.

As a rule, if the first dose of opium or morphine fails to give relief, further doses will only tend to cause excitement. The combination with atropine, according to our experience, does not tend to overcome this exciting effect, and the most reliable agent to combine for this purpose is chloral hydrate in doses of one ounce, repeated until hypnotic effects are produced.

In many cases of violent abdominal pain, such as occurs in volvulus, acute enteritis, gastritis, etc., opium and morphine fail entirely to give relief, and we now employ cannabis indica as an effectual anodyne and hypnotic in these conditions (see p. 408).

Many of such cases are of a fatal nature from the commencement; but this should not deter us from giving the patients relief from the agonizing pain which is present. As a rule, the hypodermic injection of morphine gives more reliable effects than opium administered by the mouth, for reasons already stated.

Powdered opium given in the form of bolus takes a long time to act in the horse, and an important point to remember is, that in affections of the alimentary canal absorption is retarded, and *pain* affords great resistant power to the action of the drug, which appears to expend itself on the morbid process. From the latter fact we learn that the doses of opium or morphine must be regulated according to the demands of the case, and that insufficient amounts are of no practical value; pain must be relieved, or it will hasten fatal results.

As an antispasmodic, the tincture of opium is employed in the treatment of intestinal colic, and is combined with the spiritus ætheris nitrosi for this purpose.

In *gastritis*, in all patients, the preparations of opium are useful for relieving irritability, pain, and spasm, and giving the inflamed part rest.

In *diarrhœa*, after the administration of a laxative, to remove the probable cause of the affection, some preparation of opium is indicated when the intestines remain irritable and relaxed.

In such instances the tinctura chloroformi et morphinæ (chlorodyne) is very useful, and may be administered in starch or flour gruel, and combined with an antacid.

In *dysentery* opium allays pain and straining, and may be administered with astringents, such as tannic acid, ipecacuanha, acetate of lead, etc.

In *enteritis*, *peritonitis*, *metritis*, the hypodermic injection of morphine is largely employed as an anodyne, and, as already mentioned, it is advisable to administer in addition a hypnotic such as chloral hydrate, so as to avoid the exciting effects of the morphine.

In certain affections of the *respiratory system* opium may be indicated, but great discrimination is necessary in its employment.

In the primary stages of *pleurisy*, accompanied by severe pain in the chest and harassing cough, opium judiciously prescribed gives beneficial results in combination with the other details of treatment.

In cases of *cough* depending on reflex irritation, or on excessive irritability of the nerves and centre, opium is indicated, and may be given with benefit in the form of the tinctura camphoræ composita.

In *tetanus* the hypodermic injection of morphine combined with atropine has been employed with a variable degree of success.

In *premature labour pains*, in *post-partum hæmorrhage* and *straining*, and in cases of *eversion* of *the uterus*, *bladder*, or *vagina*, opium or morphine are administered with benefit as sedatives and antispasmodics.

In cases of *intestinal hæmorrhage* opium is of great value, as it arrests the movements of the bowel, and has a sedative effect on the circulation. In such cases it should be combined with acetate of lead or preparations containing tannic acid.

In *diseases of the heart*, in which pain and distress are prominent symptoms, opium judiciously administered is beneficial; but as it is a dangerous cardiac depressant, other anodynes, such as belladonna, are preferred.

In *diabetes mellitus*, occasionally met with in dogs, but rarely in horses, opium or codeine administered twice daily gives favourable results.

As an antidote to strychnine - poisoning, morphine has the power of antagonizing the muscular spasms; and Professor F. Smith records an instance of a dog poisoned with strychnine, and so convulsed that recovery seemed impossible, but after five grains of morphine had been injected hypodermically the muscular spasms ceased, the animal slept for twenty-four hours, and recovered.

Contra-Indications of Opium and Morphine.—In congestive and inflammatory affections of the brain. In diseases of the respiratory organs with shallow, embarrassed breathing, and a tendency to death from asphyxia, opium or morphine is apt to still further depress respiratory function.

In cough and respiratory distress, with abundant secretion, as in the bronchitis of weak or debilitated subjects, opium leads to retention and inspissation of the products, aggravation of the cause, and a tendency to asphyxia.

In renal disorder or disease, if the action of the kidneys be deficient, opium tends to increase this condition, and there is a probability of the retention and accumulation of morphine in the system.

Externally, opium is employed as a topical anodyne in the form of liniment, prepared by mixing equal parts of the tincture of opium and soap liniment.

In cases of eversion of the uterus, vagina, or bladder, the parts are washed with a solution of opium and belladonna before being returned to their normal positions.

In hæmorrhoids, opium is useful applied in the form of the unguentum gallæ cum opio.

Apomorphinæ Hydrochloras—Hydrochlorate of Apomorphine.

Prepared by heating morphine or codeine in sealed tubes with hydrochloric acid.

Preparation.

Injectio Apomorphinæ Hypodermica—2 grains dissolved in 100 minims of camphor-water.

Dose.—Subcutaneously for dogs, ♏ii. to ♏v.

Actions and Uses.—Apomorphine is the quickest and most reliable of all emetics; it acts upon the vomiting centre, and but slightly on the stomach, being mainly an *indirect* emetic.

It is employed in canine practice in doses of gr. $\frac{1}{25}$ to gr. $\frac{1}{10}$ hypodermically, and gr. $\frac{1}{10}$ to gr. $\frac{1}{6}$ by the mouth. Its effects are produced in from 5 to 20 minutes, consisting of moderate nausea, repeated vomiting, and the disturbances of the respiratory and circulatory organs, usually caused by emetics. It is stated not to cause local irritation of the stomach, and to leave little or no after-effects.

Small doses (gr. $\frac{1}{20}$) are expectorant.

Apomorphine administered to the horse produces no attempts at vomition, but causes alarming symptoms of cerebral excitement.

Cannabis Indica—Indian Hemp.

The dried flowering or fruiting tops of the female plants of Cannabis sativa, grown in India, and from which the resin has not been removed. It contains a glucoside, *cannabin;* an active principle, *cannabinon;* a volatile alkaloid, *cannabinine;* another alkaloid, *tetano-cannabine;* and a volatile oil, *cannabene.*

Preparations.

Extractum Cannabis Indicæ—Alcoholic—6 in 1.

Doses.—Horses and cattle, ʒss. to ʒi.; dogs, gr. $\frac{1}{4}$ to gr. i.

Tinctura Cannabis Indicæ—1 of extract to 20 of spirit.

Dose for dogs, ♏ v. to ♏ xx.

Actions.—The physiological effects of the active principle and alkaloids of cannabis indica have not been fully determined. Tetano-cannabine is said to be a convulsant.

The extract is the preparation concerning which we have some definite knowledge, and which is generally employed in practice.

Cannabis indica acts as a *hypnotic* and *anodyne* when administered in sufficient doses.

It does not produce the intoxicating effects in veterinary patients recorded as occurring in man, and no exciting action is noticed as the primary effects of the drug.

Individual susceptibility and a variable composition of the drug probably account for the differences sometimes observed in its action on horses, but in the majority of instances, if a suitable dose be administered, marked hypnotic and anodyne effects will be produced. Cannabis indica resembles opium in its actions to a certain extent, but instead of the cerebro-spinal excitement induced by the latter drug, we have a condition of profound sleep, probably depending on the effects of the agent on the cerebrum.

Administered in doses of from half an ounce to one ounce of the extract, it commences to act in from twenty minutes to half an hour; the horse assumes a sleepy appearance, the eyelids droop, the head may be shaken in a listless manner, the animal usually retains the standing posture, with the head in the corner of his stall; as the drug continues to exert its action, a snoring sound is heard during inspiration, and the animal appears unconscious to surrounding influences.

These effects may continue for a period of from ten to twelve hours, and gradually pass off; but if the dose has been excessive, or if the animal be particularly susceptible to the action of the drug, an alarming state of narcosis may be produced. The lips are retracted, the tongue hangs from the mouth, the pulse is weak and accelerated, respirations hurried, shivering fits occur at intervals, there is partial loss of control over the hind extremities, the animal keeps its head in a corner, and if disturbed tends to return to its former position, a flow of frothy saliva issues from the mouth, the penis may be pendulous.

Even in this condition the animal may attempt to feed on a bran-mash, but the lips are usually worked in a semi-unconscious manner, and little or nothing is swallowed. This state of narcosis may continue for an indefinite period, but after the administration of diffusible stimulants it gradually passes off, with but little degree of nausea or loss of appetite, and no interference with the action of the bowels or kidneys. Even medicinal doses will in some horses produce an apparent loss of control over the hind extremities, but this gradually passes off without any untoward effects. In man the drug is stated to produce a similar effect, and in addition a partial anæsthesia of the limbs occurs after full doses.

We have no evidence of the toxic effects of cannabis indica, and, according to Professor F. Smith, even large doses will not cause death in the horse, although a very profound state of narcosis is induced.

Medicinal Uses.—In consequence of its marked hypnotic effects, in addition to its anodyne action, cannabis indica is an agent of very great value for the relief of acute pain in horses, irrespective of its origin.

As we have already stated, opium or morphine will fail to give relief in many cases of violent abdominal pain, in consequence of acting as cerebro-spinal excitants, even when large doses have been administered.

In such instances cannabis indica will give relief; its effects are reliable, and it does not produce the extreme nausea which occurs after opium or morphine.

Even in cases of a fatal nature from the commencement, it gives the patient ease from the uncontrollable agony which he is suffering.

Professor F. Smith first directed the attention of the profession to the value of this drug as an anodyne and hypnotic for the horse, and clinical experience amply justifies the high opinion which he held of it.

It is necessary to obtain a reliable preparation, and a proper dose should also be administered, the amount usually recommended in text-books being in our experience useless.

It is best administered in the form of bolus, the average dose being half an ounce; but in some instances one ounce may be necessary. Should there be any indications of a recurrence of pain, the drug should be repeated until hypnotic effects are produced.

In cases where profound narcosis occurs for a lengthened period, either from individual susceptibilities or from excessive doses of the drug, it can be overcome by the administration of diffusible stimulants or the hypodermic injection of ether.

In tetanus cannabis indica has been employed with variable success, and may be administered in the form of electuary placed between the molar teeth.

In chorea in dogs, it is highly recommended by some practitioners for tranquillizing the involuntary spasms which occur in this affection.

It is probable that, as the actions of cannabis indica are more perfectly understood, its medicinal uses will be more extensive. One difficulty at present consists in obtaining preparations of a definite degree of strength.

Coca—Coca.

The dried leaves of Erythroxylon coca, a shrub from South America. Coca leaves contain about 0·2 per cent. of an alkaloid, *cocaine*.

Preparation.

Cocainæ Hydrochloras—Hydrochlorate of Cocaine. *Prepared* by a complex process from the crude drug.

Actions and Uses.—A solution of the hydrochlorate of cocaine, when applied to an exposed mucous surface, or injected hypodermically, paralyzes the sensory nerves and contracts the vessels of a part.

It thus produces *local anæsthesia and anæmia.* This condition may last for fifteen minutes or longer, according to the strength of the solution employed.

Internally, coca acts as a *stimulant*, *tonic*, and *restorative*, when given in small doses.

In full doses it causes great muscular restlessness and excitement, the brain, medulla and cord are powerfully stimulated from above downwards, and convulsions of cerebral origin occur.

Toxic doses paralyze the posterior columns of the spinal cord and the peripheral sensory nerves; and finally paralyze the central nerve-centres, causing death from asphyxia.

In horses doses of 60 to 80 grains, injected subcutaneously, cause restlessness, excitement, salivation, dilatation of the pupil, effects which disappear in about two hours.

Dogs are very susceptible to the action of cocaine, and hence great care is necessary to avoid strong solutions in employing this agent as a local anæsthetic.

If an excessive amount be absorbed, it quickly produces muscular spasms, epileptic fits, the animal rolling about and champing the jaws, with great salivation; clonic spasms occur, and death in a short time from asphyxia.

The chief use of cocaine is as a *local anæsthetic* in minor surgery, especially in that of the eye, throat, etc.

A 4 or 5 per cent. solution is employed in ophthalmic surgery, being applied once or twice before operation at intervals of a few minutes. Its action commences in from three to five minutes, and increases in from ten to twenty minutes, usually disappearing within half an hour.

In cases of *iritis* and *ulceration of the cornea* a solution of cocaine proves a very useful application.

Foreign bodies embedded in the cornea are removed with facility after the application of a solution of cocaine to the part.

Cocaine is largely employed for the production of local anæsthesia, in the removal of tumours, etc.

The strength of the solution may vary from 5 to 20 per cent. The 5 per cent. solution is most commonly used; it should be freshly prepared, and, in the case of large growths, from ten to twenty drops are injected at each of three or four points underneath the skin, and into the part to be removed.

In neurotomy a hypodermic injection of from twelve to fifteen drops of the solution at the points of operation removes sensation from the skin, subcutaneous tissues, and the nerve-trunks. In firing it has also been employed with success.

CHAPTER XI.

THE VEGETABLE KINGDOM—*Continued.*

Belladonnæ Folia — BELLADONNA LEAVES.

THE fresh leaves, with the branches to which they are attached, of Atropa belladonna (deadly nightshade); also the leaves separated from the branches and carefully dried, gathered when the fruit has begun to form, from wild or cultivated British plants.

Doses.—Horses and cattle, ℥ss. to ℥i.; dogs, grs. v. to grs. x.

Belladonnæ Radix—BELLADONNA ROOT.

The root of Atropa belladonna, carefully dried.

Preparations.

Extractum Belladonnæ—a *green* extract—4 from 100 of *fresh* leaves.
Doses.—Horses, ʒi. to ʒii.; cattle, ʒii. to ʒiii.; sheep, grs. x. to grs. xx.; dogs, gs. ss. to grs. iii.

Extractum Belladonnæ Alcoholicum.—A spirituous and aqueous extract; this is about four times the strength of the green extract, and is prescribed in one quarter of the doses of the latter.

Tinctura Belladonnæ—1 of *dried* leaves in 20 of proof spirit.
Doses.—Horses, ℥ss. to ℥i.ss.; cattle, ℥ii.; sheep, ʒi.; dogs, ♏v. to ♏xx.

Glycerinum Belladonnæ—Equal parts of extract of belladonna and glycerine.
Doses.—Double those of the green extract.

Unguentum Belladonnæ—1 of the alcoholic extract to 9 of benzoated lard.

Linimentum Belladonnæ—1 ounce to $1\frac{1}{2}$ ounces of spirit with $\frac{1}{20}$ of camphor.

Atropina—Atropine.

An alkaloid obtained from belladonna root.

Atropinæ Sulphas—Sulphate of Atropine.

Prepared by dissolving atropine in dilute sulphuric acid and water and evaporating.

Solubility—1 in 4 of water.

Incompatibles.—Caustic alkaloids, which decompose it. Morphine, physostigmine, and strychnine are in various respects and degrees physiological antagonists.

Liquor Atropinæ Sulphatis (B.P.)—1 in 100 with camphor-water. Contains 4 grains to the fluid ounce.

Doses.—Of the liquor atropinæ sulphatis (B.P.): horses and cattle, ʒi. to ℥ii.; dogs, ♏i. to ♏iv. Given by the mouth.

Administered by *hypodermic injection:* horses and cattle, ♏xii. (=$\frac{1}{10}$ grain) to ♏xxiv. (=$\frac{1}{5}$ grain); dogs, ♏i. to ♏ii. (=gr. $\frac{1}{120}$ to gr. $\frac{1}{60}$).

Homatropinæ Hydrobromas.

The hydrobromate of an alkaloid prepared from tropine. Tropine is obtained from atropine.

This resembles atropine in its actions, but is less persistent in its effects on the eye as a mydriatic.

(1) immediate local action.

Externally, belladonna and atropine in the form of aqueous suspension or solution are not absorbed by the skin, but if combined with alcohol, camphor, glycerine, etc., the atropine is readily conveyed through the epidermis.

It can be absorbed from exposed mucous membranes and from inflamed or abraded areas of skin.

Belladonna depresses the sensory nerve-endings, and thus acts as a *local anæsthetic* and *anodyne.*

It contracts the bloodvessels and then relaxes them, and reduces the activity of motor nerve-filaments to underlying muscles. It also depresses any special nerve-endings with which it may come in contact, such as the nerves of the sudoriparous and mammary glands.

Applied to the eye, it causes dilatation of the pupil, as well as when given internally.

Internally, it causes dryness of the mouth and throat, which action is, however, a specific one. In the stomach it has a slight anodyne effect, while its action on the intestines is also a specific one, to be presently described.

(2) ACTION ON THE BLOOD.

Atropine enters the blood rapidly, and leaves it for the tissues, without producing any appreciable effects on the former.

(3) SPECIFIC ACTION.

Atropine reaches the different tissues quickly, producing marked effects on different portions of the system. A moderate dose causes dryness in the mouth and throat, with slight difficulty in swallowing; the pupils are dilated, the bowels may become relaxed, and the pulse is reduced in frequency.

Larger doses cause a frequent pulse, restlessness, accelerated respirations, disorder of vision, irregular movements with delirium, and finally coma. We shall now proceed to analyze these phenomena.

On the Convolutions of the Cerebrum.—Belladonna acts as a *depressant* in medicinal doses; in large doses it may produce *delirium.*

On the Spinal Cord.—It first slightly increases, and then diminishes, reflex irritability, but it does not possess a powerful action on this region.

On the Medulla Oblongata.—Belladonna produces marked effects on the vital centres.

It *stimulates the respiratory centre* in a direct manner, causing more frequent and deeper respiratory movements, while toxic doses cause paralysis of this centre.

The *cardiac centre* is temporarily *stimulated*, causing a primary slowing of the action of the heart.

The *vaso-motor centre* is first *stimulated*, and then *depressed.*

The sensory nerves are *depressed*, specifically as well as locally.

The *motor nerves* have their irritability diminished; but this is not lost except after large doses.

The *voluntary muscles* are unaffected by the drug.

On special efferent nerve-terminations belladonna exerts marked depressing effects:

(*a*) *It paralyzes the endings of the third nerve* (motor oculi) *in the sphincter of the pupil and in the ciliary muscle*, causing *dilatation of the pupil* and disturbance of accommodation. This effect is believed to be purely local in its cause, and, according to some authorities, the sympathetic is slightly stimulated.

(*b*) *It paralyzes the terminations of the chorda tympani in the submaxillary* gland, the effects being an arrest of saliva, and dryness of the mouth and throat; probably the mucous glands of the mouth are also paralyzed.

(*c*) *It depresses the terminations of the sudoriparous nerves in the sweat glands*, and thus acts as a powerful *anhidrotic*, diminishing the amount of perspiration to a marked degree.

(*d*) *It paralyzes the lacteal nerve-terminations*, and arrests the secretion of milk (if present).

(*e*) *It briefly stimulates the ends of the vagus in the heart*, but quickly *paralyzes* them.

(*f*) *It paralyzes the terminations of the vagus in the* *bronchial walls*, also the *afferent branches of the vagus* in the same parts.

(*g*) *It depresses the inhibitory branches of the splanchnics in the intestinal walls*, thus causing relaxation of the bowels and *increased peristaltic movements*.

Its action on the ganglia, plexuses, and muscular coat is not definitely known.

On the heart and circulation belladonna exerts marked actions.

The *action of the heart is slowed* temporarily by stimulation of the cardiac centre, as already mentioned, and also by stimulation of the terminal ends of the vagus in the heart.

The pulse next *rises in frequency*, due to paralysis of the terminal ends of the vagus, but the force of the systole is not reduced after moderate doses.

Toxic doses depress the intracardiac ganglia, and finally paralyze the heart muscle, death occurring from cardiac failure, with the ventricle in diastole.

According to some authorities, death results from asphyxia, due to paralysis of the respiratory centre.

On the circulation belladonna produces effects by its action on the vaso-motor centre.

The primary effect of the drug, viz., the stimulation of this centre, causes contraction of the systemic arteries, and a temporary rise of the blood-pressure; this coincides with the cardiac acceleration.

The secondary effect of full doses is to *depress* the vaso-motor centre; this causes *relaxation* of the peripheral vessels and a *lowering of the blood-pressure*, and if this be extreme, it coincides with the paralysis of the cardiac ganglia and muscle, and contributes to the final arrest of the circulation.

On Respiration.—Owing to its powerful stimulating effect on the respiratory centre, already mentioned, the respiratory movements become more frequent and deeper; toxic doses paralyze this centre. The *tension* of the muscular coat of the bronchi is diminished and the air current facilitated, due to paralysis of the terminations of the vagus in the bronchial walls.

Sensibility and *reflex action* in the same parts are diminished, *i.e.*, dyspnœa and cough, this effect depending on paralysis of the afferent branches of the vagus.

The *body temperature* is temporarily raised by moderate doses, but it falls with the failure of the circulation after large doses.

Toxic Effects — *In the Horse.* — The experiments of Hertwig demonstrate that large doses of belladonna cause dulness, uneasiness, dilated pupils, loss of appetite, tympanitis of the stomach and intestines, pulse quick, small and gradually imperceptible, respirations short, quick and accompanied by flapping of the nostrils.

No hypnotic effects were produced; some of the cases exhibited imperfect power of moving the hind extremities, others showed symptoms of abdominal pain.

Some cases terminated in thirty to fifty hours after the first dose, but in others the symptoms gradually abated. Six ounces of the dried root usually proved fatal.

Antidotes.—The administration of diffusible stimulants, alcohol, ammonia, etc.; artificial respiration if necessary.

In the dog, emetics should be early resorted to.

Lime-water is believed to be destructive to atropine, and has been recommended as an antidote.

As atropine is rapidly eliminated by the kidneys, the catheter should be employed to remove the urine, which is often retained in poisoning by belladonna. The hypodermic injection of pilocarpine is also recommended, being to some extent a physiological antagonist.

(4) REMOTE LOCAL ACTION.

Atropine is rapidly excreted in the urine in an unchanged condition. It acts as a *diuretic*, increasing the urea, phosphates, sulphates, and water of the urine. In its passage through the ureters, bladder, and urethra it exerts *remote local anodyne effects*.

Medicinal Uses.—*In affections of the respiratory organs* belladonna is frequently employed, in consequence of its soothing effects on the afferent and efferent nerves of the bronchi, its stimulating action on the respiratory centre, and its power of abating excessive mucous secretion.

In *pharyngitis, laryngitis, and bronchitis* it relieves spasm and irritable cough, renders deglutition easier, and may be administered in the form of electuary in such cases.

In *asthma* it has been employed with success in both horses and dogs.

In some forms of *cardiac affection* belladonna is believed to relieve cardiac pain and palpitation, being always preferred to opium for such cases. Its effect is probably an indirect one, referable to frequent emptying of the ventricles, lowering of the vascular tension, and prevention of distension of the heart, without diminishing cardiac force.

In *gastritis* in all patients belladonna is a very valuable agent.

In cattle it may be combined with sodæ bicarb. and ol. lini, and *gives beneficial results in cases of inflammation of the abdomasum*.

In *gastritis and gastro-enteritis* in dogs it is recommended by Professor Wild, Royal Veterinary College, in combination with carbolic acid, and alternated with liq. plumbi diacet. (*Veterinarian*, August, 1894).

In *enteritis* it is combined with opium, or in the form of hypodermic injection composed of atropine and morphine.

In *puerperal eclampsia* in cows it has been employed with marked success.

In *tetanus* belladonna has been extensively prescribed in doses of ʒi. to ʒiii. of the extract placed between the teeth several times a day, and is a favourite agent with many practitioners in the treatment of this usually fatal affection. It is also applied locally if any wound exist.

In cases of *irritation of the bladder*, *rectum*, or *uterus*, belladonna is both prescribed internally as well as employed in the form of injection.

In *constriction of the cervix uteri*, which may be present in cases of delayed parturition, the extract of belladonna is applied locally, and gives beneficial results, overcoming the rigid and unyielding condition of the part.

Belladonna is sometimes *combined with purgatives*, as it assists their action and lessens the tendency to irritation of the intestine.

Externally, belladonna is extensively employed in the treatment of *mammitis* or *garget* in all patients. It checks the secretion of milk, reduces inflammation and pain, relieves tension, and tends to arrest impending abscess. Even when it fails to prevent suppuration, it limits the abscess and subdues the pain. For such purpose it is best applied in the form of ointment composed of—glycerinum belladonnæ 1 part, unguentum althææ 2 parts, lanoline 2 parts. This is rubbed into the part after frequent fomentation with hot water.

In affections of the eye, atropine sulphate is employed locally as a solution containing from 2 to 4 grains to the ounce of distilled water. It prevents or breaks down adhesions in *iritis*, and may be alternated with myotics, such as physostigmine.

In *keratitis* and *conjunctivitis* it reduces inflammatory action and relieves pain.

In *lesions of the cornea* and in *perforating ulcer* atropine lotion gives satisfactory results, and may be combined with cocaine.

In *wounds* and *injuries* to the eye belladonna should be applied around the region, as well as the solution of atropine applied to the organ itself.

In *specific ophthalmia*, the solution of atropine is very useful during all stages of the affection, when employed in conjunction with constitutional treatment.

In examinations of the eye with the ophthalmoscope, atropine is employed to dilate the pupil, and so assist in the detection of cataract.

In *wounds* accompanied by extreme pain, such as punctured wounds of the feet, the application of the extract of belladonna with glycerine gives marked relief, along with the judicious employment of poultices.

In *deep fissures of the heel*, seen as a sequel to grease in the horse, accompanied by excessive lameness and pain, the application of the glycerinum belladonna to the part gives beneficial results.

Hyoscyami Folia—Hyoscyamus, or Henbane Leaves.

The fresh leaves and flowers, with the branches to which they are attached, of Hyoscyamus niger, also the leaves separated from the branches and flowering tops, carefully dried.

Preparations.

Extractum Hyoscyami—A *green* extract from the fresh plant—20 in 1.

Doses.—Horses and cattle, ʒi.ss. to ʒiii.; dogs, grs. v. to grs. x.

Tinctura Hyoscyami—1, dried, in 8 of proof spirit.

Doses.—Horses and cattle, ℥i. to ℥ii.; dogs, ♏xv. to ʒi.

Hyoscyamine.—A crystalline alkaloid obtained from hyoscyamus, usually prescribed as a neutral sulphate.

Doses.—Horses and cattle, gr. i. to grs. iii.; dogs, gr. $\frac{1}{60}$ to gr. $\frac{1}{20}$.

Hyoscine.—A syrupy alkaloid forming salts such as the hydrobromate and the hydriodide.

Actions and Uses.—Hyoscyamus closely agrees with the actions and uses of belladonna; the following distinctions, however, merit attention:

(*a*) The pharmaceutical preparations of the drug are weaker than those of belladonna, and hence must be given in larger doses.

(*b*) The secondary or calmative effects on the convolutions are more rapid and pronounced with hyoscyamus, the sedative action probably depending on the hyoscine.

(*c*) Hyoscyamus possesses more marked laxative and carminative effects on the intestine.

(*d*) It possesses a more decided remote local anodyne action on the urinary organs.

(*e*) It does not dilate the pupil so certainly or fully as belladonna.

Hyoscyamus is prescribed as an anodyne in *irritable conditions of the kidneys and bladder*, and is combined with alkalies, such as the carbonate of potash.

The extract of hyoscyamus is often combined with purgatives, to prevent their griping and to assist their action. It has been occasionally prescribed in cases of chorea and epilepsy in dogs.

Stramonii Folia—Stramonii Semina.

The dried leaves and seeds of Datura stramonium, or the thorn apple.

The preparations in use are the extract and the tincture.

The alkaloid is *daturine*, which is either identical with hyoscyamine or is a variable mixture of atropine and hyoscyamine.

Actions and Uses.—Daturine is almost similar in its actions to atropine.

The extract of stramonium is more powerful than the green extract of belladonna, and should be prescribed in half the doses of the latter. Stramonium has a greater depressant effect on the nerves of the bronchi than belladonna. It may be employed in the treatment of spasmodic affections of the respiratory organs, such as *asthma* and *chronic bronchitis*.

Duboisine.

An alkaloid derived from an Australian plant, the Duboisia myoporoides.

The sulphate of duboisine is a mydriatic, more powerful than atropine, and may be employed in solution of 1 grain to the ounce. Stronger solutions may prove toxic.

Tabaci Folia—Leaf Tobacco.

The dried leaves of Nicotiana tabacum.

Tobacco contains from 2 to 8 per cent. of a powerful alkaloid, *nicotine*. *Tobacco smoke* contains only the smallest trace of nicotine, or none, but a number of volatile bodies, chiefly pyridine compounds.

Actions and Uses.—Tobacco given by the mouth in full doses is a *gastro-intestinal irritant*. It causes salivation, nausea, colicky pains, increased action of the bowels and kidneys, and in dogs vomition.

Nicotine is quickly absorbed, and dogs dressed with strong decoctions of tobacco frequently suffer from toxic effects. Nicotine acts chiefly on the *nervous structures ;* in small doses it causes *primary stimulation* of the cerebrum and the motor centres of the spinal cord. This is followed by *depression*, producing intense and universal debility.

Full doses cause convulsions and paralysis, respiration is primarily excited, and finally paralyzed, death occurring from asphyxia. The heart is first slowed, then accelerated, and finally weakened, due to the effect of the drug on the vagus.

Tobacco *contracts* the pupil and increases most of the secretions, thus differing from belladonna and its allies.

Nicotine has been employed in the treatment of tetanus in horses with variable results. It may be administered hypodermically in doses of gr. i. to grs. iii., also in the form of tobacco enemata.

Externally, decoctions of tobacco are sometimes employed as antiparasitic applications to cases of mange, lice, fleas, and ticks.

Other remedies, however, are far safer, while being just as effectual.

Lobelia—Lobelia.

The dried flowering herb of Lobelia inflata, imported from North America. Contains an alkaloid, *lobeline.*

Preparation.

Tinctura Lobeliæ—1 in 8 of proof spirit.
Doses.—Horses, ℥ss.; dogs, ♏ x. to ♏ xx.

Tinctura Lobeliæ Ætherea—1 in 8 of spirit of ether.
Doses.—Similar to the above.

Actions and Uses.—Lobelia in medicinal doses is a *gastro-intestinal stimulant ;* in large doses it is an irritant. It *depresses the respiratory centre* and *relaxes the bronchial muscles*, lowers the activity of the motor centres in the cord, depresses the convolutions secondarily, diminishes the force of the heart and the tension of the vessels, after brief increase of the latter. It kills by paralysis of the respiratory centre, like tobacco.

Lobelia, in the form of the ethereal tincture, has been employed in cases of *spasmodic asthma*, and in small doses makes a useful addition to expectorant mixtures for bronchitis with spasm.

Conii Folia—Hemlock Leaves.

The fresh leaves and young branches of Conium maculatum.

Conii Fructus—Hemlock Fruit.

The fruit of Conium maculatum, dried. Conium contains a liquid alkaloid, *conine*.

Preparations.

Extractum Conii—a green extract obtained from conii folia, 30 in 1.
Doses.—Horses, ʒi. to ʒii.; dogs, grs. v. to grs. x.

Succus Conii—3 of the expressed juice with 1 of spirit.
Doses.—Horses, ℥i. to ℥ii.; dogs, ʒss. to ʒi.

Tinctura Conii—1 of conii fructus in 8 of proof spirit.
Doses.—Horses, ℥i. to ℥ii.; dogs, ♏ xx. to ♏ xl.

Actions and Uses.—Authorities state that conium produces no effect on the sensory nervous system unless indirectly by poisonous doses. The *motor nerves* are the parts specially acted on; these are paralyzed from the extremities upwards; the motor regions of the spinal cord are but slightly affected, although reflex excitability is moderately reduced. The respiratory centre in the medulla is paralyzed by a toxic dose, but conium has no effect on the convolutions of the cerebrum until asphyxia supervenes. Large doses cause weakness of the extremities, drooping and swollen eyelids, dilatation of the pupils, and finally general paralysis.

Conium is seldom employed as a therapeutic agent.

Conine in the form of the hydrobromate has been prescribed in the treatment of *tetanus*, given hypodermically in doses of three to five grains, but has not yielded satisfactory results.

In *spasmodic cough* conium is recommended by some authorities, also in the treatment of *chorea* in dogs.

It has no effect on the muscular spasms produced by strychnine.

Curara—CURARE.

An extract from one or more species of Strychnos, owing its activity to an alkaloid, curarina (South American arrow poison).

Curare resembles conium in its action, viz., *paralyzing motor nerves*, without removing consciousness. It is said not to exert toxic effects when given by the mouth, but acts as a powerful poison when injected intravenously, hypodermically, or intratracheally. It has been employed in tetanus, in doses of gr. i. to grs. ii. of the alkaloid, without producing any beneficial results.

Physostigmatis Semen—CALABAR BEAN.

The dried seed of Physostigma venenosum.

Its activity depends on the presence of two alkaloids, (1) *physostigmine* or *eserine*; (2) *calabarine*. The latter has a stimulant effect on the spinal cord, but otherwise agrees in action with the former.

Preparations.

Extractum Physostigmatis—Spirituous—45 in 1.
Doses.—Horses, gr. i. to grs. iv.; dogs, gr. $\frac{1}{16}$ to gr. $\frac{1}{4}$.

Physostigmina—PHYSOSTIGMINE, ESERENE.

Obtained from the alcoholic extract of Calabar bean.

The *sulphate* and *salicylate* are the forms generally used.

Doses.—Horses and cattle, grs. i. ss. to grs. ii.; dogs, gr. $\frac{1}{60}$ to gr. $\frac{1}{10}$. Given by hypodermic or intratracheal injection, and combined with pilocarpine in doses of 3 grains for horses and cattle.

(1) IMMEDIATE LOCAL ACTION.

Physostigmine exerts no topical action on mucous or skin surfaces.

It is readily absorbed by the conjunctiva, producing a specific effect of *contraction of the pupil.*

Calabar bean, or physostigmine, administered internally, may cause nausea, and increased peristaltic action, probably of local origin.

(2) SPECIFIC ACTION.

Calabar bean possesses similar actions to its alkaloid physostigmine; the former, however, contains *calabarine,* which accounts for the convulsions sometimes noted in experiments with this drug.

Physostigmine increases most secretions, such as the salivary, lachrymal, cutaneous, and the secretion from mucous membranes, affecting probably the glandular secreting cells.

On the Nervous System.—Physostigmine has no effect on the convolutions of the cerebrum, and *consciousness is not lost*, though it is impaired by large doses.

The *spinal cord* is the region principally affected by this drug. It causes *depression*, and finally *paralysis* of the *anterior cornua* of the gray matter, which conduct impulses from the brain to the periphery. It acts in a similar manner on the *posterior cornua* (sensory portions) of the cord, the result being the production of a complete loss of the motor and reflex activity of the cord, and loss of sensibility in the extremities, the extent depending on the amount of the drug administered.

The *motor* and *sensory nerves* and the *muscles* are not affected directly, but at a later stage there follows paralysis of the intramuscular termini of the nerves.

Occasional muscular twitchings may occur, partly direct in origin.

The *respiratory centre* in the medulla is briefly stimulated, and then depressed, being finally paralyzed, death occurring from asphyxia.

The cardiac centre is primarily stimulated, as well as the intercardiac branches of the vagus, with the result that the heart beats more powerfully and less frequently, but fiually or after large doses depression occurs.

The blood-pressure rises with the increased cardiac action, and then falls later on.

On the eye physostigmine causes *contraction* of the pupil, and spasm of accommodation, whether applied locally or given internally, these effects being due to *stimulation of the fibres of the third nerve*, thus differing from the contraction caused by opium, which depends on central disturbance.

The most important action of physostigmine is exerted on the *intestinal canal.* Given by hypodermic or intratracheal injection, it causes energetic *contraction* of the involuntary *muscular fibres* of the intestinal walls, thus producing *increased peristaltic* action, giving rise to free evacuation of the bowels in a short period of time. It also causes an *increase of the fluids* secreted from the intestinal mucous membrane.

The large intestines are chiefly acted on by physostigmine, and the effects produced are more prompt and certain by the addition of pilocarpine. According to

M. Cagny, physostigmine, veratrine, and pilocarpine all excite the intestinal contractions and secretions, but with the following differences: *veratrine* increases the contractions more than the secretions; *pilocarpine* increases chiefly the secretions of the anterior portion of the digestive tube, while physostigmine increases the secretions of the posterior portion. Hence he concludes that it is of advantage to combine these three agents in the treatment of intestinal obstruction.

M. Kaufmann states that on opening the abdomen of a horse which had received a full dose of physostigmine, energetic contractions of the intestines were observed.

Post-mortem examinations of animals poisoned by this drug show pallor, contraction and hardness of the large intestine, the bladder empty and contracted, and the uterus also contracted.

We are indebted to Professor F. Smith for reliable information on the action and uses of physostigmine in the horse. This authority prefers the salicylate of physostigmine to the sulphate, as the former produces less colicky pains than the latter.

The combination with pilocarpine was found more efficient, a smaller dose being also required. It may be administered by hypodermic or intratracheal injection; by the latter method it acts quicker.

The average medicinal dose, viz., 1½ grains, administered by hypodermic injection, acts in from twenty to sixty minutes, but may remain an hour and a half before any symptoms are produced. Administered by the trachea, its action may commence in from twenty to twenty-five minutes, but rarely beyond an hour.

'The earliest indications are loud intestinal murmurs, the passage of flatus, with slight colicky pain; this is shortly followed by evacuation of the contents of the rectum, and the motions then pass at intervals of a few minutes, each becoming gradually softer, more watery, less formed in balls, until the stage is reached when the evacuations are moist and fluid, resembling cow's fæces.

'All this time the abdominal disturbance has become greater; the animal lies down, but seldom rolls, the intestinal murmurs are louder, the passage of flatus almost continuous, straining marked, the fæces voided with great rapidity, often ejected with force, and several ounces of a brown-coloured fluid will at this time accompany each motion. In about two to two and a half hours from the time of injection the effects commence to pass off, and during this time an almost incredible amount of fæces will have been excreted.'—'Action of Physostigmine on the Horse,' by Professor F. Smith. See *Veterinary Journal*, April, 1888.

The addition of pilocarpine increases the action of the physostigmine. The symptoms, in addition to those described, are: Salivation of more or less intensity, and increased peristaltic action without increase of abdominal pain.

The salivation may be sometimes excessive, and usually commences in from three to five minutes after injection. The secretion pours from the mouth; there are constant movements of the tongue, and a large amount of saliva is swallowed. The quantity of saliva swallowed, and also the increased pancreatic secretion, may act both chemically and mechanically on the intestinal canal.

Atropine is a physiological antagonist of physostigmine, as it paralyzes muscles, stimulates the respiratory and cardiac centres, and dilates the pupils.

Medicinal Uses.—*In impaction of the colon*, accompanied by paralysis of its walls, physostigmine has given excellent results, administered by hypodermic injection.

Professor F. Smith recommends the intertracheal injection of the drug in the form of solution, in 6 to 8 drachms of warm water; this may be injected into the trachea without inconvenience, the addition of 2 or 3 grains of pilocarpine, as already mentioned, being of advantage.

Physostigmine is *contra-indicated* in cases of volvulus and intussusception, and in inflammatory conditions of the intestine; hence it is necessary to arrive at a correct diagnosis before prescribing this drug, otherwise a fatal termination may be hastened by increasing inflammatory action or causing rupture of the intestinal walls.

Physostigmine should not be employed in the case of pregnant animals, in consequence of its stimulating action on the muscular fibres of the uterus.

In tetanus, Calabar bean and physostigmine have been employed, but usually give only temporary relief.

In diseases of the eye, physostigmine is applied in the form of solution (2 grains of the sulphate to 1 ounce of water) to ulcerations of the cornea, and, alternated with atropine, to prevent and remove adhesions formed by iritis, physostigmine contracting the pupil, while atropine dilates it.

Although antagonistic to strychnine in its action on the spinal cord, physostigmine is of little or no use as an antidote, neither is it of much real service in the treatment of poisoning by atropine.

Jaborandi—PILOCARPI FOLIOLA.

The dried leaflets of Pilocarpus pennatifolius.

The most important alkaloid of jaborandi is *pilocarpine*. It contains another alkaloid, jaborine, which resembles atropine in its action, and is antagonistic to pilocarpine.

Preparations.

Extractum Jaborandi—Alcoholic and aqueous.
Doses.—Horses, ʒss. to ʒi.; dogs, grs. ii. to grs. x.

Tinctura Jaborandi—1 in 4 of proof spirit.
Doses.—Horses, ℥i. to ℥ii.; dogs, ʒss. to ʒi.

Pilocarpinæ Nitras—Nitrate of Pilocarpine.
Doses.—By hypodermic injection: horses, grs. ii. to grs. iii.; dogs, gr. $\frac{1}{10}$ to gr. $\frac{1}{3}$.

(1) IMMEDIATE LOCAL ACTION.

Jaborandi applied to the conjunctiva causes *contraction of the pupil*, by stimulating the terminations of the third nerve. This effect commences quickly, and may last from one and a half to twenty-four hours before finally disappearing.

(2) SPECIFIC ACTION.

Jaborandi and pilocarpine have the power of stimulating glandular secretion. They increase the salivary, lachrymal, nasal, bronchial, intestinal, pancreatic, and urinary secretions.

They have little or no effect on the skin of animals, and Professor F. Smith has demonstrated by experiment that the sweat-glands of the horse are perfectly insensible to the action of pilocarpine.

The secretion of saliva in the horse is greatly increased by the hypodermic injection of 3 grains of pilocarpine; in five or six minutes free salivation occurs, with champing of the jaws, the effects lasting for over two hours. This action is due to stimulation of the terminal ends of the chorda tympani in the glands, as well as of its centre.

The nasal and bronchial secretions are augmented, and in some instances a large amount of bronchial mucus is poured out.

Pilocarpine increases *intestinal secretion* and *peristalsis*, but has less effect on the intestinal muscular fibres than physostigmine, while it stimulates intestinal glandular secretion more powerfully than the latter. In moderate doses it increases the secretion of urine, and is believed to stimulate the *pancreas*.

These effects of the drug depend on its power of stimulating the peripheral terminations of efferent nerves in glands and involuntary muscles, and also to a stimulating effect on the nerve-centres presiding over secretion.

The action of the heart is temporarily accelerated, but afterwards slowed and weakened, and blood-pressure is lowered, these effects being partly due to the action of the drug on the vagus in the heart, and partly on the cardiac ganglia. The temperature falls from one half to one degree.

The physiological antagonist of pilocarpine is atropine, which arrests glandular secretion and paralyzes the nerve-endings of involuntary muscles.

Medicinal Uses.—The chief use of pilocarpine in veterinary practice depends on its power of increasing intestinal secretion and peristalsis, hence it is combined with physostigmine in the treatment of *intestinal impaction* with paralysis of the intestinal walls (see p. 430).

It is recommended by Kaufmann as an *expectorant* in bronchial catarrh, asthma, etc.

It is also recommended in renal affections with a tendency to uræmia; but as it possesses little or no effect on the skin of animals, its therapeutic value in removing urea and water by this channel is doubtful.

Pilocarpine has been employed with success as an antidote to atropine.

Muscarinæ Nitras—Nitrate of Muscarine.

The liquid alkaloid obtained from the fungus Agaricus muscarius, the fly agaric.

Actions and Uses.—Muscarine resembles pilocarpine in its actions, but if locally applied to the eye it *dilates* the pupil, while if given hypodermically it causes contraction of the pupil.

It antagonizes atropine in all its actions, with the exception of its effect on the pupil.

Muscarine causes *contraction of the pulmonary vessels,* which effect is overcome by the hypodermic injection of atropine.

It is said to cause less salivation than pilocarpine, but to act on the intestines far more powerfully.

We are not aware of its employment in veterinary practice.

Gelsemium—Yellow Jasmine.

The dried rhizome and rootlets of Gelsemium sempervirens or nitidum. Contains a powerful alkaloid, *gelsemine.*

Preparations.

Tinctura Gelsemii—1 in 8 of proof spirit.

Gelseminæ Hydrochloratis — Hydrochlorate of Gelsemine.

Actions and Uses.—Gelsemium acts as a *powerful depressant* to the motor regions of the spinal cord, producing paralysis, followed by sensory depression and anæsthesia.

Death occurs after toxic doses from asphyxia; the heart is also depressed.

Applied locally it *dilates* the pupils, but administered internally it causes *contraction,* resembling muscarine in this respect.

Gelsemium has been employed in the treatment of tetanus in the horse, in doses of ʒss. of the tincture, or $\frac{1}{2}$ to 1 grain of the alkaloid, but the effects produced were not anything more satisfactory than those obtained from other drugs.

Ergota—Ergot, Secale Cornutum.

The sclerotium (compact mycelium or spawn) of Claviceps purpurea, produced between the pales and replacing the grain of Secale cereale, the common rye. Ergot contains an alkaloid, *cornutine*, and two acids, *ergotinic* and *sphacelinic*.

Doses.—Horses and cattle, ℥ss. to ℥i.; sheep, ʒi. to ʒi.ss.; dogs, grs. xx. to grs. xxx.

Preparations.

Extractum Ergotæ Liquidum—1 in 1; aqueous with spirit added.

Doses.—Horses and cattle, ʒii. to ʒiv.; dogs, ♏xv. to ♏xxx.

Tinctura Ergotæ—1 in 4 of proof spirit.

Doses.—Horses and cattle, ℥ss. to ℥i.; dogs, ♏x. to ♏xxx.

Ergotinum—Ergotin.

Doses.—Horses and cattle, ʒss. to ʒi.; dogs, grs. ii. to grs. v.

Injectio Ergotini Hypodermica—1 in 2 of camphor-water.

Doses.—By hypodermic injection: Horses and cattle, ʒss. to ʒii.; sheep, ♏x. to ♏xx.; dogs, ♏iii. to ♏vi.

Actions.—The chief portions of the system acted on by ergot are the circulation, the central nervous system, respiration, the intestines and uterus. It stimulates and contracts involuntary muscular fibres, and diminishes the blood stream passing through the arterioles. *The arteries* become smaller, the *blood-pressure rises*, and the *heart* is reduced in frequency.

On the nervous system ergot possesses no direct influence on the highest (cerebral) centres, but may disturb the circulation in the brain.

The spinal cord is affected in a marked degree, large doses producing irritation, followed by paralysis of the sensory centres, evidenced by cramps or twitching of the limbs, staggering gait, and convulsions.

Respiration becomes infrequent after large doses of ergot, and death occurs from asphyxia, due to paralysis of the respiratory centre.

The intestines have their peristaltic movements increased, and become anæmic.

The uterus contracts actively after the administration of ergot, which thus acts as an *ecbolic*. It also becomes anæmic, these effects being more pronounced if the animal is pregnant, or more so if parturition has commenced, when the labour pains become more powerful and longer.

The effects of ergot on the intestines and uterus are believed to depend on stimulation of the centres in the spinal cord, as well as on an action of the drug on the involuntary muscular tissue.

Toxic Effects.—The protracted use of ergotized grain gives rise to a train of symptoms termed *ergotism.*

This is characterized by gastro-intestinal derangement, diarrhœa, impaired circulation and nutrition, resulting in *dry gangrene*, chiefly involving the extremities—ears and tail.

The effect of the drug on the spinal cord may give rise to muscular spasms, and sometimes epileptiform convulsions.

Abortion frequently occurs, especially in cattle, from feeding on ergotized grasses, this being chiefly noticed during wet seasons.

Ergot reduces the amount of urine, sweat, and milk, by affecting the local blood-pressure and the gland centres in the brain and spinal cord.

Medicinal Uses.—*As an ecbolic*, *i.e.*, to cause expulsion of the contents of the uterus, ergot is employed in the second stage of labour in cases of *uterine inertia*, where there is no obstacle to the passage of the fœtus. Its use demands judgment and care.

In *post-partum hæmorrhage* ergot is prescribed as a *hæmostatic*, producing beneficial results by causing contraction of the uterus. It is best given in the form of ergotin, hypodermically.

In *hæmoptysis*, *hæmatemesis*, and other internal hæmorrhages, ergot is very useful, given by the mouth or hypodermic injection.

It is believed to act in such cases by contracting, or even closing, the arterioles, and thus promoting coagulation within them.

In retention of the placenta ergot is employed as a constituent of 'cleansing drenches,' the following being a useful formula:

℞ Pulv. ergotæ, ℥i.
Mag. sulph, ℥x.
Ammon. carb., ℥ss.

M. Sig. To be given in two pints of warm ale.

Nux Vomica—The Seeds of Strychnos Nux Vomica.
Pulvis Nucis Vomicæ—Powdered Nux Vomica.

Doses.—Horses, grs. xx. to ʒi.; cattle, ʒi. to ʒii.; sheep, grs. x. to grs. xx.; dogs, gr. i. to grs. iii. Repeated twice daily.

Preparations.

Extractum Nucis Vomicæ—
Doses.—Horses and cattle, grs. iv. to grs. xv.; dogs, gr. ¼ to gr. i.

Tinctura Nucis Vomicæ—contains 1 grain of alkaloids in 1 fluid ounce (1 to 10).
Doses.—Horses and cattle, ʒii. to ℥ss.; sheep, ♏xv. to ʒi.; dogs, ♏v. to ♏xx.

Nux vomica contains 2 alkaloids, ·2 to ·5 per cent. of *strychnine*, and ·12 to 1·0 per cent. of *brucine* united with a crystalline acid, *strychnic* or *igasuric* acid.

Brucine is much weaker and slower in its action than strychnine.

Strychnina—STRYCHNINE.

Prepared by a complex process from nux vomica.

Doses.—Horses, gr. $\frac{1}{2}$ to grs. iii.; cattle, grs. iii. to grs. v.; sheep, gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$; dogs, gr. $\frac{1}{30}$ to gr. $\frac{1}{12}$. The minimum doses should be administered at first, and then gradually increased to the maximum amounts.

Liquor Strychninæ Hydrochloratis contains $4\frac{1}{2}$ grains to 1 fluid ounce of spirit, water, and dilute hydrochloric acid (1 in 100).

Doses.—Hypodermically: Horses, ʒi.; cattle, ʒi. to ʒii.; dogs, ♏ii. to ♏iv.

ACTIONS OF NUX VOMICA AND STRYCHNINE.

(1) IMMEDIATE LOCAL ACTION.

Externally strychnine possesses powerful antiseptic properties, while brucine is a local anæsthetic. These actions are of no therapeutical value in consequence of the poisonous nature of the drug.

Internally nux vomica and strychnine possess all the properties of vegetable *bitters*, described in Chapter XIII., p. 452.

Strychnine is believed to *increase* the peristaltic action of the intestines.

(2) ACTION ON THE BLOOD.

Strychnine is rapidly absorbed from all mucous surfaces, or from the cellular tissues when given by hypodermic injection. It enters the blood and reduces the absorptive power of the red corpuscles for oxygen, and lessens the discharge of carbonic acid from the plasma.

(3) SPECIFIC ACTION.

Strychnine enters the tissues quickly, its effects being especially exerted on the *nervous system.*

It is very slowly excreted therefrom, and if administered in frequently repeated medicinal doses, it possesses a *cumulative action* (see p. 43). It exerts a *tonic* influence on the nervous system, stimulates the gray matter of the spinal cord, increases its reflex excitability, and also stimulates other reflex nerve centres. It promotes secretion of saliva, improves appetite, and increases the gastro-intestinal movements.

The respiratory, cardiac, and vaso-motor centres are stimulated, causing increased frequency and depth of respirations, and increased number and force of the heart-beats. Some individuals are very susceptible to the action of nux vomica and strychnine.

Larger doses or small amounts frequently repeated may lead to sudden twitchings of the muscles of the limbs, hyperæsthesia, and slight difficulty in swallowing.

Toxic doses produce *violent clonic* convulsions, and death from exhaustion and asphyxia, the latter being due to spasmodic arrest of the respiratory muscles.

The symptoms resemble those of tetanus to a certain extent, but *differ* from the latter in the complete relaxation of the muscles between the convulsive seizures, in their sudden development, and in the rapidity of their course, the muscles of the jaws not being primarily affected.

The temperature is raised during the convulsions. The *convolutions* of the cerebrum are unaffected by strychnine. The chief action is exerted on the *motor centres of the spinal cord;* these are powerfully *stimulated*, and their *reflex excitability* greatly increased.

Reflex muscular spasms are originated by the slightest stimulation of the skin, or by a loud sound or a bright light. The power of the respiratory muscles is greatly increased, and carried to such an extent that they remain contracted in inspiration, and thus give rise to asphyxia. The vital centres in the medulla are stimulated at the same time, but the muscles and the motor and sensory nerves are comparatively unaffected by strychnine; its local application, however, is said to stimulate them.

Horses and cattle are less susceptible to the action of strychnine than dogs.

According to Kaufmann, the toxic dose for the horse is 3 to 6 grains, given hypodermically. Cattle take much larger doses than horses when the drug is administered by the mouth, while dogs are very susceptible, being destroyed by $\frac{1}{6}$ to $\frac{1}{3}$ of a grain.

Antidotes.—In the dog, if noticed early, prompt emetics should be immediately employed. Chloral hydrate forms the most reliable antidote, and in severe cases may be given intravenously. Other antidotes are chloroform (by inhalation), bromide of potassium, Calabar bean, the latter being of doubtful value.

Medicinal Uses.—In *atonic dyspepsia* nux vomica and strychnine are prescribed as *bitter tonics*. They check unhealthy deviations of the gastric mucous membrane, and thus promote digestion.

In convalescence from debilitating diseases, when digestion is weak, nux vomica is of great service; also in cases of recurring flatulence; it gives tone to the gastric walls, and checks irregular fermentation. In chronic gastric catarrh small doses frequently repeated give beneficial results.

In all such cases the tincture of nux vomica may be prescribed, along with bicarbonate of soda and gentian or calumba.

In cases of *chronic constipation*, depending upon atony of the intestines, nux vomica is prescribed with small doses of aloes to give tone to the intestinal walls and to stimulate peristaltic action.

In *paralysis*, whether of the limbs, intestines, or bladder, nux vomica and strychnine are useful. They are chiefly indicated in chronic motor paralysis, but should not be employed in cases accompanied by irritation or congestion. In cases of weakened motor power succeeding parturient apoplexy in cattle, the hypodermic injection of strychnine gives favourable results.

In *defective nervous power*, which sometimes occurs within two or three days after parturition in cows, the use of strychnine is indicated.

In *cerebro-spinal meningitis* in horses, strychnine is recommended by Mr. Lockhart, of New York, in doses of one grain repeated two or three times a day.

In *canine practice*, strychnine is a valuable agent in cases of paralysis resulting from distemper or other causes. It is also employed in convalescence from exhausting diseases, in chorea, and in some cases of asthma and chronic bronchitis, and may be combined with iron salts or prescribed in the form of Easton's syrup (see p. 263).

In consequence of the cumulative action of nux vomica and strychnine, and the susceptibilities of some patients to the specific action of these drugs, great discrimination is necessary in prescribing them, and the minimum doses should be employed at first.

In cases of *paralysis* the doses should be gradually increased, and in some instances it may be necessary to continue them until slight muscular twitchings are produced.

Caffeina—Caffeine.

An alkaloid usually obtained from the dried leaves of Camellia thea (the tea plant) or the dried seeds of Coffea Arabica (the coffee plant). Caffeine and theine are considered identical, and the same alkaloid is also obtained from the leaves of gurana, as well as from kola seeds. It is homologous with theobromine, which is obtained from the Theobroma cacao.

Doses.—Horses and cattle, grs. xv. to ʒi.; dogs, gr. i. to grs. iv.

Caffeinæ Citras—Citrate of Caffeine.

A weak compound of caffeine and citric acid, and may be administered in double the doses of the above.

Actions and Uses.—Caffeine *stimulates*, and *subsequently paralyzes*, the nerve centres of the cerebrum, but in the lower animals the spinal centres are simultaneously affected to such a degree that convulsions occur, resembling those produced by strychnine. It exerts a restorative effect in both voluntary and involuntary muscles, and muscular contraction seems more easily executed. Caffeine primarily stimulates the cardiac and respiratory centres in the medulla; it strengthens and lengthens the cardiac systole, while diastole is shortened; large doses cause death by arresting the heart in systole. The blood-pressure first rises and then falls, and temperature is temporarily raised.

Caffeine is excreted in the urine and bile, and in passing through the kidneys the renal cells are stimulated. This, in conjunction with its effects on the heart and vessels, causes it to act as a *diuretic*.

Caffeine has been employed in cases of cardiac diseases with dropsy in canine practice, being more rapid and less irritant than digitalis. It has also been prescribed as a nerve stimulant in cases of milk-fever in cows and in distemper in dogs, but with doubtful results.

CHAPTER XII.

THE VEGETABLE KINGDOM—*Continued.*

Digitalis Folia—Foxglove Leaves.

The leaves of Digitalis purpurea, the purple foxglove, carefully dried.

The active principle of digitalis is known as *digitalinum* or *digitalin.* This is proved to be a compound of four glucosides, namely: (1) Digitalin proper; (2) digitalein; (3) digitoxin; (4) digitonin.

Digitalin is seldom prescribed; the dose for the horse is stated to be from gr. $\frac{1}{4}$ to gr. i.

Incompatibles of Digitalis and its Preparations.—Persalts of iron, which give a slight inky colour, by combining with the tannic acid present in the drug; acetate of lead; preparations of cinchona.

Preparations.

Pulvis Digitalis Folia—Powdered Digitalis.

Doses.—Horses, grs. xv. to ʒss.; cattle, ʒss. to ʒi.; sheep and pigs, grs. v. to grs. x.; dogs, grs. ss. to grs. ii. Repeated twice daily, with due precautions in consequence of the cumulative action of the drug.

Tinctura Digitalis—1 in 8 of proof spirit; contains $54\frac{1}{2}$ grains to the fluid ounce.

Doses.—Horses, ℥i.ss. to ℥iv.; cattle, ℥iv. to ℥v.; sheep, ♏ xx. to ♏ xxx.; dogs, ♏ v. to ♏ xx.

ACTIONS OF DIGITALIS.

(1) IMMEDIATE LOCAL ACTION.

Externally digitalis exerts a slightly irritant action, but is not absorbed by the unbroken skin according to some authorities; others state that it can be absorbed when applied as a decoction to the skin.

Internally, in full doses, it deranges digestion in all animals, causing nausea, and occasionally diarrhœa with vomiting in dogs.

These effects are due to both a local and a specific action.

(2) ACTION ON THE BLOOD AND SPECIFIC ACTION.

The active principles of digitalis enter the blood freely, and reach the tissues; they are slowly eliminated therefrom, so that even small doses, if too frequently repeated, tend to accumulate in the system.

Digitalis, when administered through the circulation, or applied for the purpose of experiment to the exposed heart, induces *persistent contraction of the ventricles.* It also causes an increase of vigour and diminution of frequency of the cardiac action, with contraction of peripheral vessels and rise of blood-pressure.

The chief specific action of the drug is exerted on *the circulatory organs*, the other portions of the system being affected in a secondary manner. The action of digitalis on the *heart* and *bloodvessels* is divided by Dr. Mitchell Bruce ('Materia Medica and Therapeutics') into four stages, as follow, the first being shorter, and the other stages more marked, as the dose is increased.

First Stage.—The heart *falls in frequency*, and *beats with increased force*, these effects being due respectively to *stimulation of the vagus* in the heart and medulla, and to *stimulation of the intrinsic cardiac ganglia.*

The *arterial pressure rises*, due to the increased cardiac force, and to stimulation of the vaso-motor centre and vaso-motor nerves.

The total result of these effects is that the diastole is lengthened and the ventricles are well filled, while, in consequence of increased cardiac force, the ventricles are thoroughly emptied, and the arteries are well filled, and are kept in this condition by the vaso-motor action of the drug. Thus, the *veins are more thoroughly emptied*, and *the arteries properly filled.*

Second Stage.—The *vaso-motor apparatus of the renal arteries* is suddenly depressed and these vessels become relaxed, while the state of the heart remains unchanged. There is thus increased force of circulation on the renal glomeruli, the result being an *increase in the excretion of the urinary water*, digitalis thus being a *diuretic.*

Third Stage.—The *heart rises in frequency*, due to depression of the vagus, and probably also to irritation of the accelerator nerves; it *loses force* as the intrinsic ganglia and heart-muscle commence to become exhausted. The vaso-motor apparatus becomes depressed, and this, along with the weakening of the heart, causes the *arterial pressure to fall* throughout the system.

The total result is *commencing failure of the circulation.*

Fourth Stage.—The intrinsic ganglia and the myocardium fail, the action of the heart becomes irregular, infrequent, and weak, being finally arrested in diastole, the blood pressure gradually sinking from loss of cardiac power and paralysis of the vessel walls. *Death is due to general circulatory failure.*

Respiration is temporarily quickened, but more permanently slowed, and fails at last only through the circulation.

The temperature is temporarily raised by the increased circulatory force, but is lowered by the augmented blood-flow in the skin.

The central nervous system is not directly acted on by digitalis, but is secondarily affected through the blood-supply; it has no marked effect on sensory or motor nerves.

On the kidneys the effect of digitalis is uncertain in the healthy animal, as it depends on the period at which the renal vessels commence to relax, on the duration of the second stage, and on the relation of the action of the drug on the heart to its action on the vessels, these all being variable.

Authorities state that in a healthy animal the urine is not increased in bulk, but that in cases of disease, such as certain forms of dropsy, it is increased in a marked degree. The action of the drug on the urine is not due to any direct influence on the renal cells, but chiefly on the heart and vessels generally, *partly on the renal arteries.*

Toxic Effects.—According to Hertwig, 1 ounce, and in some cases 6 drachms, of powdered digitalis, administered in bolus to horses, caused in three to ten hours loss of appetite, frequent urination, fluid fæces sometimes tinged with blood, the pulse at first full and frequent, but afterwards small, slow, and irregular, difficulty of respiration, contraction of the pupil, languor, and death after twelve to sixteen hours.

Messrs. Bouley and Reynal, experimenting with large doses of digitalis in horses, found that the circulation became more rapid, the heart-beats more abrupt, and their energy increased, and accompanied after a certain time with a vibratory thrill and a decided metallic tinkling. As poisoning went on, a distinct bellows murmur was heard, becoming more audible on exertion; the pulse was small, thready, and intermittent; and as death approached the beats were very rapid, being from 90 to 140 per minute (Dr. Ringer, 'Hand-book of Therapeutics').

Medicinal Uses.—*In affections of the heart,* digitalis, employed judiciously, is an agent of great therapeutical value.

It is indicated *when the nervo-muscular structures of the cardiac walls tend to fail*, resulting in a fall of the circulatory force, the cavities of the heart being incompletely emptied, the arteries insufficiently filled, and the veins imperfectly drained. In such cases the pulse becomes small, weak, and irregular; cardiac distress occurs, the veins become distended, dropsy and visceral disorder supervene, and frequently congestion of the lungs with marked dyspnœa is present. This condition occurs under a variety of circumstances, such as the different forms of valvular disease.

In the case of horses affected with marked organic disease of the heart treatment is useless for obvious reasons; however, in favourite auimals, and in dogs, it may be required in order to prolong life at the request of the owners.

Digitalis is *indicated* when natural compensation fails or does not occur (see p. 135); it produces beneficial results by lengthening diastole, and thus increasing the force of the cardiac wall, by this means prolonging venous flow and ventricular rest; the pressure in the arteries is sustained, and the blood driven in a steady stream into the veins.

The symptoms noted above will thus be alleviated and the dropsy removed, absorption of the fluid being accomplished by increased venous flow, the profuse diuresis causing its excretion by the kidneys.

In such cases attention must be paid to digestion and to dietetics, and it is often of advantage to combine digitalis with a preparation of iron and quinine.

In pericarditis, digitalis is recommended in the earlier stages by some practitioners, but Professor Williams is of opinion that in this affection the drug acts injuriously, interfering with the appetite, and tending to accumulate in the system.

In functional or nervous palpitation, accompanied with debility, or in reflex cases with gastric disorder, small doses of digitalis, by controlling the vagus, give favourable results in many instances; but it is necessary to remember the tendency of the drug to interfere with digestion. During convalescence from influenza, or other exhausting diseases, we sometimes find an irregular or an intermittent pulse, which is greatly benefited by the judicious administration of digitalis, combined with mineral and vegetable tonics.

In broken wind and chronic cough digitalis is frequently employed in combination with other drugs, and is certainly of value in many cases, although we may not be able to explain its action on these affections in a satisfactory manner.

The late Professor Dick recommended in such cases a combination of 30 grains each of digitalis, opium, camphor, and calomel, given once daily; while if continued for a week or longer, the calomel should be omitted.

In suppression of urine, accompanying nephritis, where it becomes necessary to excite the secretion, Professor Williams recommends a decoction of digitalis, repeatedly applied as a fomentation to the loins, or as a poultice; this is to be discontinued immediately after the kidneys have commenced to act.

Contra-Indications.—*In pure hypertrophy* of the heart, and during the compensation period, digitalis should not be employed (see p. 135).

In aortic incompetence it is contra-indicated, as it prolongs diastole, and thus permits a greater reflux of blood but if the ventricle tends to fail it may be employed.

In fatty degeneration of the heart digitalis should be withheld, as by causing irregular contraction it may lead to rupture.

In *irritable* or *dyspeptic* conditions of the alimentary canal, digitalis should not be prescribed until a normal state of digestion is brought about.

In prescribing digitalis it is necessary to remember the *cumulative* action of the drug, so that proper intervals be allowed between each dose, otherwise it enters the tissues more quickly than it is excreted, and may suddenly exert toxic effects.

Convallaria.

The entire plant of Convallaria majalis, the lily of the valley.

Preparations.

Extractum Convallariæ—Aqueous.
Doses.—Horses, ʒss. to ʒii.; dogs, grs. ii. to grs. viii.

Tinctura Convallariæ—
Doses.—Same as those of tincture of digitalis.

Actions and Uses.—Convallaria resembles digitalis in its actions; it has also decided *diuretic* effects.

It has been employed with success in some cases of cardiac dropsy, and is recommended in cases of functional and organic cardiac affections. It is said to be less liable to cause nausea than digitalis, but is seldom used in veterinary practice.

Strophanthus.

The mature ripe seeds of Strophanthus hispidus.

Preparation.

Tinctura Strophanthi—1, dried, in 20 of pure ether and spirit.
Doses.—Horses, ʒi. to ʒii.; dogs, ♏ii. to ♏x.

Actions and Uses.—Strophanthus is a *cardiac stimulant* and *diuretic*, being closely allied to digitalis in its action on the circulation, and may be prescribed in the same class of cases where digitalis has failed or disagreed.

Scilla—Squill.

The bulb of Urginea scilla.

Preparations.

Acetum Scillæ—1 in 8 of diluted acetic acid.
Syrupus Scillæ—Acetum scillæ 1 with 2 of refined sugar.
Doses.—Horses, ℥i.; dogs, ʒss. to ʒi.

Actions and Uses.—Squill closely resembles digitalis in its action on the heart and circulation, and produces diuresis in a similar manner.

Two points of difference require notice:

(1) Squill is *more irritant* to the stomach and intestines than digitalis, causing vomiting and purging when administered in full doses to dogs.

(2) Squill is a *powerful expectorant*, this action being probably a remote local one, the active principle of the drug stimulating the structures in the bronchial walls during its excretion.

It may be prescribed as a *stimulant expectorant* in cases of chronic bronchitis, in which it produces beneficial results by increasing the local circulation and secretion, accelerating the removal of the products, and strengthening the action of the heart. It may be combined with the liquor ammonii acetatis or with camphor.

CHAPTER XIII.

THE VEGETABLE KINGDOM—*Continued.*

Simple Bitters, Aromatic Bitters, and Aromatic Volatile Oils.

These form a large group of vegetable substances, and it will be convenient to select a type of each class for a full description of its actions and uses, and to compare the others with it.

As a type of simple bitters we may select *calumba*, and as types of *aromatic bitters* we have *gentian* and *aurantium*. Certain alkaloids, such as quinine, strychnine, etc., also possess actions as bitters.

Aromatic volatile oils are represented by oil of cloves, oil of peppermint, etc.

Calumbæ Radix—Calumba Root.

The dried transversely cut slices of the root of Jateorrhiza calumba. Active priuciple : *calumbin.*

Preparations.

Calumbæ Radix Pulvis—Powdered Calumba.
Doses.—Horses, ʒii. to ʒiv.; cattle, ℥i. to ℥ii.; sheep and pigs, ʒss. to ʒi.; dogs, grs. v. to grs. xx.

Tinctura Calumbæ—1 in 8 of proof spirit.
Doses.—Horses, ℥i. to ℥ii.; cattle, ℥ii. to ℥iii.; sheep and pigs, ʒi. to ʒii.; dogs, ʒss. to ʒi.

ACTIONS OF CALUMBA AND OTHER VEGETABLE BITTERS.

(1) IMMEDIATE LOCAL ACTION.

Externally.—Calumba and other bitters possess antiseptic and disinfectant properties, and to a certain extent are capable of arresting decomposition and fermentation, but they are not employed for this purpose.

Internally.—In the mouth calumba and other bitters *stimulate the nerves of taste*, and also induce several *reflex* effects of importance in connection with digestion, as follows:

(*a*) They increase the flow of *saliva*, and thus favour the necessary action of this secretion on the food in the mouth, as well as its stimulant action on the gastric secretion.

(*b*) They stimulate the vessels and glands of the stomach through the central nervous system, and thus increase gastric secretion in a second way. This effect is heightened if the bitter be aromatic, and there is increased relish given for food by the pleasant flavour.

(*c*) *In the stomach* calumba and other bitters *act directly on the gastric nerves*, causing a sensation closely resembling hunger. The appetite is thus increased, and if food be given shortly afterwards the effects described above afford means of ensuring proper digestion of it. The action of bitters is assisted by a combination with aromatics, and with alcohol (such as contained in tinctures of the drugs).

(*d*) Calumba and other bitters exert a controlling action on any decomposition or excessive fermentation which may be set up in the stomach and intestines. They pass slowly along the intestines, and unless they contain tannin (which is present in many), they slightly increase peristaltic action. If given in excess, or for too long a period, bitters tend to irritate the stomach and induce indigestion.

(*e*) Bitters, besides increasing the local circulation, also produce a remote effect on the heart and systemic vessels, causing increased blood-pressure, and acting as 'general tonics.'

(2) ACTION ON THE BLOOD, AND SPECIFIC ACTION.

We are not aware of any *direct action* of bitters on the blood or tissues beyond those just described. Their *indirect action* is decided, as they are the means of introducing into the blood an increased amount of nutrient material, thus acting as tonics.

Medicinal Uses.—*As stomachics* calumba and other bitters are of great value, and are frequently employed to *stimulate gastric digestion* in cases of atonic dyspepsia, where the appetite and powers of digestion and assimilation are interfered with, such as occur in convalescence from acute diseases, also in overworked animals, and in instances due to errors of dieting. They are combined with acids or with alkaline stomachics, as the case may require, and are rendered more active by the addition of an aromatic tincture.

Calumba is one of the least irritating of the bitter stomachics. Bitters should not be continued for too long a period, or administered in too concentrated a form. In cases of dyspepsia accompanied by pain, and excessive mucous secretion, or, in the case of dogs, by vomiting, and in organic disease of the stomach, they must be prescribed with caution or avoided altogether.

The action of bitters on the intestines increases their value in cases of indigestion, as they remove flatulence and tend to promote evacuation.

Given by the mouth, or in the form of enema, infusions of bitters act as *anthelmintics*, preventing and destroying threadworms.

Quassiæ Lignum—QUASSIA WOOD.

The chips, shavings, or raspings of the wood of Picræna excelsa. Active principle: *quassin.*

Preparations.

Infusum Quassiæ—1 in 80 of cold water.

Doses.—Horses and cattle, ℥iv. to ℥viii.; dogs, ʒi. to ʒiv.

Tinctura Quassiæ—1 in 27 of proof spirit.

Doses.—Horses and cattle, ℥ss. to ℥i.ss.; dogs, ʒss. to ʒi

Actions and Uses.—Quassia is a *simple bitter*, possessing the various properties fully described under calumba. The following points are worthy of notice:

(1) Its preparations *contain no tannin*, and may be combined with salts of iron without any chemical change occurring.

(2) It is intensely bitter, as compared with calumba or gentian.

(3) The infusion of quassia, used as an enema, is an excellent anthelmintic remedy destroying both ascarides and lumbrici.

Gentianæ Radix—Gentian Root.

The dried root of Gentiana lutea, the yellow gentiau. Contains 1 per cent. of a bitter glucoside, *gentiopicrin.*

Preparations.

Pulvis Gentiauæ Radix—Powdered Gentian.

Doses.—Horses, ℥ss. to ℥i.; cattle, ℥i. to ℥ii.; sheep and pigs, ʒi. to ʒii.; dogs, grs. v. to grs. xx. Repeated two or three times daily.

Tinctura Gentianæ Composita—Compound Tincture of Gentian—Gentian, 6; bitter orange-peel, 3; cardamoms, 1; proof spirit, 80.

Doses.—Horses, ℥i. to ℥ii.; dogs, ʒss. to ʒii.

Actions and Uses.—Gentian possesses the action of other *bitters* as described under calumba. It is most extensively employed in veterinary practice, is slightly *aromatic*, possesses but little astringency, and is more stimulant to the bowels, and more disinfectant than many other bitters.

In cases of *atonic dyspepsia*, especially among young animals, it is useful, conjoined with bicarbonate of soda and ginger. As a *general tonic* it may be combined with sulphate of iron.

In convalescence from debilitating diseases gentian is an excellent stomachic, and in combination with alcohol, such as in the form of tincture, or administered in ale, it proves a valuable stimulating tonic.

In cattle practice it is also largely employed, in cases of indigestion, torpidity of the rumen, etc., and may be combined with nux vomica, and small doses of sulphate of magnesia.

In canine practice, the compound tincture of gentian forms one of the best vegetable tonics, and may be combined with quinine with advantage.

Aromatic bitters resembling gentian are *cascarilla*, *chirata*, *serpentaria*, *canella*, *cusparia*, etc.

Aurantii Fructus—Bitter Orange.

Preparation.

Tinctura Aurantii—6 of fresh rind in 20 of spirit.

This substance is an *aromatic* and *bitter*, and is chiefly employed as a flavouring agent in pharmacy.

Hydrastis Rhizoma.

The dried rhizome and rootlets of Hydrastis canadensis, or yellow root.

Preparation.

Extractum Hydrastis Liquidum — spirituous and aqueous—1 in 1.

Actions and Uses.—Hydrastis is a *bitter* and a *spinal stimulant*, somewhat resembling nux vomica. Applied to mucous surfaces it acts as a *hæmostatic* and *astringent*. Its chief use in veterinary practice is in the treatment of *nasal gleet*, depending on a diseased condition of the Schneiderian mucous membrane. It is used in the form of an injection by means of a syringe, and of the strength of one ounce to one quart of warm water.

The liquid extract of the United States Pharmacopœia is said to be the best preparation of the drug for this purpose.

Oleum Caryophylli—Oil of Cloves.

The oil distilled from the dried flower-buds of Eugenia caryophyllata, or clove.

Cloves may be taken as a type of a large group of agents known as the **aromatic volatile oils**. These are of complex and variable chemical composition, and are closely allied, on the one hand, to phenol and benzoic acid, and on the other hand to the balsams and gum-resins.

We shall describe the actions of oil of olives at length, so that it will only be necessary to compare the other members of the group with it.

(1) IMMEDIATE LOCAL ACTION.

Oil of cloves and allied substances closely resemble oil of turpentine in their properties. Applied to the skin they cause redness, and a degree of inflammation, with temporary pain, which gives place to local anæsthesia. They act as *antiseptics*, *local anæsthetics*, *stimulants*, and *counter-irritants*, turpentine and camphor being common applications for these purposes.

Internally.—In the *mouth* oil of cloves and its allies act as antiseptics, they also cause dilatation of the local vessels, and thus increase circulation, heat, and nutrition; in concentrated form they may even cause inflammation. Simultaneously the nerves of *taste* are powerfully excited, and certain *reflex* results of importance in digestion follow these local changes.

(*a*) There is increased flow of saliva and of mucus.

(*b*) The gastric mucosa becomes hyperæmic, causing a sense of hunger, and a flow of gastric juice.

(*c*) The appetite is stimulated, and there is increased relish for food.

In the stomach the aromatic volatile oils act as powerful *stomachics*, as follows : The gastric vessels are dilated, the gastric nerves are first stimulated and then soothed, pain is thus relieved, and the contents of the stomach, if tending to decompose, as in dyspepsia, are partly disinfected. There are important *reflex* effects. The muscular coat of the stomach is stimulated, and the gastric movements increased, with probable relaxation of the cardiac orifice in the case of dogs.

Flatulence and spasm are relieved, the aromatic volatile oils thus acting as *carminatives*. By reflex action also distant organs are stimulated. The action of the heart is increased, the blood-pressure raised, and the spinal and medullary centres are temporarily excited. These agents thus act as *general stimulants* and *antispasmodics*.

In the intestines portions of the aromatic oils remain unabsorbed, and increase the local circulation and secretions, also stimulating the peristaltic movements and expelling flatus. They relieve or prevent pain and spasm, and are often employed as *correctives* of the griping tendencies of many purgatives. Oil of cloves possesses a slight astringent action by reason of the tannic acid it contains.

(2) ACTION ON THE BLOOD.

Oil of cloves and other aromatic oils enter the blood, and are partly oxidized by the red corpuscles ; they then leave the circulation mainly unchanged. Some are believed to increase the number of white corpuscles by dilating the abdominal vessels, and thus stimulating the organs which supply the blood with leucocytes.

(3) SPECIFIC ACTION.

Unless given in very large doses, the aromatic oils do not produce any specific effects on the tissues or organs. Generally speaking, they are *stimulants* and *antispasmodics*, but the major part of this effect depends on reflex action from the stomach, such as described previously.

(4) REMOTE LOCAL ACTION.

The aromatic oils are excreted by the kidneys, skin, bronchi, liver, and intestines, partly unchanged and partly as resins.

In passing through these structures they *stimulate*, and to a certain extent *disinfect*, them, this being especially the case with the oil of turpentine.

Medicinal Uses.—These will be discussed under the heading of each member of the group.

Oil of cloves has been recommended as an application to cases of open joint, the beneficial effects recorded being probably due to its anodyne and disinfectant properties.

Oleum Menthæ Piperitæ—Oil of Peppermint.

The oil distilled from fresh flowering peppermint, Mentha piperita.

Composition.—It consists of a terpene, *menthene*, and stearoptene, *menthol*, or peppermint camphor.

Actions and Uses.—Oil of peppermint resembles other aromatic oils in its actions. It differs, however, in its action locally, as, instead of dilatation, it causes at first active contraction of the vessels, leading to a sensation of coldness when taken by human beings. It paralyzes the ends of sensory nerves with which it is brought in contact, and hence relieves gastro-intestinal pain, and acts as a carminative. It is contained in the tinctura chloroformi et morphinæ (see p. 338).

Menthol is a vascular stimulant and *local anæsthetic*.

Thymol.—A stearoptene obtained from the volatile oils of Thymus Vulgaris. It is *antiseptic*, *disinfectant*, and *deodorant*. A saturated solution in water is a very powerful antiseptic, but seldom employed. In the form of spirituous solutions in ointments it has been used as an application in skin affections.

Oil of Origanum is obtained from Thymus vulgaris; it acts as an *irritant* when rubbed into the skin, and is often added to blistering ointments and liniments.

Oil of Lavender and **Oil of Rosemary** resemble the other aromatic oils in their action, and are chiefly employed as components of stimulating liniments. Compound tincture of lavender is contained in liquor arsenicalis, and the oil of lavender is an ingredient of compound camphor liniment.

Zingiber—Ginger.

The scraped and dried rhizome of Zingiber officinale. Ginger contains an *aromatic volatile oil*, a complex mixture of hydrocarbons and their oxidation products.

Doses.—Horses, ʒiv. to ℥i.; cattle, ℥i. to ℥ii.; sheep and pigs, ʒi. to ʒii.; dogs, grs. x. to grs. xx.

Preparation.

Tinctura Zingiberis—1 in 8 of spirit.

Doses.—Horses, ℥ss. to ℥i. ss.; dogs, ♏xv. to ♏xx.

Actions and Uses.—Ginger is extensively employed as a *carminative* and *stomachic* in all patients. It is combined with purgatives to diminish their tendency to nauseate and gripe, being added to the aloetic bolus for the horse, and to the sulphate of magnesia for ruminants.

Anisi Fructus—Anise Fruit.

The dried fruit of Pimpinella anisum. The chief constituent is the official oil.

Oleum Anisi—Oil of Anise.

The oil distilled from anise fruit.

Actions and Uses.—The actions and uses of anise resemble those of the aromatic oils in general. It is believed to possess a stimulant action on the bronchial mucous membrane, being excreted partly by this channel, hence it is a favourite component of formulæ for the relief of cough in horses, besides being a flavouring agent. The anise fruit may be given to horses in doses of ℥ss. to ℥i. in combination with other remedies. The oil of anise is seldom employed except as a flavouring ingredient.

Caraway, Coriander, Fenugreek, Fennel, Dill, Cardamoms, all contain aromatic volatile oils, and resemble anise in their actions. They enter into the composition of various 'condition powders' and popular condiments for horses and cattle.

Arnicæ Rhizoma.

The dried rhizome and rootlets of Arnica montana.

Arnica contains a small quantity of *volatile oil* of complex composition, also *tannic acid* and a resinous glucoside, *arnicin*.

Preparation.

Tinctura Arnicæ—Tincture of Arnica—1 in 20.

Doses.—Horses, ℥i. to ℥ii.; dogs, ʒss. to ʒi.

(1) IMMEDIATE LOCAL ACTION.

Externally.—Arnica applied to the skin increases the cutaneous circulation.

Internally it is a stimulant to the alimentary canal, like volatile oils in general. It also acts as a general stimulant when given in medicinal doses, probably in part by a reflex action from the stomach.

(2) SPECIFIC ACTION.

It acts as a stimulant to the brain and whole nervous system. In large doses it is an irritant to the gastro-intestinal canal, and causes depression of the circulation and nerve centres. It is excreted by the kidneys and skin, exerting remote stimulant effects thereon.

Medicinal Uses.—*Internally* the tincture of arnica is recommended by Professor Williams in cases of pulmonary congestion, and he advises the administration of one or two ounces, believing that it stimulates the cutaneous circulation, and is calculated to restore the equilibrium of the circulation in the system.

Externally arnica is extensively employed as an application to strains and bruises, etc., and although some authorities question its therapeutic value in such cases, experience enables us to state that it produces beneficial effects. It prevents swelling, and hastens the absorption of effused blood, and according to Dr. Phillips ('Materia Medica and Therapeutics') it has the power of restoring contused muscular fibre to its healthy condition in a short space of time.

He recommends the internal administration of small doses of arnica every two or three hours in cases of concussion and shock, also in hæmorrhages arising from mechanical violence, such as epistaxis and hæmoptysis.

Arnica may be employed in the form of liniments, containing from two to four ounces of the tincture to the pint of water, combined with tincture of camphor or soap liniment (see p. 230).

Oleum Terebinthinæ—Oil of Turpentine.

The oil distilled from the oleo-resin (turpentine) obtained from Pinus Australis, Pinus tæda, and sometimes from Pinus pinaster and Pinus sylvestris, rectified if necessary. The oleo-resin, turpentine, is an impure solution of *resin* in 15 to 30 per cent. of the official volatile oil.

Doses.—Horses, ℥i. to ℥ii.; cattle, ℥ii. to ℥iii.; sheep and pigs, ʒi. to ʒiv.; dogs, ♏x. to ♏xxx.; six-month-old calves, ℥ss.; six-month-old lambs, ʒi.

The oil of turpentine should be well shaken up in bland oils, or made into an emulsion with mucilage or eggs, before administration, so as to avoid its irritating effects on the mouth and throat.

Preparations.

Linimentum Terebinthinæ—Ol. tereb., 16; camphor, 1; soft soap, 2; water, 2. Mix the soap with the water; dissolve the camphor in the turpentine; rub all together till mixed, and add sufficient water to make a fluid emulsion.

ACTIONS OF TURPENTINE.

(1) IMMEDIATE LOCAL ACTION.

Externally.—Turpentine, applied to the skin or exposed mucous membranes, acts as an *antiseptic* and *disinfectant*, and also as a *local stimulant* and *counter-irritant*. It stimulates the local circulation, acts as a rubefacient, and if applied of sufficient strength, acts as a vesicant. It irritates the local nerves at first, and then depresses them.

Some animals are very susceptible to this local effect of oil of turpentine, which causes a high degree of irritation, especially in horses and dogs with thin skins. Turpentine may be absorbed by the unbroken skin.

Internally.—In the stomach oil of turpentine in medicinal doses acts as a *powerful carminative*, resembling other aromatic volatile oils in this respect. It is a *gastric disinfectant* a stimulant to the vessels, a sedative to the local nerves, and a temporary reflex stimulant.

In the *intestines* turpentine exerts important actions, and may be found in the colon, in which also it is partly excreted.

It acts in a reflex manner as a *stimulant to the muscular coat* of the intestines, causing contraction, expulsion of gas and fæces, and recovery of tone (if this has been lost by tympanitic distension); it also acts as a *disinfectant* and vascular stimulant, while in large doses purgation will be produced.

Turpentine acts also as an *anthelmintic*, being capable of destroying intestinal parasites. Used in the form of an inhalation, the oil of turpentine acts as a stimulant and disinfectant to the respiratory organs.

(2) ACTION ON THE BLOOD.

Oil of turpentine is freely absorbed from all surfaces, and enters the blood unchanged. Even in medicinal doses it is believed to be partially oxidized at the expense of the blood. If injected intravenously, it may produce rapidly fatal effects, which are partly referable to its coagulating influence on the blood.

(3) SPECIFIC ACTION.

In medicinal doses oil of turpentine acts as a *reflex stimulant* as well as a general stimulant. It is rapidly absorbed, diffused, and excreted.

In full doses it causes at first stimulation and then paralysis of the vaso-motor centres; the blood-pressure falls, and the action of the heart is disturbed. The cerebral and spinal centres are briefly stimulated, and then depressed, the actions of the drug in toxic doses resembling those of alcohol (see p. 325). Experiments demonstrate that large doses given to dogs cause gastro-enteritis, staggering gait, irritation and congestion of the urinary organs, and frequently hæmaturia.

The **antidotes** recommended are small doses of sulphate of magnesia, demulcent drinks, and laudanum or morphine to relieve pain.

(4) REMOTE LOCAL ACTION.

Oil of turpentine, like the majority of volatile oils, is excreted almost unchanged by the cutaneous and mammary glands, by the lungs and respiratory passages, the kidneys, and probably by the liver and intestines. During its excretion by these channels it produces important effects.

In moderate doses it causes *diuresis*, while excessive amounts may produce complete suppression of urine, irritation and congestion of the urinary organs, repeated attempts at micturition, and frequently hæmaturia.

Part of the drug is excreted as a violet smelling body; this and the unchanged portion exert remote local effects as stimulants and disinfectants in the bladder and urethra.

During its excretion by the respiratory passages oil of turpentine acts as a *vascular stimulant to the bronchial walls*, and as a disinfectant to the parts and to their products. Its excretion by the colon contributes to its effect in causing the expulsion of gas and fæces.

Medicinal Uses.—In *gastric tympany* and *flatulent colic* in horses, the oil of turpentine is a very valuable remedy, causing expulsion of the gas, arresting fermentation, and giving tone to the muscular coat of the organs involved. It may be administered along with a purgative dose of ol. lini, and combined with the spiritus ammon. aromat., while if pain be present, chlorodyne or tr. opii may be given in addition.

In *tympanitis* of the rumen, commonly known as *hoven* in cattle, oil of turpentine is also a very effectual agent, and may be given in full doses, combined with a preparation of ammonia and an oleaginous purgative.

In cases of indigestion, characterized by distension of the rumen and general digestive disturbance, frequently met with in calves, oil of turpentine, combined with spiritus ammon. aromat. and ol. lini, gives excellent results, prescribed in the following formula: ℞. Ol. tereb., ℥ss.; spiritus ammon. aromat., ℨi.ss.; ol. lini, O.ss. F. m.

This may be repeated in three hours if necessary.

In *purpura hæmorrhagica*, oil of turpentine is an agent of great value, probably producing its effects by some special action on the bloodvessels.

It may be administered in ounce doses, combined with a preparation of iron, twice or three times daily, and mixed in a proper amount of milk and eggs, chlorate of potash being given at the same time in the patient's food or drinking-water.

As a *hæmostatic*, oil of turpentine is of unquestionable value in cases of internal hæmorrhages, such as from the lungs, stomach, intestines, and uterus. In such instances it may be given in large doses, care being taken that it is properly diluted with some bland fluid.

As an *anthelmintic*, oil of turpentine is an effectual agent for horses, but should be avoided in dogs, as it is likely to produce irritating effects. For the horse, in the case of tapeworms, the following is a useful formula: ℞. Ol. tereb., ℥ii.; ext. filicis liq., ℥i.; ol. lini, Oi. M. To be given fasting, after the animal has been kept for a few days on soft food.

In *parasitic bronchitis* in calves and lambs, oil of turpentine is extensively employed, and may be administered in doses of half an ounce to calves and one drachm to lambs, mixed with milk, and repeated at intervals of two or three days.

For calves *intra-tracheal* injections are largely employed, consisting of ol. tereb., ʒi. to ʒii.; ac. carbolic, ʒss.; chloroform and glycerine, āā ʒss. By this means the parasites are directly acted on and destroyed.

Oil of turpentine is very useful in cases of *parasitic diarrhœa and anæmia* in cattle, due to the presence of strongyli in the fourth stomach. It may be given in milk or mucilage, and combined with a preparation of iron.

As an *antidote* to *phosphorus*, turpentine is employed in the form of the crude oil, which converts the poison into a harmless compound, and causes its elimination by the kidneys (see p. 275).

Contra-Indications.—In congestive and inflammatory conditions of the kidneys, and in gastritis, enteritis, etc., turpentine should not be prescribed.

Dogs are particularly susceptible to the action of the drug, hence it should be administered in small doses, and the effects carefully watched.

Externally, oil of turpentine is largely employed as a constituent of stimulating liniments, embrocations, etc. Its vesicating effect should be avoided, as it is likely to produce a blemish, besides causing excessive irritation, restlessness, and excitement in horses.

The liniment of turpentine is extensively used as a stimulating application to rheumatic affections of joints and muscles. It is also applied as a mild counter-irritant to the walls of the chest in respiratory affections, and employed to prevent chilling during the process of keeping hot applications to the thoracic and abdominal regions.

Terebene.

Produced by the action of sulphuric acid on oil of turpentine and distillation; resembles the latter in its actions, but is less acrid and less liable to cause irritation of the kidneys. It is sometimes prescribed internally in cases of chronic bronchitis, and may be administered as an emulsion. Externally it is stimulant, antiseptic, and a deodorizer.

Resin.

The residue left after distillation of oil of turpentine from the crude oleo-resin; is a favourite ingredient of diuretic masses and powders.

The *doses* for horses and cattle are from ʒss. to ℥i.

Externally, it is employed in the form of ointment as a mild local stimulant and disinfectant to ulcers and unhealthy surfaces.

The **Unguentum Resinæ**, commonly known as 'digestive ointment,' is prepared by melting together—resin, 4; yellow wax, 2; simple ointment, 8; almond oil, 1.

Resin is contained in many forms of *plasters* to impart firmness and adhesiveness.

Pix Liquida—Tar.

A bituminous liquid obtained from the wood of Pinus sylvestris and other species of Pinus by destructive distillation.

Preparations.

Oleum Picis Liquidæ—Oil of Tar—obtained by distilling tar.

Pix Nigra—Pitch—the residue remaining after the distillation of tar.

Unguentum Picis Liquidæ—Tar (by weight), 5; yellow wax, 1; almond oil, 1; melt together, and stir till cold.

Aqua Picis—Tar Water—Stir a pint of tar with half a gallon of water for fifteen minutes, and decant.

Action and Uses.—*Externally*, tar acts as a *vascular stimulant* and *tissue alterative*, and for such purposes is frequently employed in the form of ointment, or as a constituent of ointments and liniments in cases of dry scaly skin diseases.

It is also valuable as an application for mange in both horses and dogs, and may be combined with sulphur and an oleaginous basis, the addition of an alkali rendering the preparation more efficacious.

As a dressing for *brittle hoofs* in horses, often accompanied by insufficient growth of healthy horn, the oil of tar, mixed with vaseline, is a useful application.

Internally, tar acts as a *disinfectant* and *expectorant*. It is a favourite palliative remedy in cases of chronic cough and broken-wind in horses, the method adopted being to place a certain amount of tar in the receptacle from which the animal's drinking-water is drawn. After a time this water is readily partaken of, and in our experience such treatment is of value in conjunction with other details. Tar in such cases probably acts by favouring gastric digestion as well as by its expectorant effects.

Pitch, administered in the form of bolus, is recommended by Professor Williams in the treatment of dry scaly skin diseases, such as pityriasis ('Principles and Practice of Veterinary Surgery').

Oleum Cadinum—Oil of Cade.

Obtained by destructive distillation of the woody portions of Juniperus oxycedrus; is an agreeable form of tar, and combined with soap and spirit it may be employed in the treatment of chronic eczema and other skin affections of the dog.

Juniperi Oleum—Oil of Juniper.

Obtained from the fruit of Juniperus communis; resembles turpentine in its actions, but is less powerful.

It is believed to produce *diuretic* effects by stimulating the renal cells in a specific manner, increasing both solids and water. It may be employed as a diuretic in cases of dropsy, not depending on acute renal disease.

The *dose* for horses is ʒi. to ʒii., and dogs, ♏ii. to ♏iv., given dissolved in spirit, and combined with saline diuretics.

Oleum Eucalypti—Oil of Eucalyptus

The oil distilled from the fresh leaves of Eucalyptus globulus, Eucalyptus amygdalina, and probably other species of Eucalyptus, the gum-tree from Australia.

Doses.—Horses and cattle, ʒi. to ʒii., dogs, ♏ii. to ♏x., may be administered, dissolved in spirit, or in mucilage. In cases of septic diseases these doses should be increased and repeated at intervals.

Actions and Uses.—*Externally*, oil of eucalyptus is a powerful *antiseptic* and *disinfectant*, and in the form of ointment (1 to 5) it forms a valuable surgical dressing. As *an inhalation* it proves of great service in bronchitis, allaying irritation, and preventing fœtor of the secretions.

Internally it acts as an *antipyretic* and *antiperiodic*, resembling quinine to a certain extent.

We have observed excellent results from its employment in cases of influenza in horses complicated with bronchitis, and in cases of distemper in dogs, accompanied by profuse and fœtid nasal discharge. In such instances, frequent inhalations of the drug were employed, along with its internal administration.

Eucalyptus is excreted by the kidneys and lungs, and exerts antiseptic actions on the mucous surfaces of these regions. It is indicated in *pyelitis*, *cystitis*, and as it resembles other volatile oils in its action on the gastro-intestinal canal, it may be employed in certain affections of the stomach as a *gastric disinfectant*.

Camphora—CAMPHOR.

A stearoptene obtained from the wood of Cinnamomum camphora, readily powdered if moistened with rectified spirit.

Doses.—Horses, ʒss. to ʒii.; cattle, ʒii. to ʒiii.; sheep, grs. x. to grs. xx.; dogs, grs. ii. to grs. v.

Preparations.

Spiritus Camphoræ—1 in 10 of rectified spirit.

Doses.—Horses, ℥ss. to ℥i.; cattle, ℥i. to ℥ii.; sheep, ʒss. to ʒi.; dogs, ♏x. to ♏xxx.

Linimentum Camphoræ Compositum—Camphor, 20; strong solution of ammonia, 40; spirit, 120; oil of lavender, 1.

Tinctura Camphoræ Composita—See p. 394.

ACTIONS OF CAMPHOR.

(1) IMMEDIATE LOCAL ACTION.

Externally camphor resembles to a certain extent the actions of oil of turpentine and other volatile oils. It is a *feeble antiseptic*, a *stimulant* to the *local circulation*, and a sedative to the nerves after primary stimulation.

Internally it acts very much like volatile oils, increasing the local circulation, the saliva and the mucous flow in the mouth. In the stomach it acts as a *carminative*, and exerts reflex effects, stimulating the heart and nervous system. It possesses similar effects in the intestines, and acts as an antispasmodic, besides lessening irritability of the mucous membrane.

(2) SPECIFIC ACTION.

A portion of the camphor administered is found unchanged in the organs and tissues; the remainder appears to combine with glucose.

The chief action of camphor is exerted on the *nervous system.* In large doses it acts as a *narcotic,* and may induce convulsions. In moderate doses it stimulates the brain, spinal cord, respiratory functions, and the heart, the latter being also acted on in a reflex manner from the stomach. The diaphoretic effects described as occurring in man are not observed in veterinary patients.

(3) REMOTE LOCAL ACTION.

Camphor is excreted by the respiratory organs unchanged, acting as an *expectorant* in a similar manner to turpentine. It is also excreted by the skin and kidneys.

Medicinal Uses.—As a *carminative,* camphor is employed in cases of *diarrhœa* in the form of the tinctura camphoræ composita. It is recommended by some authorities in *enteritis* in combination with opium.

In cases of *bronchitis,* both acute and chronic, it exerts beneficial effects by its expectorant action, and may be combined with spiritus ætheris nitrosi and belladonna, when cough is a prominent symptom. When the administration of fluids becomes dangerous, in consequence of violent fits of coughing, camphor may be given in the form of *electuary,* being combined with potass. chloras and extract of belladonna.

Camphor is frequently employed as a constituent of various *cough* mixtures and powders, the following being a useful powder for recent cases: Camphor. pulv., ʒss.; pulv. fol. belladonnæ, ʒii.; potass. chlor., ʒii.; pulv. anisi fruct., ʒss. This may be given twice daily in the food.

In cases of *irritable cough in dogs,* often accompanying distemper, small doses of camphor in combination with squills and belladonna give favourable results.

Externally.—Camphor is extensively employed as a constituent of various stimulating liniments. It may be combined with tincture of arnica and liq. ammoniæ fort. (see p. 230), which makes a useful liniment. The compound camphor liniment is frequently used as a mild counter-irritant to the throat, thoracic walls, etc.

The beneficial effects of camphor externally may be ascribed to its power of increasing the nutrition of injured or indurated parts, and relieving pain. Combined with chloral hydrate it forms an efficient local anodyne.

Benzoinum—Benzoin.

A balsamic resin obtained by incisions in the bark of Styrax benzoin and other species of Styrax.

Benzoin contains 12 to 15 per cent. of *benzoic acid*, a trace of cinnamic acid, two resins, and a volatile oil.

Preparations.

Adeps Benzoatus—1 to 50 of prepared lard.

Tinctura Benzoini Composita—'Friar's Balsam'—Benzoin, 8; prepared storax, 6; balsam of Tolu, 2; Socotrine aloes, $1\frac{1}{2}$; spirit, 80.

Acidum Benzoicum—Benzoic Acid—Prepared from benzoin by sublimation. Benzoic acid is contained in tinctura camphoræ composita (see p. 394).

Ammonii Benzoas—Prepared from benzoic acid and solution of ammonia.

Sodii Benzoas—Prepared from benzoic acid and carbonate of sodium.

(1) IMMEDIATE LOCAL ACTION.

Externally, benzoin and its preparations are *antiseptics* and *disinfectants*, also acting as slight stimulants to the vessels. They possess slight styptic properties.

Internally, when inhaled in concentrated form, they act as slight irritants to the respiratory passages, while if diluted they are mild stimulants.

In the stomach, benzoic acid acts as a slight irritant; its salts possess this effect in a less degree.

(2) ACTION ON THE BLOOD.

Benzoin and benzoic acid enter the blood in the form of benzoate of sodium; the acid is partly converted into hippuric acid by combination with a molecule of glycoll, the same change occurring in the kidneys.

(3) SPECIFIC ACTION.

Benzoic acid and its preparations are to a certain extent *antipyretic*, and are believed by some authorities to increase metabolism.

(4) REMOTE LOCAL ACTION.

Benzoic acid is excreted by the kidneys, skin, and salivary glands, and probably by the respiratory organs. It increases the flow of urine, and is removed by the kidneys partly unchanged, and partly as hippuric acid. It also stimulates the bronchial secretions, thus acting as an expectorant.

Medicinal Uses.—Benzoic acid and its ammonium salt are recommended in cases of *cystitis*, with *alkalinity of the secretion and phosphatic deposits*; it is believed to produce beneficial effects by acidulating the urine and stimulating and disinfecting the mucous surfaces.

As an Expectorant.—The compound tincture of benzoin is occasionally employed in cases of chronic bronchitis, in doses of ℥i. to ℥i.ss. for horses, and ʒss. to ʒi. for dogs.

Externally.—The compound tincture of benzoin was at one time extensively employed as a dressing for wounds under the familiar name of 'Friar's Balsam.' Other more effective and less irritating antiseptic agents have now taken its place, but it is still occasionally used as a dressing for unhealthy wounds.

Balsam of Peru and Balsam of Tolu

resemble benzoin in their actions; both contain benzoic acid.

Balsam of Peru is recommended by Dr. Fleming in the treatment of mange in house dogs; it destroys the *acari*, and relieves the itching and inflammation of the skin. It may be applied of the strength of 1 to 4 of alcohol.

Myrrh

resembles the other oleo-resins in its actions. It is stimulant, disinfectant, expectorant, and stomachic.

Valerianæ Rhizoma—Valerian Rhizome.

The dried rhizome and rootlets of Valeriana officinalis. Contains a volatile oil and valerianic acid.

Preparations.

Tinctura Valerianæ—1 in 8 of proof spirit.

Doses.—Horses, ℥i. to ℥ii.; dogs, ʒss. to ʒi.

Sodii valerianas **Zinci valerianas** **Quininæ valerianas**	Compounds of valerianic acid with bases.

Actions and Uses.—Valerian acts in a similar manner to other substances containing volatile oils, but has a more marked *stimulant* effect on the central nervous system. It is a powerful *carminative*, *circulatory stimulant*, and *antispasmodic*. Valerianic acid does not appear to possess the action of the volatile oil just mentioned, so that the valerianates exhibit the actions of their bases. Valerian is said to have little effect on horses and cattle even in large doses. In dogs it is occasionally prescribed in cases of chorea and epilepsy, but we have not observed any beneficial results from its employment.

Asafœtida—Asafœtida.

A gum-resin obtained by incision from the living root of Ferula narthex and other species. Contains a volatile oil, resin and gum.

Doses.—Horses, ʒii. to ʒiv.; cattle, ℥i.; sheep, ʒi.; dogs, grs. v. to grs. xx.

Preparation.

Tinctura Asafœtida—1 in 8.

Dose.—Horses, ℥ss. to ℥i.ss.; cattle, ℥ii.; dogs, ♏xx. to ʒss.

Actions and Uses.—Asafœtida resembles other volatile oils and gum-resins in its action on the alimentary canal; but instead of possessing aromatic properties, it is very disagreeable to the taste and smell. It acts as a stimulant to the mouth and stomach, and reflexly as a nervine stimulant. It has a special action on the intestines, stimulating the muscular coat, and being antispasmodic. It is partly excreted by the lungs, acting as a *stimulant and disinfectant* expectorant.

The chief use of asafœtida in veterinary practice is in cases of flatulent conditions of the intestines. It is sometimes employed in the treatment of *flatulent colic*, combined with oil of turpentine, aromatic spirit of ammonia, and raw linseed oil. It was recommended by the late Professor Robertson in cases of constipation and torpidity of the bowels in horses, in combination with aloes and nux vomica.

Galbanum and Ammoniacum

are gum-resins acting in a similar manner to asafœtida and other oleo-resins. Ammoniacum is sometimes prescribed as a *disinfectant expectorant* in cases of chronic bronchitis with profuse discharge.

Capsici Fructus—Capsicum Fruit.

The dried fruit of Capsicum fastigiatum. Distinguished as chili pepper, and as cayenne pepper when ground.

Preparation.

Tinctura Capsici—1 in 27.

Actions and Uses.—Capsicum is a *pungent stomachic, carminative*, and *stimulant*. It is sometimes employed as one of the constituents of chlorodyne (see p. 338).

Other varieties of peppers, viz., *black and white peppers*, resemble capsicum. They are often employed as popular remedies in country districts for colic in horses, being mixed with whisky or gin, etc. They possess *local stimulant* and aromatic effects on the mouth, stomach, and intestines, and during their excretion act as *remote local stimulants* of the circulation and nutrition in the urethra and rectum.

Sinapis—Mustard.

A mixture of the powdered seeds of white mustard—Brassica alba—and of black mustard—Brassica nigra. Contains a bland fixed oil, and when this has been extracted and the mustard mixed with water at 120° and distilled, the official *volatile oil*, oleum sinapis, is obtained. This has a penetrating odour and a blistering action on the skin, and as the seeds and powder of mustard are devoid of these irritating properties, the oil is believed to be developed by a decomposition of their constituents.

Actions.—Mustard, applied in the form of properly prepared paste to the skin, promptly acts as a *rubefacient* and *nervous stimulant*, causing increased local circulation, heat, and severe burning pain. This effect is followed by *loss of sensibility* of the part to other impressions and relief of previous pain. If the application be prolonged, *vesication* results by the production of local inflammation.

Various effects on distant organs are produced, the heart, blood-pressure, respiration, and nerve-centres being stimulated by the first application of the agent, soothed during the stage of anæsthesia and relief of pain, while if vesication be severe depression will result (see section on 'Counter-irritation,' p. 197).

Uses.—The chief use of mustard is as a *counter-irritant* in respiratory affections—that is, when the adoption of such means is indicated. The mustard should be made into a paste with water at a temperature of 100°, and rubbed well into the skin, and washed off with tepid water after fifteen or twenty minutes.

In preparing the mustard, too hot water should be avoided, also agents such as vinegar, spirits, etc., should not be added, as the formation of the essential oil is thus prevented. Here we must caution the student against the indiscriminate or excessive use of mustard, especially in the case of well-bred horses or those with fine skins. If applied too severely it causes great irritation, followed by depression, and may produce a blemished condition of the skin. The cases in which counter-irritation will prove of service can only be ascertained by clinical experience. There is no advantage gained by applying the mustard in so severe a manner that great disorganization of the skin results; such an occurrence should be rigidly avoided, as besides the risk of blemish it causes great depression of the system. As a general rule, if the patient is progressing favourably, counter-irritants should not be employed. The indications for their use will be found at p. 201.

In certain abdominal affections the application of mustard to the abdominal walls seems to give relief.

As a *popular emetic* mustard is given dissolved in warm water to dogs, from one to three teaspoonfuls acting promptly as a local emetic.

CHAPTER XIV.

THE VEGETABLE KINGDOM—*Continued.*

In this chapter those vegetable drugs acting as *purgatives* will receive notice.

In veterinary practice but few vegetable purgatives are as yet in common use, in consequence either of their employment not giving satisfactory results, or because they have not received sufficient trial. In human medicine a large variety of purgatives are employed, a combination of two or more being found of advantage.

Oleum Crotonis—Croton Oil.

The oil expressed from the seeds of Croton tiglium. The active principle of croton oil is obscure; it is believed to contain a vesicating and a purgative principle distinct from each other.

Doses.—Horses, ♏x. to ♏xx.; cattle, ʒss. to ʒi.

Preparation.

Linimentum Crotonis—Croton oil, 1; oil of cajeput, 3½; spirit, 3½.

Actions.—*Externally*, croton oil is a *powerful irritant* to the skin, and if freely used produces papules, followed by severe pustules, which are slow to heal and may leave a blemish.

Internally, croton oil is a *drastic cathartic*, acting very rapidly, sometimes within one or two hours, producing frequent, full, and fluid dejections. It acts by direct irritation of the intestinal mucous membrane, and causes heightened peristaltic action, increased watery transudation, and probably glandular hypersecretion. It has no special cholagogue action. The muscular excitement and consequent griping induced by the drug are believed to commence before it has reached the duodenum, and are referred partly to a reflex action originating in irritation of the gastric nerves.

In large doses croton oil acts as an irritant poison, causing violent purgation and gastro-enteritis in all animals.

The **antidotes** are opium and demulcents.

Medicinal Uses.—In consequence of its violent effects, croton oil is but rarely employed as a purgative for horses. In cases where a speedy and complete evacuation of the bowels and a diminution of arterial pressure are demanded, such as in cases of phrenitis, meningitis, stomach staggers, etc., the drug may be given to the horse, combined with belladonna or hyoscyamus. In cases where the administration of a bolus or a drench is impossible, croton oil may be placed between the molar teeth, mixed with ext. belladonna. In dogs it should not be employed; indeed, generally speaking, in all patients the use of this drug should be avoided as much as possible, and milder purgative agents, with the use of enemata, should be depended on to act on the bowels.

In cattle, croton oil is an effectual purgative, and will often produce effects when other agents fail. At one time it was freely given in the treatment of that affection known as 'fardel-bound,' but often with disastrous results, as the disease has been proved to be due to a condition of inflammation of the abomasum, a state in which violent purgatives are contra-indicated. Croton oil or other drastic purgatives should *never be given* in cases of inaction of the bowels depending on inflammatory changes, a paralyzed condition of the intestinal walls, or intestinal obstruction.

Externally, croton oil is employed as a counter-irritant for cattle in the form of the linimentum crotonis.

Elaterium.

A sediment from the juice of the fruit of Ecballium elaterium, the squirting cucumber. Contains the official active neutral principle *elaterin*.

Doses.—Horses and cattle, grs. v. to grs. x.; dogs, gr. $\frac{1}{10}$ to gr. $\frac{1}{2}$.

Actions and Uses.—Elaterium is a *powerful hydragogue* purgative, producing very watery motions, with griping and considerable depression. It is but seldom employed for horses, but is prescribed for dogs in dropsical affections and uræmia depending on renal disease; it relieves the venous pressure by free evacuation of fluid into the bowel. It is recommended by Professor Williams in cases of acute congestion of the liver in the dog, in order to cause a drain from the portal system.

Colocynthidis Pulpa—Colocynth Pulp.

The dried fruit of Citrullus colocynthis. Contains a bitter glucoside, *colocynthin*, and a resinous powder, *citrullin*.

Preparations.

(1) **Extractum Colocynthidis Compositum**—Colocynth pulp, 6; extract of Socotrine aloes, 12; resin of scammony, 4; curd soap, 3; cardamom seeds, 1; proof spirit, 160.

Dose.—Dogs, grs. ii. to grs. v.

(2) **Pilula Colocynthidis et Hyoscyami**—Colocynth pulp in powder, 1; Barbadoes aloes, 2; resin of scammony, 2; sulphate of potassium, $\frac{1}{4}$; oil of cloves, $\frac{1}{4}$; extract of hyoscyamus, 3; distilled water, a sufficiency; mix.

Dose.—Dogs, grs. v. to grs. xv., according to size.

Actions and Uses.—Colocynth is a gastro-intestinal stimulant and powerful *drastic, hydragogue cathartic*, acting on the muscular coat, and increasing the secretions of the intestinal glands. According to Dr. Rutherford, it

31

also acts as a *powerful hepatic stimulant*, rendering the bile more watery, but increasing the secretion of biliary matter. In large doses it is a gastro-intestinal irritant.

Colocynth is always used in combination with milder purgatives and carminatives. It is seldom prescribed for horses, but is a useful purgative for dogs, in the form of the pilula colocynthidis et hyoscyami.

Colocynthin or citrullin is recommended by Baum as a purgative for the horse. He administers 10 to 15 grains in the form of enema, combined with 6 ounces of glycerine and alcohol, and states that it occasions a prompt movement of the bowels; he has also observed satisfactory results from the administration of this agent to dogs and pigs.

Cambogia—Gamboge.

A gum-resin obtained from Garcinia Hanburii. Contains about 73 per cent. of a resinous substance, *gambogic acid*.

Dose.—For cattle, ℥ss. to ℥i., given in combination with other purgatives.

Actions and Uses.—Gamboge is a *powerful hydragogue* and drastic *cathartic* resembling colocynth, but possesses no cholagogue action. It is also diuretic, being partly excreted by the kidneys. In consequence of its irritant drastic effects it is not prescribed for horses or dogs, but is occasionally employed in combination with other purgatives for cattle.

Jalapa—Jalap.

The dried tubercles of Ipomœa purga, otherwise called Exogonium purga. Contains 15 to 20 per cent. of the official resin, which is composed of two glucosides—*convolvulin* and *jalapin*.

Dose.—Dogs, grs. x. to ʒi., according to size; pigs, ʒi. to ʒiii.

Preparations.

Tinctura Jalapæ—1 in 8 of proof spirit.
Dose.—Dogs, ʒss. to ʒii.

Extractum Jalapæ—2 in 1.
Dose.—Dogs, grs. v. to ʒss.

Actions and Uses.—Jalap is a *hydragogue cathartic* producing copious watery discharges. According to Dr. Rutherford it is a moderately powerful hepatic, and a powerful intestinal stimulant.

Jalap has but little action on horses or cattle, 2 to 4 ounces having but a slight effect on the bowels, while increasing the activity of the kidneys according to Moiroud. For *dogs* and *pigs* it is a useful purgative, and may be advantageously combined with calomel and a carminative.

Scammony.

A gum-resin obtained from the root of Convolvulus scammonia; resembles jalap in its actions, but is more irritant and liable to gripe. It is a *powerful stimulant of the intestinal glands,* and to a less degree of the liver. It is not prescribed alone, but is an important ingredient of the pilula colocynthidis et hyoscyami (see p. 481).

Podophylli Rhizoma—Podophyllum Rhizome.

The dried rhizome and rootlets of Podophyllum peltatum, American May apple.

Preparations.

Podophylli Resina—Resin of Podophyllin—contains an active principle, *picropodophyllin.*

Doses.—Horses, ʒi.; dogs, gr. $\frac{1}{4}$ to grs. ii.; generally combined with hyoscyamus and calomel.

Tinctura Podophylli—1 grain in 1 fluid drachm of rectified spirit.

Doses.—Horses, ℥ss. to ℥i.ss.; dogs, ♏xv. to ʒi.

Actions and Uses.—Podophyllin, according to some authorities, acts as a *purgative* and *cholagogue* in horses and dogs, while others state that its action is very uncertain when used alone. On dogs it is said to act as a powerful *hepatic stimulant*, and in large doses as a violent purgative. The purgative effect appears to be due to stimulation both of the muscular coat and the glands of the intestine, as well as to increase of the biliary flow. Podophyllin may be employed in combination with calomel and hyoscyamus in cases of *torpidity or congestion of the liver.*

Aloe Barbadensis—Barbadoes Aloes.

The juice when inspissated which flows from the transversely cut bases of the leaves of Aloe vulgaris, Barbadoes and Curaçoa aloes.

Doses.—Horses, ʒii. to ʒvii., according to size and requirements; cattle, ℥i. to ℥ii.; dogs, grs. xv. to grs. xxx.

Preparation.

Aloin—a crystalline substance extracted from aloes.

Doses.—Horses, ʒi. to ʒii.; dogs, grs. iii. to grs. x.

Actions.—Aloes acts upon the stomach and intestines as a *bitter* and *purgative.* The former effect resembles that of *calumba* and other bitters (see p. 452).

The purgative action of aloes demands special attention, as it is the drug chiefly employed as a cathartic for the horse. It increases both the peristaltic movements and intestinal secretions, acts chiefly on the large intestines, and is a stimulant of the biliary flow.

The action of aloes as a purgative is very slow, especially if the intestinal contents are not previously in a soft condition. The ordinary dose in an animal not prepared generally takes sixteen to twenty-four hours to operate. If the animal be properly prepared, purgation may be produced in about twelve hours.

In some rare instances aloes produces diuresis instead of purgation. It is believed to stimulate the pelvic circulation generally as *well as that of the rectum.*

Aloes is absorbed and enters the circulation, and is excreted chiefly by the intestinal glandular apparatus.

In *ruminants* the action of aloes is often uncertain, and large doses have been administered without producing purgation. This peculiarity is believed to depend on the fact that the chief action of aloes is exerted on the large intestines, which are not developed to the same extent in ruminants as in horses.

In *dogs*, aloes is slow and uncertain when administered alone. Large doses are often tolerated as compared with those suitable for man.

Medicinal Uses.—Aloes is the *purgative in general use for horses*. It is by no means an ideal purgative, as the length of time which it takes to act, and the nausea induced by the drug, are great drawbacks. However, in our present state of knowledge we are unable to suggest a more reliable or safer purgative agent, but it seems highly probable that in the future a combination of purgatives will be discovered which will act in a shorter space of time and with less nausea than aloes given alone.

Aloes is best given in the form of a properly prepared bolus, care being taken in its preparation not to apply too high a temperature in melting the ingredients. It is made up in the form of a mass containing a small amount of some volatile oil to prevent hardening and drying; from this the required quantity is made into balls. It is advisable to combine two drachms of ginger and half a drachm of the extract of hyoscyamus or belladonna with the physic ball so as to avoid the tendency to griping. Few veterinary surgeons now go to the trouble of preparing their own aloetic masses, as there are reliable wholesale chemists who make up the required formula in a satisfactory manner, and send out the physic balls neatly covered with gelatine.

Before a purgative ball is administered it is necessary to have the horse properly prepared, and to have precautions taken as to after-treatment, as stated at p. 93, under the heading of purgatives; above all things, cold water should be prohibited, and when the physic has commenced to act, perfect rest in the stall is imperatively necessary, and any green foods, roots, etc., should be rigidly interdicted.

In cases where full purgative effects are required, it is of advantage to combine calomel with the aloes in the proportion of half a drachm of the former with four drachms of the latter; this is especially recommended in cases where it is difficult to produce purgation with the ordinary dose of aloes.

Too large a dose of aloes, or neglect of the necessary precautions already mentioned, may induce a condition of *superpurgation*, and in some instances great constitutional disturbance occurs, with congestion of the intestinal mucous membrane and death from exhaustion, laminitis sometimes occurring as a complication.

In some cases even a moderate dose of aloes will induce superpurgation and serious symptoms, in spite of all necessary precautions, these effects probably depending on individual idiosyncrasies to the drug. We often observe that purgation continues for a longer period than usual, but if no constitutional disturbance be present, and if the pulse is regular, no danger is to be apprehended. But if the pulse becomes frequent and feeble, and the purging constant, with symptoms of uneasiness, with or without distension of the abdomen, then steps must be taken immediately to overcome the injurious effects of the purgative.

In cases where death occurred after the excessive action of aloes, Professor Williams gives the following *post-mortem* appearances: 'Congestion of the intestinal mucous membrane generally, concentrated in many cases in that of the cæcum caput coli; a thick tarry appearance of the blood, and extreme blackness, congestion, or apoplexy of the lungs, the blood being, as it were, deprived of its watery elements, altered in its composition, rendered too viscid to circulate through the pulmonary capillaries, and so altered chemically as to render it unfit for perfect oxidation' ('Principles and Practice of Veterinary Medicine').

In the treatment of superpurgation due to the effects of aloes, great discrimination is necessary to avoid checking the action of the intestines suddenly, as congestion of the mucous membrane may be induced.

If the horse, although purging freely, appears moderately lively, and the countenance natural, without any marked change in the pulse, then he should be allowed well-boiled thin flour-gruel, and be warmly clothed, and cold fluids of all kinds avoided. If the purging still continues, it should be *gradually* overcome, and Professor Williams recommends two ounces each of tr. opii and creta preparata in a quart of flour-gruel every three or four hours until the purging is checked. We have found this treatment of great value in such cases.

If prostration be present stimulants should be given, the best in our experience being brandy and port wine, three wineglassfuls of each being combined with the flour-gruel.

It becomes a matter of very great importance to the veterinary surgeon if serious or fatal results occur after he has prescribed the usual dose of aloes for a horse. He should be especially careful to ascertain that the animal has been properly prepared, and that the intestines are in a fit state, before administering the purgative. He should also give clear instructions to the groom or attendant with reference to the care of the animal, as many cases of ill effects after aloes are due to neglect of the ordinary precautions, and the veterinary surgeon's reputation suffers in consequence.

In prescribing aloes, we must remember that a proper dose is necessary, as an insufficient amount is apt to be longer retained in the system, producing irregular effects and an excessive degree of nausea. If the dose does not take effect in twenty-four hours, moderate walking exercise should be ordered; but when it commences to act, the horse should be kept at rest, and not worked until the physic has 'set.'

In cases where the ordinary dose of aloes fails to act, it is not safe to administer another until forty eight hours have elapsed. If immediate effects are necessary, we prefer to depend on the use of raw linseed oil, and the administration of enemata by means of the long rectum tube.

Aloes is recommended by many practitioners in the treatment of *spasmodic colic* depending on the presence of irritating ingesta in the alimentary canal.

The difficulty of arriving at a correct diagnosis in cases of abdominal pain, however, makes us hesitate before prescribing a drug which, if the case happens to be the commencement of a more serious condition, will destroy the chances of a successful termination, and tend to a fatal result.

We have to consider, too, the time which aloes will take to act in an animal without any preparation, and hence the safer and more rational treatment is to relieve the pain by the administration of an anodyne, and to combine with it a suitable dose of raw linseed oil; by this means, no matter what the result of the case happens to be, no possible injury will be inflicted by treatment. If we were enabled to accurately diagnose the *cause* of abdominal pain to be the presence of irritating ingesta, then indeed the administration of the purgative ball would be rational treatment; but clinical experience and post-mòrtem examinations teach us that, although the primary symptoms may point to a simple case of spasmodic colic, they may in reality be the precursors of a serious condition in which strong purgatives are entirely contra-indicated.

In cases of *impaction of the colon* in the horse, Professor Williams recommends an enema composed of 2 ounces of aloes dissolved in a pint of hot water, and administered at a temperature of 90° Fahr. with the long rectum tube.

Contra-Indications.—Aloes is *contra-indicated* in irritable or inflammatory conditions of the alimentary canal, also in respiratory affections, in *influenza*, and all debilitated conditions of the system.

In *laminitis* only a moderate dose should be given, as too large an amount is likely to increase the already inflamed condition of the laminæ.

If a horse exhibits the slightest sign of a catarrhal affection or of a cough, aloes should not be prescribed, as it may induce superpurgation, or may weaken the system and so render the animal in a condition less able to withstand the effects of any respiratory disease which may follow.

Aloes is occasionally prescribed as a *bitter tonic*, and is given in small doses, combined with other bitters and aromatics, or with a mineral tonic, such as sulphate of iron.

In cattle practice, aloes is sometimes prescribed along with other purgatives, usually in the form of a solution. We have observed favourable results in some cases from its employment, where the ordinary purgatives did not appear to produce any effect.

In canine practice, aloes is not prescribed alone; it enters into the composition of the compound colocynth and hyoscyamus pill, which is an effectual purgative for the dog.

Socotrine and Cape Aloes are varieties not employed in veterinary practice.

Aloin, in doses of two drachms, has been found to act as a reliable purgative in horses by some practitioners, causing less dulness, nausea, and griping than aloes. Others have not recorded such satisfactory results from its use.

Senna.

The dried leaflets of various species of Cassia; is not employed in veterinary practice. It acts as a purgative by stimulating the muscular coat of the intestine, probably by reflex action from the mucous surface of the bowel, the colon being chiefly acted on.

Rhei Radix—Rhubarb Root.

The dried root of Rheum palmatum and other species. Contains 3 to 4 per cent. of *cathartic acid*, the purgative constituent of senna; also *rheo-tannic acid*, possessing astringency, and a bitter colouring matter, *chrysophan*.

Actions and Uses.—In small doses rhubarb, given to dogs, is a *bitter stomachic and intestinal astringent*. In larger doses it causes purgation by stimulating the intestinal movements and the liver; the cathartic acid at first exerting its influence; afterwards an astringent effect is produced. According to Moiroud, even in large amounts rhubarb has no purgative effect on horses or cattle. As a purgative and cholagogue for the dog, it may be given in doses of grs. xv. to grs. xxx., combined with either calomel or jalap.

In cases of obstinate diarrhœa in foals and calves, 2 drachms each of rhubarb and carbonate of magnesia, with 10 to 20 grains of opium, given twice a day in well-boiled wheat-flour gruel, often give favourable results, acting as stomachics and astringents.

Oleum Ricini—Castor Oil.

The oil expressed from the seeds of Ricinus communis. The bulk consists of *ricinoleate of glyceryl.*

Doses.—Cattle, O.i.; sheep and pigs, ℥ii. to ℥iv.; dogs, ʒss. to ʒii.; foals, ℥i. to ℥ii.

Actions and Uses.—*Externally*, pure castor oil is bland in its nature, resembling almond oil. It acts as a local sedative and protective, and is often applied to the conjunctiva to lessen irritation after the removal of foreign bodies from the eye, or after injuries by caustic substances to the cornea or conjunctiva.

Internally, pure castor oil is a *simple purgative*, mild and painless in its effects. It is believed to act by stimulating the muscular coat and intestinal glands, but not the liver. It produces no effect on the stomach, but if gastric irritation be present, or if the oil is not pure, it will cause nausea and vomiting in dogs. On reaching the duodenum, castor oil is decomposed by the pancreatic juice, and the ricinoleic acid commences to act. It causes purgation also when administered as an enema.

For the horse, castor oil is an uncertain purgative, producing much nausea, and cases are recorded where full doses caused serious symptoms of superpurgation. For foals, however, it often acts very effectually, and is prescribed in cases of retention of the meconium; it may also be administered in the form of enema with advantage in such cases. It should be combined with a dose of sweet spirits of nitre, and a carminative, such as oil of peppermint. In cases of *diarrhœa* due to the presence of *irritating ingesta*, both in foals and calves, a dose of castor oil should be the first step in treatment.

In cattle, it is an effectual purgative, the chief drawback to its employment being the loss of appetite, and degree of nausea induced. It is of advantage to combine castor oil and raw linseed oil in cases of arrested action of the bowels in cattle, enemas of the same being also of service.

In dogs, castor oil is indicated in cases of obstinate constipation and in intestinal obstruction, being given in the form of enema as well as by the mouth. It is of advantage to combine half doses of olive oil and castor oil, and to administer the enemas by means of a long gum-elastic rectum tube. Unfortunately, in cases of this nature the stomach is usually in a very irritable condition, and any oily substances given by the mouth are quickly expelled by vomiting. It is necessary to prepare a special mixture of castor oil in such cases, the B.P. mistura olei ricini, as follows, often acting well:

Castor oil, 6 drachms; oil of lemon, 10 minims; oil of cloves, 2 minims; syrup, $1\frac{1}{2}$ drachms; solution of potash, 1 drachm; orange-flower water, to produce 2 ounces.

The dose is from $\frac{1}{2}$ to 2 ounces, repeated at intervals until effects are produced.

The addition of a small dose of sweet spirit of nitre also renders castor oil more palatable. It is of importance to prescribe only the refined and pure castor oil, in order to avoid irritating and nauseating effects.

Oleum Lini—Raw Linseed Oil.

The oil expressed in Britain without heat from linseed —Linum usitatissimum, flax. In prescribing it is important to remember that *boiled* linseed oil is used in the arts as a drying oil, and for certain purposes litharge is added during the boiling, so that the boiled oil may contain lead and exert toxic effects. The raw linseed oil should be procured as fresh as possible.

Doses.—Horses, O.i. to O.i.ss; cattle, O.i.ss. to O.ii.; sheep and pigs, ℥iv. to ℥vi.; dogs, ℥i. to ℥ii.

Actions and Uses.—In full doses linseed oil acts as a *mild purgative.* It is devoid of irritating effects, and is extensively employed in cases where active purgatives, such as aloes, are contra-indicated.

In the form of enema it is an agent of great value in all animals, and should be administered by means of the long rectum tube in cases of intestinal obstruction depending on impaction of the colon; by this method we have observed the most satisfactory results.

One drawback to the use of linseed oil is the nauseating effects which it is apt to produce, and interference with appetite. For this reason we should avoid the administration of large amounts by the mouth, and adopt the method by enema, the long rectum tube enabling us to propel the oil into the colon.

In *cattle practice*, linseed oil is of great service in a large variety of cases. By softening the gastric contents it often produces beneficial effects when purgatives such as sulphate of magnesia fail.

In *impaction of the omasum* and *inflammation of the abomasum,* conditions frequently associated, large doses of linseed oil, combined with belladonna and glycerine, forms the most reliable treatment, as the exhibition of strong purgatives seldom gives relief, but tends to increase the existing condition.

In *hæmo-albuminura* or *red water*, linseed oil is indicated, if the saline purgative usually administered at the commencement of the affection fails to move the bowels. Linseed oil is also a convenient menstruum for the administration of irritant substances, such as oil of turpentine or croton oil. It is also a useful agent as a *demulcent* in cases of irritant poisoning.

In dogs, linseed oil is apt to cause nausea and vomiting. Linseed oil is administered to horses in a bran-mash as a *digestible nutrient*, in amounts of one or two wineglassfuls; some take it with avidity, others refuse it. It is very useful in cases where the bowels are inclined to be constipated, and the animal is in an unthrifty condition. In cases of *broken wind* it is prescribed with limewater, and is useful as a palliative remedy.

Externally linseed oil forms an effectual basis for liniments for *mange* in horses. Mixed with equal parts of limewater it forms *carron oil*, which is a valuable application to burns and scalds.

Cascara Sagrada.

The dried bark of Rhamnus purshiana.

Preparations.

Extractum Cascaræ Sagradæ—Alcoholic and aqueous.
Dose.—Dogs, grs. ii. to grs. x.

Extractum Cascaræ Sagradæ Liquidum—1 in 1.
Dose.—Dogs, ʒss. to ʒii.

Actions and Uses.—Cascara sagrada in small doses acts as a *tonic* and *stomachic.* In large doses it is an *aperient*, and if freely given to dogs is *cathartic*. It is useful in *chronic constipation* in dogs, and may be given in a single full dose, or in divided doses of ten to twenty minims three times a day.

Syrupus Rhamni—Syrup of Buckthorn.

Prepared from the recently expressed juice of Rhamnus catharticus, common buckthorn.

Dose.—Dogs, ℥i. to ℥ii.

Actions and Uses.—Syrup of buckthorn acts as a *mild cathartic* to dogs, and is employed as an adjuvant to purgative mixtures. It is also used to disguise the taste of bitter or nauseous drugs in mixtures.

Taraxacum.

Obtained from the root of Taraxacum officinale, dandelion root; is a *simple bitter*, and a *mild laxative* in the case of dogs. At one time it was believed to act as a cholagogue, but according to Dr. Rutherford, it is a very feeble stimulant of the liver.

It may be given to dogs in doses of ♏xv. to ʒii. of the liquid extract.

Euonymin.

Obtained from the root bark of Euonymus atropurpureus.

Actions and Uses.—Euonymin is a *hepatic stimulant*, a *direct cholagogue*, and a mild cathartic. It has been administered to the dog in doses of grs. ii. to grs. iv. of the dry extract in cases of hepatic derangements and jaundice, and seems likely to be a useful agent.

The dose of the tinctura euonymi is from ♏x. to ♏xl. for similar cases.

CHAPTER XV.

THE VEGETABLE KINGDOM—*Continued.*

Filix Mas—Male Fern.

The rhizome, with the persistent bases of the petioles, of Aspidium filix mas.

Preparation.

Extractum Filicis Liquidum—'Oil of Male Fern.'

Doses.—Horses and cattle, ℥ii. to ℥vi.; dogs, ♏x. to ♏xxx. Administered in milk or in emulsion.

Actions and Uses.—Male fern is an *active anthelmintic*, being especially destructive to the *tapeworm.*

In large doses it acts as an irritant, and may cause gastro-enteritis in dogs. It may be given to the horse in combination with half a dose of ol. terebinthinæ in raw linseed oil. For the dog it may be combined with areca-nut, and given dissolved in milk.

It is of advantage to administer a purgative afterwards in order to assist in the removal of the parasites.

Santoninum—Santonin.

A neutral crystalline principle obtained from the dried unexpanded flower-heads of Artemisia maritima, worm-seed.

Doses.—Horses, ʒss. to ʒi.; dogs, grs. ii. to grs. v.; given with an oleaginous purgative.

Actions and Uses.—Santonin is an effectual *vermicide*, particularly destructive to *round and thread worms*, but having little effect on the tapeworm. It is absorbed into the blood as sodium santonate, and in full doses may cause disturbance of consciousness in dogs, with giddiness, vomiting, and convulsions, and great constitutional disturbance. These effects should be carefully avoided by regulating the dose according to the size of the animal. Santonin is excreted by the kidneys as an obscure product of its oxidation in the system, and causes slight diuresis. It colours acid urine greenish-yellow, and alkaline urine red or purple.

Areca.

The seed of Areca catechu, the betel-nut tree.

Doses.—Dogs, grs. xv. to ʒii.; given shaken up with milk.

Action and Uses.—Areca-nut is an *astringent* and *vermicide*, acting chiefly on the *tapeworm.*

Previous to its administration a purgative should be administered so as to clear out the intestines; the drug should then be given to the dog after a few hours' fasting, and is best administered in milk, a second purgative being afterwards necessary to cause expulsion of the parasite. In treating the dog for tapeworm, it is of advantage to combine areca-nut with the extract of male fern.

A variety of anthelmintics are, in addition to those mentioned, employed in human medicine, but are seldom prescribed in veterinary medicine. Among these we may mention **kousso, kamala, spigelia, pomegranate root bark,** etc.

CHAPTER XVI.

THE VEGETABLE KINGDOM—*Continued.*

Acidum Tannicum—Tannic Acid, Tannin.

An acid extracted from galls. Galls are excrescences on Quercus lusitanica, a shrubby species of oak, caused by the puncture and deposit of ova of Cynips gallæ tinctoria.

Doses.—Horses, ʒss. to ʒii.; dogs, grs. ii. to grs. x.

Incompatibles.—Gelatine, mineral acids, alkalies, persalts of iron.

Preparation.

Glycerinum Acidi Tannici—1 to 4, with the aid of heat.

Acidum Gallicum—Gallic Acid.

Prepared by boiling 1 part of powdered galls with 4 parts of dilute sulphuric acid for half an hour, straining and purifying.

Doses.—Same as those of tannic acid.

Incompatibles.—Spirit of nitrous ether, metallic salts, including persalts of iron.

Tannic acid is the glucoside to which oak bark, galls, logwood, and many vegetable astringents owe their properties.

Actions.—Taunic and gallic acids differ only in the degree of their action, but gallic acid has no astringent taste, does not precipitate solutions of gelatine, and hence possesses no local astringent properties. The action of tannic acid and of the many substances containing it depends chiefly upon its property of precipitating albumin and gelatine.

Applied to the broken skin or to exposed mucous surfaces, it condenses the albuminous and connective tissues, coagulates the fluids, reduces the sensibility of the nerves, and compresses the vessels by constringing the connective tissues, thus diminishing the circulation through them. It also coagulates blood if applied in a concentrated form.

Tannic acid thus acts as a powerful *indirect styptic* and *constringent.* It does not cause active contraction of the vessels like lead and other agents, but dilates them, and by an indirect constringent influence this effect is then more than neutralized.

In the *mouth* tannic acid causes dryness of the tongue and throat, with thirst, the parts being constringed and partially anæsthetized.

In the *stomach* tannic acid precipitates the pepsin and the albumins of the gastric juice, in full doses it constringes the mucous membrane, reduces the circulation, and diminishes the secretion.

In the *intestines* the astringent effect of tannin is continued, hence its employment, or that of substances containing it, in cases of diarrhœa, etc.

During its passage along the alimentary canal portion of the tannin is converted into gallic acid, which enters the blood, the remainder being excreted in the fæces. Tannin enters the blood as gallic acid, but we have no definite knowledge as to any further astringent effect on the vessels or coagulating influence on the blood. If injected directly into the veins tannic acid causes clotting and embolism, followed by death.

The specific action on the tissues is believed to depend altogether on gallic acid, the effects being *astringent* and *styptic.*

Tannic and gallic acids are excreted chiefly as the latter, partly as pyrogallic acid, in the urine, which it darkens in colour. Some authorities believe that these agents have the power of arresting renal hæmorrhage, but this action is doubtful.

Medicinal Uses.—In relaxed conditions of the pharynx and throat, tannic acid is applied locally in the form of glycerinum acidi tannici, and gives favourable results.

In *hæmorrhage* from the stomach, full doses of the acid act as direct styptics.

In *diarrhœa, dysentery*, tannin or its compounds are frequently prescribed, the latter being preferred, such as catechu or kino, and may be combined with antacids and opium.

As an antidote to antimony and alkaloids, such as morphine, strychnine, etc., tannic acid is employed, as it forms insoluble compounds, a purgative being afterwards given, and an emetic in the case of dogs.

Externally tannic acid, combined with glycerine and water, is recommended in the weeping stages of eczema. It is also employed as an application to ulcerated surfaces, as it condenses the superficial layer of cells, coagulates the discharge, and is believed to possess a disinfectant action besides.

Gallic acid, in the form of the unguentum gallæ cum opio, is employed in the treatment of hæmorrhoids.

Pyrogallic Acid.

A body obtained from gallic or tannic acid by carefully heating; possesses a powerful affinity for oxygen, and thus acts as an *antiseptic* and *disinfectant* in 1 to $2\frac{1}{2}$ per cent. solutions. It also acts as a caustic and local stimulant. It has been recommended in cases of psoriasis, and also in the removal of malignant growths.

In toxic doses it causes vomiting, purging, and general nervous depression in dogs, and possesses a destructive influence on the red corpuscles of the blood, which becomes of a brownish appearance and readily coagulates.

Catechu—Catechu.

An extract of the leaves and young shoots of Uncaria gambier.

Doses.—Horses, ʒi. to ʒiii.; cattle, ʒii. to ʒvi.; sheep and pigs, ʒss. to ʒi.; dogs, grs. v. to grs. xx.

Incompatibles.—The alkalies, metallic salts, and gelatine.

Actions and Uses.—Catechu resembles tannic acid in its actions. It is employed as an *astringent* in cases of persistent *diarrhœa and dysentery* in all patients, and may be combined with opium, chalk, and ginger, and repeated at intervals if necessary, it is best administered in well-boiled flour gruel.

Kino—Kino.

A juice obtained from the trunk of Pterocarpus marsupium; closely resembles catechu in its actions, and may be employed for similar purposes, and in the same doses.

In the form of the pulvis kino compositus—Kino, 15; opium, 1; cinnamon, 4—it is a useful agent for obstinate diarrhœa in dogs, and may be prescribed in doses of grs. v. to grs. xx.

Hæmatoxyli Lignum—Logwood.

The sliced heart-wood of Hæmatoxylon campechianum.

Preparation.

Decoctum Hæmatoxyli—1 in 20 with $\frac{1}{8}$ of cinnamon.

Doses.—Horses, ℥viii. to ℥x.; cattle, ℥x. to ℥xv.; dogs, ʒss. to ℥i.ss.

Actions and Uses.—Hæmatoxylon possesses the astringent action of tannic acid, and may be employed in the same class of cases. It forms a most effectual astringent in some cases of *obstinate diarrhœa* in cattle, often succeeding when other agents have failed. It is frequently used as an empirical remedy in the treatment of 'red water' in cattle, some stock-owners attributing remarkable success to its employment.

Hamamelidis Cortex—Hamamelis Bark.

The dried bark of Hamamelis virginica, the witch hazel.

Hamamelidis Folia.

The dried leaves of Hamamelis virginica.

Preparations of Hamamelis Bark.

Tinctura Hamamelidis—1 in 10 of proof spirit.

Doses.—Horses and cattle, ℥ss. to ℥ii.; dogs, ♏v. to ʒi.

Extractum Hamamelidis Liquidum—Hazeline—1 in 1.

Doses.—Horses and cattle, ʒss. to ʒii.; dogs, ♏v. to ♏x.

Actions and Uses.—Hamamelis is *astringent* and *hæmostatic* both locally and remotely. It is prescribed internally in cases of passive hæmorrhage, such as epistaxis, hæmoptysis, hæmatemesis. It is also recommended in the treatment of diarrhœa, dysentery, etc., and in diseases dependent upon an unhealthy condition of the mucous membrane of the vagina, intestinal canal, bladder, and urethra; but clinical experience with the drug has not yet been sufficient to justify these claims.

Externally, it forms a useful non-irritating *styptic.*

Ipecacuanha—Ipecacuanha.

The dried root of Cephaëlis ipecacuanha. Contains from $\frac{1}{4}$ to 1 per cent. of *emetene*, which is its active principle.

Doses.—Horses, ʒi. to ʒi.ss.; dogs, gr. ss. to grs. ii.

As an *emetic* for dogs, grs. x. to grs. xxx.

Preparations.

Pulvis Ipecacuanhæ Compositus—'Dover's Powder'—ipecacuanha, 1; opium, 1; sulphate of potassium, 8—(1 in 10).

Doses.—Horses, ʒi. to ʒiii.; dogs, grs. v. to grs. xv.

Vinum Ipecacuanhæ—An acetic extract, dried, powdered, dissolved in sherry, and filtered (1 in 20).

Dose.—Dogs, as an *expectorant*, ♏v. to ♏xxx. As an *emetic*, ʒiii. to ʒvi.

Actions and Uses.—*Externally*, ipecacuanha acts as an irritant to the skin and exposed mucous membranes.

Internally.—In the stomach in small doses it is a *gastric stimulant*, increasing local circulation and secretion.

In the dog, ipecacuanha in doses of 15 to 30 grains acts as an *emetic*, both by its local effect on the stomach as well as by its action on the vomiting centre in the medulla; it is thus both a *direct* and an *indirect emetic*.

In the intestines ipecacuanha also exerts stimulating effects, and increases the flow of mucus; in large doses it may act as an irritant.

In cases of *dysentery* it has the power of arresting the inflammatory action in the intestine, and checking the liquid and blood-stained evacuations, and for such purposes is given in large doses frequently repeated.

Ipecacuanha is excreted by the various mucous membranes, including those of the bronchi, the stomach, the intestines, also by the liver. On the bronchi it causes increased secretion and stimulates the nerves, thus acting as an *expectorant*. It has a remote action on the liver, and acts as a *direct cholagogue*. We do not observe any diaphoretic effect in our patients from the employment of ipecacuanha, such as is described as occurring in man.

The chief purpose for which ipecacuanha is used in veterinary practice is as an *expectorant*, in the dry stages of *bronchitis*. It is prescribed in combination with liq. ammon. acet., and frequently repeated, and is believed to promote secretion of bronchial mucus. It may also be employed with benefit in the form of 'Dover's Powder,' and this preparation has been recommended in cases of *dysentery* in all patients.

Buchu Folia—Buchu Leaves.

The dried leaves of Barosma betulina and other species.

Preparations.

Infusum Buchu—1 in 20.

Doses.—Horses, ℥viii. to ℥x.; dogs, ℥i. to ℥ii.

Tinctura Buchu—1 in 8 of proof spirit.

Doses.—℥ii. to ℥iii.; dogs, ʒi. to ʒii.

Actions and Uses.—Buchu is a mild *tonic* and *diuretic*, and exerts *astringent* effects on the bladder and urino-genital mucous membrane. Its chief use is in cases of *irritation of the bladder* and urethra, also in *cystitis*, and in inflammatory affections of the pelvis of the kidney. It relieves pain, reduces irritability, and promotes healing and cessation of the muco-purulent discharge. It may be combined with hyoscyamus and bicarbonate of potassium, or mixed with linseed-tea or barley-water.

Pareira, Uva Ursi, and **Collinsonia Canadensis** are agents possessing similar actions and uses to buchu.

CHAPTER XVII.

THE VEGETABLE KINGDOM—*Continued.*

Cinchona.

Obtained from the bark of different species of Cinchona. Cinchona bark contains *four alkaloids:* (1) *Quinine;* (2) *cinchonine;* (3) *quinidine;* (4) *cinchonidine.* The yellow cinchona bark usually contains the largest amount of quinine, of which it should yield 2·5 to 3·8 per cent. The *astringent* principle of cinchona depends on cinchotannic acid; this turns *green* with persalts of iron.

Incompatibles.—Ammonia, limewater, metallic salts, gelatine.

Doses.—Horses, ʒii. to ʒiv.; cattle, ℥i. to ℥ii.; dogs, grs. x. to grs. xv.

Preparations.

Tinctura Cinchonæ—1 in 5 of proof spirit.

Doses.—Horses, ℥i. to ℥ii.; dogs, ʒss. to ʒi.

Tinctura Cinchonæ Composita—Red cinchona bark, 2 ounces; bitter orange-peel, 1 ounce; serpentary, ½ ounce; saffron, 55 grains; proof spirit, 1 pint

Doses.—Similar to those of tr. cinchona.

Quininæ Sulphas—SULPHATE OF QUININE.

Prepared from the powder of various kinds of cinchona bark, with subsequent neutralization of the alkaloid by sulphuric acid. Soluble in 700 or 800 parts of cold water, but readily dissolved in water by the addition of a small amount of dilute sulphuric acid (one minim will dissolve each grain).

Incompatibles.—Alkalies and their carbonates, astringent infusions, and substances containing tannin.

Doses.—*As a tonic:* horses, grs. xx. to ʒi.; dogs, gr. i. to grs. v.; *as an antiperiodic and antipyretic:* horses, ʒii. to ʒiv.; dogs, grs. v. to grs. xx.

Quininæ Hydrochloras—HYDROCHLORATE OF QUININE.

Prepared in a similar manner to sulphate of quinine, hydrochloric acid being substituted for sulphuric. This salt is more soluble than the sulphate.

Preparation.

Tinctura Quininæ—1 grain in 1 fluid drachm of tincture of orange.

Doses.—Horses, ℥i. to ℥ii.; dogs, ʒss. to ʒii.

ACTIONS OF CINCHONA AND QUININE.

The actions and uses of cinchona resemble those of their most important active principle, quinine, so that we shall describe them together.

(1) IMMEDIATE LOCAL ACTION.

Externally quinine and its salts possess *antiseptic* and *disinfectant* properties, and are capable of arresting some forms of fermentation and decomposition.

Internally.—In the mouth, stomach, and intestines, quinine acts as a powerful bitter, in a similar manner to that described under calumba (p. 452). The *stomachic* effect is obtained from small doses, and is distinct from the *specific* effect to be presently described.

In small doses it improves appetite and digestion, stimulates the heart and circulation, and its continued use produces *general tonic effects.* In large doses quinine tends to interfere with digestion.

In the stomach quinine and its salts are converted into the chloride, which is soluble and diffusible, and readily enters the blood.

(2) ACTION IN THE BLOOD.

Quinine is found in the blood very shortly after its administration, and exerts several important effects therein when given in full doses.

1. It causes enlargement of the individual red corpuscles.

2. It binds the oxygen more firmly to the hæmoglobin, so that oxygenation is less active.

3. It diminishes the number, contractility, and movements of the white corpuscles, and thus checks diapedesis.

If blood be freshly drawn from the vessels it is ascertained that—

4. Quinine retards the formation of acid, which naturally occurs in blood removed from the vessels.

5. It reduces the ozonizing power of blood, *e.g.*, on guaiacum and turpentine.

The total effects produced on the blood are:

(*a*) *Interference with oxygenation* by lessening the amount of oxygen given up by the red corpuscles to oxidizable bodies.

(*b*) Interference with the functions of the white corpuscles.

(3) SPECIFIC ACTION.

Quinine quickly enters the tissues without decomposition, but is not completely excreted for a long period, especially in febrile conditions of the system. The maximum effect of full doses is produced in about five hours, so that if the specific effect is desired, it is necessary to administer a single large dose, and to follow it up with smaller doses, as small amounts given over a length of time do not sufficiently accumulate.

We do not observe the nervous phenomena in our patients which are produced in man by a full dose of quinine. Certain important specific effects, however, occur, to which we shall briefly refer:

1. Quinine in the healthy subject *lowers the body temperature* only very moderately, but in a high febrile condition the lowering of temperature is very marked.

2. Quinine *reduces the amount of nitrogenous excretions*, *i.e.*, the urea and uric acid.

The amount of carbonic acid is also believed to be reduced in amount, both in health and in febrile cases.

3. Quinine, therefore, *reduces the metabolism* of the body in a marked degree, and experiments have demonstrated that it possesses some influence over living cellular protoplasm, which renders the latter less liable to incorporate oxygen, and more resistant of metabolic change.

It is rational, then, to conclude that the effect of quinine in the system is to check metabolism by interfering with the oxidation of protoplasm generally; it also interferes with oxygenation and with the associated action of ferments.

In febrile cases the fall of temperature produced by quinine is due to *diminished production of heat*, and not to increased loss of heat. This effect is produced through the tissues, and not through the heat-regulating centre.

It is probable that the fermentative processes produced by certain organisms, which may be the cause of fevers, are controlled by quinine, this being another factor in its power of reducing abnormal temperature.

In small doses quinine accelerates the heart and raises blood-pressure, but in full doses it diminishes the force and frequency of systole, strengthens diastole, and lowers blood-pressure; these effects depend on a direct action on the cardiac ganglia and muscle, also on the vessel-walls and vaso-motor centre.

In dogs, toxic doses cause death by respiratory and cardiac failure.

(4) REMOTE LOCAL ACTION.

Quinine is chiefly excreted in the urine as the amorphous alkaloid, and acts as a slight diuretic. It is also believed to be removed by the skin, and to diminish perspiration.

Medicinal Uses.—*As a bitter stomachic and tonic*, quinine is prescribed extensively in cases of *atonic indigestion* in horses, and is of great benefit given in doses of 20 to 30 grains, combined with small amounts of dilute hydrochloric acid and tincture of nux vomica.

In *convalescence* from debilitating diseases, quinine is combined with a non-irritating preparation of iron, such as the liq. ferri dialysatus, the combination improving appetite, and acting as a general tonic to the system.

In canine distemper it is a very valuable agent, and should be prescribed in small doses, frequently repeated, its effect on micro-organisms probably accounting for its beneficial action in this affection.

As an antipyretic it is one of the most useful agents which we possess. In cases of influenza, acute pneumonia, and acute rheumatism, quinine is invaluable when the temperature ranges high. It should be given in a dose of half an ounce at first, and followed at intervals of two hours with doses of two drachms, until the temperature falls.

If much debility be present, it is of advantage to administer stimulants at the same time, so as to overcome any depressing effects which might be produced by the drug. When the temperature is reduced, quinine may be continued in small doses with benefit.

In such cases we believe that, in addition to its power of reducing excessive temperature, quinine produces valuable results by its action as an *internal antiseptic*, and by its influence on micro-organisms.

It has been employed with success by Veterinary Captain Burke, A.V.D., in cases of malarial and other fevers affecting horses and cattle in India (*Veterinarian*, October, 1877).

Cinchonine and other alkaloids and products of cinchona may be employed as substitutes for quinine, their actions being similar.

Cinchonine is $\frac{1}{3}$ to $\frac{1}{2}$ as powerful as quinine.

Cinchona bark contains only a small percentage of alkaloids, and hence is a bulky agent to administer. It contains a quantity of tannin, and may be prescribed in combination with iron in cases of relaxed conditions of the bowels, as a *bitter stomachic* and *tonic astringent.*

In canine practice for similar purposes the compound tincture may be employed.

Acidum Salicylicum—Salicylic Acid.

Prepared by passing carbonic acid into a mixture of carbolic acid and caustic soda at a high temperature, and decomposing the salicylate of sodium with an acid and subsequent purification. Or prepared *naturally* from natural salicylates, such as the oils of winter-green, sweet birch, etc. Salicylic acid is very insoluble in water, readily in alcohol and in ammonium acetate.

Incompatibles.—Spirit of nitrous ether, iron salts.

Doses.—Horses and cattle, ʒii. to ʒiv.; sheep, ʒss. to ʒi.; dogs, grs. iii. to grs. xv.

Preparation.

Sodii Salicylas—Salicylate of Sodium.

Prepared by the action of salicylic acid on carbonate of sodium or on caustic soda. Readily soluble in water, but slightly in alcohol.

Doses.—Horses and cattle, ʒii. to ℥i.; sheep, ʒss. to ʒi.; dogs, grs. x. to grs. xxx.

Salicin.

A glucoside obtained from the bark of Salix alba, and other species of Salix and of Populus.

Doses.—Horses, ʒi. to ʒiii.; dogs, grs. iii. to grs. xv.

ACTIONS OF SALICYLIC ACID AND SALICYLATE OF SODIUM.

(1) IMMEDIATE LOCAL ACTION.

Externally, salicylic acid is an *antiseptic* and *disinfectant*, scarcely inferior to carbolic acid, 1 part in 60 destroying developed bacteria. It also stimulates the local circulation.

Salicylate of sodium has no antiseptic or disinfectant power unless combined with a mineral acid to liberate the salicylic acid.

Internally.—In the stomach salicylic acid, unless in a moderate dose, well diluted, acts as a local irritant, causing nausea and vomiting in the dog.

The sodium salt is far less irritant, and is preferred in canine practice.

(2) ACTION IN THE BLOOD.

Salicylic acid is rapidly absorbed, and exists in the blood as the salicylate of sodium. It is believed that the acid is again liberated, but positive evidence on this point, and also on the changes which the drug undergoes in the blood, is wanting.

(3) SPECIFIC ACTION.

The action of salicylic acid and its sodium salt on the tissues is identical, as the former is converted into the latter. Full doses cause in dogs nausea and vomiting, disturbed respiration, depression of the heart after primary excitation, relaxation of the vessels, and lowering of blood-pressure. According to Dr. Rutherford, salicylate of sodium is a powerful liver stimulant, but a very slight stimulant of the intestinal glands. Moderate doses act as cardiac stimulants, and increase the cutaneous circulation; the temperature may be slightly lowered, although nitrogenous waste is said to be increased.

Horses withstand the effects of large doses of salicylic acid to a remarkable extent, the only symptoms recorded being slight dyspepsia due to irritation of the alimentary mucous membrane.

Dogs are more susceptible, and toxic doses of 75 grains, administered hypodermically, are reported to have produced dyspnœa, vomiting, weakness of hind-quarters, and convulsions followed by fatal paralysis.

The most important action of salicylates is the power which they possess of *reducing high temperature* in febrile cases. This effect is believed to depend on some influence which they exert on the pathological cause of pyrexia, probably by acting on micro-organisms in a manner not yet understood.

(4) REMOTE LOCAL ACTION.

Salicylic acid is slowly excreted in the urine, sweat, bile, and mucous secretions generally, chiefly as salicylates or the free acid, partly as salicyluric acid.

On the kidneys and urinary passages, it acts as a *stimulant* and *disinfectant*, and increases the *acidity of the urine*. In large doses it may irritate the kidneys, so as to cause albuminuria, and even hematuria.

Medicinal Uses.—In *febrile conditions*, with excessive high temperature, salicylate of sodium is recommended, such as in cases of influenza, pneumonia, etc. It is stated to be more rapid in its actions than quinine, less lasting in its effects, and more depressant to the circulation; but in our experience quinine gives far more reliable results.

In acute rheumatism, in all patients, the salicylate of sodium is regarded by many practitioners as a specific in reducing temperature, relieving pain, lessening the swelling and other local symptoms, and shortening the duration of the disease. In many instances, however, favourable effects have not resulted from the employment of this drug, probably because the doses prescribed have not been sufficiently large. It is of no value in cases of chronic rheumatism.

In prescribing salicylic acid or its sodium salt, the doses should be repeated at intervals of two hours, and may with advantage be combined with the bicarbonate of potassium in full doses. When the pyrexia declines the dose of the salicylate should be gradually reduced, so as to avoid the danger of relapses occurring, which are very common in acute rheumatism.

The sodium salt is preferred to the acid itself, as it is soluble, and less likely to derange digestion. *Salicin* is stated to be less powerful in its action than the salicylates, but to be better sustained, and to cause less cardiac and vascular depression.

Salicylate of sodium is recommended in the treatment of chronic inflammatory affections of the bladder with foul alkaline urine and phosphatic deposits.

Externally, salicylic acid is extensively used as a *surgical dressing*, in the form of cotton-wool or lint impregnated with the drug by the aid of glycerine.

Thioform.

A basic bismuth salt of dithio-salicylic acid; is prepared by mixing solutions of a soluble bismuth salt and dithio-salicylate of sodium.

Actions and Uses.—Thioform has been suggested as a substitute for iodoform, and is highly recommended by Professor Hoffman as a surgical dressing. The

33

following are the advantages which it possesses over iodoform:

(1) It has greater antiseptic strength.

(2) It is free from toxic properties and from odour.

(3) It has a marked desiccative action.

(4) It can be finely powdered, and is not hygroscopic, and retains its extreme fineness and consistence. It has been employed with success in the treatment of affections of the stomach and intestines accompanied with fermentation, hæmorrhagic diarrhœa, loss of appetite, emaciation, and general debility.

In one case of chronic catarrh of the stomach and intestines in a dog, with a history of emaciation and frequent stools mixed with blood, reported at the Wiesbaden clinic, thioform was administered in large doses; at first 2 drachms daily, together with milk diet. On the second day the hæmorrhagic diarrhœa entirely ceased, and the appetite returned, so that more solid food was soon given, and in five weeks the animal had perfectly recovered. In this case opiates and subsalicylate of bismuth had been previously prescribed without any success.

As an *antiseptic dressing* for wounds thioform is an excellent agent; it does not form a hard covering on the wound beneath which the secretions are apt to collect, but produces a supple protective layer which absorbs the wound serum and allows it to pass away; it has also a non-irritant desiccative action on wounds and ulcers, and compared with iodoform it far surpasses it in healing qualities. Professor Hoffman recommends to dust a thin layer of thioform on the wound, previously cleansed and dried.

In wounds of the eyes and eyelids, also in *conjunctivitis* and *keratitis*, thioform acts as an excellent antiseptic dressing. It can be applied by means of a diffuser, and we have seen the best results from its employment in such cases. The powder is extremely fine, does not irritate, and tends to promote rapid healing. The only drawback to the general employment of thioform in veterinary practice is its high price at present.

CHAPTER XVIII.

THE VEGETABLE KINGDOM—*Continued.*

Oleum Olivæ—Olive Oil.

The oil expressed from the ripe fruit of Olea Europea.

Actions and Uses.—Olive oil is *laxative* and *emollient.* It is given internally in cases of irritant poisoning; it antagonizes the action of alkalies by forming soaps, and retards solution and absorption of arsenic. It forms a useful laxative enema for intestinal obstruction in the dog.

Externally olive oil is extensively employed as a basis for liniments. Made into an emulsion with carbonate of potash and water, it forms an excellent application for softening the scales on parts which have been fired or blistered.

Sapo Durus—Hard Soap, Sodium Oleate. Made with olive oil and soda.

Sapo Mollis—Soft Soap, Potassium Oleate. Made with olive oil and potash.

Preparation.

Linimentum Saponis—Soap Liniment—Sapo durus, 16; camphor, 8; oil of rosemary, 3; spirit, 128; water, 32.

Actions and Uses.—Soaps are in familiar use for the purposes of cleansing the skin, etc., and for removing the scales in chronic skin diseases. They also form serviceable additions to laxative enemas.

The soap liniment is employed as a stimulating application, and also as a basis for other liniments.

Glycerinum—GLYCERINE.

A sweet principle obtained by reaction of fats and fixed oils with aqueous fluids, and containing a small percentage of water.

Actions and Uses.—*Externally* glycerine is slightly *stimulant* and *antiseptic*, and diluted it is *demulcent* and emollient.

It is largely used as a constituent of lotions where a desiccant effect is desirable, in addition to an emollient action.

Glycerine possesses marked powers as a solvent for fixed alkalies, alkaloids, and their salts. It is readily absorbed by the unbroken skin, and will carry into the system alkaloids or other active substances; thus, when combined with belladonna and applied to the skin, the atropine will become absorbed.

In pharmacy glycerine is combined with substances such as carbolic acid, tannic acid, boric acid, etc., forming an excellent vehicle for these agents.

It is sometimes prescribed in mixtures containing iron, to disguise the taste of the latter.

As an astringent, emollient application for cases of *mud fever*, *cracked heels*, and *grease* in horses, equal parts of glycerine and liquor plumbi diacet. are combined.

As a laxative enema glycerine has been highly recommended, in amounts of half an ounce to an ounce for horses, either pure or diluted with one-third part of water. For dogs half a drachm to a drachm may be administered.

The method adopted is to inject the agent with a common wound syringe having a bulbous extremity.

According to Joly (*La Presse Vétérinaire*, March, 1888), glycerine causes hyperæmia and irritation of the mucous membrane and muscular coat of the rectum, and rapidly excites defæcation.

We have not observed these effects to occur in the horse after the use of glycerine enemata. In the dog, however, glycerine often exerts beneficial effect in cases of intestinal obstruction.

In the form of suppositories glycerine is also very useful in similar cases.

Theriaca—Treacle.

The uncrystallized residue of the refining of sugar.

Actions and Uses.—Treacle is demulcent, nutritive, and slightly laxative. It is combined with saline purgatives for cattle, increasing their action, preventing nausea, and disguising the bitter taste, and may be given in doses of one pound. Treacle is employed in pharmacy as a convenient excipient for ball masses, etc.

Tragacantha—Tragacanth.

A gummy exudation obtained from the stem of Astragalus gummifer.

Preparation.

Mucilago Tragacanthæ—1 in 80 of water, with the aid of rectified spirit.

Acaciæ Gummi—Gum Acacia.

A gummy exudation from the stem and branches of Acacia Senegal.

Preparation.

Mucilago Acaciæ—Gum, 4; water, 6.

Actions and Uses.—Both tragacanth and gum acacia are demulcents. They are chiefly used as vehicles for heavy powders, such as bismuth; also in the form of emulsions to prevent the irritating effects of certain drugs, such as chloral hydrate, in the mouth and throat.

Glycyrrhizæ Radix—Liquorice Root.

The root, fresh and dried, of Glycyrrhiza glabra.

Preparation.

Extractum Glycyrrhizæ—Aqueous.

Actions and Uses.—Liquorice is a *demulcent*, and increases the flow of saliva and mucus when placed between the molar teeth. It is chiefly used as a basis for preparing *electuaries*, and is believed to allay irritation of the respiratory passages.

Lini Semina—Linseed.

The dried ripe seeds of Linum usitatissimum, flax.

Preparation.

Farini Lini — Linseed Meal — linseed reduced to powder.

Actions and Uses.—*Externally* linseed meal is extensively employed in the form of poultices to convey heat and moisture to parts, and thus affect the nerves, circulation, and nutrition generally.

Internally, in the form of linseed tea (made with about one part of steeped seeds to fifteen or twenty parts of boiling water, and infused for two hours), it forms a useful demulcent drink for horses and cattle in irritable conditions of the throat, alimentary canal, kidneys and bladder, and is believed to have a remote local effect on the bronchi and urinary passages.

In febrile cases it also acts as a *valuable nutrient*, and patients should be encouraged to partake of it; it may be also allowed in the form of well-boiled gruel, or mixed with bran mashes.

Linseed and linseed cakes are familiarly known as valuable feeding stuffs for cattle and sheep, aud in restricted amount for horses.

Hordeum Decorticatum—Pearl Barley.

The dried seed of Hordeum distichon divested of its integuments.

Preparation.

Decoctum Hordei—Barley Water—1 boiled in 15 of water.

Actions and Uses.—Barley water is *nutritive* and *demulcent*, and is chiefly employed in cases of irritable conditions of the bladder and urinary passages, the animal being allowed to drink it at pleasure.

Farina Tritici—Wheaten Flour.

The grain of wheat (Triticum sativum) ground and sifted. Chiefly used in the form of wheaten flour gruel in cases of diarrhœa, superpurgation, etc.

Amylum—Starch.

Procured from the grains of wheat, maize, and rice. Is used in the form of starch mucilage, in cases of diarrhœa, dysentery, etc., being demulcent and emollient. It is an antidote for excessive doses of iodine.

Externally starch is protective and absorbent. It is also employed in the form of paste to stiffen bandages for surgical purposes.

Althææ Radix—Marsh Mallow.

The root of Althæa officinalis.

Actions and Uses.—Marsh mallow contains a large amount of mucilage. When digested with boiling water the mucilage is extracted and made into an ointment, which is a valuable *emollient* and *demulcent* application in cases of *mammitis* or *garget*. This ointment, combined with belladonna and glycerine, and applied to the udder with a moderate amount of friction, is an excellent application in cases where the udder is greatly inflamed and painful.

Chaulmugra Oil.

Obtained from the seeds of Gynocardia odorata. Contains about 12 per cent. of an active principle, *gynocardic acid.*

Actions and Uses.—Chaulmugra oil has been employed in human practice in cases of eczema and chronic skin affections. It is also recommended in the treatment of rheumatism, being given internally as well as applied locally. We are not able to produce any evidence of its employment in veterinary practice. It might prove useful in cases of obstinate eczema in dogs in the form of ointment containing 15 to 25 grains of gynocardic acid to the ounce of vaseline.

CHAPTER XIX.

GROUP II.—THE ANIMAL KINGDOM.

Adeps Lanæ Hydrosus—'LANOLINE.'

Prepared from Adeps lanæ or wool fat, the purified cholesterin fat of sheep's wool, by melting seven parts of the wool fat with three of distilled water in a warm mortar, and stirring in the water gradually and thoroughly.

Actions and Uses.—Lanoline differs from ordinary fats by containing crystals of cholesterine instead of glycerine. It is not decomposed by boiling with alkaline solutions; that is, it does not form soap, and it absorbs water readily.

Lanoline can be rubbed into the skin with great ease, and has remarkable penetrating and absorptive powers; it is devoid of irritating effects. It forms the best basis for ointments of all kinds, especially those employed for affections of the skin, and also those for the purposes of counter-irritation.

The ointments of cantharides and of biniodide of mercury, prepared with lanoline as a basis, produce a far better effect than when the basis is of lard or vaseline. It is advisable to mix a small amount of vaseline when preparing the ointments, as lanoline alone is apt to become of too firm a consistence. A crude form of lanoline forms an excellent dressing for weak and brittle feet in horses.

Adeps Preparatus—PREPARED LARD.

The purified fat of the hog, Sus scrofa.

Preparation.

Adeps Benzoatus—Prepared lard, 50; benzoin, 1.

Actions and Uses.—Lard is a simple emollient. It is frequently employed as a basis for ointments; but, in consequence of its tendency to become rancid, vaseline is generally preferred. The benzoated lard is not affected by keeping.

Cetaceum—Spermaceti.

Obtained from the head of the sperm whale. This is an *emollient*, and is also employed in pharmacy.

Gelatinum—Gelatine.

Obtained from gelatigenous animal tissues; is chiefly employed for coating balls, pills, etc.

Oleum Morrhuæ—Cod-liver Oil.

The oil obtained from the fresh liver of the codfish, Gadus morrhua. Contains 5 per cent. of free fatty acids.

Doses.—Horses, ℥ii. to ℥viii.; cattle, ℥v. to ℥x.; dogs, ʒi. to ʒiv.

Actions and Uses.—Cod-liver oil is *nutrient*, *tonic*, and *alterative*. It is more easily digested than other oils, from the amount of free acid contained in it, which facilitates saponification, emulsion, and absorption. It increases the richness of the chyle, improves the quality of the blood, especially as regards the corpuscles, and is thus a *hæmatinic*. It is a nutritive of the first importance, and is not only oxidized in the tissues, but spares the metabolism of the nitrogenous elements.

It may be prescribed with benefit in cases of *general debility* in all animals, and should be given in the minimum doses at first, so as to avoid interfering with digestion, and it is of advantage to combine an aromatic oil.

In dogs it is a very useful agent, in convalescence from distemper, and in young animals not thriving, also in the various cases of nervous affections.

It is **contra-indicated** in diarrhœa, in hæmoptysis, and in febrile conditions, also in irritable conditions of the stomach.

In cases where the oil does not agree, it is of advantage to prescribe alkaline stomachics before feeding, and the oil afterwards.

Mel—Honey.

A saccharine secretion deposited in the honeycomb by Apis mellifica, the hive bee.

Actions and Uses.—Honey increases the secretions of the mouth and throat, acts as a demulcent, relieving dryness, pain, cough, and difficulty in swallowing. Its chief use is in the form of *gargles* in cases of glossitis, irritation of the mouth and throat, stomatitis, aphtha, etc., and for such purposes it is combined with chlorate of potash or borax.

Cantharis—Cantharides.

The Cantharis vesicatoria, dried, also termed Spanish fly or beetle. Collected chiefly in Hungary. Contains ·4 to 1 per cent. of an active principle, *cantharidin*, probably an acid, which is volatile, soluble in glacial acetic acid, ether, chloroform, alcohol and oils, and is a powerful irritant.

Preparations.

Tinctura Cantharides—1 in 80 of proof spirit.

Doses.—Horses, ℨi. to ℨiv.; dogs, ♏v. to ♏x.

Unguentum Cantharidis—1 to 8. (See Appendix, p. 546.) Should not be heated beyond 200° Fahr. in preparation, as the active principle is volatile.

ACTIONS AND USES OF CANTHARIDES.

(1) Immediate Local Action.

Cantharides, applied to the skin, acts as a *rubefacient* and *vesicant*. Its effects differ from those of mustard in being much less rapid, but of a more severe degree.

Applied in the form of a properly prepared ointment, it causes, generally between three and twelve hours, the formation of large vesicles, which after a variable time burst, and discharge a yellow serous fluid which dries into scurfy cicatrices. If too freely used, it may cause excessive inflammation of the deeper layers of the skin, suppuration, and perhaps sloughing, with injury to the hair bulbs, and a permanent blemish as the result. If applied to a large surface, the cantharidin may become absorbed, and produce effects presently to be described.

Internally cantharides, unless freely diluted, acts as an irritant to the mouth, throat, and stomach, and in toxic doses causes gastro-enteritis, strangury, and hæmaturia.

Cantharidin enters the blood both from surfaces too extensively blistered and from the stomach, and finds its way into all the organs, from which it is slowly eliminated. It disturbs the heart, respiration, and nervous system, causing irritability, quickened pulse, and injected mucous membranes.

Cantharidin is slowly excreted by the kidneys, appearing in the urine, which conveys it to the bladder and genital organs. In small doses it causes diuresis and frequent desire for micturition, and in some cases is believed to act as an aphrodisiac—*i.e.*, stimulates the sexual appetite.

In full doses cantharides produces nephritis, with scanty bloody urine, or even suppression; the penis becomes swollen, frequent erections occur, and in females the uterus may become congested.

Antidotes.—In cases where cantharidin has been absorbed, and produces irritation of the urinary passages and strangury, a few doses of tincture of opium with bicarbonate of soda should be administered in mucilaginous fluids, and the animal allowed cold linseed tea to drink. The blistered part should be washed immediately with warm water and a dilute alkali, and an emulsion composed of olive oil, carbonate of potash, and water applied. It is a mistake to apply oil alone, as it tends to render the cantharidin more soluble.

In cases where applications of cantharides produce excessive swellings of the limbs, with a tendency to suppuration and sloughing of the skin (and let it be remembered that such may occur, no matter how carefully applied), apply fomentations, astringent lotions, and give gentle exercise as soon as the pain subsides. If the swellings involve the sheath and the under surface of the abdomen, Professor Williams recommends the parts to be punctured, so as to allow the escape of the contained fluid.

Medicinal Uses.—Small doses of cantharides, such as 5 grains for the horse, are sometimes prescribed in cases of nasal gleet in combination with mineral tonics, but other agents are far safer and more effectual.

Externally, cantharides is extensively used as a *vesicant* in the form of the ung. cantharidis, and may be employed for all the purposes of a counter-irritant (see p. 199). Where active effects are required it is advisable to combine equal parts of the ung. cantharidis with the ung. hyd. biniodidi. If properly prepared and carefully applied, cantharides does not as a rule cause any blemish, and in preparing the ointment it is necessary to heat the vehicle to about 200° Fahr., so as to dissolve the cantharidin, the usual strength of the application being 1 to 8 or 1 to 12.

It is also necessary to tie the horse's head to the rack after the blister is applied for forty-eight hours, in order to prevent him biting the part, or licking it with his lips or tongue, which would cause a blemish, and also blister the mouth, etc.

Some practitioners do not observe these precautions, but leave the animal loose, and they state that no untoward effects occur. However, the risk of injury from the teeth is too great, and the safest plan is to adopt precautions to avoid it. If the blistered part is within reach of the tail, the latter should be tied up so as to prevent the blister being carried to the sheath, thighs, or mammary gland.

Weak preparations of cantharides are believed to stimulate the growth of hair, and hence are recommended as a local application in cases where the hair-roots are weak.

Contra-Indications.—Cantharides should not be employed as a counter-irritant in patients suffering from affections of the kidneys, or in irritable conditions of the genito-urinary passages. It should also be avoided in cases characterized by debility, and in weakly, exhausted subjects.

In young animals it must be used with great caution, and in dogs only mild preparations should be employed, taking care that they do not lick the part.

Counter-irritants of all kinds should be avoided when a part is in an already inflamed or irritable state, and measures should be adopted to reduce this condition before a blister is applied.

Precautions to be observed in Blistering.

(1) Not more than two legs should be blistered at one time, and three weeks should elapse before the others are blistered, and between each application.

(2) If the effects of a blister are not sufficiently apparent in about thirty hours after application, a little

more may be applied; but great discretion is necessary to avoid excessive action.

(3) The blistered part should not be kept in too soft a condition, and the use of oil, etc., should be interdicted; the best application is an emulsion of carbonate of potash, oil and water (see p. 548).

(4) In applying blisters to parts which have been fired, discretion is necessary; and if the firing has been severe the blister should be mild. In well-bred horses with fine skins severe blisters should not be used.

(5) In applying blisters it is important to *avoid the flexures* of joints, such as the posterior portion of the knee, the anterior portion of the hock, and the hollow of the pastern, as fissures may be produced in these parts which are difficult to heal.

(6) In very hot weather extensive and severe blisters should not be employed.

APPENDIX

VETERINARY PHARMACY,

INCLUDING THE ART OF PRESCRIBING AND DISPENSING, WITH HINTS ON THE ADMINISTRATION OF MEDICINES;

ALSO EXAMPLES OF PRESCRIPTIONS.

VETERINARY PHARMACY.

PHARMACY is the *art* of making the preparations indicated or ordered by the therapeutist, and includes the dispensing of prescriptions.

The details of pharmacy and dispensing must be studied *practically*, and it is essential that the student should spend a proper period of his time in dispensing prescriptions, and thus become familiar with the appearance and doses of the various drugs, so as to be able to obtain a definite knowledge of the subject, as he will find it impossible to fix them in his memory by endeavouring to study from books alone.

Veterinary pharmacy in the present day differs in a marked degree from that of former times. We are not now compelled to prepare our own drugs, and are saved the labour and time of making up tinctures, etc., and also boluses, pills, etc., as there are reliable wholesale chemists and druggists who now undertake this portion of the work, and perform it in a manner, and on terms, which no practitioner could manage to accomplish.

For example, boluses, according to any formula required, are now prepared in an excellent manner, and covered with an airtight but soluble material, thus ensuring rapidity of action, non-impairment of keeping properties, and facility of administration. We must especially mention in this respect the duraplastic balls prepared by Messrs. Wyleys and Co., of Coventry.

To the student a large saving of time will be afforded, as instead of now burdening his mind with an endless number of methods of preparation, impurities, etc., he will be enabled to devote his energies to the actions and uses of the medicinal agents.

In canine practice, too, a wonderful improvement has been made in the preparation of pills covered with gelatine, etc., easily administered, and readily soluble.

While we are averse to the custom of prescribing similar formulæ for cases of the same disease, and would prefer to treat individual cases on their merits, still, every practitioner has favourite combinations which he has found successful in treatment, and these he will continue to employ; besides, we have to consider the great saving of time to the busy professional man, to have the formulæ, which he is in the habit of using, dispensed, ready for use, in a reliable and neat manner.

The veterinary pharmacy should be kept in an orderly condition, as nothing looks so slovenly as want of attention in this respect. All stock bottles should be neatly labelled; this can be cheaply and effectually done by having labels printed with black lettering on a yellow ground; these can be sized and varnished, and look extremely well when mounted. All poisons should be kept apart in a special portion of the pharmacy shelves, and be marked with a distinguishing label to avoid any mistakes being made.

Every practitioner should keep a prescription-book, in which are entered all prescriptions dispensed; this, besides being valuable for reference, gives the student excellent opportunities of acquiring a proper knowledge of the art of prescribing and dispensing. In addition to these details, the student should make himself familiar with the administration of the different forms of preparations to the various patients. To be proficient in this he must learn to work himself, as no amount of theoretical instruction will be of value in this respect; and he will find it absolutely necessary in many cases, when in practice, to personally administer medicines to his patients, if he wishes to be sure of their effects being produced.

In dispensing prescriptions the student should aim at neatness in all details.

Powders should be thoroughly mixed and blended, and folded up in paper similar to that made use of by chemists; they are then arranged in cardboard boxes in quantities of six or twelve, and a proper label affixed with directions for use.

Mixtures should be thoroughly blended, and if this is not possible, directions should be affixed to shake the bottle before using. This is particularly necessary in the case of irritating fluids, such as oil of turpentine, ammonia, etc. Mixtures should be dispensed in proper bottles, and suitable labels with directions thereon affixed.

Lotions, liniments, etc., should have special labels, so as to avoid the danger of mistakes occurring, as attendants on animals are often very careless in this respect.

Physic balls, if sent out, should have *clear* directions printed on the cardboard box containing them, with reference to the preparation of the horse and after-treatment. This is a very important matter when we consider the carelessness or ignorance of many grooms in this respect; while the veterinary surgeon who supplies the medicine is apt to receive blame if any untoward effects occur.

Blisters should also have labels attached to them containing specific directions, so as to avoid mistakes in applying them.

In dispensing, the student should pay particular attention to *accuracy*, and also to the doses of the medicinal agents, as it is only by this means that he can remember facts of importance in connection with this subject.

Veterinary medicines should be dispensed with similar care and attention to neatness as those sent out by chemists for the use of human beings. There is no excuse for the employment of dirty bottles, newspaper coverings, carelessly-folded powders, and other evidences of slovenly methods, which we often observe in connection with the veterinary pharmacy. The minute amount of extra trouble involved in paying attention to these little details is amply compensated for by the satisfaction given to clients, many of whom appreciate method and neatness in the preparation of medicinal agents for their animals as well as for themselves.

A well-kept pharmacy saves an enormous amount of trouble, as it enables the practitioner to at once lay his hand on whatever agent he requires. In addition to this, it serves to train the student to habits of accuracy and business methods, of vital importance to him in his future career. We usually find that a student who is accurate and neat in dispensing is equally interested and careful in the other details of routine work.

WEIGHTS AND MEASURES, WITH SYMBOLS.

In 1864 the Apothecaries' Weight was abolished, and the following standard weights were adopted:

		Symbol.
1 grain (*granum*)	... ...	gr. i.
1 ounce (*uncia*)	= 437·5 grains ...	℥i.
1 pound (*librum*)	= 16 ounces ...	lb. i.

The scruple ℈, a weight equivalent to 20 grains, was also abolished; but great inconvenience was caused for want of some denomination between the grain and the ounce, so that a weight termed the *drachm* was retained (*drachma*—symbol ʒi.) to signify 60 grains. This, however, does not represent the $\frac{1}{8}$ part of an ounce, as in the fluid measures, for the standard ounce contains but 437·5 grains.

Measures.

		Symbol.
1 minim (*minimum*)		♏i.
1 fluid drachm (*drachma*)	= 60 minims.	f.ʒi.
1 fluid ounce (*uncia*)	= 8 fluid drachms.	f.℥i.
1 pint (*octarius*)	= 20 fluid ounces.	O.i.
1 quart (*quartus*)	= 2 pints.	Qt.i.
1 gallon (*congius*)	= 8 pints.	C.i.

Relation of Measures to Weights.

1 minim	= $\frac{9}{10}$ grain of water.	
1 fluid drachm	= $54\frac{3}{5}$ grains	,,
1 fluid ounce	= 1 ounce	,,
1 pint	= $1\frac{1}{4}$ pounds	,,
1 gallon	= 10 pounds	,,

Domestic Measures.

A teaspoonful is equivalent to 1 fluid drachm.
A dessertspoonful is equivalent to 2 fluid drachms.
A tablespoonful is equivalent to half a fluid ounce.
A wineglassful is equivalent to $1\frac{1}{2}$ to 2 fluid ounces.
A tumblerful is equivalent to 10 to 12 fluid ounces.

These measures, however, are only approximate, and cannot be relied on when accuracy is required.

A popular method of measuring certain medicines is by the 'drop,' but as this varies according to the density and viscidity of the fluid, it cannot be relied on, and a graduated measure glass should be employed.

Metric System.

The metrical or decimal system of weights and measures is official on the Continent of Europe. The *gramme*, which is taken as the *unit of weight*, is a cubic centimetre of water at 4° C. or 39·2° Fahr.

1 gramme	= 15·4323 (about $15\frac{2}{5}$) grains.	
1 decigramme	= ·1 gramme	= 1·543 (about $1\frac{2}{5}$) grains.
1 centigramme	= ·01 gramme	= ·15 (about $\frac{2}{13}$) grain.
1 milligramme	= ·001 gramme	= ·015 (about $\frac{1}{65}$) grain.

1 ounce is equal to about $28\frac{1}{2}$ grammes.
1 pound is equal to about $453\frac{3}{5}$ grammes.

MEASURES.

1 litre = 1 pint, 15 ounces and 2 drachms.
1 decilitre = 3 ounces and $230\frac{3}{4}$ grains.
1 centilitre = $154\frac{1}{3}$ grains.
1 millilitre = about $15\frac{1}{2}$ grains.

PRESCRIBING AND PRESCRIPTION-WRITING.

The subject of prescribing has been already noticed in Part I., p. 31, and also the component parts of the classical prescription alluded to at p. 46.

We may here again repeat that a prescription should contain as few medicinal agents as possible, that the technical portion of it should be written in Latin, and the signature or directions for its use or employment should be in English.

The names of drugs must always be written in full wherever there may be the smallest chance of error occurring. Thus, abbreviations such as *acid. hydroc. dil.* should be avoided as being dangerous, as it might signify dilute hydrochloric acid or dilute hydrocyanic acid. Again, *hyd. chlor.* might signify calomel or corrosive sublimate, mistakes which would occasion very serious consequences. Such terms should be distinguished as *acid. hydrochloric dil.* and *acid. hydrocyanic dil.*, also as *hyd. subchlorid.* and *hyd. perchlorid.*; indeed, in the majority of instances it is far safer to write *hyd. subchlorid.* in its vernacular name, *calomel*.

A prescription consists of five parts:

(1) *The superscription*, consisting of a single sign, ℞, an abbreviation for *recipe*, signifying 'take.'

(2) *The inscription*, or body of the prescription, containing the names and quantities of the drugs ordered. The names of the drugs or preparations are in the genitive case, and should be legibly written in the proper Latin idiom.

(3) *The subscription*, or directions to the dispenser, also written in Latin.

(4) *The signature*, or directions for use, headed by the abbreviation *sig.*, or signa. After this are added (5) the name of the owner of the animal, with the sex and colour of the patient, the date, and the initials of the prescriber.

Certain abbreviations are allowed, viz., *m.* (misce), signifying mix; *s.* (signa); *āā.* (ἀνά), of each; *ft.* (fiat), make; *div.* (divide); *q.s.* (quantum sufficit), a sufficiency; *ad*, up to, the amount to; *c̄* (cum), with; *ss.* (semi), a half; *pulv.* (pulvis), a powder; *bol.* (bolus); *lin.* (linimentum), a liniment; *ung.* (unguentum), an ointment; *mist.* (mistura), a mixture; *haust.* (haustus), a draught, etc.

Constant practice will enable the student to become proficient in the writing of prescriptions. He is advised to at first write the names of the drugs which he intends to employ, and then to fill in the doses. Students often have considerable difficulty in approximating the doses for mixtures, and it is hoped that the following explanation will materially assist them :

The practitioner usually computes his doses according to domestic measures, such as a wineglassful, a tablespoonful, etc. The amount of a mixture is prescribed according to the requirements of the case, in bottles of various sizes, usually pint and half-pint bottles for horses and cattle, and from 8 ounce to 4 ounce bottles for dogs. The dose of mixtures for horses is generally computed in quantities of wineglassfuls, and for dogs in doses of from a tablespoonful to a teaspoonful.

Now, in ordering a certain quantity of a mixture the prescriber has first to ascertain the number of doses which the phial contains, and then to decide the amount of each drug to be given in every dose; then by multiplying this by the number of doses contained in the phial he obtains the proper amount to prescribe, so that each wineglassful or tablespoonful, as the case may be, represents a sufficient dose of the medicinal agent.

Example.

℞ Tr. digitalis, ʒx.
Tr. ferri perchlor., ℥ii.ss.
Aqua ad O.i.

F. m. Sig. Give two wineglassfuls twice a day in a pint of ale.

The above, which is an example of a *cardiac tonic* for the horse, explains the method of approximating the doses. Thus, we are ordering a pint bottle of the mixture, and of this two wineglassfuls are to be given as a dose twice a day. Now, a pint bottle contains 20 ounces, and a wineglassful is equivalent to 2 ounces, so that it would contain ten wineglassfuls, or five doses of two wineglassfuls each. The dose of tr. digitalis for the horse is about ʒii. ; this multiplied by five gives the amount of the drug necessary for the pint bottle, viz., ʒx. Again, the ordinary dose of the tr. ferri perchlor. is ℥ss. ; this multiplied by five gives ℥ii.ss., so that every two wineglassfuls of the above mixture represents ʒii. of tr. digitalis and ℥ss. of tr. ferri perchlor.

In canine practice we can work on similar lines, the amounts generally prescribed varying from a tablespoonful to a teaspoonful, according to the size of the patient ; and the capacity of the phials may be from 8 ounces to 2 ounces, according to requirements.

Example.

℞ Quininæ sulph., grs. xl.
Ac. sulph. dil., q.s.
Tr. nucis vom., ʒii.
Syr. aurantii, ℥ii.
Aqua ad ℥viii.

F. m. Sig. Give a tablespoonful twice a day.

The above represents a nervine tonic mixture for a full-sized dog. The mixture contains 8 ounces, equivalent to sixteen doses of a tablespoonful each. In each dose we are giving about 2½ grains of quininæ sulph., and about 8 minims of tr. nucis vom.

The following table may be found useful to the student while dispensing or prescribing, as it will enable him to judge of the amount requisite to ensure a proper number of medicinal doses :

Phial.	Doses of wineglassfuls.		Doses of half-wineglassfuls.		Doses of tablespoonfuls.		Doses of dessertspoonfuls.		Doses of teaspoonfuls.
1 pint =	10	=	20	=	40	=	80	=	160
½ pint =	5	=	10	=	20	=	40	=	80
8 oz. =	4	=	8	=	16	=	32	=	64
6 oz. =	3	=	6	=	12	=	24	=	48
4 oz. =	2	=	4	=	8	=	16	=	32
2 oz. =	1	=	2	=	4	=	8	=	16

Another table which may prove useful to the student in the pharmacy is one relating to the strength of solutions, such as in the preparation of the various antiseptic dressings and lotions.

The following gives the proportion as regards the strength of preparations by parts as well as calculated by percentage, and also the number of grains to the ounce, and to the pint, to form solutions of specific strength. These are not strictly accurate, as they are calculated so as to avoid fractions; but they will be found sufficiently so for practical work :

Part.	Parts.				Grains.	Grains.
1 to	1000 is =	$\frac{1}{10}$% =	about	½ to f.℥i. =	10 to O.i.
1 to	500 is =	$\frac{1}{5}$% =	,,	1 to ℥i. =	20 to O.i.
1 to	100 is =	1% =	,,	5 to ℥i. =	100 to O.i.

Part. Parts.			Grains.	Drachms.
1 to 80 is	= $1\frac{1}{4}$%	=	about 6 to ℥i. =	2 to O.i.
1 to 50 is	= 2%	=	,, 10 to ℥i. =	$3\frac{1}{3}$ to O.i.
1 to 40 is	= $2\frac{1}{2}$%	=	,, 12 to ℥i. =	4 to O.i.
				Ounces.
1 to 20 is	= 5%	=	,, 24 to ℥i. =	1 to O.i.
1 to 10 is	= 10%	=	,, 48 to ℥i. =	2 to O.i.
			Drachms.	
1 to 5 is	= 20%	=	,, $1\frac{3}{5}$ to ℥i. =	4 to O.i.
1 to $2\frac{1}{2}$ is	= 40%	=	,, $3\frac{1}{5}$ to ℥i. =	8 to O.i.
1 to 2 is	= 50%	=	,, 4 to ℥i. =	10 to O.i.
1 to $1\frac{1}{4}$ is	= 80%	=	,, $6\frac{2}{5}$ to ℥i. =	16 to O.i.

HINTS ON THE METHODS OF ADMINISTRATION OF MEDICINES.

To administer the different forms in which medicinal agents are prescribed requires tact, dexterity, and practice. We are fully aware that a large proportion of medicinal agents which we order, for horses especially, is either not administered at all, or the major portion of it is wasted by ignorant or careless attendants. These facts will often account for the want of success attributed to the use of certain medicinal agents in the treatment of disease, and as a rule it is only when we either administer the medicines ourselves, or see it properly done, than we can be sure of results.

Balls are administered either with the hand alone or assisted by a balling-iron, when the animal has very sharp teeth, or has acquired a habit of working the jaws vigorously when the hand is introduced into the mouth. Some practitioners use a form of balling-gun which appears to work very well.

In administering a ball, the most important point is to secure a proper hold of the animal's tongue, and to prevent the head being raised too high, by an assistant keeping his hand on the nose. The ball is held between three fingers, and the hand, being brought together as much as possible, is passed rapidly along the roof of the mouth, the ball pushed gently into the region of the pharynx, and the hand quickly withdrawn. It may be necessary to keep the animal's head held up for a few minutes, if it does not swallow the bolus, or to allow it to take a few sups of water. In some horses it is very difficult to administer medicine in the solid form, as they acquire great dexterity in rejecting the bolus, and chew vigorously when the hand is introduced into the mouth. Others persistently cough and reject the bolus, no matter how carefully administered. For the latter, medicines in the fluid form must be substituted.

The student should render himself proficient in the administration of balls, and constant practice alone will enable him to accomplish this.

The duraplastic horse balls prepared by Messrs. Wyleys and Co., Coventry, are easily administered, and are a vast improvement on the old-fashioned paper-covered article.

Medicinal agents administered in the solid form take a considerable time to become soluble, and in a fit state for absorption. Experiments have demonstrated this point, and also that there is little or no absorption from the stomach of the horse; hence, if this organ is impacted with ingesta or distended with gas, and its walls in a semi-paralyzed condition, it is evident that drugs in the solid form will not produce any effect, as they will not pass beyond the stomach. Clinical experience furnishes sufficient evidence of this fact, and in such cases drugs should be administered by hypodermic injection.

In cattle, medicines in the solid form are seldom administered, as such would remain among the extensive contents of the rumen, and produce little or no effect.

In dogs, medicines may be conveniently administered in the form of pills, which are now prepared in an excellent manner by wholesale chemists, coated with either gelatine or sugar. These are easily swallowed, and are prepared so that the contents are readily soluble.

Drenches require to be carefully administered, so as to avoid the danger of any of the fluid passing into the larynx and trachea. The horse's head should not be held too high, and the tongue should be left perfectly free; if any attempt be made to cough, the animal's head should be released immediately. The drench should be administered slowly, as by pouring too much at a time into the mouth there is danger if the animal coughs, and, besides, a large amount of the medicine is wasted. Drenches should be administered out of a proper tin drenching-horn, as glass bottles are very dangerous if they happen to get broken between the animal's teeth.

In cases of respiratory affections, with laryngitis or bronchitis, drenches should not be administered if possible, as from the irritable condition of the throat, etc., and the tendency to violent fits of coughing, the fluid may find its way into the trachea and bronchi, and give rise to mechanical bronchitis. In cases of this kind, medicines should be given in the patient's drinking-water, or in the form of an electuary placed between the molar teeth.

In cattle, great care is necessary in administering medicines in the fluid form, and many accidents have occurred from the fluid entering the trachea and bronchi, due to carelessness in this respect. The drench should be administered slowly, care being taken not to have the animal's head held too high; it should also be held in as straight a manner as possible.

In cases of **milk-fever**, in which swallowing is difficult or impossible, no fluids should be given by the mouth, but should be directly introduced into the rumen by means of Toope's trocar and cannula, which is an invaluable instrument in such cases.

In dogs, medicines in the fluid form are easily administered, it being of advantage to have the mixtures in as palatable a form as possible. The best plan is to pour the fluid slowly into the corner of the mouth, first distending the cheek with the finger so as to form a sort of pouch: the medicine is then readily swallowed without any inconvenience.

Powders should not contain substances having a disagreeable or nauseous taste, as otherwise they will be refused by the patient. Properly prepared they are readily taken in the food, and are a most convenient method of administering medicines. As a rule, powders should not be mixed in a hot medium, but should first be incorporated with a portion of cold bran mash, and then mixed in the feed. Heat increases the smell and taste of medicinal substances. Medicines possessing little or no taste, such as saline substances, are readily taken when dissolved in the patient's drinking-water, the latter being left within reach so that it can be partaken of at pleasure.

Electuaries are prepared in a semi-fluid condition, so that they can be easily placed between the patient's molar teeth when swallowing is difficult or impossible, such as in cases of acute laryngitis and in tetanus. They become dissolved in the secretions of the mouth, and are then slowly swallowed.

Hypodermic and intratracheal injections are the most reliable methods of introducing medicinal agents into the system. The proper doses are now prepared in the form of hypodermic pellets, which can be readily dissolved in a small amount of water when required for use. The loose skin of the neck or breast is the most convenient site for hypodermic injections, the most important points in connection with which, are to have the syringe, needle, and fluid in an aseptic condition, and to avoid employing anything of an irritant nature in the solution. Neglect of these precautions is often the cause of abscesses occurring at the seat of injection.

In intratracheal injections, one of the spaces between the rings of the trachea is selected, about midway along its course, the needle is inserted, and the fluid slowly forced in.

Another method of administering medicines has of late years been growing in favour; this consists in introducing the medicinal agent in the form of solution directly into the large intestine of the horse and the rumen of the cow by means of a narrow trocar and cannula, and an indiarubber syringe attached, invented by Mr. Toope. It has given most satisfactory results in cases of flatulent colic in the horse, and tympanitic conditions of the rumen in the cow. It is also of great advantage in administering medicines in cases of milk-fever in cattle, when the power of swallowing is impaired or lost.

It is necessary for the veterinary surgeon, especially in a country practice, to have a portable medicine chest in which he can carry the medicinal agents required in ordinary cases, as it is often difficult, if not impossible, to obtain medicines in country places, and many cases which he is called to, require immediate treatment.

The medicine case should be made either of leather or wood, of a portable shape, and should contain stoppered bottles of sufficient strength of material.

The following medicinal agents will be found of service :

1 8-oz. bottle of either tr. opii or chlorodyne.
1 ,, ,, of spts. æth. nit.
1 4-oz. ,, of spts. ammon. aromat.
1 ,, ,, of ol. tereb.
1 20-oz. ,, of ol. lini.
1 4-oz. ,, of æther sulph.
1 ,, ,, of creolin.
1 tube of hypodermic pellets of morphine.
2 balls of ext. cannabis indica.
2 physic balls.
1 4-oz. bottle of glycerinum belladonnæ.
1 pot of vaseline.
1 oz. iodoform.
½ lb. antiseptic wool.
2 bandages.
Wound syringe.
1 4-oz. bottle of liq. ferri perchlor.
Small instrument case.
Hypodermic syringe.
Measure-glass.
1 purgative mixture for cattle.
2 drachms of croton oil.
1 tin drenching-horn.
Winton's enema syringe.

A case thus fitted will prove of inestimable value, because in many instances the practitioner is not informed of the nature of the case, especially when summoned by telegram, and his destination may be far away from any pharmaceutical chemist.

PRESCRIPTIONS.

FEBRIFUGES.

Horses.

℞ Liq. ammonii acet., ℥x.
Spts. æth. nit., ℥vi.
Aqua ad O.i.

F. m. Sig. Give two wineglassfuls every four hours in half a pint of water.

℞ Quininæ sulph., ʒx.
Ac. sulphuric. dil., q.s.
Aqua ad O.i.

F. m. Sig. Give two winegla sfuls every three hours in two glasses of whisky and two glasses of warm water until the fever declines.

In Hyperpyrexia.

℞ Chlorodyni, ʒi.
Spts. æth. nit., ℥ii.
Liq. ammonii acet., ℥ii.
Aqua ad ℥xv.

F. m. S g. Give every three hours in three glasses of whisky. (*Useful in the primary stages of influenza, when rigors are present.*)

℞ Mag. sulph., ℥xii.
Potass. nit., ʒi i.

Div. in pulv. vi. Sig. Give one twice a day dissolved in the patient's drinking-water.

Dogs.

℞ Spts. æth. nit., ʒii.
Liq. ammonii acet., ʒiii.
Aqua ad ℥viii.

F. m. Sig. Give two teaspoonfuls every three hours. For dogs of larger size the dose may be increased in prop rtion.

Febrifuges for Dogs—*continued.*

℞ Quininæ sulph., ʒi.ss.
Ac. sulph. dil., q.s.
Sodii hyposulph., ʒii.
Aqua ad ℥vi.

F. m. Sig. Give two teaspoonfuls three times a day.
(*Useful in the primary stages of distemper.*)

DIURETICS.

Horses.

℞ Potass. acet., ℥ii.
Tr. digitalis, ʒx.
Spts. æth. nit., ℥v.
Aqua ad O.i.

F. m. Sig. Give two wineglassfuls every four hours in half a pint of water.

℞ Tr. colchici, ℥v.
Spts. æth. nit., ℥v.
Liq. ammon. acet., ℥vi.
Aqua ad O.i.

F. m. Sig. Give two wineglassfuls every four hours until the kidneys act.
(*Useful in azoturia, with scanty secretion of urine.*)

℞ Pulv. resinæ, ʒiii.
Potass. nit., ʒii.

Div. in pulv. vi. Sig. Give one twice a day in the food.

Dogs.

℞ Potass. acet., ℥ss.
Syr. scillæ, ℥ss.
Tr. digitalis, ʒi.
Spts. æth. nit., ℥ss.
Aqua ad ℥vi.

F. m. Sig. A tablespoonful three times a day.
(*Useful in dropsy due to cardiac disease.*)

TONICS.

Horses.

℞ Liq. ferri dialysatus, ℥iii.
Tr. quininæ co., ℥x.
Aqua ad O.i.

F. m. Sig. Give two wineglassfuls twice a day in half a pint of water.

(*Useful where a non-astringent preparation of iron is indicated.*)

℞ Tr. ferri perchlor., ℥iii.
Potassæ chlor., ℥ii.
Syrupi, q.s.
Aqua ad O.i.

F. m. Sig. Give two wineglassfuls every four hours.

(*Useful in purpura.*)

℞ Ferri sulph., ʒvi.
Mag. sulph., ʒv.
Ac. sulph. dil., ʒss.
Tr. quassiæ, ʒv.
Aqua ad O.i.

F. m. Sig. Give two wineglassfuls twice a day in a pint of ale.

(*Useful in debility, with a tendency to constipation.*)

℞ Ferri sulph., ʒvi.
Pulv. gentian, ℥ii.
P. carui sem., ℥ii.

Div. in pulv. vi. Sig. Give one twice a day in the food.

Cattle.

℞ Mag. sulph., ʒxii.
Ferri sulph., ℥ii.
Pulv. gentian., ℥iii.
P. carui sem., ℥iii.

Div. in pulv. vi. Sig. Give one twice a day in the food, or dissolved in a pint of ale.

Tonics—*continued.*

Dogs.

℞ Tr. ferri perchlorid., ℥ss.
Tr. quassiæ, ℥ii.
Glycerini, ℥ss.
Aqua ad ℥vi.

F. m. Sig. Give from two teaspoonfuls to a tablespoonful (according to size of dog) twice a day.

℞ Quininæ sulph., grs. xxiv.
Ac. sulph. dil., q.s.
Syr. aurantii, ℥ii.
Aqua ad ℥vi.

F. m. Sig. Give two teaspoonfuls three times a day.

ALTERATIVES.

Horses.

℞ Liq. arsenicalis, P.B., ℥ii.
Tr. gentian. co., ℥v.
Aqua ad O.i.

F. m. Sig. Give two wineglassfuls twice a day after feeding.

℞ Sulphur. sub., ℥ii.
Potass. nit., ℥i.ss.
Sodii bicarb., ℥ii.
P. carui sem., ℥ii.

Div. in pulv. vi. Sig. Give one twice a day in the food.

GASTRIC TONICS.

Horses.

℞ P. nucis vom., ℥ss.
Pulv. gentian., ℥ii.
Sodii bicarb., ℥ii.
P. carui sem., ℥ii.

Div. in pulv. vi. Sig. Give one twice a day in the food, or dissolved in a pint of ale.

Gastric Tonics—*continued.*

Dogs.

℞ Tr. nucis vom., ℥ss.
Liq. arsenicalis, P.B., ʒi.
Tr. gentian. co., ℥i.
Syr. aurantii, ℥i.
Aqua ad ℥vi.

F. m. Sig. Give two teaspoonfuls three times a day after feeding. Increase the dose for large-sized dogs.

CATHARTICS.

Horses.

℞ Aloes Barb., ʒv.
Ext. belladonnæ, ʒss.
P. zingib., ʒii.

Ft. bol. i. Sig. Physic ball.

℞ Hyd. subchlorid., ʒi.
Aloes Barb., ʒiv.
Ext. belladonnæ, ʒss.
P. zingib., ʒii.

Ft. bol. i. Sig. To act as purgative and cholagogue.

℞ Ol. tereb. rect., ℥i.
Ol. lini. O.i.ss.

F. m. Sig. Oleaginous purgative.

℞ Physostigminæ salicylas, grs. i.ss.
Pilocarpinæ nitras, grs. iii.
Aqua, q.s.

M. Sig. To be given by hypodermic or intratracheal injection.
(*Used in cases of impaction of the colon, with paralysis of its walls.*)

Cattle.

℞ Mag. sulph., lb. i.
P. zingib., ℥i.
Theriacæ, lb. i.
Aqua ferv., O.iii.

M. S'g. Give all at one dose, administering slowly.

Cathartics for Cattle—*continued.*

℞ Ol. crotonis, ʒi.
Hyd. subchlorid., ʒii.
Ol. lini, Qt. i.
F. m. Sig. One dose.

(*Useful in cases where a very active purgative is necessary.*)

Dogs.

℞ Ol. ricini, ℥ss. to ℥i.
Spts. æth. nit., ʒss.
Syr. rhamni, ℥ss. to ℥i.
F. m. Sig. Purgative mixture.

℞ Ext. colocynth. co., grs. iii.
Pil. hydrargyri, gr. i.
Ext. hyoscyamus, gr. i.
Ft. pil. i. Sig. Give one or two, according to the size of the dog.

ASTRINGENTS.

Horses.

℞ P. catechu, ʒvi.
Cretæ prep., ℥ii.
P. camphoræ, ʒiii.
P. zingib., ℥i.
Div. in pulv. vi. Sig. Give one every four hours in a pint of flour gruel.

℞ Chlorodyni, ℥ss.
Tr. camphor. co., ℥i.
Cretæ prep., ℥ss.
Aqua ad O.ss.
F. m. Sig. Give in a pint of flour gruel.

Foals.

℞ Chlorodyni, ʒi.
Tr. rhei, ʒii.
Cretæ prep., ℥ss.
Aqua ad ℥iv.
F. m. Sig. Give in half a pint of flour gruel. Repeat in two hours if necessary.

Astringents—*continued.*

Cattle.

℞ P. ext. hæmatoxyli, ℥ii.
Cretæ prep., ℥ii.
Aqua, q.s.

F. m. Sig. Give in a pint and a half of flour gruel.

Dogs.

℞ Chlorodyni, ♏xv.
Cretæ prep., grs. xx.
Tr. gentian. co., ♏xx.
Aqua ad ℥ss.

F. m. Sig. Give in a little starch and milk. Repeat in two hours if necessary.

ANODYNES AND ANTISPASMODICS.

Horses.

℞ Chlorodyni, ℥ii.
Spts. æth. nit., ℥ii.
Ol. lini, O.i.

F. m. Sig. Give at one dose. Repeat in two hours if necessary
(*Useful in simple colic.*)

℞ Morphinæ hydrochlor., grs. x.
Ac. hydrochlor. dil., q.s.
Chloral hydras, ℥i.
Mucilago acaciæ, q.s.
Aqua, O.i.

F. m. Sig. One dose.
(*Useful in cases where morphine produces an exciting effect.*)

℞ Ext. cannabis indica, ℥ss.

Ft. bol. i. Sig. One dose. Repeat in an hour if necessary.
(*Useful in cases of violent or persistent abdominal pain.*)

Anodynes and Antispasmodics—*continued.*

Dogs.

℞ Tr. opii, ♏v. to ♏xx.
Spts. æth. nit., ʒss.
Tr. zingib., ♏xx.
Aqua, ℥ss.
Sig. One dose. Repeat in two hours if necessary.

ANTI-TYMPANITICS.

Horses.

℞ Creolin, ℥ss.
Ol. tereb., ℥ii.
Spts. ammon. aromat., ℥ii.
Tr. asafœtidæ, ℥ii.
Ol. lini, O.i.ss.
F. m. Sig. One dose.
(*Useful in flatulent colic.*)

Cattle.

℞ Creolin, ℥i.
Ol. tereb., ℥iv.
Spts. ammon. arom., ℥iv.
Ol. lini, O.i.ss.
F. m. Sig. One dose.
(*Useful in hoven.*)

GASTRIC SEDATIVES.

Horses.

℞ Glycerini belladonnæ, ʒii.
Tr. opii, ℥i.
Sodii bicarb., ℥ss.
Aqua ad O.i.
F. m. Sig. One dose. Repeat every three hours.
(*Useful in gastritis.*)

Gastric Sedatives—*continued.*

Cattle.

℞ Glycerini belladonnæ, ℥ss.
Sodii bicarb., ℥ss.
Aquæ, O.i.

F. m. Sig. One dose. Repeat every three hours.

(*Useful in inflammation of the fourth stomach, after a few doses of raw linseed oil have been administered.*)

Dogs.

℞ Ac. hydrocyanic dil., ♏i. to ♏iii.
Bismuthi subnit., grs. v. to grs. xx.
Mucilago acaciæ, q.s.

F. m. Sig. One dose. Repeat in an hour if necessary.

(*Useful in gastritis and obstinate vomiting.*)

ANTHELMINTICS.

Horses.

℞ Ol. tereb., ℥ii.
Ext. filicis liq., ʒii.
Liq. ferri dialysatus, ℥ss.
Ol. lini, O.i.

F. m. Sig. One dose. To be given fasting.

Dogs.

℞ Santonini, grs. iii.
Pulv. areca, grs. xx.

Ft. pulv. i. Sig. To be given in milk. For dogs of larger size this dose may be doubled.

EXPECTORANTS AND RESPIRATORY SEDATIVES.

Horses.

℞ Pulv. camphoræ, ʒiii.
Potass. chlor., ʒi.ss.
P. fol. belladonnæ, ʒi.ss.
Pulv. anisi fruct., ʒii.

Div. in pulv. vi. Sig. Give one twice a day in the food.

(*Useful in simple coughs depending on catarrh.*)

Expectorants and Respiratory Sedatives for Horses—*continued.*

℞ P. fol. aconiti, ʒvi.
P. digitalis, ʒiii.
Arsenic. alb., grs. iv.
P. anisi fruct., ℥ss.

Div. in pulv. vi. Sig. Give one every night in the food.
(*Useful in chronic cough.*)

℞ Liq. arsenicalis, P.B., ℥ii.
Tr. nucis vom., ℥iii.
Tr. camphor. co., ℥iii.
Aqua ad O.i.

F. m. Sig. Give two wineglassfuls twice a day after feeding.
(*Useful in coughs depending on gastric derangements.*)

Dogs.

℞ Tr. belladonnæ, ʒss.
Syr. scillæ, ʒss.
Tr. camphor. co., ℥i.
Aqua ad ℥vi.

F. m. Sig. Give two teaspoonfuls three times a day.

COUNTER-IRRITANTS.

℞ Pulv. cantharides, ℥xx.
Ol. tereb. rect., ℥xii.
Acid. acetic. fort., ℥ix.

Mix for twenty-four hours, then add $2\frac{1}{4}$ lb. each of lanoline and vaseline, melted at a temperature of 200° Fahr., and stir well till thoroughly mixed. Keep in an air-tight jar.

Sig.: *Ung. Cantharides Co. Fly blister.*

℞ Hyd. biniod., ʒii.
Lanolini, ℥xii.
Vaselini, ℥iv.

Ft. ung. Sig.: *Ung. Hyd. Biniod.*
(*Useful for the treatment of ossific affections of joints, etc.*)

Counter-Irritants—*continued.*

℞ Hyd. biniod., ℥iv.
Potass. iod., ℥iii.
Aqua, ℥ii.

Dissolve, then add—

℞ Pulv. cantharides, ℥viii.
Spts. vini meth., ℥xxxiv.

Digest for fourteen days, and after filtering add sufficient methylated spirit to make 40 oz. of clear fluid.

(*Very strong blistering fluid, to be applied with a brush.*)

LINIMENTS.

℞ Ol. tereb., ℥i.
Liq. ammon. fort., ℥i.
Ol. olivæ, ℥iv.

Ft. lin. Sig.

(*As a counter-irritant for application to the throat, etc.*)

℞ Ol. tereb., ℥xvi.
Camphoræ, ℥i.
Sapo mollis, ℥ii.
Aqua destil., ℥ii.

Mix the soap with the water, dissolve the camphor in the turpentine, rub together till thoroughly mixed, add sufficient water to make a fluid emulsion.

Sig.: *Lin. Tereb. Album.*

(*As a stimulating liniment.*)

℞ Tr. arnicæ, ℥iv.
Tr. camphoræ, ℥iv.
Liq. ammon. f., ℥ii.
Sapo mollis, ℥ii.
Aqua ad O.i.

Ft. lin. Sig.: *Lin. Camph. c. Arnicæ.*

(*Useful as a mild stimulating liniment.*)

℞ Tr. iodi, ℥ii.
Spts. picis, ℥ii.
Sapo mollis, ℥ii.

Ft. lin. Sig. Apply with a brush once a day.

(*Useful as an absorbent liniment in cases of capped hocks, windgalls, etc.*)

Liniments—*continued.*

℞ Iodi., ʒv.
Potass. iod., ʒii.
Glycerini, ℥i.
Spts. rect., Qt. i.
Ft. lin. Sig.: *Linimentum Iodi.*
(*Useful as an application for enlarged glands and bursæ.*)

℞ Potass. carb., ʒii.
Ol. olivæ, O.ss.
Aqua, O.ss.
Ft. lin. Sig.: *Lin. Alba. White liniment.*
(*For applying after blisters.*)

℞ Liq. plumbi diacet., O.ss.
Ol. eucalypti, ʒii.
Ol. olivæ, O.ss.
Ft. lin. Sig. Apply twice a day.
(*For mud fever, cracked heels, grease, etc.*)

LOTIONS.

Astringent.

℞ Plumbi acet., ℥i.
Zinci sulph., ʒvi.
Aqua ad O.i.
Ft. lotio. Sig.: *Lotio Alba. White lotion.*

Antiseptic.

℞ Creolin, ʒii.
Pyoktanin, grs. viii.
Aqua, O.i.
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(*For dressing wounds.*)

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Ft. lotio.

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Ft. lotio. Sig.: *Lotio Hydrargyri Flava. Yellow wash.*
(*Useful in cases of collar and saddle galls, and ulcerated surfaces.*)

℞ Ac. boric., grs. iv.
Aqua laurocerasi, ʒss.
Aqua destil., ℥ss.

Ft. lotio. Sig. Apply twice daily.
(*As a collyrium in conjunctivitis.*)

℞ Argenti nit., grs. iv. to grs. vi.
Aqua destil., ℥i.

Ft. lotio. Sig. Apply with a camel's-hair brush once daily.
(*As an application for albugo and nebula.*)

℞ Atropinæ sulph., grs. ii. to grs. iv.
Aqua destil., ℥i.

Ft. lotio. Sig.: *Liq. Atropinæ Sulph.*
(*As an application to keratitis, ophthalmia, etc.*)

OINTMENTS.

℞ Iodi, ʒi.
Potass. iod., ʒss.
Lanolini, ʒviii.

Ft. ung. Sig.: *Ung. Iodi. Absorbent ointment.*

℞ Sulphur sub., ʒi.
Plumbi acet., ʒss.
Creolin, ʒss.
Ol. eucalypti, ʒss.
Vaselini, ℥iv.
Lanolini, ℥iv.

Ft. ung. Sig. Apply twice daily.
(*In cases of grease, cracked heels, etc.*)

Ointments—*continued.*

℞ Sulphur sub., ℥i.
Potass. carb., ʒss.
Lanolini, ℥iv.

Ft. ung. Sig.: *Ung. Sulpho-Alkalinum.*

(*Useful in cases of parasitic skin affections in the dog.*)

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(*Useful as an antiseptic ointment.*)

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