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ANÆSTHESIA & NARCOSIS OF ANIMALS & BIRDS

BY FREDERICK HOBDAY


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ANÆSTHESIA & NARCOSIS OF ANIMALS AND BIRDS

BY

FREDERICK T. G. HOBDAY, F.R.C.V.S., F.R.S.E.

HONORARY VETERINARY SURGEON TO HIS MAJESTY THE KING; FELLOW OF THE ROYAL SOCIETY OF MEDICINE; HONORARY MEMBER OF THE AMERICAN VETERINARY MEDICAL ASSOCIATION; CORRESPONDANT ÉTRANGER DE LA SOCIÉTÉ DE MÉDECINE VÉTÉRINAIRE DE BRABANT; EXAMINER IN SURGERY TO THE ROYAL COLLEGE OF VETERINARY SURGEONS; AND FORMERLY PROFESSOR OF THERAPEUTICS IN THE ROYAL VETERINARY COLLEGE, LONDON

LONDON
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1915

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TO

PROF. AUGUSTUS WALLER, M.D., F.R.S.

Professor of Physiology in the University of London.

WHOSE WORK ON THE ADMINISTRATION OF CHLOROFORM

HAS DONE SO MUCH TO

DEMONSTRATE THE SAFETY OF THIS ANÆSTHETIC

WHEN GIVEN BY DOSIMETRIC METHODS

PREFACE

THE progress of anæsthetics in veterinary surgery has not been as rapid as it ought to have been, and it is in the hope that a small textbook specially devoted to the subject may be helpful in this direction that this contribution is brought before the notice of the profession.

That it may be a guide to the student in the selection of an anæsthetic for his future patients is the hope of the author, and if it is also found of value as a work of reference for the busy practitioner, and thus ameliorates pain in the animal world, the time devoted to the deductions and opinions brought forward—many of them quite contrary to the usual teaching—will not have been spent in vain.

To reason for the animal world merely from analogies with human patients is liable to give rise to grave errors, as indeed is also the attempt to reason that because one species of animal is a good subject for a certain anæsthetic every other kind must be.

It is necessary to have " practical " experience with each kind before opinions can be deduced, and it is in order that students of the subject may have a framework for future work that so many observations and experiments are given in detail.

To Professor Waller, F.R.S., and Mr. W. L. Symes,

M.R.C.S., of the Physiological Department of the University of London, I am indebted for much encouragement; to Professor Wooldridge, F.R.C.V.S., of the Royal Veterinary College, to Mr. Victor Fisher, managing editor of the *Veterinary Journal*, and to my publishers, I have to express my thanks for kind assistance in getting the proofs through under rather difficult circumstances; whilst to Messrs. Arnold and Sons I have again to acknowledge the loan of blocks for illustrations, principally of inhalers and apparatus designed and altered by them with much skill and patience according to my wishes.

If it aids at all in the alleviation of pain, I think it can legitimately be entitled to claim that, small in size as it is, the work will have justified its existence.

FREDERICK HOBDAY.

KENSINGTON, W.,
September, 1915.

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CHAPTER I

INTRODUCTORY

EVERYONE will admit that operations, whether on human or animal patients, should be performed painlessly whenever possible, and it is for the members of the veterinary profession to act as pioneers in the direction of educating the general public into the fact that in most instances this can be done. At the same time, the safety of the patient must always be the first consideration of the operator; for it is of no avail to have done any operation, however clever, if the patient succumbs to the anæsthetic. For this reason, amongst others, agents which are narcotics, and substantially lessen pain without actually entirely abolishing it, are sometimes used, and for many minor operations their use is justifiable. The humane members of the public, too, must not forget that veterinary surgeons, except in large towns, often live many miles apart, and for one to act as anæsthetist to the other is sometimes impossible, even if fee considerations did not stand in the way; and as no anæsthetic is "absolutely fool-proof" there must always be a certain amount of risk taken by everybody when the anæsthetist is an amateur. Although the surgeon may be an expert anæsthetist, there are times during every serious operation when his mind must be fully occupied by

his own work, and to divide his attention between the two things might spell disaster for both.

Again, the veterinary anæsthetist needs expert knowledge of the arrangement of the internal organs of his patients, as the digestive system of one species is totally different from that of another; and this is a point of the greatest importance when considering how each shall be prepared and secured before the anæsthetic is given.

For example, the horse, dog, and pig have each one stomach; the ox, sheep, and goat each have four; the camel has three; and some of these are intractable and very bulky animals, and have to be operated upon in all kinds of improvised situations, where they cannot be placed gently on neat operating-tables, as with human patients; nor will they remain quiet and refrain from struggling at the mere request of the doctor and nurses.

Canine and feline surgery approach nearer to human surgery in this respect than that of any other in the sphere of the veterinary surgeon, for with dogs and cats it is possible to manipulate them almost in any way one wishes, and to operate upon them in any position which is convenient to the surgeon. The use of anæsthetics for these animals has generally attained a high level of excellence.

In the horse, too, anæsthetics are now almost universally employed—in the British Isles, at all events—for all major operations. For the ox, sheep, and pig species, however, we have yet to discover a safe and convenient narcotic or anæsthetic, for in operations upon these animals especially the question of time and cost has to be considered; and unless the law intervenes and *enforces* the universal use of anæsthetics (as was discussed in the Anæsthetics Bill for Animals before Parliament in 1913), their use must be left, in each case, to the discretion of the qualified operator.

CHAPTER II

THE SELECTION OF AN ANÆSTHETIC

In selecting an anæsthetic, the surgeon must always take into consideration the age and condition of his patient, the severity of the operation, the chance which the animal has had of being properly prepared, and other circumstances which may occur at the time or may have occurred previously. For example, in certain cases of accident, or other cause of urgency, the stomach may be full, or the patient may be weak and faint from loss of blood, and the use of a general anæsthetic inadvisable. In such cases a local anæsthetic, or perhaps only a narcotic, may be indicated, and in these matters the qualified surgeon alone can be the proper judge of what is best to use.

Amongst the general anæsthetics, one can select from chloroform, ether, A.C.E. or A.E.C. mixture, ethyl chloride, and nitrous oxide gas; whilst with those whose use is only local we have cocaine, eucaine, novocaine, stovaine, holocain, endrenin, codrenin, hydrochloride of urea and quinine, H.M.C. mixture, ethyl chloride, and orthoform, with adrenalin, renastyptin, suprarenin, and styptics of that class as useful adjuncts.

Ethyl chloride as a general anæsthetic and nitrous oxide gas are not used to any extent in veterinary practice, partly because of the expense either of the drug or the apparatus required for administration, and partly because chloroform, ether, or A.C.E. mix-

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tures are more applicable and convenient. Experimental work has, however, been done with each of them, and the undermentioned extract* on the use of nitrous oxide is interesting, showing as it does that this anæsthetic, like all others, requires great care and skill in its administration.

"Date: July 22, 1909; 7.30 p.m.; cold night.

"CASE 1.—Subject: Wire-haired terrier bitch. Gas administered for two and a half minutes, and she was not under. The facepiece was then removed and grease put round the edge of it, when she became completely cyanosed and well under the influence of N_2O in one and a quarter minutes. Estimated she took 6 gallons of gas. Recovered when facepiece was removed and plenty of air allowed.

"CASE 2.—Subject: Black and tan terrier bitch (mongrel). Became completely cyanosed in two minutes five seconds. She had rigors twice, which did not occur in Case 1, but was noticed in Case 3. Respirations ceased, and she lay collapsed for some time. Estimated took 6 gallons. Recovered when facepiece was removed and allowed plenty of air.

"CASE 3.—Subject: Fox terrier bitch in whelp (condition poor). She took 2 gallons in fifty seconds, when outlet valve became defective. The facepiece was removed and the valve readjusted; then we gave her about another 4 gallons, making 6 gallons in all, 'without air,' when she became completely cyanosed. She was totally collapsed, and had rigors twice; her heart was beating, but respirations practically ceased for almost thirty seconds.

"We forced the last 4 gallons to see if it would kill her. The facepiece was then removed; she breathed once of her own accord, and artificial respiration was resorted to, when she took five minutes to recover, and was then able to stand. Violent twitchings of the head and ears took place on the ears being 'flicked' or pinched.

"These animals were fed at 10 a.m., and they took the gas quietly with almost imperceptible struggling. Two of the animals took no notice of a pin being stuck into the ribs or tail, showing that they were sufficiently under the anæsthetic to enable any small operation to be performed. Pupil dilated, conjunctival reflex gone.

* "Administration of Nitrous Oxide Gas to Dogs," by H. Harling Capes, L.D.S. (Edin.), and R. Lewis Green, M.R.C.V.S. (*Veterinary Record*, November 18, 1911).

"'Repetition' on same three dogs in same order, July 27, 1909.

"CASE 1.—Four gallons was given first administration; she was one minute going under, and became cyanosed. Administered again immediately 5 gallons in forty-five seconds; she became completely under, cyanosed, and had rigors. Air was administered each time.

"CASE 2.—'Given with air.' First administration, 4 gallons; caused complete cyanosis in one minute forty seconds. Rigors. The patient was under the influence of N_2O about thirty seconds (the same as is usual in the case of a human being).

"Second administration 'without air.' Nine gallons, and she was completely cyanosed in one minute thirty-five seconds. Breathing ceased, and she was dead in one minute thirty-six seconds.

"CASE 3.—Gave 4 gallons in one and a quarter minutes; very little cyanosis; eyes insensitive. A very small amount of air was given, and she was under about thirty seconds.

"Second administration: Gave 4 gallons, and she was completely under in one minute, but only slightly cyanosed. She had slight rigors during recovery.

"This bitch was pregnant, and the whelps were alive.

"*Muzzle.*—The muzzle was specially made, and can best be described as a very 'elongated facepiece,' the same as used by dentists, with a vertical expiratory valve. The gas was admitted through a two-way stop-valve exactly similar to the one used by dentists. The one way admits N_2O only; the other admits air only, and shuts off the N_2O. The skilful administration of a little air with the N_2O prolongs the period of anæsthesia.

"*Signs of Anæsthesia.*—The general signs of anæsthesia in dogs are very much the same as in the human being—viz., a good pulse, full, firm, and slightly quickened. Relaxed muscles usually, but sometimes rigidity occurs. No stertor or jactitation was noticed in the dogs.

"*Cyanosis.*—Cyanosis in dogs is specially noticed on the lips and tongue, and, in our opinion, this cyanosis, coupled with muscular relaxation, is the surest guide as to when to remove the facepiece. Absence of 'conjunctival reflex,' in our opinion, is of no value as a guide in the case of dogs.

"We believe that with practice and an improved apparatus it would be quite possible to satisfactorily give gas to dogs.

"Animals placed in 'irrespirable gases' become convulsed before death, but when made to respire N_2O their respiration simply grows more and more shallow, finally ceases, and the animals die painlessly."

CHAPTER III

METHOD OF PREPARATION AND SECURING OF THE PATIENT

In all cases the risk is minimized if the patient is properly prepared, and by this is particularly meant that due attention must be paid to the condition of the digestive organs. The heart and respiratory organs should always be examined, and if any defect is detected, the owner should be warned that extra risk is incurred. The same warning should be given when dealing with an animal excessively fat or abnormally thin; whilst my experience has also taught me to extend that warning in cases of disease of the kidneys or bladder, especially in the dog and cat. With the horse, ox, sheep, and pig a full twenty-four hours' fasting is advisable, a small quantity of water only being permitted about six or eight hours before the actual time of operation. With the dog and cat abstention from solid food for about eighteen or twenty hours is a wise precaution, but milk or beef-tea may be given in small quantity until within six hours of the actual time of anæsthetization. The method of securing is of the utmost importance in all patients, and the acme of safety is attained when the patient can be so fixed that the lungs and heart have full and free play.

If the patient can be induced to keep still without being secured in any way by the legs, the standing

posture is the most natural, and therefore the most safe; but as this cannot always be done on account of the position of the incision or for other reasons, the next best thing is to think out the position which will give the chest the most freedom. In the dog and cat this is easily attained by the use of an operating-table, or even by the use of hobbles, the bodies of these animals readily accommodating themselves in this way; and for the horse either an operating-table is used, or the animal is cast with a rope or with hobbles.

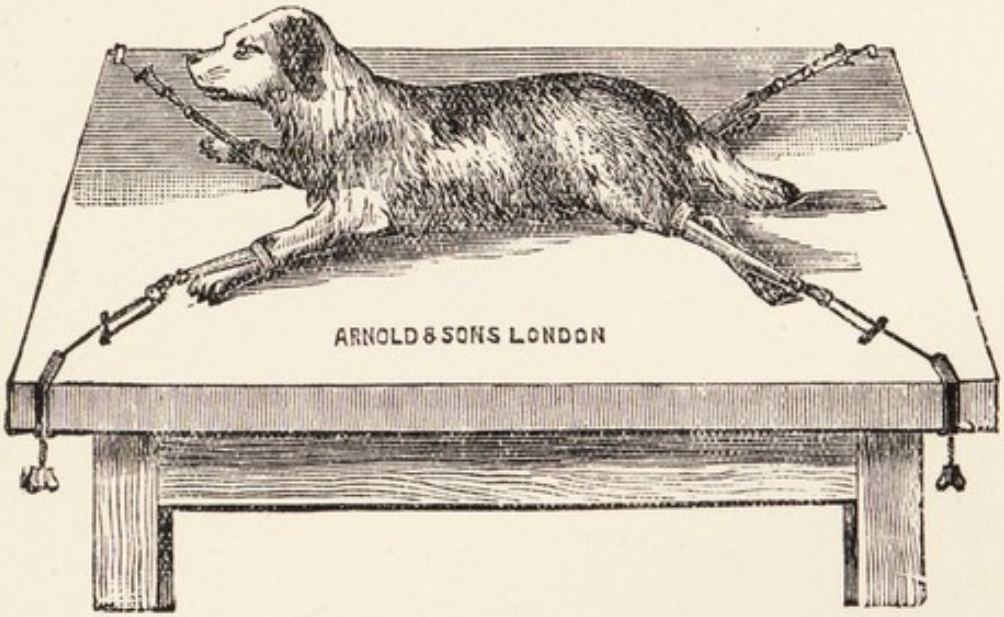

FIG. 1.—DOG SECURED IN THE SAFEST POSITION FOR GENERAL ANÆSTHESIA.

The ox is cast and secured with ropes or hobbles in a somewhat similar manner as the horse, but if hobbles are used they are of a somewhat different pattern and applied in a different manner. In so far, however, as we are concerned when dealing with the subject of securing as applied to the administration of anæsthetics, the position when the beast is secured is practically the same.

The sheep and pig are rarely anæsthetized, but when this is done the legs are usually all tied together,

the animal being placed on its side; or all four legs may be stretched out, as is done in the case of the dog and cat. The pig takes chloroform exceptionally well when secured in this way.

Whatever method, however, is adopted, the chief axiom to recollect is to give as much freedom as possible to the organs in the chest, and to avoid pressure upon either the thorax or the abdomen.

CHAPTER IV

GENERAL ANÆSTHETICS

These include chloroform, ether, and A.C.E. mixture.* Ethyl chloride and nitrous oxide can be used, but are not often administered.†

Of these, *chloroform* is generally preferred, but it is also the one which necessitates the greatest care in its administration. If given, however, by rational methods and with an ordinary amount of care, it may legitimately be claimed that it is a safe and reliable anæsthetic for the horse and dog, and I make this assertion after having personally carried out at least 10,000 administrations for all varieties of surgical work in one or other of these varieties of animal. In the ox, sheep, and pig I have used it successfully, but not extensively, and I have heard of numerous deaths in these animals from its use.

It is important that the chloroform shall be fresh, and not have become decomposed by exposure to sunshine or strong daylight.

For the cat, whether kitten or adult, and for the puppy, experience has taught me that A.C.E. or ether give less risk, and that if chloroform is used it must be given very cautiously, and the anæsthetist should give his undivided attention to his work.

* This consists of a mixture of 1 part of alcohol, 2 parts of chloroform, and 3 parts of ether.

† See pp. 4, 5, and 16.

The Horse.

For the horse, when cast, several methods of applying chloroform are adopted, the safest and most convenient, in my experience, being with the **Cox pattern of inhaler,** or one of its modifications.

It consists merely of a canvas bag which may or may not be lined with leather,* having a draw-string attachment at the lower end and a leather strap to pass behind the ears.

FIG. 2.—THE COX PATTERN OF CHLOROFORM INHALER.

It is placed over the horse's nostrils only, and the attendant, who is kneeling near the head, keeps the tongue pulled well forward and out at the upper side of the mouth, retaining this in his hand during the whole of the period of anæsthesia; or (a suggestion I learnt from Mr. Cundell, M.R.C.V.S.) this organ can be secured by a tape slip-noose, kept at the side of

* If canvas alone is used, it is of advantage to stiffen the parts which come just over the nostrils with strips of cane, which are sewn on, and thus prevent pressure on the *alæ*.

the mouth by being attached to the halter or head-collar on the patient. The latter gives less chance of lacerating the frænum.

The horse having been cast and secured, the anæsthetist then pours the chloroform (from 1 to 1½ ounces is usually a safe and sufficient dose to commence with) on cotton-wool,* and places it in the draw-string attachment at the end of the mask, covering the inhaler and nostrils with an ordinary blanket or horse-rug (once folded only), and awaits results.

For about four or perhaps six minutes the horse neighs, struggles, and passes through a stage of excitement; then unconsciousness slowly supervenes, the muscles relax, the tail becomes limp, and eventually, if the application of the chloroform is continued, the corneal reflex disappears. From experience I never like to reach this stage before ten or twelve minutes has elapsed.

For many operations, however, it is not necessary to push matters quite to this stage, as the degree of insensibility is now sufficient for short operations, especially for those, such as castration, involving incisions in the region of the hind-quarters. Moreover, it is a matter of common observation that when the inhaler is removed and air admitted to the nostrils the horse often enters into a still deeper stage of anæsthesia.

As a general rule my own experience has been that 1½ ounces of chloroform, administered with the aid of a Cox's inhaler, suffices for a horse the size of an

* Cotton-wool is much preferable to use than a sponge. It is cleaner and more hygienic, whilst its small cost enables it to be destroyed after each anæsthetization, and in addition the nostrils and lips are never blistered; the application of lard or vaseline, which is apt to dirty the inhaler, is quite unnecessary. A piece 18 inches square (or less) can be folded in such a way that it can be used for at least six horses, and yet give each a clean surface.

ordinary hunter or carriage horse, for almost every operation which can be performed within ten or fifteen minutes. For longer operations more chloroform can readily be added at the discretion of the anæsthetist in from 2 to 4 drachm doses at intervals when considered necessary.

A somewhat crude method of chloroforming the horse consists in closing up one nostril with cotton-wool, and placing a sponge or cotton-wool containing chloroform over the orifice of the other nostril, the whole being covered with a rug or towel. The nostrils and lips should be well covered with lard or vaseline beforehand, or they will become blistered; and this remark also applies when a sponge is used with Cox's inhaler.

FIG. 3.—CARLISLE INHALER (COLONEL RAYMOND'S IMPROVED PATTERN).

Improvised inhalers have been made on emergency with a pillow-case* tied around the head, and even with an old top-hat.

The **Carlisle pattern of inhaler** consists of a stiff leather mask which covers the whole of the mouth and nostrils, the chloroform being poured on a sponge which is fixed in a tray at the bottom. The sponge is wrung out in warm water before the chloroform is poured on it, 1 or 1½ ounces (depending upon the size of the horse) being administered at the commencement, and added to at the discretion of the anæsthetist in 2 or 4 drachm doses.

The **disadvantage** of a pattern which covers both the nostrils and the mouth is that the tongue cannot

* *Veterinary Journal*, October, 1913 (C. E. Hill, M.R.C.V.S.).

be pulled forward; and as the thick portion of the back of the tongue is apt to fall back into the throat, dangerous symptoms often arise from interference with the passage of air into the larynx. It is obvious that a mask which allows of the tongue being pulled forward must give a very decided advantage.

The **Junker pattern of inhaler** has been applied by Messrs. Krohne and Sesemann to the horse, and was brought to the notice of the profession by Mr. Wallis Hoare, F.R.C.V.S., but it has never been in popular usage. For one reason, it is costly as compared with some of the others; secondly, it is cumbersome to carry about; thirdly, it takes a long time to produce a satisfactory anæsthesia; and, fourthly, if the horse's system becomes saturated with chloroform, the animal lies for a long time on the ground before getting up, and there is, in consequence a certain amount of danger of congestion of the underneath lung, and even of chloroform pneumonia afterwards.

The principle of the apparatus is that air is driven, by the aid of a foot-bellows, through a bottle containing chloroform, the mixed vapour being sent forward into an inhaler placed over the horse's nostrils.

The only thing which can be said in its favour is that the exact proportion of chloroform to air in the mixed vapour is known, and can be regulated.

Administration of Chloroform with the Horse in the Standing Position.—At times one meets with a horse for which the act of casting and subsequent struggling would be a source of danger, either because the animal is old or has an anchylosed spine, or for some other reason. With a very vicious animal, too, it is sometimes difficult and dangerous to attempt to get the hobbles on the hind-legs. In such cases the horse may have the chloroform administered in the standing position.

Some veterinary practitioners adopt this as a routine measure, and always place the chloroform mask on the head of the colt or horse before attempting to apply any means of restraint.

The late Mr. Richard Roberts, F.R.C.V.S., was a great advocate of this method, and numerous practitioners who were at one time pupils of his have adopted his pattern of mask.

This consists of an ordinary leather inhaler of sufficient size to cover the nostrils and lower lip, being strapped on like a nosebag.

At the front a hole, about the size of a champagne cork, is punched out of the leather, and through this a piece of string is passed attached to a sponge inside, at the bottom of the mask.

The colt or horse, being held by a rope on either side of a strong head-collar, is led out into a large open space of soft ground—a field for preference—with the mask on; 2 ounces of chloroform are then poured through the hole in the mask on to the sponge, the hole being closed with the cork in such a way that the string attached to the sponge is able to be reached again if needed.

Sometimes everything passes off well, and the colt, in three or four minutes, after perhaps walking in a circle a time or two, merely sways from side to side, and gently falls down.

At other times there is a good deal of excitement, as the colt will rear and plunge, and may even fall over backwards. This is one reason why it is advisable always to have plenty of space when first applying chloroform in the standing position.*

* Some operators, for this reason, give a dose of chloral hydrate an hour beforehand (Major Ryan, A.V.C., *Veterinary News*, August 21, 1915).

PLATE I.

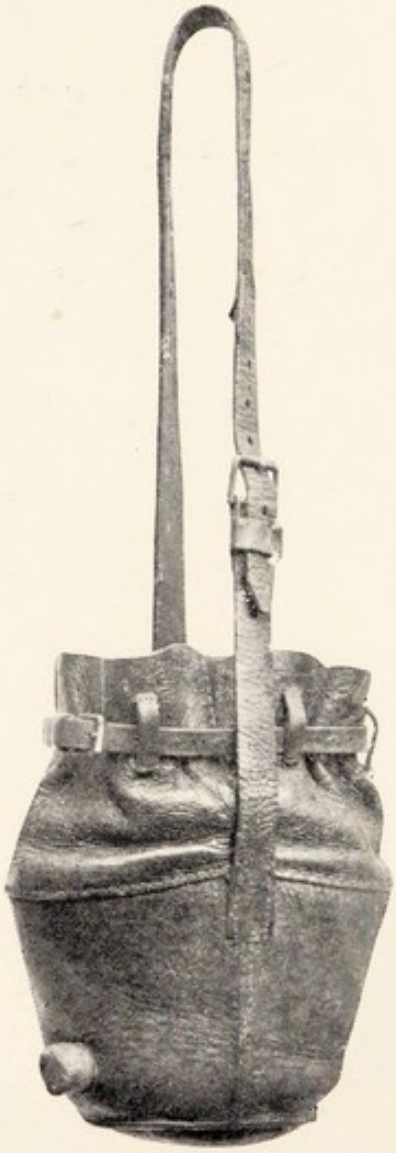

FIG. 4.—ROBERTS'S PATTERN OF INHALER FOR CHLOROFORMING IN THE STANDING POSITION.

[*To face p.* 14.

Mr. W. B. Nelder, F.R.C.V.S., recently introduced* a pattern of inhaler with which he has had considerable experience, and with which he claims that there is no period of violent excitement, the reason being that the vapour is inhaled so gradually and in such small proportion at first.

The mask covers the nostrils and lower lips, and has

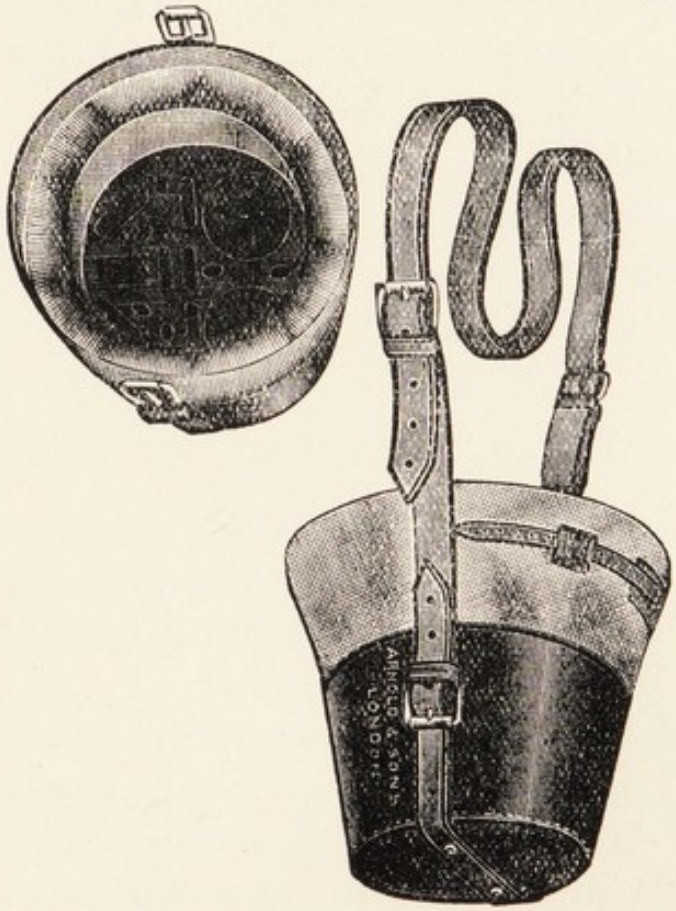

FIG. 5.—NELDER'S PATTERN OF CHLOROFORM INHALER.

a pad of felt in the lower receptacle, this being covered with about 1½ ounces of chloroform.

Nelder advises that it shall be put on in the loose-box about ten minutes before the horse is led into the operating yard, and the horse left to himself until under partial narcosis. After being led out, another ounce of chloroform is added, the hobbles being put on some ten minutes later, before the horse actually

* Proceedings of the Central Veterinary Society, July, 1912.

begins to stagger about; the animal then falls quietly, and does not struggle when going down.

Ether, Ethyl Chloride, Nitrous Oxide, and A.C.E. Mixtures are not suitable or convenient for the horse or the larger animals.

The chief disadvantages are, firstly, that a very large quantity is necessary before anæsthesia can be produced; secondly, that the stage of excitement is very prolonged, and this, in a powerful animal like the horse, is obviously a great drawback; and, thirdly, that so much of the drug is necessary that the cost, when a number of animals have to be anæsthetized, is very considerably and unnecessarily increased as compared with the cost of chloroform.

The Ox, Sheep, Goat, and Pig.

It is not often that general anæsthetics are administered to cattle, sheep, goats, or pigs, although all these animals will take chloroform if properly given and they have been well fasted.

The latter is essential, especially in the cow and sheep, whose rumen, if distended, forms an element of danger from its pressure on the diaphragm. A further hint with regard to the anæsthesia of sheep is always to keep the head up whilst the animal is on its side, as otherwise regurgitation occurs, and death supervenes from mechanical pneumonia about two days later.*

In cases of distokia, especially in animals who carry a number of young, such as is the case in the pig, chloroform is very useful, and generally a light anæsthesia effects the purpose desired.

The chief factors which militate against their

* For this hint I am indebted to Mr. George Elmes, F.R.C.V.S.

general use for ordinary operations are, first, the smallness of the fees obtainable for operations on these animals, this not allowing for a skilled assistant nor for the extra time necessary; and, secondly, that the chief operation performed on these animals (castration) is done so expeditiously by an expert that it is only a matter of seconds, whilst the animals afterwards appear to suffer no mental ill-effect or inconvenience whatever as the result of the absence of an anæsthetic. In the ox it has been recommended to intoxicate the patient with rum, about a pint being given, diluted in water, half an hour or so before an operation.

For some painful or prolonged operations, such as the removal of the thyroid gland of the goat, chloroform is preferable, but it is astonishing how much can be done with the aid of cocaine and other local anæsthetics.

The fact that expert operators will castrate or spay a pig in thirty seconds,* and will castrate calves and lambs wlth almost equal speed—whilst to do it properly under chloroform would take at least ten or fifteen minutes—forms a very strong argument against the general use of anæsthetics for this operation.

The Dog.

For the adult dog chloroform is an ideal anæsthetic, if only the vapour is given in a rational manner; but with puppies great care must always be exercised, and, except in expert hands, A.C.E. mixture or ether is safer.

In the case of large dogs the anæsthetic may be given by the open methods, but even with them it is safer to be administered by the aid of an inhaler.

* The author has frequently timed this.

For the open method an ordinary graduated drop-bottle is used, the chloroform being allowed to fall *slowly* and *carefully*, drop by drop, on the single fold of a thin towel, or, better still, a piece of flannel stretched over a wire or leather frame (an ordinary muzzle answers very well) which has previously been placed across the animal's nostrils and face.

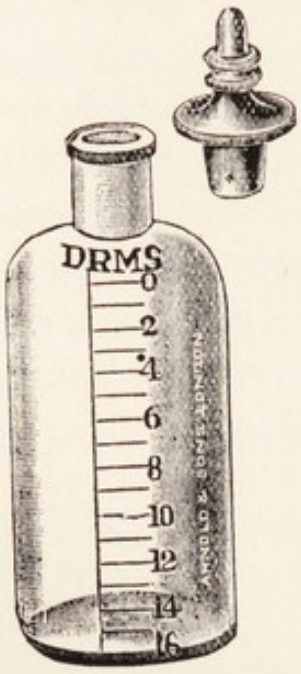

FIG. 6.—DROP-BOTTLE.

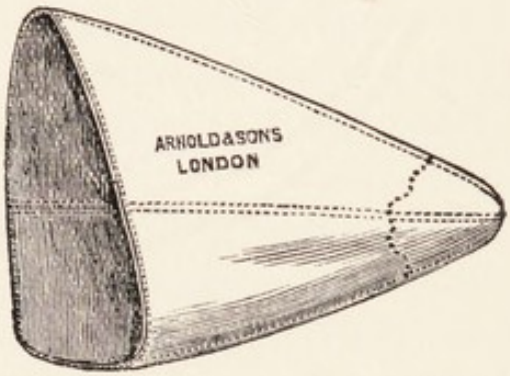

FIG. 7.—WIRE MUZZLE MASK.

The chief safeguard to be thought of when chloroforming a small animal is to be sure that anæsthetization takes place very slowly. To hurry matters by pushing the anæsthetic too soon is to court disaster; and for a toy dog, or even one the size of a terrier, a minimum of four minutes (and, better, five) should be allowed, whilst for a big dog from six to ten minutes are not too long. Once the stage of complete anæsthesia has been reached, it requires the application of a very little chloroform now and again to keep the patient in an unconscious condition.

Chloroforming by the aid of an inhaler is by far the safer method, and various patterns of apparatus have

been devised. Of these, the ones in most common use are the Junker's and several patterns devised by the author. The advantages claimed for an inhaler are that the vapour does not irritate the nostrils, and an exact percentage can be administered. They can all be used for other anæsthetics besides chloroform.

The **Junker inhaler** consists of a bottle, containing chloroform, air being blown through it by the aid of a rubber bellows worked by the hand or by the foot, the mixed vapour being forced on into a mask placed on

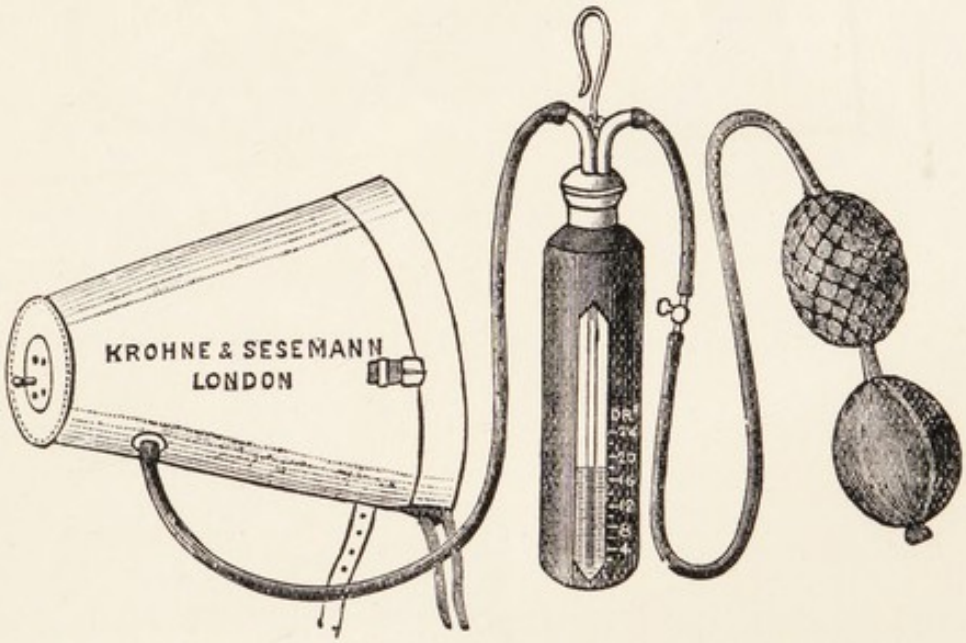

FIG. 8.—JUNKER PATTERN OF ANÆSTHETIC INHALER.

the patient's face. With this it is estimated that the mixed vapour which is driven onwards contains 3·5 per cent. of chloroform. The author's first pattern, which, with others, was demonstrated before the Society of Anæsthetists in 1899, and was fully described in several medical* and veterinary journals† at that time, consists of an ordinary double rubber bellows affixed to a bottle containing chloroform in such a way that it *sucks* a well-mixed vapour of chloroform and air over the surface of the anæsthetic, and

* *Lancet ; British Medical Journal.* † *Veterinary Record.*

then drives it on into the mask on the patient's face. With this the percentage has been estimated by Mr.

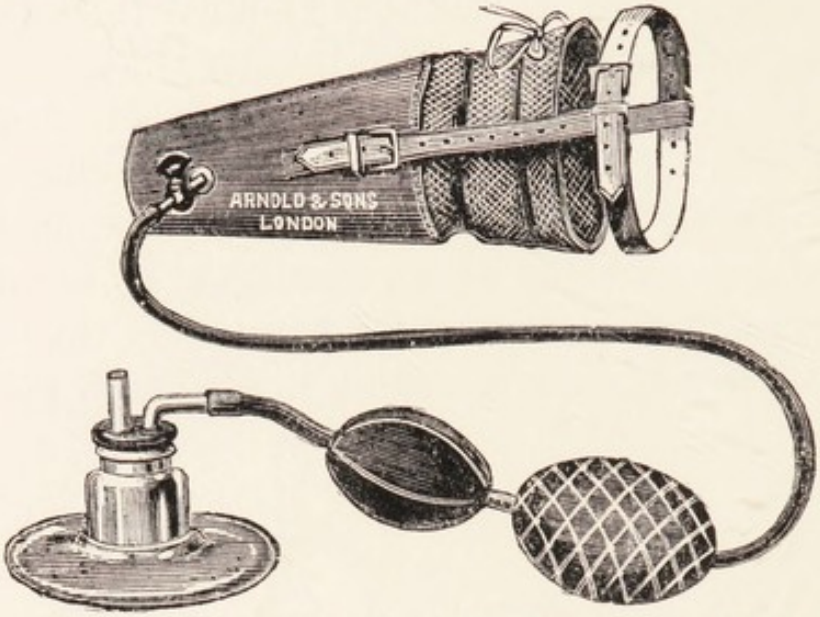

FIG. 9.—THE AUTHOR'S FIRST PATTERN OF INHALER.

W. L. Symes, M.R.C.S., of the Physiological Department, University of London, to average 1·9 to 2 per

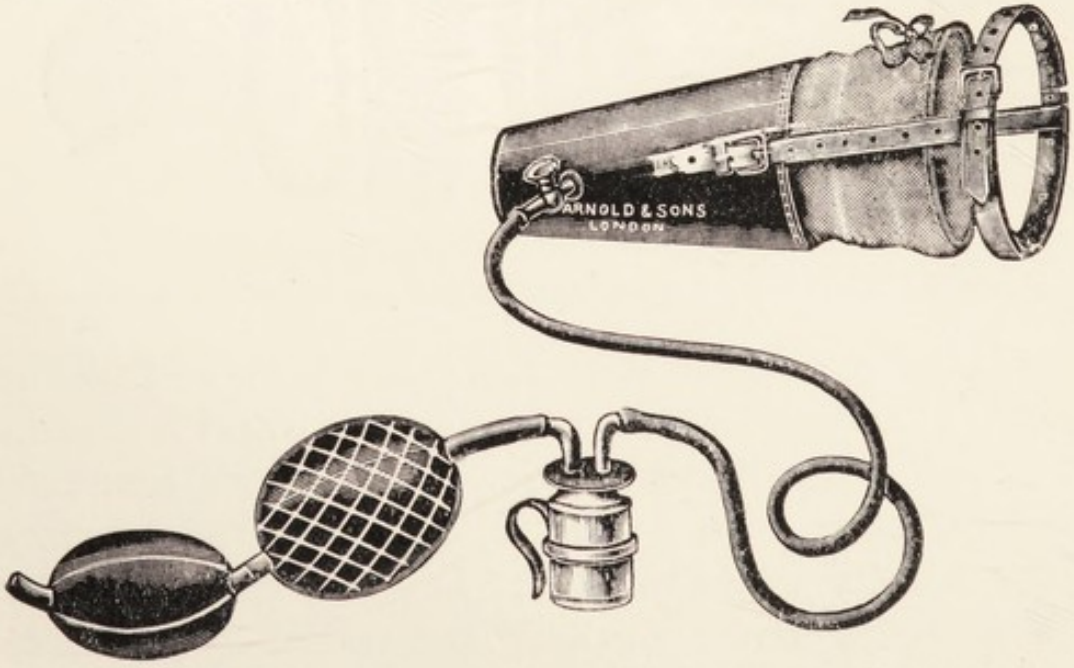

FIG. 10.—THE AUTHOR'S SECOND PATTERN OF INHALER.

cent.; and with this apparatus many thousands of small animals have been safely chloroformed.*

With the author's second pattern of inhaler the air

* More than 3 per cent. is dangerous, and for prolonged operations 1·9 to 2 per cent. answers excellently.

is driven by the aid of bellows, or from a cylinder (oxygen can also be used in this way) over the surface of the anæsthetic, and so into the mask; and a still further improvement is illustrated in Figs. 12 and 13, whereby the use of electricity and a small motor fan does away entirely with all the manual labour.

These two patterns, adapted to the use of electrical power, were shown at the meeting of the Central

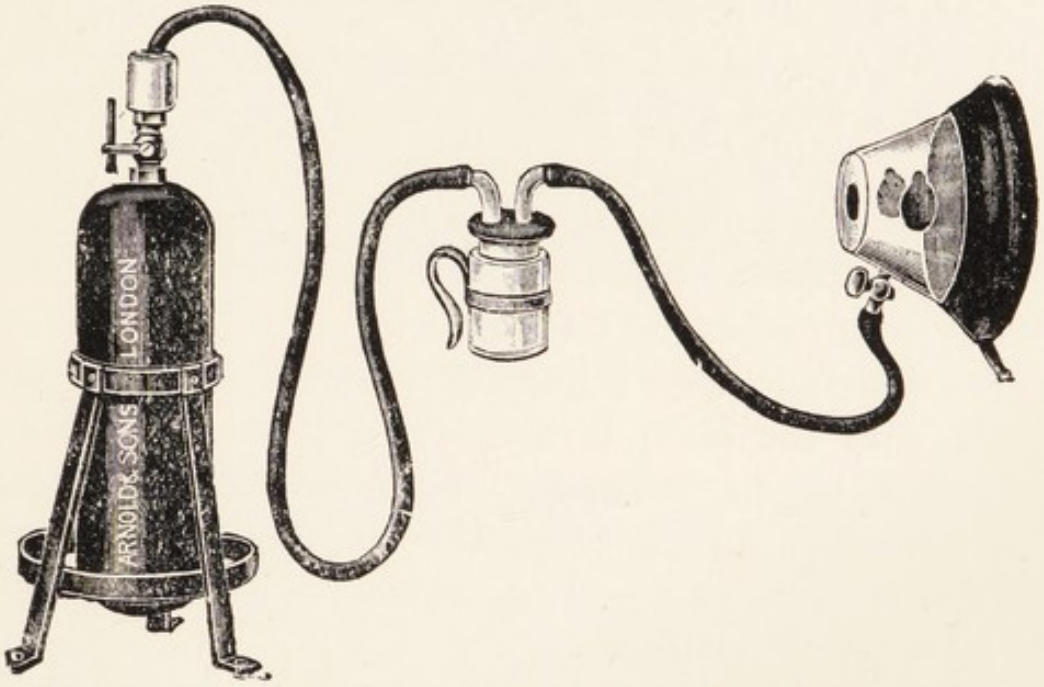

FIG. 11.—THE USE OF A CYLINDER OF COMPRESSED AIR OR OXYGEN.

Veterinary Medical Society in the winter session of 1913, and in August, 1913, at the meeting of the Anæsthetic Section of the International Medical Congress.

With either of these patterns of apparatus an exact percentage, varying from ½ per cent. (or even less) upwards, can be attained without any exertion on the part of the anæsthetist, who thus has both hands left free to manipulate the mask, and can give this his undivided attention.

Fig. 12 is designed to be used wherever electricity is laid on, and has merely to be switched on to an ordinary lamp-socket or to a plug in the wall.

Fig. 13 is designed for use in places where electric power is not laid on, and the motor is driven by an accumulator. Each is portable, and occupies no more space and has no more weight than an ordinary microscope in its box.

All these patterns of inhaler are used in much the same way, and work equally well for ether or A.C.E. mixture as for chloroform. The patient is secured in the abdominal position on an operating-table in the usual manner, and the mask fastened over the face. The anæsthetist then firmly presses the mask on to the animal's face, putting the thumb and finger of the right hand behind the angle of the jaw (*not* under the throat), and the palm of the left hand flatly but firmly over the end of the mask.

An assistant then pumps the vapour into the inhaler, and the hand is withdrawn from the end at intervals, at the discretion of the anæsthetist, until the patient is unconscious, when it may be removed altogether. After this a few pressures of the bellows at intervals will suffice.

If the patient is a young dog, cat, or monkey, it is safer to leave the end open throughout; but with a large dog, if the animal does not become anæsthetized within a reasonable time, it is preferable to hasten unconsciousness by the aid of a drop-bottle and a cloth spread over the end of the mask.

The secret of success with chloroform is to allow plenty of air and only just a sufficiency of well-diluted chloroform vapour for the purpose required.

The following completion of a report* upon 800 consecutive administrations of chloroform to canine patients demonstrates the safety of chloroform if properly administered.

* *Journal of Comparative Pathology and Therapeutics*, March, 1900, vol. xiii., part i.; *Veterinary Record*, April 19, 1902; *Lancet*, May 12, 1900.

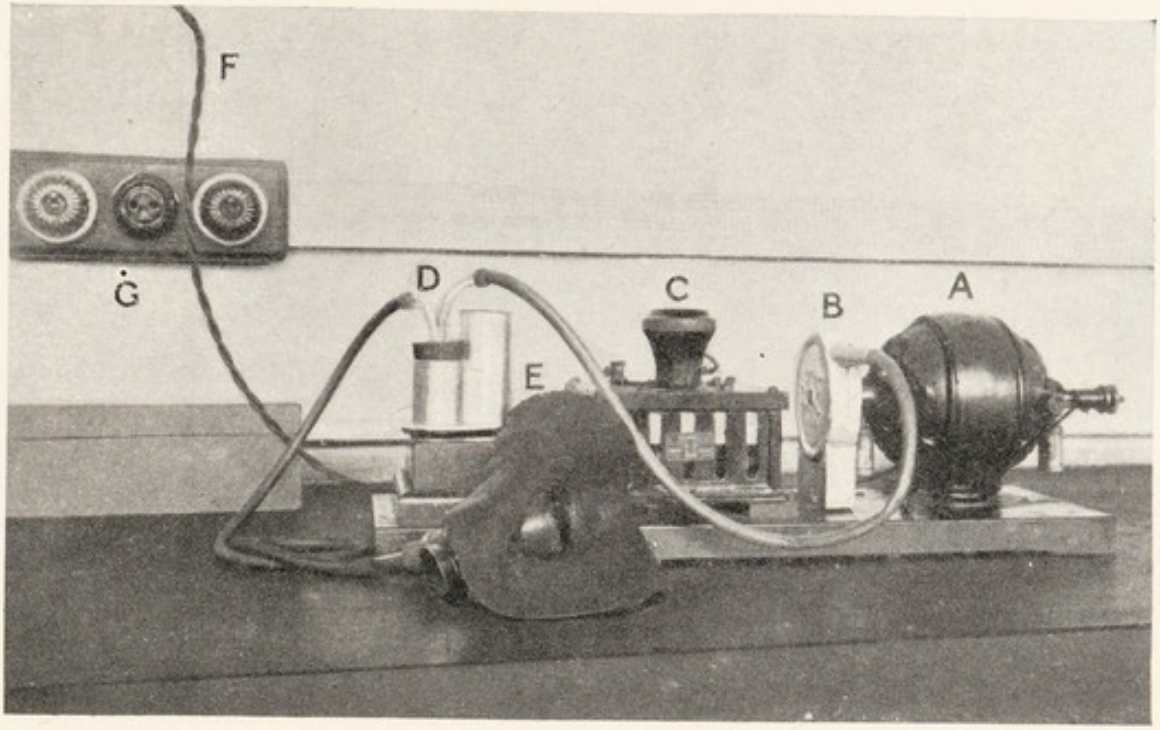

FIG. 12.—AN ELECTRICAL MOTOR AND FAN FOR THE ADMINISTRATION OF ANÆSTHETIC VAPOUR.

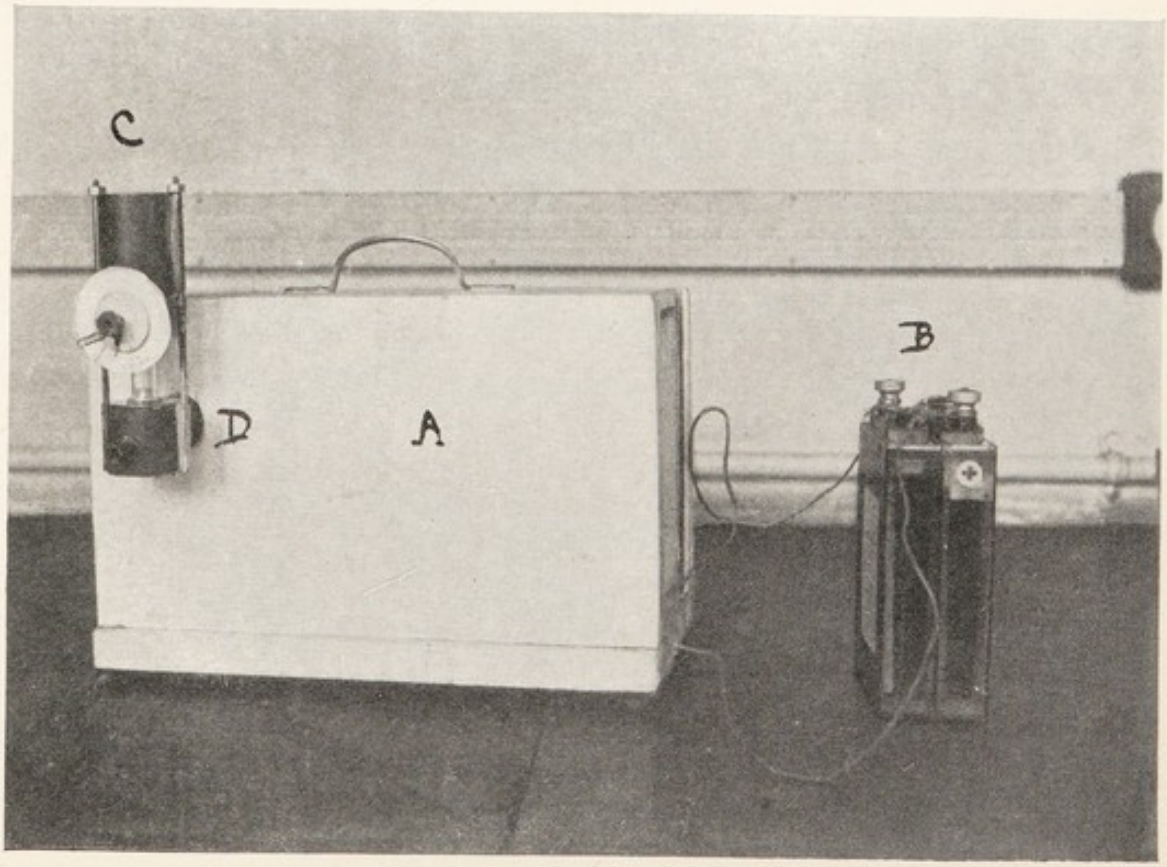

FIG. 13.—A PORTABLE ELECTRIC MOTOR FOR USE WITH AN ACCUMULATOR.

[*To face p.* 22.

Date.	*No.*	*Breed.*	*Sex.*	*Age.*	*Condition.*	*Operation.*	*Time taken to anæsthetize.*	*Period of Complete Anæsthesia.*
1898.								
June 1	501	St. Bernard	M	3 mos.	Good	Reduce fracture	4 mins.	7 mins.
,, 29	502	Retriever	M	15 mos.	Good	—	4½ mins.	8 mins.
July 14	503	Fox terrier	F	Aged	Good	Remove tumour	5 mins.	20 mins.
,, 14	504	Pug	F	4 yrs.	Fat	Oöphorectomy	2½ mins.	26 mins.
,, 15	505	Wire-haired terrier	F	5 yrs.	Six weeks pregnant	Ovaro-hysterectomy	2 mins.	28 mins.
Sept. 4	506	Manchester toy	F	3 yrs.	Pregnant	Parturition	1 min.	50 mins.
,, 7	507	Pug mongrel	M	10 mos.	Good	—	4½ mins.	11 mins.
,, 8	508	Bull terrier	M	3 mos.	Good	Operation on claws	1 min.	22 mins.
,, 8	509	Fox terrier	M	2 yrs.	Good	—	2 mins.	14 mins.
,, 8	510	Collie	F	3 mos.	Good	Amputation of leg	2 mins.	35 mins.
,, 8	511	Italian greyhound	M	12 mos.	Poor	Chorea	4 mins.	20 mins.
,, 9	512	Airedale	M	10 mos.	Good	Amputation of digits	3 mins.	20 mins.
,, 9	513	Toy terrier	F	5 yrs.	Good	Remove tumour	2 mins.	35 mins.
,, 10	514	Fox terrier	M	2 yrs.	Good	Laparotomy	3 mins.	30 mins.
,, 10	515	Toy bull terrier	F	7 mos.	Good	Amputation of leg	1½ mins.	25 mins.
,, 19	516	Fox terrier	M	Aged	Very fat	Hæmatoma of ear	3½ mins.	14 mins.
,, 19	517	Fox terrier	F	4 yrs.	Weak	Hysterectomy	2 mins.	32 mins.
,, 22	518	Manchester terrier	F	9 yrs.	Fat	—	3 mins.	9 mins.
,, 22	519	Blenheim spaniel	F	6 yrs.	Pregnant, fat	Cæsarean section	2 mins.	64 mins.
,, 26	520	Manchester terrier	M	8 mos.	Good	—	2½ mins.	13 mins.
,, 27	521	Whippet	M	10 mos.	Good	Operation on claws	3 mins.	29 mins.
,, 28	522	Setter	F	Aged	Good	Remove tumour	10 mins.	28 mins.
,, 29	523	Collie	M	10 mos.	Poor	—	8 mins.	8 mins.
Oct. 8	524	Black-and-tan terrier	M	9 mos.	Good	Fracture and reset limb	2 mins.	25 mins.
,, 8	525	Fox terrier	M	12 mos.	Very fat	Remove tumour	4 mins.	20 mins.
,, 10	526	Collie	M	—	Good	—	2 mins.	12 mins.
,, 13	527	Dalmatian	M	2 yrs.	Poor	Laparotomy	3 mins.	16 mins.

Date.	*No.*	*Breed.*	*Sex.*	*Age.*	*Condition.*	*Operation.*	*Time taken to Anæsthetize.*	*Period of Complete Anæsthesia.*
1898.								
Oct. 14	528	Fox terrier	M	5 yrs.	Poor	—	7 mins.	15 mins.
,, 22	529	Collie	M	5 yrs.	Good	—	3½ mins.	15 mins.
,, 22	530	Fox terrier	F	15 mos.	—	—	2 mins.	29 mins.
,, 25	531	Fox terrier	M	2 yrs.	Good	Remove tumour	1¾ mins.	18½ mins.
,, 25	532	Fox terrier	F	4 yrs.	Very fat	Remove tumour	3½ mins.	26 mins.
,, 27	533	Fox terrier	F	9 yrs.	Very fat	Remove tumour	4 mins.	56 mins.
,, 28	534	Toy bull terrier	F	2 yrs.	Fair	Cæsarean section	1 min.	55 mins.
,, 29	535	Fox terrier	M	3 yrs.	Good	—	2 mins.	14 mins.
,, 29	536	Bull terrier	M	18 mos.	Good	Suture wound	1½ mins.	16 mins.
Nov. 2	537	St. Bernard	M	9 wks.	Good	Pterygium	1½ mins.	8½ mins.
,, 2	538	Fox terrier	F	6 yrs.	Heavily pregnant	Hysterectomy	4½ mins.	36 mins.
,, 3	539	Toy Manchester terrier	M	8 wks.	Good	Entropium	¾ min.	17 mins.
,, 3	540	Collie	M	3 yrs.	Good	Laparotomy	3½ mins.	13 mins.
,, 4	541	Irish terrier	M	4 mos.	Good	Castration	2 mins.	2 mins.
,, 7	542	Fox terrier	M	18 mos.	Poor	—	3 mins.	5 mins.
,, 22	543	Collie	F	Aged	Good	Remove tumour	7 mins.	60 mins.
,, 24	544	Toy Manchester terrier	F	5 yrs.	Weak	Hysterectomy	2 mins.	33 mins.
,, 28	545	Fox terrier	M	4 yrs.	Good	—	—	6 mins.
,, 30	546	Fox terrier	F	2 yrs.	Good	Amputation	3 mins.	25 mins.
Dec. 1	547	Fox terrier	F	6 yrs.	Very fat	—	2 mins.	14 mins.
,, 1	548	Bulldog	M	1 yr.	Good	—	3½ mins.	7 mins.
,, 1	549	Fox terrier	F	7 yrs.	Bad	—	4 mins.	5 mins.
,, 4	550	St. Bernard	M	3 mos.	Good	Pterygium	2 mins.	9 mins.
,, 4	551	Fox terrier	M	6 yrs.	Poor	Laparotomy	2 mins.	33 mins.
,, 6	552	Bull terrier	M	5 mos.	Poor	—	4 mins.	5 mins.
,, 8	553	Collie	M	1½ yrs.	Good	Amaurosis	5 mins.	19 mins.
,, 8	554	Retriever	M	Aged	Fair	—	3½ mins.	6 mins.
,, 9	555	Setter	M	15 mos.	Poor	—	2 mins.	8 mins.

,, 9	556	Fox terrier	M	Aged	Very fat	Tumour	4 mins.	45 mins.
,, 9	557	Griffon	M	6½ mos.	Good	—	2 mins.	13 mins.
,, 10	558	Collie	M	Aged	Very fat	Castration	7 mins.	14 mins.
,, 13	559	Retriever	M	7 mos.	Good	—	2 mins.	4 mins.
,. 16	560	Fox terrier	M	2 yrs.	Poor	Paralysis	6 mins.	17 mins.
,, 19	561	Fox terrier	M	4 yrs.	Good	Fistula of anus	3 mins.	17 mins.
,, 20	562	Irish terrier	M	5 mos.	Good	—	4 mins.	3 mins.
,, 20	563	Irish terrier	F	Aged	Very fat	Tumour	4 mins.	26 mins.
1899.								
Jan. 9	564	Manchester terrier	F	6 yrs.	Good	—	2½ mins.	9 mins.
,, 9	565	Fox terrier	F	1 yr.	Good	—	5 mins.	5 mins.
,, 9	566	Fox terrier	M	2 yrs.	Good	—	1 min.	7 mins.
,, 9	567	Fox terrier	M	15 mos.	Good	—	6 mins.	15 mins.
,, 11	568	Wire-haired terrier	M	2 yrs.	Good	—	5 mins.	5 mins.
,, 13	569	Pug	M	3 yrs.	Very fat	—	4 mins.	10 mins.
,, 16	570	Retriever	F	3 yrs.	Good	Oöphorectomy	4 mins.	40 mins.
,, 17	571	Fox terrier	F	2 yrs.	Very fat	—	8 mins.	7 mins.
,, 17	572	Black and tan terrier	M	15 mos.	Good	—	3 mins.	15 mins.
,, 18	573	Maltese	M	1 yr.	Poor	—	3½ mins.	6 mins.
,, 18	574	Fox terrier	F	7 yrs.	Very fat	—	5 mins.	14 mins.
,, 21	575	Schipperke	F	7 mos.	Good	Suture wound	2 mins.	15 mins.
,, 21	576	Schipperke	F	6 mos.	Good	—	2½ mins.	16 mins.
,, 23	577	Spaniel	F	15 yrs.	Good	—	2½ mins.	13 mins.
,, 24	578	Manchester terrier	M	2 mos.	Good	—	½ min.	18 mins.
,, 24	579	Collie	F	Aged	Good	—	9 mins.	14 mins.
,, 25	580	Dachshund	F	6 mos.	Good	Umbilical hernia	2 mins.	15 mins.
,, 25	581	Fox terrier	F	6 yrs.	Good	Inguinal hernia	4½ mins.	9 mins.
,, 27	582	Fox terrier	F	7 mos.	Good	To examine fracture	3 mins.	7 mins.
Feb. 3	583	Pug mongrel	F	Aged	Good	—	2 mins.	18 mins.
,, 4	584	Retriever	M	8 yrs.	Emaciated	For intestinal concretion	3½ mins.	136 mins.
,, 6	585	Fox terrier	M	Aged	Good	—	2½ mins.	5 mins.
,, 7	586	Spaniel	F	6 mos.	Good	Oöphorectomy	2½ mins.	40 mins.
,, 11	587	Great Dane	M	2 yrs.	Good	Operate on ears.	5 mins.	25 mins.
, 13	588	Collie	M	2 yrs.	Poor and weak	—	3 mins.	—

Date.	*No.*	*Breed.*	*Sex.*	*Age.*	*Condition.*	*Operation.*	*Time taken to Anæsthetize.*	*Period of Complete Anæsthesia.*
1899.								
Feb. 13	589	Fox terrier	M	3 yrs.	Good	—	2 mins.	6 mins.
,, 14	590	Fox terrier	M	Aged	Good	Extract teeth	2½ mins.	9 mins.
,, 17	591	Fox terrier	M	7 mos.	Good	For Roentgen rays	1½ mins.	20 mins.
,, 28	592	Fox terrier	F	7 yrs.	Good	Remove tumour	2 mins.	18 mins.
,, 28	593	Fox terrier	F	Aged	Good	Remove tumour	2½ mins.	25 mins.
March 6	594	Blenheim spaniel	F	4 yrs.	Good	Dystokia	3 mins.	30 mins.
,, 6	595	Terrier	M	10½ yrs.	Fat, asthma	—	3 mins.	6 mins.
,, 7	596	Retriever	M	Aged	Good	—	9 mins.	4 mins.
,, 8	597	Irish terrier	F	6 mos.	Poor	Oöphorectomy	3½ mins.	2 mins.
,, 12	598	Fox terrier	F	3 yrs.	Good	Inguinal hernia	3 mins.	70 mins.
,, 15	599	Fox terrier	F	7 yrs.	Good	Inguinal hernia	2½ mins.	48 mins.
,, 20	600	Irish terrier	F	—	Good	Removal of tumour	5 mins.	45 mins.
,, 21	601	Fox terrier	—	—	Good	Reduce fracture	5 mins.	9 mins.
,, 21	602	Fox terrier	F	5 yrs.	Good	Remove tumour	6 mins.	40 mins.
,, 21	603	Pug	F	Aged	Very fat	—	1½ mins.	13 mins.
,, 25	604	Fox terrier	M	12 mos.	Good	—	2½ mins.	10 mins.
April 4	605	Whippet	M	6 mos.	Good	Dislocated shoulder	4 mins.	6 mins.
,, 4	606	Fox terrier	F	3 yrs.	Good	—	2½ mins.	7 mins.
,, 6	607	Yorkshire terrier	M	6 yrs.	Good	Lithotomy	4 mins.	35 mins.
,, 6	608	Welsh terrier	F	4 yrs.	Good	—	3 mins.	5 mins.
,, 6	609	Retriever	M	3 yrs.	Weak	Laparo-enterotomy	4 mins.	1 hour
,, 10	610	Fox terrier	F	7 mos.	Weak	Laparo-gastrotomy	2 mins.	35 mins.
,, 13	611	Irish terrier	F	18 mos.	Good	Oöphorectomy	4 mins.	47 mins.
,, 15	612	Dalmatian	M	3 yrs.	Good	—	3 mins.	10 mins.
,, 19	613	Prince Charles	M	Aged	Weak	Lithotomy	4 mins.	37 mins.
,, 19	614	Toy Pomeranian	F	12 yrs.	Good	Remove tumour	2½ mins.	9 mins.
,, 25	615	Wire-haired terrier	M	3 yrs.	Good	Laparotomy	4 mins.	17 mins.
,, 28	616	Wire-haired terrier	M	4 yrs.	Good	—	3½ mins.	4 mins.
May 3	617	Fox terrier	M	10 mos.	Good	Suture gastrocnemius tendon	2 mins.	30 mins.

,,	5	618	Toy Manchester	F	9 yrs.	Good	Inguinal hernia	1 min.	32 mins.
,,	6	619	Great Dane	M	3 yrs.	Good	Amputate tail	12 mins.	8 mins.
,,	9	620	Fox terrier	F	5 yrs.	Fat	Mammary tumour	2¼ mins.	19 mins.
,,	10	621	Retriever	F	—	—	Mammary tumour	2 mins.	12 mins.
,,	16	622	Dachshund	F	5 yrs.	Poor	—	2½ mins.	6 mins.
,,	18	623	Fox terrier	F	12 yrs.	Good	—	1½ mins.	6 mins.
,,	23	624	Retriever	M	10 yrs.	Good	Laparotomy	5 mins.	55 mins.
,,	25	625	Fox terrier	F	6 yrs.	Fat	Reduce inguinal hernia	4 mins.	40 mins.
,,	26	626	Collie	M	Aged	Good	Amputation of toe	4 mins.	18 mins.
,,	29	627	Spaniel	M	Aged	Good	Castration	4 mins.	8 mins.
,,	30	628	Great Dane	—	—	Good	Amputate tail	12 mins.	20 mins.
June	2	629	Retriever	M	Aged	Good	Laparo-enterotomy	2 mins.	53 mins.
,,	2	630	Collie	M	—	Good	Amputate paw	5 mins.	49 mins.
,,	3	631	Toy bull	F	2 yrs.	Weak	Ovaro-hysterectomy	2½ mins.	30 mins.
,,	5	632	Maltese terrier	F	5 yrs.	Good	—	2 mins.	12 mins.
,,	6	633	Spaniel	F	Aged	Good	Mammary tumour	5 mins.	34 mins.
,,	7	634	Toy Yorkshire	F	3 yrs.	Good	Inguinal hernia	1½ mins.	24 mins.
,,	8	635	Fox terrier	F	4 yrs.	Very fat	Mammary tumour	4 mins.	29 mins.
,,	8	636	Collie	F	10 yrs.	Very fat	—	6 mins.	5 mins.
,,	8	637	Collie	M	—	Poor	—	3 mins.	6 mins.
,,	26	638	Fox terrier	F	4 yrs.	Poor	Cataract	3 mins.	—
,,	27	639	Aberdeen terrier	M	9 mos.	Good	Extract teeth	2 mins.	2 mins.
,,	27	640	Bull	M	12 yrs.	Good	—	3½ mins.	6 mins.
,,	28	641	Toy Manchester	F	9 yrs.	Fat	—	2 mins.	14 mins.
,,	28	642	Toy Manchester	F	6 yrs.	Good	Inguinal hernia	5 mins.	15 mins.
,,	29	643	Retriever	M	Aged	Good	—	4 mins.	5 mins.
,,	30	644	Fox terrier	F	3 yrs.	Good	—	2½ mins.	6 mins.
July	1	645	Pomeranian	M	9 yrs.	Good	Amaurosis	1½ mins.	13 mins.
,,	1	646	Mongrel Airedale	M	4 yrs.	Good	Amputate ear flap	4 mins.	5 mins.
,,	3	647	Toy Manchester	F	6 yrs.	Good	Inguinal hernia	3½ mins.	21 mins.
,,	4	648	Irish terrier	M	7 mos.	Poor	—	2 mins.	5 mins.
,,	4	649	Fox terrier	M	—	Good	—	2 mins.	12 mins.
,,	13	650	Fox terrier	M	7 yrs.	Fat	Laparotomy	2 mins.	24 mins.
,,	14	651	Collie	M	8 yrs.	Poor	—	2 mins.	3 mins.
,,	16	652	Schipperke	M	1 yr.	Good	Fistula in neck	1½ mins.	29 mins.

Date.	*No.*	*Breed.*	*Sex.*	*Age.*	*Condition.*	*Operation.*	*Time taken to Anæsthetize.*	*Period of Complete Anæsthesia.*
1899.								
July 17	653	Pomeranian	M	5 yrs.	Good	—	3 mins.	8 mins.
,, 17	654	Fox terrier	F	—	Good	—	1½ mins.	12 mins.
,, 17	655	Fox terrier	M	Aged	Good	Lithotomy	2½ mins.	9 mins.
,, 22	656	Fox terrier	F	15 mos.	Good	Ovaro-hysterectomy	4 mins.	17½ mins.
,, 24	657	Spaniel	F	12 yrs.	Good	Remove tumour	3 mins.	17 mins.
,, 24	658	Mongrel	F	—	Good	Tumour	7 mins.	35 mins.
,, 24	659	Terrier	M	10 mos.	Good	Cryptorchid castration	2 mins.	17 mins.
,, 24	660	Toy Manchester terrier	F	—	Good	—	3 mins.	5 mins.
,, 27	661	Fox terrier	F	4 yrs.	Poor	Cataract	2 mins.	3½ mins.
,, 27	662	Manchester terrier	M	9 mos.	Poor	Extract teeth	1 min.	3 mins.
,, 31	663	Fox terrier	F	8 yrs.	Good	—	1½ mins.	4 mins.
,, 31	664	Collie	M	6 yrs.	Good	Hæmatoma of ear	3 mins.	13 mins.
Aug. 1	665	Wire-haired terrier	M	10 mos.	Good	—	2 mins.	3 mins.
,, 1	666	Fox terrier	M	5 yrs.	Poor	Laparo-enterotomy	2 mins.	18 mins.
,, 2	667	Fox terrier	F	4 mos.	Good	Reduce fracture	1 min.	15 mins.
,, 2	668	Fox terrier	M	5 mos.	Good	—	1½ mins.	12 mins.
,, 2	669	Fox terrier	M	16 mos.	Good	Abdominal cryptorchid	2 mins.	35 mins.
,, 9	670	Bull terrier	M	4 yrs.	Good	—	2½ mins.	4 mins.
,, 10	671	Blenheim spaniel	M	14 yrs.	Poor	—	1 min.	4 mins.
,, 10	672	Pug	F	Aged	Good	Papilloma of vagina	5 mins.	12 mins.
,, 11	673	Bull terrier	M	—	Good	—	5 mins.	5 mins.
,, 11	674	Dachshund	F	5 yrs.	Good	—	1½ mins.	5½ mins.
,, 12	675	Retriever	M	7½ yrs.	Fair	—	5 mins.	4 mins.
,, 12	676	Collie	M	8 mos.	Poor	—	4 mins.	8 mins.
,, 13	677	Fox terrier	F	Aged	Bad, asthma	—	2 mins.	5 mins.
,, 13	678	Fox terrier	M	9 mos.	Good	—	5 mins.	2½ mins.
,, 14	679	Irish terrier	M	7 mos.	Good	Fracture	2 mins.	4 mins.
,, 14	680	Toy Manchester terrier	F	18 mos.	Weak	Dystokia	1 min.	14 mins.
,, 15	681	Maltese terrier	M	4 yrs.	Good	Extract teeth	2 mins.	6 mins.

,, 16	682	Collie	M	9 mos.	Good	—	3 mins.	4 mins.
,, 17	683	Retriever	F	6 mos.	Poor	Laparotomy	1½ mins.	2 hours
,, 22	684	Manchester terrier	M	9 wks.	Good	Reduce dislocation	¾ min.	9 mins.
,, 22	685	Fox terrier	M	13 yrs.	Poor	Extract teeth	4 mins.	5 mins.
,, 23	686	Pug	M	Aged	Very fat	—	3 mins.	6 mins.
,, 23	687	Fox terrier	F	5 yrs.	Good	—	2 mins.	12 mins.
,, 23	688	Toy Manchester terrier	F	9 wks.	Good	To wire fracture	1½ mins.	26 mins.
,, 23	689	Spaniel	M	12 yrs.	Bad	Extract teeth	1½ mins.	4 mins.
,, 23	690	Wire-haired terrier	F	5 yrs.	Good	Ovaro-hysterectomy	1½ mins.	42 mins.
Oct. 7	691	Manchester terrier	M	Aged	Good	—	4½ mins.	7 mins.
,, 19	692	Bulldog	F	5 yrs.	Poor	Oöphorectomy	2 mins.	43 mins.
,, 26	693	Fox terrier	M	3 yrs.	Good	—	2½ mins.	6 mins.
,, 26	694	Irish terrier	M	15 yrs.	Poor	—	4 mins.	2 mins.
,, 30	695	Manchester terrier	M	2 yrs.	Poor	Laparo-enterotomy	4 mins.	69 mins.
Nov. 1	696	Lurcher	M	3 yrs.	Fair	Paralysis	5 mins.	10 mins.
,, 3	697	Fox terrier	M	4 yrs.	Good	—	5 mins.	5 mins.
,, 3	698	Collie	M	Aged	Good	—	3 mins.	5 mins.
,, 8	699	Manchester terrier	F	9 yrs.	Good	Mammary tumour	5 mins.	75 mins.
,, 8	700	Collie	M	8 mos.	Good	—	4 mins.	5 mins.
,, 10	701	Irish terrier	M	3 yrs.	Good	—	3 mins.	5 mins.
,, 11	702	Scotch terrier	F	3 yrs.	Good	Mammary tumour	3 mins.	15 mins.
,, 12	703	Manchester terrier	M	3 yrs.	Good	Reduce dislocation	3 mins.	11½ mins.
,, 14	704	Mongrel	F	Aged	Good	Remove tumour	4 mins.	15 mins.
,, 16	705	Bulldog	F	3 yrs.	Poor	Oöphorectomy	12 mins.	30 mins.
,, 22	706	Fox terrier	M	4 yrs.	—	Remove tumour	3 mins.	48 mins.
,, 22	707	Retriever	M	Aged	Good	—	12 mins.	8 mins.
,, 23	708	Maltese terrier	M	Aged	Bad, asthma	—	5 mins.	7 mins.
,, 25	709	Irish terrier	F	7 yrs.	Good	Oöphorectomy	3 mins.	32 mins.
,, 29	710	Fox terrier	F	Aged	—	Remove tumour	10 mins.	50 mins.
Dec. 6	711	Manchester terrier	M	2 yrs.	—	—	4 mins.	9 mins.
,, 6	712	Fox terrier	F	Aged	Very fat	Remove tumour	—	27 mins.
,, 9	713	Skye terrier	F	15 yrs.	Weak	Remove tumour	2 mins.	7 mins.
,, 9	714	Retriever	M	2 yrs.	Good	Castration	12 mins.	18 mins.
,, 24	715	Schipperke	M	5½ mos.	Good	Remove tumour	1 min.	6 mins.
,, 30	716	Irish terrier	M	18 mos.	Good	For hæmatoma	5 mins.	60 mins.

Previously* I had published notes upon 500 consecutive chloroformizations of canine patients by the aid of a certain pattern of inhaler (Fig. 9) and a rational method of administration. Out of these only one death had occurred, and two other patients exhibited symptoms of danger, but recovered. The main object of the observations was to do away—at all events, in the minds of the members of the veterinary profession—with the prevalent idea that the dog could not be chloroformed with any reasonable degree of safety. This idea was persistently taught in the Colleges even as recently as 1895, and, although I do not think that the present-day graduates will hesitate to administer this agent before performing any painful operation where a general anæsthetic is needed, it must be confessed that old ideas die hard. It is in order that the more general use of chloroform may be furthered that the records on pp. 23 to 31 have been kept.

No.	*Breed.*	*Sex.*	*Age.*	*Time taken to anæsthetize.*	*Time kept Under Anæsthesia.*
717	Fox terrier	M	Aged	—	12 mins.
718	Wire-haired terrier	M	Aged	6 mins.	12 mins.
719	Bull terrier	F	Aged	7 mins.	15 mins.
720	Fox terrier	M	1½ yrs.	2 mins.	22 mins.
721	Fox terrier	M	Aged	6 mins.	10 mins.
722	Irish terrier	F	1½ yrs.	10 mins.	30 mins.
723	Fox terrier	F	1½ yrs.	5½ mins.	40 mins.
724	Irish terrier	M	Aged	7 mins.	17 mins.
725	Fox terrier	M	2 yrs.	10 mins.	11 mins.
726	Irish terrier	F	1 yr.	8 mins.	11 mins.
727	Fox terrier	F	Aged	3 mins.	10 mins.
728	Lurcher	F	Aged	6½ mins.	10 mins.
729	Mongrel	F	18 mos.	3 mins.	10 mins.
730	Fox terrier	M	5 mos.	4 mins.	10 mins.
731	Fox terrier	M	Aged	3½ mins.	10 mins.
732	Fox terrier	M	2 yrs.	3 mins.	10 mins.
733	Lurcher	M	9 mos.	2½ mins.	10 mins.
734	Fox terrier	M	Aged	2½ mins.	10 mins.
735	Mongrel	F	Aged	2 mins.	10 mins.
736	Mongrel	F	2 mos.	1 min.	10 mins.
737	Fox terrier	F	Aged	2¾ mins.	10 mins.
738	Lurcher	M	12 mos.	4 mins.	10 mins.
739	Manchester terrier	M	12 mos.	1¾ mins.	10 mins.
740	Spaniel	F	12 mos.	2 mins.	10 mins.
741	Fox terrier	M	12 mos.	1½ mins.	10 mins.
742	Lurcher	M	Aged	2 mins.	10 mins.
743	Wire-haired terrier	F	Aged	1½ mins.	10 mins.
744	Collie	M	Aged	1½ mins.	10 mins.
745	Collie	M	18 mos.	3 mins.	10 mins.

* *Journal of Comparative Pathology and Therapeutics*, vol. viii., p. 287; vol. xi., p. 114; *Veterinary Record*, vol. x., p. 163.

No.	*Breed.*	*Sex.*	*Age.*	*Time taken to Anæsthetize.*	*Time kept Under Anæsthesia.*
746	Collie	F	2 yrs.	2 mins.	9 mins.
747	Irish terrier	M	1 yr.	3½ mins.	12 mins.
748	Fox terrier	M	1 yr.	2½ mins.	12 mins.
749	Airedale	M	1 yr.	2½ mins.	10 mins.
750	Collie	M	9 mos.	2½ mins.	10 mins.
751	Mongrel	M	2 yrs.	1½ mins.	15 mins.
752	Fox terrier	M	2 mos.	1 min.	11 mins.
753	Spaniel	M	2 yrs.	2¼ mins.	10 mins.
754	Beagle	M	5 yrs.	2 mins.	10 mins.
755	Retriever	M	6 yrs.	1¾ mins.	8 mins.
756	Sheep dog	F	2½ yrs.	1½ mins.	10 mins.
757	Fox terrier	F	1 yr.	1 min.	10 mins.
758	Mongrel	M	1 yr.	2 mins.	10 mins.
759	Fox terrier	M	2 yrs.	1½ mins.	10 mins.
760	Wire-haired terrier	M	1 yr.	1½ mins.	10 mins.
761	Manchester terrier	M	1 yr.	2 mins.	10 mins.
762	Irish terrier	M	3 yrs.	2½ mins.	10 mins.
763	Fox terrier	F	2 yrs.	4 mins.	12 mins.
764	Bull terrier	M	1 yr.	3½ mins.	8 mins.
765	Airedale	M	2 yrs.	2½ mins.	10 mins.
766	Wire-haired terrier	F	9 mos.	3 mins.	10 mins.
767	Fox terrier	M	1 yr.	3 mins.	10 mins.
768	Whippet	M	1 yr.	4½ mins.	6 mins.
769	Fox terrier	M	4 yrs.	3 mins.	14 mins.
770	Pug	F	Aged	3½ mins.	10 mins.
771	Wire-haired terrier	F	1 yr.	2½ mins.	13 mins.
772	Fox terrier	M	1 yr.	3½ mins.	10 mins.
773	Fox terrier	M	5 yrs.	3½ mins.	10 mins.
774	Irish terrier	M	1 yr.	2½ mins.	10 mins.
775	Fox terrier	F	18 mos.	2½ mins.	10 mins.
776	Collie	M	8 mos.	4 mins.	35 mins.
777	Irish terrier	M	2 yrs.	4 mins.	10 mins.
778	Fox terrier	F	1 yr.	5 mins.	14 mins.
779	Collie	M	5 mos.	4 mins.	30 mins.
780	Mongrel	M	Aged	3 mins.	15 mins.
781	Welsh terrier	M	1 yr.	3 mins.	10 mins.
782	Scotch terrier	F	Aged	3 mins.	10 mins.
783	Yorkshire terrier	M	Aged	4 mins.	20 mins.
784	Fox terrier	M	1 yr.	3 mins.	8 mins.
785	Manchester terrier	M	2 yrs.	2 mins.	10 mins.
786	Wire-haired terrier	M	Aged	3 mins.	15 mins.
787	Fox terrier	F	2 yrs.	5 mins.	10 mins.
788	Mongrel	M	Aged	3 mins.	10 mins.
789	Fox terrier	M	Aged	3 mins.	15 mins.
790	Mongrel	F	1 yr.	4 mins.	10 mins.
791	Fox terrier	F	2 yrs.	3 mins.	10 mins.
792	Beagle	M	Aged	3 mins.	15 mins.
793	Manchester terrier	M	1 yr.	2¾ mins.	15 mins.
794	Bull	F	—	5 mins.	20 mins.
795	Toy Manchester	M	—	3 mins.	6 mins.
796	Mongrel	M	1 yr.	4 mins.	4 mins.
797	Mongrel	F	—	4 mins.	12 mins.
798	Fox terrier	—	Aged	5 mins.	5 mins.
799	Fox terrier	—	5 yrs.	4 mins.	10 mins.
800	Pug	M	6 mos.	2½ mins.	14 mins.

For the notes of the cases on pp. 30, 31, which were consecutive and not in any way chosen, I am indebted to Messrs. W. Anderson and S. M. Woodward, M.R.C.V.S., and Mr. John Hobday, a Class C student, who anæsthetized the patients during 1898 and 1899.

Out of the 300 cases recorded on pp. 23-33 only two deaths occurred, and these were fully accounted for on post-mortem examination.

Case 504.—A fat pug, suffering from ulcerating tumours of the vagina. Oöphorectomy was performed, and, unfortunately, the tumours were removed and the vagina curetted at the same time. One minute after the chloroform had been taken away the respirations suddenly ceased. Artificial respiration was applied, a full medicinal dose of Scheele's hydrocyanic acid given on the back of the tongue, and ammonia vapour applied to the nostrils. Breathing recommenced, but eventually ceased again, and death took place. I think that death in this case was probably due to shock, as it was a very severe test to perform the two operations at the same time.

In Case 549 the animal was observed beforehand to be in very bad condition, and respirations suddenly ceased after anæsthesia had been maintained for five minutes, the heart distinctly beating for fifteen seconds later. Antidotes were not placed ready for use, but artificial respiration was attempted, although without success. Post-mortem examination, made by Professor M'Fadyean, revealed well-marked tuberculous lesions in the heart, lungs, diaphragm, liver, bronchial glands, and mesentery. The growths on the pericardium had caused adhesions to form between the latter and the heart itself.

In seven other cases it was found necessary to resort to antidotal measures.

In Case 527, a Dalmatian upon which laparotomy was being performed, the breathing suddenly ceased after the animal had been under for sixteen minutes. The mask was removed as soon as this was observed, but exactly one minute had elapsed before antidotal treatment had really commenced. Artificial respiration was applied, a full medicinal dose of Scheele's hydrocyanic acid was put on the tongue, and ammonia vapour applied to the nostrils. There were no signs of returning life for four minutes, when breathing again commenced, and five minutes after this was quite normal; recovery was permanent.

In Case 588, a collie, weak and out of condition, respiration ceased within half a minute after anæsthesia had taken place.

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Artificial respiration was at once applied, the mask being removed and ammonia vapour held to the nostrils. Respiration recommenced two and a half minutes later, and the animal made a good recovery.

In Case 591, a fox terrier puppy, whilst anæsthetized for close examination of a damaged pelvis by the Roentgen rays, suddenly ceased breathing, due partly to the fact that the anæsthetist gave the anæsthetic too vigorously when the patient was under, and partly to the fact of the place where the operation was performed being very hot and much confined. The patient was moved into the fresh air, hydrocyanic acid was administered as quickly as possible on the tongue, and ammonia vapour held to the nostrils, artificial respiration being practised at the same time. After a lapse of two minutes, breathing commenced, and the dog made a good recovery.

In Case 597 the patient was also a pup, and owing to the proper apparatus being away, an improvised one of the same pattern, which did not work as well as it ought to have done, was used. After being under chloroform for two minutes, respirations suddenly ceased; 1 minim of Scheele's hydrocyanic acid was placed on the tongue, ammonia vapour applied to the nostrils, and artificial respiration applied. Recovery soon took place, and the operation was completed under ether.

In Case 638 the respiration ceased after the animal had been anæsthetized for one minute. Two minims of Scheele's hydrocyanic acid were placed on the tongue about thirty seconds later, and artificial respiration applied. Fully three minutes elapsed before breathing recommenced, but the patient made a good recovery.

In Case 688 the patient was a toy Manchester terrier puppy. Respiration suddenly ceased after twenty-six minutes of anæsthesia. The administration of 1 minim of Scheele's hydrocyanic acid, ammonia to the nostrils, and artificial respiration soon brought about a satisfactory recovery; the breathing recommenced in forty-five seconds.

In Case 689 the patient was very old and in bad condition. Respiration ceased suddenly just as complete anæsthesia took place. Two minims of Scheele's hydrocyanic acid on the tongue, ammonia vapour to the nostrils, and artificial respiration soon brought about restoration and recovery.

In only one instance (Case 705) did vomiting occur.

In Cases 569, 595, 619, 643, 646, and 714 the action of the apparatus was aided by the careful use of a little chloroform sprinkled on wadding and placed in the end of the mask.

The Cases here recorded are not in any way selected, but run consecutively as occasion arose for the anæsthetization of the patients. The students were the anæsthetists, and most of them had never seen a dog chloroformed before entering the College. Methylated chloroform was administered, and any that was left was returned into the bottle to be used over again. I think that, when these things are taken into consideration, death in only three instances (all but one fully explained on post-mortem examination) and signs of danger shown in only nine other cases, the results are highly satisfactory. Had the patients been selected and prepared, and anæsthetized with the purest chloroform administered by skilled anæsthetists, the percentage of fatalities must have been much smaller still.

The Cat and Monkey.

For the cat and monkey A.C.E. mixture or ether form the safest anæsthetic; and if chloroform is used with an inhaler, the end is better left unclosed and the vapour given slowly, especially at first.

The method of administration is much the same as with the dog, and four or five minutes should be allowed for the production of complete anæsthesia.

The vapour inhaler method is, in my opinion, much the safer method with each of those animals, as with the open method and drop-bottle it is unhappily easy, even for an expert, to administer an overdose, especially if the patient resents the whole proceeding and struggles violently.

In the case of the cat an ordinary bell-jar, under which the animal is placed with 2 or 3 drachms of chloroform, is very useful for producing anæsthesia for operations which only take a few minutes.

PLATE III.

FIG. 14.—OSTRICH READY TO BE CAST, SHOWING THE THONG AROUND THE LEGS AND AN ORDINARY PLUCKING CAP ON THE HEAD.*

* Figs. 14 and 15 are taken from "Castration and Ovariotomy," published by Messrs. W. and A. K. Johnston, Edinburgh. (Photographs by Mr. Elley, M.R.C.V.S.).

[*To face p.* 34.

Wild and Semi-domesticated Animals.

With deer, antelopes, and animals of that class, chloroform is used in much the same manner as with the horse, care being taken that no food is given to the patient for at least twenty-four hours prior to the operation. Any of the local anæsthetics can be chosen at the discretion of the operator.

With lions, tigers, and wild animals of that kind, a very strong and specially constructed air-tight box is made, and they are driven or coaxed into this. Chloroform is then introduced on cotton-wool or a sponge in a tray at the top of the box, and kept there until the patient succumbs to its influence. If working with a local anæsthetic, any of these which the operator prefers may be used.

The Bird.

Male ostriches and cockerels are sometimes caponed, whilst the hen birds also have their ovarium removed; and although a local anæsthetic is usually all that is needed in the smaller birds, for the ostrich chloroform is preferable. The method of application is by means of a canvas bag pulled over the head, the chloroform being given slowly and carefully from a drop-bottle.

In South Africa Mr. Stanley Elley, M.R.C.V.S., has chloroformed several thousands of male and female ostriches for these abdominal operations with excellent results. In the case of the ostrich, the bird is first cast and secured on the ground, whilst in the domestic fowl it is customary to spread the bird out on the table by the aid of two loops of rope or tape to

which half a brick or a bottle of water is attached as a weight, one being put around the wings, and the other around the legs.

An ordinary canine operating-table may be used, or the bird can be spread out into the required position by the aid of pieces of tape attached to nails temporarily driven in the edges of the table.

PLATE IV.

FIG. 15.—ADMINISTERING CHLOROFORM TO AN OSTRICH.

[*To face p.* 36.

CHAPTER V

STAGES OF ANÆSTHESIA

WHETHER an inhaler is used, or whether the open method is applied, there is usually a preliminary stage of struggling, the animal naturally objecting to the fact of being compelled to inhale a strange vapour. This lasts for perhaps a couple of minutes, during which time the anæsthetist endeavours to soothe the patient's fears. When the vapour begins to show its effect, a stage of involuntary excitement follows, and perhaps the sphincters may become relaxed. This lasts for about two or three minutes longer, when the struggles begin slowly to subside, and unconsciousness, commencing at the hind-quarters, slowly supervenes. The tail drops first and becomes limp, then the hind-quarters gradually relax, and finally the head drops. In the dog this stage is the usual one to be reached, but in the horse a sufficient degree of unconsciousness to pain can be attained for small and quick operations without pushing the anæsthetic quite so far. This is the stage of safe anæsthesia, and if the anæsthesia is pushed farther one enters the danger zone.

Symptoms of danger are shown when the animal begins to breathe stertorously, or if respiration becomes at all shallow or irregular, or stops suddenly. The respiration is the chief thing for the anæsthetist to watch; for although the pulse is also a guide, it is

not so reliable as the respiration as a sign of warning that danger is at hand.

As a general rule, a horse takes ten or twelve minutes to reach the safe stage of anæsthesia. A dog up to the size of a terrier, four to six minutes; whilst a larger dog (such as a St. Bernard or retriever) from six to ten minutes, when using either of the inhalers in Figs. 9 or 10. Cats and monkeys, four to six minutes.

It is unsafe to press the anæsthetic so that they are deeply anæsthetized in less time than this.

CHAPTER VI

ANTIDOTAL TREATMENT

Upon the **first sign of danger** the administration should be stopped, the mask removed, and all restraint taken off. Artificial respiration should be started; the tongue should be pulled well forward and worked rhythmically, and the back of the throat cleared as much as possible. As much fresh air should be given as can be managed, and strong ammonia vapour (liquor ammon. fort.) held to the nostrils, whilst a full medicinal dose of **Scheele's hydrocyanic acid** should be given immediately, either on the tongue or hypodermically.* There is no quicker stimulant to the respiratory centre than this drug, and if once the respiration can be stimulated to start afresh, it can usually be maintained by artificial respiration. The dose should be a *full medicinal* one. In the horse I have generally used from ʒss. to ʒi. hypodermically; in the dog, from ♏i. to ♏v. on the tongue; in the cat, ♏i. or ♏ii., also on the tongue.†

For the performance of **artificial respiration** in the horse, the ribs over the thorax should be compressed rhythmically by throwing the weight of the operator's body upon the palms of the hands placed over them;

* *Lancet* (Hobday), January 1, 1898; *Journal of Comparative Pathology and Therapeutics*, vol. xi., p. 101; L. S. Backus, New York State Veterinary College Physiology Reports.

† See pp. 32, 33.

or, better still, in a heavy horse, this act is more effectually carried out if a man stands upon the thorax and raises his legs and body up and down, being supported in his position by a colleague.

FIG. 16. — DROP-BOTTLE FOR THE ANTIDOTAL ADMINISTRATION OF HYDROCYANIC ACID TO THE TONGUE.

In the dog and cat the best method is to compress the ribs by a series of short, sharp movements of the hand or fingers. In all animals it is better to try to have the patient lying with the left side uppermost, as in this position the heart has the least pressure upon it, and is nearest to the stimulating effect of the fingers.

Other antidotes which may be used are **ammonia vapour, strychnine,** and **nitrite of amyl.**

In using strychnine with the dog and cat, the greatest care must be taken, as these animals have an extraordinary susceptibility for this drug.

My own experience of it for antidotal purposes in these animals has not been good, and the results with hydrocyanic acid have been infinitely better.

Nitrite of amyl is used by application under the nostrils, where it is inhaled in much the same way as ammonia vapour. Comparing its effects with those of the latter, experience teaches that, of the two, the strong ammonia is the more reliable.

CHAPTER VII

LOCAL ANÆSTHETICS

Of drugs which act as local anæsthetics we have now an excellent choice. The chief point to consider with the smaller animals is the relative toxicity of the drug; and of this the anæsthetist ough to make himself well acquainted before making the application, especially if this is to be done hypodermically.

The local anæsthetic effect of some of these drugs is wonderful if only they are applied properly, *the secrets of successful application being to get the anæsthetic in the proper place, and, secondly, to allow sufficient time to elapse before commencing the operation.* By way of illustration, let us take the operation of double plantar neurectomy in the horse's leg under the anæsthesia of cocaine. Four grains of cocaine are dissolved in a drachm of sterilized water. The skin is shaved and sterilized by painting with petrol or iodine or iodized chloroform, which is allowed to dry on, and the syringe is sterilized by boiling. Half a drachm of this solution is carefully and slowly injected directly over each plantar nerve, and the horse is then allowed to wait for a full ten minutes before any attempt is made at incision. If the injection has been properly done, it is even possible to perform the operation in the standing position, although most operators still prefer to have the animal cast for other reasons. Such an injection, too, is of inestimable

value as a diagnostic test for certain lamenesses in the region of the foot and lower part of the fetlock.

Let us consider each anæsthetic in turn. We have for selection cocaine, eucaine, novocain, stovain, holocain, urea and quinine, eudrenin, codrenin, ether spray, ethyl chloride, H.M.C. mixture, and orthoform; whilst as useful adjuncts in several ways we have certain styptics, such as adrenalin, renastyptin, and suprarenin.

It is a wise precaution (and I write this from experience of several actual accidents which have come to my personal knowledge), if not using accurate tablets, and in weighing out amounts of any of the solid anæsthetics from the bulk, that the veterinary practitioner should either have it done by a qualified chemist, or *carefully* test his own scales before doing so. It is not an uncommon occurrence to find the small scales in a veterinary dispensary at least ½ grain (and often 2 or 3 grains) incorrect, and the result of such an error might mean all the difference between an anæsthetic and a toxic dose.

Cocaine.

Cocaine is a vegetable alkaloid prepared from the leaves of a plant (the *Erythroxylon coca*), and is used in the form of the hydrochloride, this being sold as a white crystalline powder or in tablets readily soluble in water. It is used either as a local application, being applied to the part with a camel-hair brush or from a drop-bottle, or injected hypodermically, in strength varying from 1 to 10 per cent. The solution, especially for hypodermic injection, should always be freshly prepared and made with sterilized water.

Schleich has shown that, by using a very fine-pointed needle and injecting the skin and tissues

underneath little by little in very fine layers, even major operations can be done painlessly. The anæsthesia which follows is very much aided by the œdema of the tissues thus produced, as each layer prepares the way for the one just below it. In fact, an anæsthesia can thus be produced by the use in this way of sodium chloride solution or even of distilled water alone.

If required to be kept for any length of time, a little boric acid ($\frac{1}{200}$ part) or salicylic acid is added. The formula of the official British Pharmacopœia—" injectio cocainæ hypodermica "—is:

℞	Cocain. hydrochlor.	grs. xxxiii.
	Acid. salicyl.	gr. ss.
	Aq. dest.	ʒvi.

A clear ten minutes should be allowed before making any incision with a scalpel; cocaine should not be boiled, as this deteriorates its value. For eyes, however, and exposed mucous surfaces such as those of the nostrils, a complete anæsthesia is present in four or five minutes. Anæsthesia lasts from about thirty to forty-five minutes on the average. It is very toxic, and a safe rule to follow is that a dose should not exceed $\frac{1}{10}$ grain per pound body weight. The operator should never allow a maximum dose of more than 10 grains to be absorbed at one time in a large animal of the size of a horse or an ox; $\frac{1}{2}$ grain for a cat or small dog; 2 grains for a dog the size of a terrier; and 4 grains for a dog the size of a Great Dane or a mastiff. These amounts are put down as the result of actual experiments made.*

* Hobday (*Journal of Comparative Pathology and Therapeutics*, 1895, vol. viii., p. 20; vol. x., p. 80); D. Kehoe, M.R.C.V.S. (Second Report of the Director of Veterinary Research, Union of South Africa, October, 1912).

Having heard of, and also personally experienced, several mishaps from the use of cocaine as a local anæsthetic in dogs, and thinking from the literature on the subject that there was room for original research, I made a large number of experiments and observations on the horse, dog, and cat, with a view to obtaining certain data which may be of clinical interest and practical value.*

The case which particularly drew my attention to the subject was that of a mongrel Blenheim spaniel, operated upon for mammary tumour.

Not being aware of the great danger of injecting too large a dose, and having been instructed to use a 10 per cent. solution, the student who was performing the operation injected subcutaneously about 20 minims in each of six or eight places, thus causing the animal to receive 12 or 16 grains of cocaine hydrochlor. The result was that the dog become frenzied and convulsed, showed all the symptoms of cocaine poisoning, and was dead within ten minutes, demonstrating very clearly the great care which ought to be exercised in dealing with such a powerful drug, and the necessity for an accurate knowledge of its toxic properties and doses; also the bad effects likely to ensue from overdoses.

That its therapeutic value as a local anæsthetic is indisputable, the following observations clearly show:

A. When applied to the Cornea of the Eye.

Case 1.—Horse. Foreign body on cornea. The animal was in great pain, totally unable to keep the eyelids open; the eyelids were very much swollen and very tender. The surface of the cornea was painted gently with a 4 per cent. solution. In two

* *Journal of Comparative Pathology and Therapeutics*, 1895, vol. viii., p. 20.

minutes there was apparent relief; in three minutes the cornea was quite insensitive, and the foreign body (a barley awn) was then removed without any pain being evinced.

CASE 2.—Cat. Acute ophthalmia, due to the presence of some irritant. The animal was secured on the operating-table and the cornea painted with a 2 per cent. solution. In four minutes the cornea was completely under the influence of the anæsthetic, and the foreign body was removed without any difficulty.

CASE 3.—Cat. Removal of membrana nictitans. Painted with a 2 per cent. solution of cocaine, the parts were insensitive in three and a half minutes, and the operation was apparently painlessly performed.

CASE 4.—Cow. Foreign body under upper eyelid. The parts were painted with a 4 per cent. aqueous solution; five minutes afterwards the offending agent was easily removed and with no manifestation of pain whatever. Yet the parts were so painful before the application of the cocaine solution that it was only after some strategy that the animal could be approached in order to paint the mucous membrane of the eyelids.

CASE 5.—Horse. Lacerated eyelids, required to be sutured. Painted with a 5 per cent. solution of cocaine for two minutes. Allowed four minutes, when the local anæsthetic effect was manifested and the operation performed without any difficulty.

CASE 6.—Dog. Wounded eyelids. Painted with 5 per cent. aqueous solution of cocaine hydrochlor., allowed five minutes, and sutured the edges together apparently without giving any pain.

CASE 7.—Pug dog. Ulcer of cornea, operation performed. Painted with 4 per cent. solution of cocaine, allowed four minutes, and no pain whatever was shown.

CASE 8.—Mongrel mastiff. Suffering from ophthalmia and photophobia due to the irritation produced by the membrana nictitans of both eyes, which were protruded and apparently paralyzed. The parts were painted with a 2 per cent. solution, and, after waiting four minutes, the operation of excising each of these was easily performed.

CASE 9.—Cat. Operation for excision of membrana nictitans of each eye. A 4 per cent. solution of cocaine hydrochlor. in water used, three minutes allowed, and the operation performed apparently without pain.

CASE 10.—Cat. One membrana nictitans apparently paralyzed and causing trouble. Painted with 2 per cent. solution of cocaine, and excised painlessly after allowing three and a half minutes to elapse.

CASE 11.—Cat. Excision of membrana nictitans. Painted with 4 per cent. solution of cocaine, allowed three minutes, and excised.

CASE 12.—Cat. Operation for excision of membrana nictitans. Four per cent. solution of cocaine used to paint the parts, two and a half minutes allowed, and the operation performed painlessly.

CASE 13.—St. Bernard. Operation for removal of membrana nictitans of each eye. The parts were painted with a camel-hair brush continuously for four and a half minutes with aqueous solution of cocaine of grs. iii. to ʒi. The membrana was then excised without the animal evincing the slightest sign of pain. That of the left eye was treated for three minutes in the same manner and excised like the other, no sign of pain whatever being evinced. The excision of the parts in each case took about forty-five seconds.

CASE 14.—Bull terrier. Removal of membrana nictitans from one eye. Painted well with 4 per cent. solution of cocaine for four minutes, excised, no evidence of pain whatever.

CASE 15.—Fox terrier. Operation for removal of tumour. Injected subcutaneously ℥xl. of 4 per cent. solution cocaine hydrochlor., five minutes, excised, no evidence of pain at all. Operation lasted from five to ten minutes.

B. When applied locally to Parts where the Skin is Thin, Tender, and denuded of Hair, its Anæsthetic Action is also manifested.

CASE 1.—St. Bernard dog. Removal of anal adenoma. Painted parts thoroughly and constantly for three or four minutes with a 10 per cent. solution (aqueous) of cocaine hydrochlor. Allowed twelve minutes, then removed by actual cautery. Observed that the skin was quite insensitive, but that when the subcutaneous tissues were interfered with pain was expressed.

CASE 2.—Applied with brush 10 per cent. aqueous solution continuously to inguinal and lower abdominal region of collie bitch. Allowed seven minutes before excising the skin, which was done without the least sign of pain being evinced.

C. As a Local Anæsthetic when injected Subcutaneously.

CASE 1.—Horse. Curb.

3.32 p.m.: Hypodermic injection of grs. vi. cocaine hydrochlor. (dissolved in ʒi. water); grs. iii. injected in each of two places about 1½ inches apart on same side of the hock, allowing for an anæsthesia of about 1½ inches around each seat of injection.

Four minutes: As there was no response to prick of a pin, the actual cautery was applied.

Eleven minutes: Operation completed. There had been no struggling throughout the operation. The twitch was removed after the cocaine had been injected.

4.10 p.m.: The same amount of cocaine was injected on the other side of the hock in two places as above.

Three minutes: No response to stimulus. Commenced operation, which was completed without any evidence of pain being manifested.

Fourteen days after: No deviation whatever from the normal, and usual effects of actual cautery.

Case 2.—Horse. Actual cautery for exostosis fetlock. Injected grs. i.ss. cocaine hydrochlor. (dissolved in water on each side of exostosis).

Four minutes: Commenced operation. Used twitch and held other leg up. Horse never even moved or showed any sign of pain.

Case 3.—Cab gelding. For operation on scirrhous cord. A 10 per cent. solution of cocaine hydrochlor. in water was injected in several places, as the animal was not considered a good subject to be placed under chloroform. This produced local anæsthesia of the skin, but not at all of the deeper structures.

Case 4.—Bay cab mare. Neurectomy for navicular disease; ℥xxx. of an aqueous 5 per cent. solution injected subcutaneously.

Ten minutes: No sensation shown when skin was incised; then ℥xx. of the same solution was poured in the subcutaneous tissues, *directly on to the nerve itself.*

Four minutes later: When the nerve was cut, the animal expressed no pain whatever.

The same method was adopted with like success on the other side.

Case 5.—Bay mare. Actual cautery applied around the fetlock-joint. Injected ℥x. of 4 per cent. solution of cocaine in each of two places over the metacarpal nerve on the left side.

Three minutes: Commenced the operation. No twitch was used; the mare did not struggle at all, and appeared to feel no pain throughout the operation.

The same process was repeated on the opposite side with a like result. No twitch was used, and no struggling occurred.

Case 6.—Cab horse gelding. Excision of elbow tumour. A 4 per cent. solution of cocaine hydrochlor. was injected subcutaneously in three places (above, below, and in the centre). After allowing five minutes, the skin was incised and the tumour removed, the animal manifesting no pain whatever during the operation.

Case 7.—Cart horse, tumour of shoulder excised. A 10 per cent. solution injected in four places, about 1 inch apart, around the tumour.

Five minutes: The skin was completely insensitive, and the animal expressed no signs of pain whatever.

Case 8.—Cab horse. Actual cautery for ringbone each fore-leg; gr. i. cocaine (in aqueous solution) was injected subcutaneously in each of four places. Actual cautery was applied, the animal evincing so sign of pain whatever throughout. The other leg, which was fired in a precisely similar manner, was not injected with cocaine. During the operation the animal struggled very much and evinced signs of pain continually.

Case 9.—Horse, actual cautery to fetlock-joint. Injected ℥xv. of a 4 per cent. solution on either side above the fetlock, immediately over the main trunk of the metacarpal nerve.

Six minutes: Commenced the operation. No twitch was used. Animal stood quite quiet without evincing the slightest symptom of pain throughout the whole operation.

Case 10.—Actual cautery for ringbone and sprain of the structures around the fetlock-joint; ℥xx. of 4 per cent. solution of cocaine injected carefully on either side of the limb, *directly* over the metacarpal nerve.

Two minutes: The operation was commenced, but the animal evinced signs of pain; a further three minutes were allowed, the operation was again commenced, and finished without any further sign being shown, the animal remaining perfectly quiet throughout. The operation lasted twenty minutes.

Case 11.—Cart horse, removal of elbow tumour. Injected ℥l. of a 4 per cent. solution of cocaine altogether—viz., ℥x. in five different places subcutaneously around the tumour.

Four minutes: Excision was commenced. No sign of pain was evinced during any period of the operation.

Case 12.—Very nervous cab mare, actual cautery for sprain of flexor tendons of both fore-limbs; ℥lxxx. of 4 per cent. solution of cocaine subcutaneously injected in four places on each limb. The animal was operated upon in the standing posture. No twitch was used, and there was no evidence of any pain.

Seven minutes were allowed between the injection of the cocaine and the commencement of the operation.

Case 13.—Horse, large splint, pyro-puncture (deep). Injected subcutaneously ℥xx. of a 4 per cent. solution of cocaine.

Four minutes: Applied the cautery. No twitch was used. The other limb was simply held up out of the way of the operator. No signs of pain evinced, the animal standing perfectly quiet throughout the operation, which lasted twelve minutes.

CASE 14.—Very nervous animal, actual cautery for ringbone. Animal could only be clipped with difficulty; ℥xv. of a 5 per cent. solution of cocaine used. Injected carefully over the metacarpal nerve on either side.

Five minutes: Deeply pyro-punctured. No twitch was used. No pain evinced throughout the operation.

CASE 15.—Very nervous Irish horse, five years old, actual cautery for spavin. Great difficulty in clipping the hair off, then injected in two places (subcutaneously) on inside of hocks gr. iv. cocaine hydrochlor. (aqueous solution).

Four minutes: Cautery applied. No twitch used; no limbs secured in any way. Animal showed signs of pain during the first three strokes of the iron, but afterwards stood perfectly still and apparently felt nothing.

CASE 16.—Actual cautery, fetlock exostosis. Injected ℥xx. of 4 per cent. solution subcutaneously over the exostosis. Operation lasted ten minutes, animal evinced no sign of pains.

CASE 17.—In order to demonstrate the difference manifested when actual cautery was applied with or without cocaine, the following case was taken:

An animal was suffering from spavin on each hock, and it was deemed necessary to resort to actual cautery.

In the near hock ℥x. of a 5 per cent. solution was injected in each of four places about 1 inch apart.

Four minutes were allowed. The twitch was removed and the cautery applied. Throughout the whole operation there was no struggling whatever.

The same operation was performed on the off-hock, no cocaine being used. This time the animal struggled, and in various other ways evinced signs of pain.

CASE 18.—White-haired terrier bitch. Operation on mammæ. Injected ℥xl. of a 4 per cent. solution (freshly prepared), in four different places, subcutaneously around the seat of operation (℥x. in each place). The bitch thus received 1⅝ grains of cocaine hydrochlor. The effect of the cocaine was to cause great constitutional disturbance; the animal salivated freely, appeared distressed, and kept continually moving the head about from side to side. Was constantly protruding the tongue from the lips; the pupils of eyes were slightly dilated. This effect lasted from twenty-five to thirty minutes.

CASE 19.—Operation. Collie bitch. Six weeks or two months old, about 10 pounds. Injected subcutaneously ℥xlv. of a 4 per cent. solution of cocaine; this caused slight constitutional disturbance and slight involuntary muscular spasms. Pupil of eye unaffected.

Case 20.—Horse. Elbow tumour. Injected grs. iv. cocaine to ℥i. water in several places around the tumour.

Allowed five minutes. Animal apparently felt no pain whatever when the skin was incised.

Case 21.—St. Bernard bitch. Excision of tumour from left mammæ. About ℥i. of a 4 per cent. solution of cocaine was injected in several places around the tumour (a soft fibroma); in five minutes there was no apparent sensation, and the operation was successfully performed without any symptoms of pain being evinced.

Case 22.—Fox terrier. Excision of indurated portion of the mammary gland; ♏xxx. of a 4 per cent. solution of cocaine hydrochlor. were subcutaneously injected, and the indurated portion removed without any apparent pain.

Case 23.—St. Bernard mongrel bitch. Adenoma removed from mammary gland; ℥i. of a 4 per cent. solution of cocaine hydrochlor. injected in several places subcutaneously around the tumour caused local anæsthesia in four minutes, and the only manifestation of pain evinced was when the last few dissections were being made through the deeper structures.

Case 24.—Mongrel collie, 50 pounds weight, for operation.

First day, 9.55 p.m.: Temperature 101° (at rectum). Injected grs. iv. cocaine hydrochlor. (dissolved in ℥i. water) subcutaneously in flank.

Four minutes: Licking lips. Local anæsthesia well shown for 1 inch around seat of injection.

Twenty-five minutes: Pupils slightly dilated, licking lips, pricking ears up at all sounds, greatly increased nervous sensibility. Local anæsthesia still present. Still licking lips occasionally, otherwise all right.

One hour and thirty-five minutes: No local anæsthesia.

Second day, 7.30 a.m.: All right.

Case 25.—Mongrel pup, 18 pounds, small tumour.

First day, 4.56 p.m.: Injected grs. ii. cocaine hydrochlor. (in ♏xv. water) subcutaneously in flank.

Two minutes: Quiet. Local anæsthesia not yet produced.

Three minutes: Quiet, but lively when spoken to.

Five minutes: Very sensitive to sounds. Local anæsthesia for about 1 inch around seat of injection, licking lips occasionally.

Two hours: Apparently all right.

Second day: All right, hearty and well. Remained so.

Case 26.—Terrier, 22 pounds weight. Very lively.

First day, 10.20 a.m.: Injected subcutaneously grs. iv. cocaine hydrochlor. dissolved in water.

Twenty-five minutes: Very quiet; lay down on belly.

Three hours ten minutes: Very uneasy, continually champing jaws; salivating freely, licking lips with tongue, looking round and moving about continually. Pupils slightly dilated, but could see distinctly, as evinced by crouching when pretended to strike. Skin sensitive to stimulus. Temperature 101·4°.

Four hours forty minutes: Uneasy; still slight salivation.

Second day: All right, as lively and noisy as ever.

CASE 27.—Fox terrier, about 18 or 20 pounds, healthy.

12.55 p.m.: Injected subcutaneously in neck grs. ii. cocaine hydrochlor. dissolved in water.

Three minutes: Licking lips occasionally. Very sensitive to all sounds, but the skin around the seat of inoculation not so sensitive to stimulus as that on other parts of his body.

Six minutes: Complete local anæsthesia for 1½ inches around seat of inoculation.

One hour five minutes: No signs of the cocaine; all right.

CASE 28.—Boar hound. Removal of dew claws. Injected gr. i. cocaine hydrochlor. (aqueous solution) in each leg subcutaneously.

Three minutes: Commenced to operate, but animal showed signs of pain; waited three more minutes, then again attempted the operation, which was performed painlessly.

Cocaine is readily absorbed into the system from serous membranes, and it is equally readily absorbed from mucous surfaces, so that the administrator must not lose sight of the fact that it is toxic. It appears to be especially useful to allay irritation of the stomach, acting by its local anæsthetic effect on nerve terminals there.

The fact that cocaine, when brought into direct contact with a large nerve trunk, will cause anæsthesia of all parts supplied by that trunk below the seat of injection may be made use of as a valuable aid to diagnosis in certain diseases, as the following observations will show:

CASE 1.—Cab gelding. Seat of lameness somewhat obscure, navicular disease suspected. Injected grs. ii. cocaine in aqueous solution on either side of the limb directly over the metacarpal nerves.

Five minutes: Lameness perceptibly diminished.

Ten minutes: Lameness scarcely noticeable.

Case 2.—Mare. Obscure lameness, foot suspected. Injected ℥xxx. of a 5 per cent. solution on either side of the leg just above the fetlock.

Ten minutes: No lameness, thus proving that the seat of lameness was below the point of injection.

Case 3.—Cab gelding, aged, free clinique. Obscure lameness, foot suspected of navicular disease, very lame. Injected ℥xxx. of a 5 per cent. solution cocaine on either side of leg over metacarpal nerves.

Six minutes: Lameness perceptibly less; there was no response whatever on the inside of the leg to prick of a pin; on the outside (which had not been injected so thoroughly) there was sensation, although not so much as in a healthy foot.

Ten minutes: Lameness had almost disappeared; so much so that the opinion as to navicular disease was confirmed, and neurectomy was performed immediately. After this operation there was no lameness whatever.

Case 4.—Cart gelding, suspected navicular, free clinique. Injected subcutaneously over the metacarpal nerves on each side grs. iii. of cocaine hydrochlor. (in ℥i.ss. water).

Ten minutes: Lameness perceptibly improved; neurectomy was performed about ten or fifteen minutes later, the result being that the lameness completely disappeared.

Case 5.—Horse. Suspected navicular disease. Injected ℥xxx. of 4 per cent. solution cocaine over each metacarpal nerve.

Allowed five minutes: Animal was very much improved in gait. The operation of neurectomy was performed, after which the animal, when trotted, showed no lameness at all.

Case 6.—Van horse. Navicular disease. Neurectomy. After cocaine solution had been utilized to assist in diagnosis (grs. iii. on each side), to produce local anæsthesia, a further grs. iii. was injected over each metacarpal nerve; the animal thus got grs. xii. altogether. This caused symptoms of uneasiness, distinctly increased sensitiveness to sounds, and general hyperæsthesia.

There need be no fear that 10 grains will kill an animal the size of a horse, but if this dose is exceeded —as, for example, might easily be done by want of thought or careless weighing out—it will be found that in a proportion of patients the result will be an involuntary twitching of the muscles and restlessness, which would irritate and greatly inconvenience the operator.

Cocaine is the chief ingredient of the various prep-

arations used as stimulants to racehorses which are **"doped,"** the drug being given hypodermically about ten minutes before a race, and the effect being to produce an excitant and stimulating effect which causes the horse to frantically endeavour, for the time being, to excel himself in regard to speed. By a method of chemical research discovered by Professor Kaufmann, of the Alfort (Paris) Veterinary School, it is now possible to discover, even after the race is over, evidences of cocaine in the saliva of a horse which has been " doped " with any preparation containing this drug.

Symptoms of an **overdose** are shown by a hypersensitiveness to sound, the animal becoming excited and restless, the limbs twitching, eyes rolling, respiration laboured, frothy saliva appearing around the lips, and eventually, if a toxic dose has been administered, death occurs from heart failure after several violent convulsions.

In the horse, if not secured, the animal becomes frantically excited and absolutely uncontrollable; whilst in the dog, if allowed to be free in a large open space, the animal will run about with widely staring eyes and frothing at the lips until it falls over. Respiration then becomes very laboured and the spasms very violent.

For *antidotal* treatment a narcotic dose of morphia should be given hypodermically as speedily as possible—in the horse from 5 to 10 grains, and in the dog from ½ to 2 grains, according to size.

Administer nitrite of amyl inhalation to the nostrils, and keep the animal as quiet as possible. The symptoms are very alarming, but as a rule, if too much has not entered the system and the animal is alive at the end of half an hour, the patient will recover.

The use of adrenalin, suprarenin, renastyptin, or one of the same class of agents which act as astringents to the bloodvessels around and on the part, with or immediately prior to the use of cocaine, considerably diminishes the toxicity of this latter agent, as it retards the absorption of the drug in the tissues surrounding the part to be anæsthetized, and also into the system.

Eucaine.

Eucaine is a synthetically prepared drug, and occurs, like cocaine, in white crystals, being used in the form of the hydrochloride.

It is soluble in 10 parts of water, but not quite so quickly as cocaine, and is used in practically the same way, usually in from 2 to 5 per cent. solutions. Its effect is not shown so quickly, nor is its toxicity quite so great. It is not so good as cocaine for eye cases, as it sometimes irritates the conjunctival membrane. It is, moreover, toxic, and must therefore be used with discretion, the symptoms of an overdose being similar to those of cocaine.

To be quite on the safe side, the maximum dose for an animal the size of a horse or ox should not exceed that of cocaine, and there is no need to exceed this to get the desired anæsthetic effect.

The same remarks which have applied to cocaine in regard to antidotal treatment and its combination with adrenalin, or an agent of that class, apply equally to eucaine.

Some operators prefer to use a mixture of cocaine and eucaine together, as the effect of the latter lasts longer than that of cocaine.*

* *Journal of Comparative Pathology and Therapeutics*, vol. viii., p. 20; vol. x., p. 80 (Hobday.)

Novocain.

Novocain is a synthetic preparation (para-amido-benzoyl-diethylamino-ethanol), being used in solution, and sold either as a white crystalline powder or in specially prepared tablets.

It is used as the hydrochloride, and is readily soluble in water. The same general remarks as to its clinical use apply as with cocaine; it can be boiled without deterioration.

As with cocaine, it is toxic, but not nearly to such an extent;* and, like cocaine, it can be used with adrenalin, suprarenin, and similar agents.

The respective dosages used for anæsthetic purposes are practically the same as for cocaine, and the anti-dotal treatment, when necessary, is similar. It is used in from 1 to 10 per cent. solutions, and does not readily deteriorate if kept even for several weeks.

The following notes on the clinical use of novocain on actual cases by Herr Dom and Herr Fehse,† German veterinary practitioners, (published in the *Wochen-schrift für Tierheilkunde und Viehzucht*), are of interest.

Herr Fehse says:

"The investigations made by the author at the Royal Veterinary High School in Berlin, with the assistance of Professor Regenbogen, with the object of determining the toxicity and anæsthetic value of novocain for domestic animals, demonstrated that novocain, either with or without the addition of supra-

* Dr. C. N. de Brocq, who made numerous experiments on frogs, mice, and rabbits, states that if the toxicity of cocaine be represented as 1, that of novocain will represent 0·490; whilst Dr. Biberfield, of Breslau University, states that in his opinion it is seven times less toxic than cocaine.

† For these notes I am indebted to the Saccharin Corporation Ltd., London, E.C.

renin, is a good local anæsthetic, and of only one-tenth the toxicity of cocaine.

" Five and ten per cent. solutions of novocain were employed for operation on the eyes of dogs and horses, and found to produce a satisfactory anæsthesia. As sometimes with 5 per cent. solutions the anæsthesia was not quite complete, the author recommends the use of a 10 per cent. solution for this purpose. The anæsthetic action develops promptly, and is complete in about seven to ten minutes. No toxic symptoms or changes in the eye, such as disturbance of the accommodation or irritation of the cornea or connective tissue, were ever observed. After dropping the solution in the eye, not a single dog or horse exhibited any signs of pain or irritation in the eyes.

" Novocain has frequently been employed in the Royal Veterinary High School in Berlin for operations on animals, of which the author details a large number:

" From this experience the author declares that 1 and 2 per cent. novocain solutions provide a satisfactory local anæsthesia for operations. In no case were any symptoms observed attributable to a toxic action of novocain.

" Brown terrier dog, four years old, removal of a growth size of a hen's egg from the back; 4 c.c. of 1 per cent. novocain solutions injected around the growth. After seven minutes, growth enucleated and the wound closed with eight stitches. Anæsthesia complete during operation. Healed by primary intention.

" Dog, three years old, amputation of crushed tail; 4 c.c. of 1 per cent. novocain solution injected around the base, and amputated after six minutes without pain.

" Terrier, second toe of left hind-foot amputated; 4 c.c. of 1 per cent. novocain solution injected. Operation after seven minutes with no exhibition of pain.

" St. Bernard dog, ten years old, growth size of hen's egg in middle of left shoulder-blade; 7 c.c. of 1 per cent. novocain solution injected around the growth. Operation after eight minutes

absolutely painless. Wound stitched and healed by primary intention.

" Collie dog, three years old, removal of growth; 8 c.c. of novocain solution. Complete anæsthesia during operation after eight minutes.

" St. Bernard puppy, hernia umbilicus size of Brazil nut; 2 c.c. of 2 per cent. novocain solution injected. After five minutes painless operation. Healed by primary intention.

" Bitch, twelve years old, with sarcoma in inner side of hind-leg size of fist; 4 c.c. of 2 per cent. novocain solution injected. Operation after six minutes painless.

" Terrier bitch, eleven months old, hernia umbilicus; 2 per cent. novocain solution injected. Good anæsthesia after six minutes.

" Terrier puppy, ten weeks old; 2 per cent. solution used for same operation as above with like good result.

" Pomeranian bitch, six years old, mammary carcinoma, size of pigeon's egg; 2 c.c. of 2 per cent. novocain solution injected, and operation carried out after five minutes. Patient showed slight signs of pain.

" Poodle dog, two years old, periostitis ossificans of the secondary and tertiary phalanges of third toe of left hind-foot; 2 c.c. of 1 per cent. novocain suprarenin injected, and operation carried out five minutes afterwards without pain. Healed by primary intention.

" Dog, seven years old, growth size of walnut on prepuce; 5 c.c. of 1 per cent. novocain suprarenin solution injected. Complete anæsthesia after five minutes.

" Injections of novocain have been employed by the author and the veterinary surgeon of the General Omnibus Company of Berlin for the purpose of diagnosis of causes of lameness.

" Generally from 7 to 10 c.c. of a 3 per cent. novocain solution, either with or without suprarenin, were injected for this purpose. The anæsthetic action developed in eight to twenty-five minutes, and lasted above one hour.

" Whereas Rahnenfuhrer observed toxic symptoms in nearly every case where he injected a like quantity of cocaine for diagnostic purposes, which symptoms considerably increased the difficulty of diagnosis,

besides the danger to animals and staff, the author never observed any toxic symptoms from the use of novocain, which is, therefore, for practical purposes to be preferred to cocaine.

" Novocain solutions were found to keep well. The author has used both freshly prepared solutions and solutions that had been kept several months, even in white bottles exposed to light. He found no loss in anæsthetic value after six months, even if the solutions had become yellow from exposure; and although some of the solutions had been boiled up several times, he could distinguish no difference in value from a freshly prepared solution."

Herr Dom says:

" Most remedies, as we see from literature, have been tried only on the horse and dog, and not upon cattle. I have myself tried cocaine and then stovain with either adrenalin or with synthetic adrenal preparations. With horses both are good, but with cattle I only obtained unsatisfactory results in actinomycosis, and in some eye operations. For a long time I have now used for local anæsthesia *novocain in combination with suprarenin*—a synthetic adrenal preparation. I obtain both in sterilized solution in sealed glass tubes according to the following formula:

Novocain	..	..	.. 15 grains.
Suprarenin	..	..	.. 10 minims.
Aqua dest.	..	..	.. 150 „

" As required, I dilute the solution before operation with 2 to 4 ounces of water. I have carried out a series of operations, and obtained extremely good results. Thus a horse, with a testicular botryomycosis nearly the size of its head was removed in three-quarters of an hour without any signs of pain

and without hæmorrhage, owing to the action of the suprarenin. In this case I used three tubes of the above solution diluted with 6 ounces of water.

" A cancerous growth on both sides of the hind-leg I was able to operate without any necessity to hold the foot very firmly. In this case the solution was injected into both lateral nerves above the fetlock. I have also tried the above solution on cattle in many cases. Smaller actinomycoses could be totally removed standing without any symptom of pain on the part of the animal. Complete anæsthesia was also obtained in an operation on a sclerotic growth, the size of a hazel-nut, in an ox, and was removed without any struggle on the part of the animal.

" To induce complete anæsthesia in the case of tumours, it is absolutely necessary that a long injection needle be used (I myself use one 10 centimetres—English measurements, 4 inches—long, made by Hauptner), and to anæsthetize deeply round the field of operation. If the skin only is rendered insensitive by subcutaneous injection, the enucleation may cause considerable pain. On the other hand, if the injections are made deep into the nerves, the superficial area is also rendered insensible. Of course, injections must be made round the field of operation."

Novocain as compared with other local anæsthetics —lethal dose per 1 kilo body weight:

SUBCUTANEOUS INJECTIONS.

	Cocaine.	Stovaine.	Novocain.	Alypin.
	Gramme.	Gramme.	Gramme.	Gramme.
Rabbits ..	0·05 to 0·1	0·15 to 0·17	0·35 to 0·4	0·05
Dogs ..	0·05 to 0·07	0·15	0·25 (not yet fatal)	0·07

Corresponding tests were made with intradural injection, showing the following results:

	Cocaine.	Stovaine.	Novocain.
	Gramme.	Gramme.	Gramme.
Cats ..	0·018	0·025 to 0·05	0·15 (not yet fatal)

For general surgical use, therefore, if one utilizes it in 1 to 5 per cent. solutions, and employs the same doses as with cocaine, one gets the same excellent results without the risk of toxic effects.

Stovaine.

Stovaine (chlorhydrate of amyleine) was discovered by Dr. Fourneau, a French chemist, and is the chlorhydrate of dimethylamin β-benzoylpentonol. It is readily soluble in water, and the solution can be sterilized by boiling without spoiling the anæsthetic property of the drug.

Its anæsthetic property is equally as good as that of cocaine, whilst it is about one-third less toxic, and it is equally applicable for hypodermic injection, for local application to exposed or to mucous surfaces, and for intraspinal anæsthesia.

Bier advises, for intraspinal anæsthesia, the following formula:

Stovaine	0·10 gramme.
Sod. chlorid.	0·10 ,,
Aq. dest.	ad 1 c.c.

also:

Stovaine	0·08 gramme.
Adrenalin borate	0·00026 ,,
Sod. chlorid.	0·0022 ,,
Aq. dest.	ad 2 c.c.

each of these solutions being sterilized in an autoclave before use. The doses given hypodermically are the same as for cocaine.

Stovaine is incompatible with perchloride or biniodide of mercury and with all alkalies, and even weak boracic acid must not previously be passed through the syringe before use.

Holocaine.

Holocaine is a synthetic preparation prepared by combining phenacetin and paraphenetidin. It is used in the form of the hydrochloride. It is soluble in water, and the same remarks apply as with cocaine.

Its toxicity is slightly less than that of cocaine, and it is used principally for ophthalmic cases in 1 per cent. solution, anæsthesia being produced in about a minute, and lasting for ten or fifteen minutes, the chief advantage claimed for it being that it does not cause any intra-ocular tension.*

It is not advisable for general use as a hypodermic injection, or for use over any extent of surface, as it is more toxic than cocaine, producing symptoms resembling those of strychnine.

Hydrochloride of Urea and Quinine.

This agent is one of the most recently discovered of the local anæsthetics, and is prepared either in sterilized solution in hermetically sealed tubes or in tabloids. It is of value for sinuses and for rectal work in the form of suppository. It can be painted on locally or used hypodermically, and the advantage of each of the others which is claimed for it is that its anæsthetic effect, although taking a little longer than cocaine to be produced, lasts for a much longer period, even several days, whilst it does not produce any cerebral excitement such as sometimes follows the

* *British Medical Journal Epitome*, 1898, p. 99 ; *Year-Book of Treatment for* 1898, pp. 158, 368, 454.

use of cocaine. It is therefore useful in cases where the wound is irritable, especially for a restless patient who will persist in attempting to use its tongue or teeth upon the parts which have been operated upon, in doses the same as cocaine.

For local application it is used in from 1 to 5 per cent. solution, its value being particularly demonstrable in canine patients, whose tendency to lick their wounds is so well known.

Wooldridge* has reported a number of cases of its use, the following being interesting:

Case 1.—Amputation of the dew claws of a fox terrier. The patient, about nine months old, was placed on the table, and after preparing the site I injected 1 c.c. of 1 per cent. solution of hydrochloride of urea and quinine into each digit to be removed. The animal struggled and screamed at each insertion of the needle, this fact serving to emphasize the action of the agent. After an interval of twenty-five to thirty minutes the digits were excised by making an incision in each case quite ¾ inch long, and dissecting out the respective phalangeal bones, and finally suturing with fine silk. Throughout the whole operation there was not the slightest indication of pain, a very marked contrast from the patient's behaviour at the needle puncture. The wounds healed by first intention.

Case 2.—Mammary tumour of a cocker spaniel. The tumour in question was a large one, about the size of one's fist, so inject. morph. (B.P.) ℥xxx., was injected under the skin of the back. Half an hour later 4 c.c. of ½ per cent. solution of hydrochloride of urea and quinine, with ℥x. of 1 in 1,000 solution of renastyptin was injected round the base of the tumour.

After a further interval of twenty minutes, and after suitable preparation of the site, the operation was commenced by an incision through the skin near the summit of the tumour, the mid-point of the incision being about 1½ inches away from the point of injection of the agent. There was a very marked flinching there, but no indication of sensation when the incision was extended to the immediate neighbourhood of the seat of injection. There was no pain around the base of the tumour, and there was practically no hæmorrhage, one small vessel being detected and

* *Veterinary Journal*, October, 1912.

ligatured before being cut. The operation wound, though large, did quite well, and healing was rapid.

Case 3.—Mammary tumour in a fox terrier. This was also a very large tumour, larger than one's fist, so morphia gr. i. was first administered half an hour before the local anæsthetic. Hydrochloride of urea and quinine, 4 c.c. of ½ per cent. solution, was then injected, partly subcutaneously along the intended line of incision and partly into the base of the tumour, and an interval of half an hour allowed to elapse before making the incision. The local anæsthetic was perfect, but no styptic action could be ascribed to the agent. The operation wound healed readily and without complications.

Case 4.—Shoulder tumours in a horse. This case consisted of two small tumours, each about the size of a walnut, and one on each shoulder. I injected 1 c.c. solution of hydrochloride of urea and quinine subcutaneously in each case. The needle was inserted from below upwards, and almost all the solution was injected over the upper part of the tumours. The first incision was made half an hour later. There was a complete absence of sensation in the upper portion of the operation area, but flinching in the lower. The same conditions were repeated a few minutes later when the second tumour was excised. Two sterilized silk sutures were inserted in each case, and healing took place by first intention.

Compared with cocaine it is less toxic and much cheaper. It is slower in action; an interval of at least half an hour should be allowed between injection and incision, but its action lasts longer.

Eudrenin.

This agent is a combination of 1 per cent. of β-eucaine hydrochloride, and about 1 in 30,000 of adrenalin chloride, preserved with chloretone. Thus, each cubic centimetre (16·9 minims) contains 0·01 gramme (⅙ grain) of eucaine and 0·00003 gramme (1·2000 grains) of adrenalin. The advantage claimed for the combination of the two drugs is that one gets the anæsthetic effect of the cocaine combined with the astringent and bloodless effect of the adrenalin, and this advantage is one worthy of every consideration. It is usually sold in hermetically sealed tubes, and can

be used hypodermically, or applied with a camel-hair brush (or from a drop-tube) locally. On account of its expense it is chiefly used for the smaller animals, although it can be used equally well for the horse and ox.

In regard to its toxicity, the dosage adhered to is much the same as eucaine, although its toxicity is decidedly not so great, the adrenalin having a marked effect in retarding rapid absorption by its restricting influence on the surrounding vessels.

Codrenin.

This agent is a combination of cocaine and adrenalin in physiological salt solution with chloretone. Chloretone is added on account of its analgesic and antiseptic properties, preserving the properties of the solution much better and for a longer time when opened and exposed to the air. As with eudrenin, it is dispensed in hermetically sealed tubes, and can be used hypodermically or applied with a brush locally.

The same remarks apply to codrenin as to eudrenin. Both are very valuable agents, especially for such operations as neurectomy in the horse, and the removal of tumours both in large or small animals.

Ether Spray.

Ether spray was first introduced into general use as a local anæsthetic by the late Sir Benjamin Richardson, M.D., and is applied by a special spraying apparatus as illustrated.

The result is due to the numbing effect it has on nerve terminals, and it is suitable for operations on the skin or small superficial tumours.

The part to be operated upon should be shaved

and rendered aseptic with iodine or some such agent, and well dried before the ether is applied, the operation being performed as speedily as possible, as if

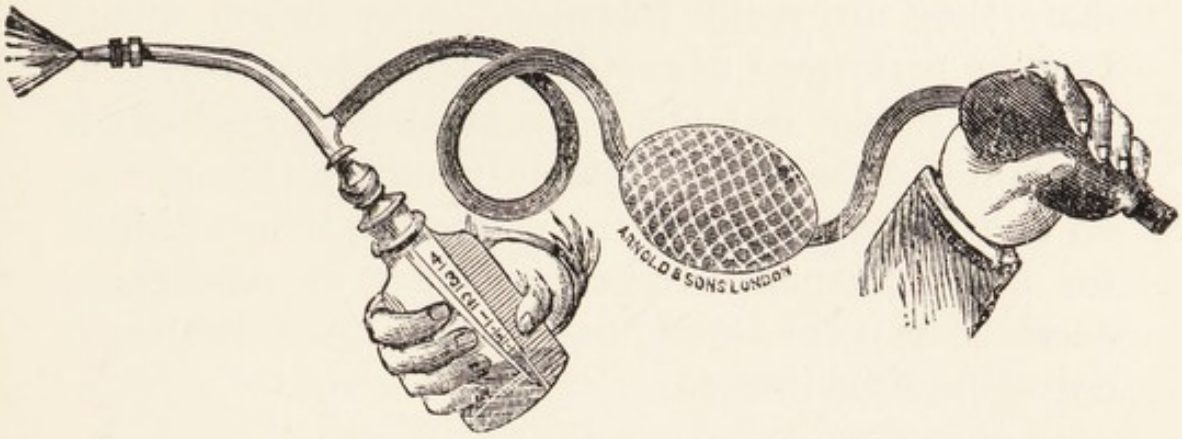

FIG. 17.—ETHER SPRAY APPARATUS.

freezing is maintained for any length of time the wound will not heal readily and there is danger of necrosis.

Ethyl Chloride.

Ethyl chloride is one of the alcohol derivatives, and occurs as a clear fluid which is dispensed in specially made vials suitable for the distribution of the

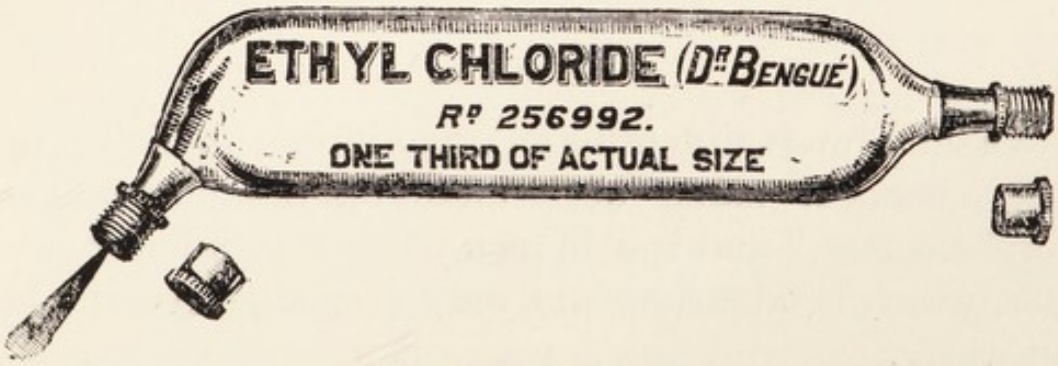

FIG. 18.—ETHYL CHLORIDE SPRAY.

anæsthetic. It is principally used as a local anæsthetic for minor operations upon the skin, such, for example, as the lancing of painful abscesses or the removal of small tumours, its expense precluding its universal adoption for general anæsthesia. It is

applied in the form of a spray directed upon the spot which is required to be anæsthetized, and anæsthesia is complete when the parts become white, in which state they are really frozen. The operation should then be performed as rapidly as possible, as this condition does not last long. In animals the process is facilitated if the hair is previously removed by shaving on and around the spot, as if freezing is maintained for many moments there is danger of subsequent necrosis, or if the wound has to be sutured, healing is not always *per primam*.

H.M.C. Mixture.

A mixture of hyoscine, morphine, and cactin is occasionally used hypodermically as a narcotic to allay excitement before the administration of a general anæsthetic, and sometimes, in canine patients, it is used alone for minor operations.

It is not, however, better than morphia alone, and as there is some danger attached to it, there is no advantage to be derived by its use.

Orthoform.

Orthoform is a synthetic preparation, rejoicing in the chemical name of "methyl-para-amido-meta-oxybenzoate," and is sold as a white crystalline powder, which is odourless and only very slightly soluble in water.

It is not used as a surgical anæsthetic for operations, but is useful for painful wounds, being applied pure or mixed with starch, or, better still, with collodion, and painted on as a protective and soothing agent.

It is too expensive for general use with the larger animals, but is serviceable in canine practice.

CHAPTER VIII

INTRASPINAL ANÆSTHESIA

It has been found in human beings that by the injection of certain local anæsthetics into the sub-arachnoid fluid of the spinal cord an anæsthesia can be produced below the spot, of sufficient power to enable even such major operations as the amputation of a limb to be performed without pain.

The favourite site for the injection is the space between the sixth and seventh lumbar vertebra, and it is made by the carefully sterilized needle of a hypodermic syringe, with the usual antiseptic precautions as regards the skin, etc., scrupulously carried out. In animals this method of producing anæsthesia has not found many followers, as both in a large animal, such as a horse or ox, and a small animal, such as a dog or cat, it is somewhat difficult of application.

In connection with this subject, however, the following abstract of a thesis and illustrations by M. Mennerat, which was presented before the Société Centrale de Médecine Vétérinaire of Paris at the meeting held on February 5, 1914, is of great interest.*

Sendrail and Cuillé practised puncture at the level of the lumbo-sacral space. This wide space is easy to locate; but, as indicated in Fig. 19, *b*, the dural sac at this level is very narrow, and if the needle penetrates

* *Bulletin de la Société Centrale de Médecine Vétérinaire*, Paris. Reproduced by kind permission of MM. Asselin et Houzeau.

easily into the vertebral canal it has little chance of puncturing the meninges: the liquids injected pass into the rachidian canal, and not into the subarachnoidean space. The method of Sendrail and Cuillé is therefore uncertain in its results.

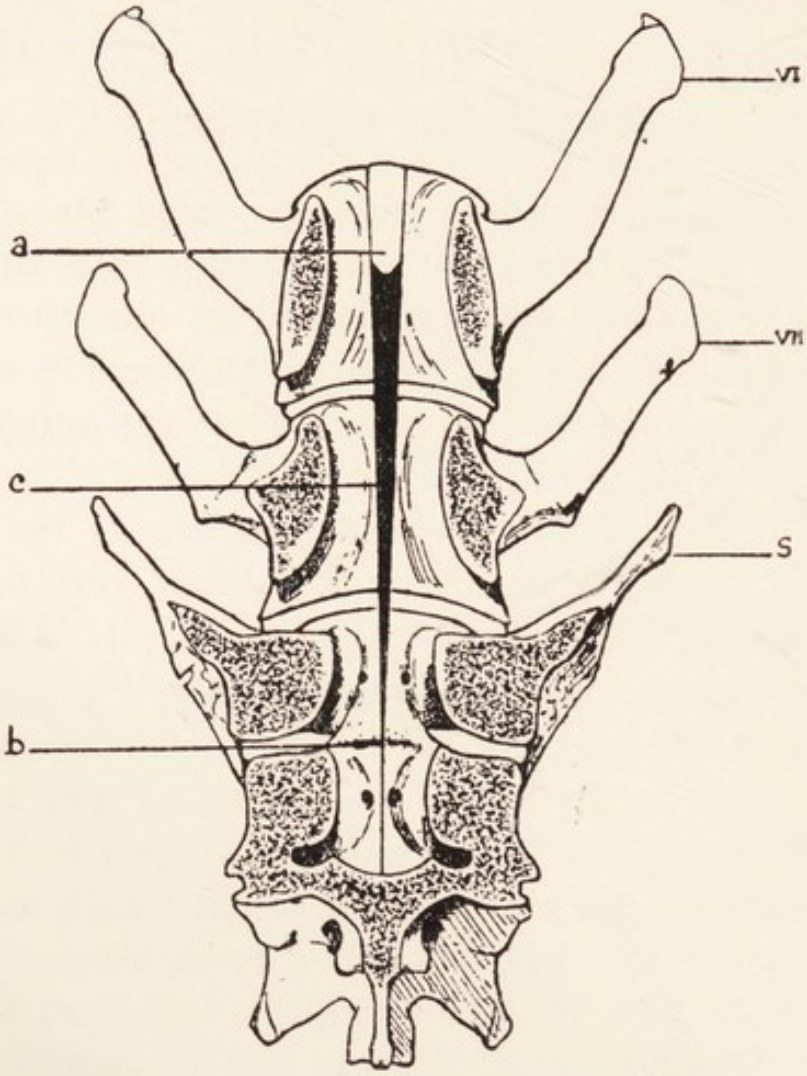

FIG. 19.—HORIZONTAL SECTION OF THE SPINAL CORD (DIAGRAMMATICAL).

a, Termination of the cord; *b*, termination of the dural sac; *c*, intraspinal fluid.

In 1911 MM. L. Lépinay and E. Lépinay advised making the puncture in the sixth interlumbar space, *on the median line*, following the anterior edge of the spinous apophysis of the seventh lumbar vertebra. The diameter of the dural sac is well developed, but

the puncture is very difficult to effect, by reason of the overriding of the bodies of the vertebræ; generally one breaks the needle. The very delicate technique requires particular expertness, even in the opinion of both authors.

M. Mennerat practises puncture between the sixth and seventh lumbar vertebræ, as in the previously described procedure; but, instead of introducing the needle on the median line, he passes it over the side of the spinous apophysis of the seventh lumbar vertebra (Fig. 20), where it necessarily emerges into

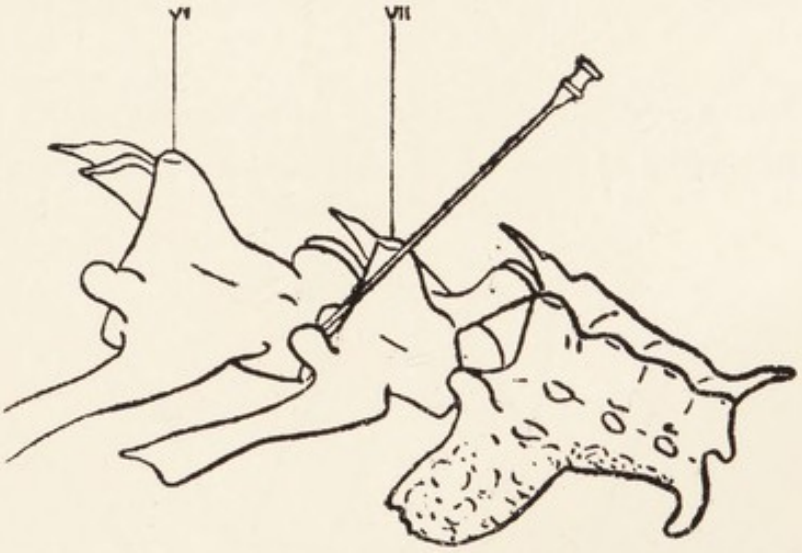

FIG. 20.—NEEDLE IN POSITION IN THE SIXTH LUMBAR SPACE.

the dural sac, of which the diameter corresponds closely to that of the vertebral gap, giving passage to the needle.

This needle is 8 centimetres long for large dogs, and 5 centimetres for small dogs, although it ought only to penetrate about half its length; one need then take little account of giving the needle an oblique direction.

Restraint.—The author has thought out a special method of restraint. To obtain a large amount of flexion of the intervertebral spaces, the dog is placed on a table in the sterno-abdominal position, the

posterior parts hanging over one of the edges of the table, the posterior members brought forward and tied together above the hocks; in this position the

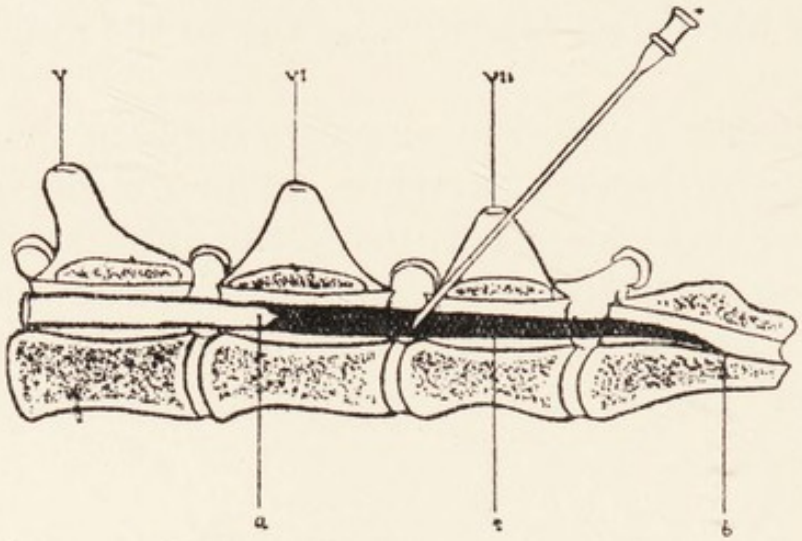

FIG. 21.—MEDIAN SECTION (DIAGRAMMATICAL).

a, Termination of the cord; *b*, termination of the dural sac; *c*, intraspinal fluid.

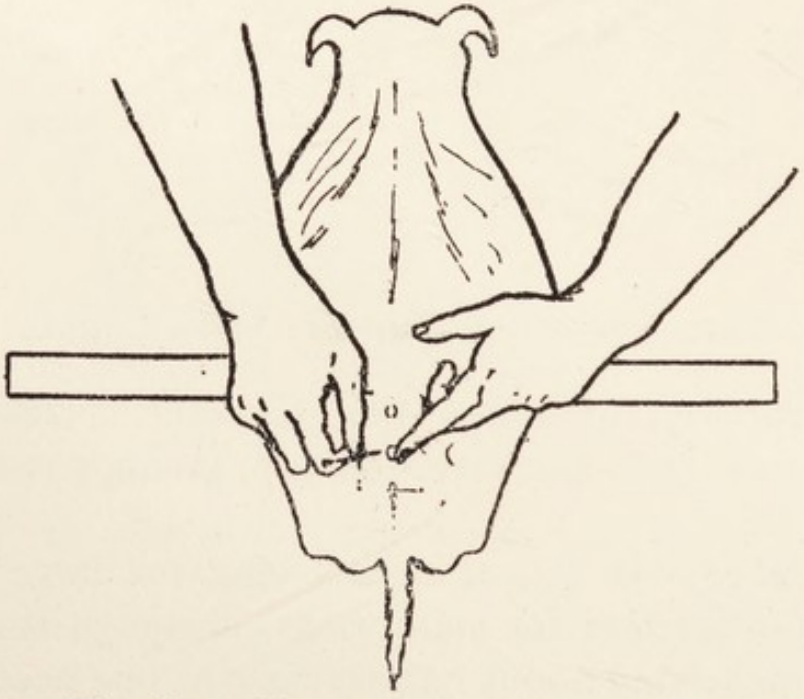

FIG. 22.—THE LEFT INDEX-FINGER INDICATES THE SPINAL PROCESS OF THE SEVENTH LUMBAR VERTEBRA.

lumbo-sacral region ought to be perpendicular to the ground (Figs. 22 and 23).

Technique of the Operation.—After having soaped, shaved, and disinfected the lumbo-sacral region, the

operator places himself on the left side of the subject, his back turned to the head of the animal (Fig. 22). With the index-finger of the left hand he slides postero-

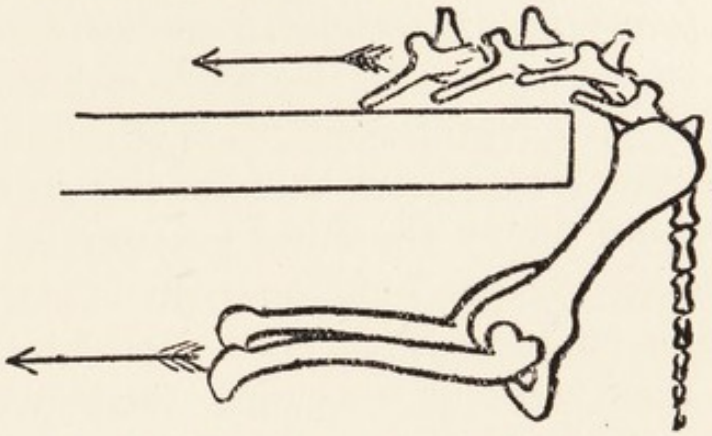

FIG. 23.—THE SKELETON IN THE POSITION SUGGESTED.

anteriorly over the spinous apophyses of the sacral region, which are welded together (Fig. 22), reaches the

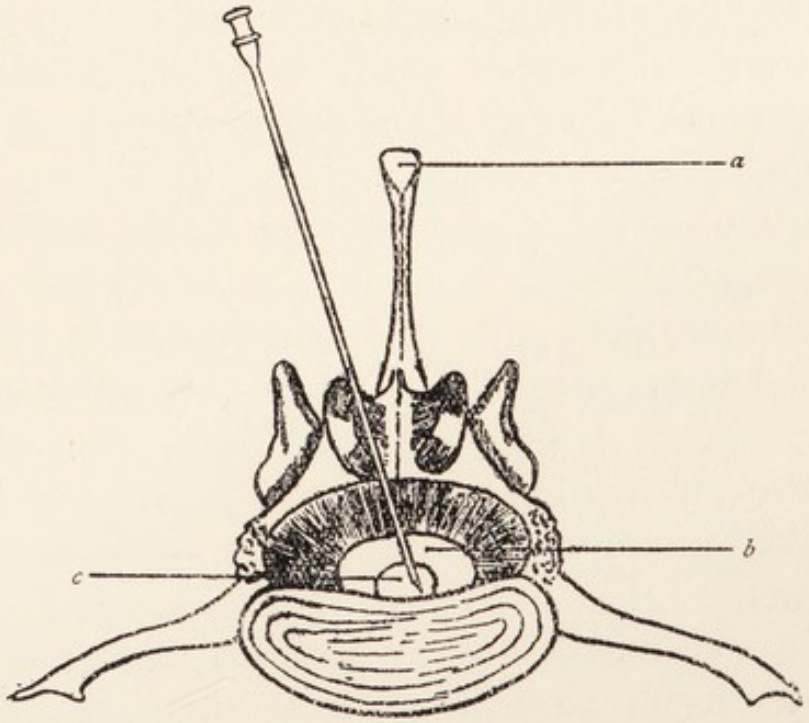

FIG. 24.

a, Body of the vertebra in the sixth lumbar region; *b*, spinal canal; *c*, dural sac.

lumbo-sacral space, and drops over the spinous apophysis of the seventh lumbar vertebra (point of guidance). The needle, held between the thumb and right

index-finger, thrust ½ centimetre beyond this point of guidance, slides over the nail of the left index-finger. This needle ought to be directed *obliquely from above to below, from behind to in front, from outside to inside*—that is to say, towards the median line. Thrust progressively, it traverses the skin, the lumbar aponeurosis, the long dorsal muscle, the interlamellar ligament, and finally the dural sac; rarely does any spinal liquid escape, but the point of the needle on arriving on the nerves of the tail of the horse, irritates them without wounding them, which provokes a struggle on the part of the animal. This indicates that the needle is in good position, and that one can then make the injection.

Substances Employed.—M. Mennerat experimented with cocaine, stovaine, and novocain.

Solutions of cocaine easily deteriorate; one may prepare them as required, or preserve them in special ampoules of a blue colour.

Posology.—The doses used are—Large dogs: 10 to 15 centigrammes in 5 to 8 c.c. of boiled water; medium-sized dogs: 6 to 10 centigrammes in 3 to 5 c.c. of boiled water; small dogs: 2 to 4 centigrammes in 1 to 2 c.c. of boiled water. These doses are not dangerous, as one can inject 0·015 gramme of cocaine per kilogramme of animal weight without causing accidents.

If one wishes to obtain anterior analgesia, it is necessary to force the liquid in strongly, and to *raise* the posterior part of the column to facilitate diffusion of the solution. For anæsthesia of the posterior part of the column one slowly injects half of the above doses. Novocain has the advantage over cocaine of suppressing the period of excitement, but its analgesic value is less perfect and less durable; it is advan-

tageous for short anæsthesia in the dose of 0·01 gramme per kilogramme of animal weight. Stovaine in the same doses is even less analgesic than novocain.

Symptoms.—After the use of cocaine, analgesia occurs most frequently at the end of five to ten minutes. The dog totters on his posterior limbs; then paraplegia appears; sensibility afterwards extends progressively postero-anteriorly. With strong doses nausea supervenes without vomition; the pulse is accelerated, the respiration remains normal, the temperature rises, and a period of lively enough excitement is produced; these drawbacks are not observed with stovaine and novocain.

Twenty-five intraspinal injections were made by M. Mennerat, without failure or accident, chiefly in old dogs for which chloroform anæsthesia might have proved fatal.

The duration of anæsthesia was two to three hours with cocaine, an hour and a half or more with novocain and stovaine. It has always given precise and constant results, no case of death has been registered, and operatory shock has always been nil.

The technique for the cat is the same as for the dog; the needle being that used for small dogs.

The doses employed are, for cocaine: Large cats, 2 centigrammes in 1 c.c. of boiled water; small cats, 1 centigramme in 0·5 c.c. of boiled water.

Analgesia thus obtained is rapid and perfect, and of the same duration as in the dog. By reason of the peculiar sensibility of the cat to chloroform and ether, this method of spinal anæsthesia is destined to render great service, particularly in abdominal surgery.

CHAPTER IX

NARCOTICS

THERE are certain agents which do not always absolutely abolish pain to such a complete extent that they can be termed " true anæsthetics," but they have such a numbing effect on the senses of animals that operations can be performed upon them without evidence of any great pain, and without the extra risk which accompanies any agent, such as chloroform, which is apt to cause respiratory arrest. Those who have to deal with animals know that certain species have certain well-marked idiosyncrasies for the effects of certain drugs, and as an illustration one cannot take a better example than the susceptibility of the dog to the narcotizing effect of morphia.

Although such drugs are more to be classed as narcotics than as true anæsthetics, their use is justified under certain circumstances, especially if a much greater safety is assured. It is of no use to perform a clever operation upon an animal if the said animal succumbs to the anæsthetic, neither is the owner grateful if his pet is returned to him dead.

The sentimental public, too, must not forget that for several reasons the services of a qualified veterinary surgeon to act as anæsthetist only, whilst his colleague operates (as in human practice), is not always possible, so that if a safe agent can be used which renders the operation to all intents and purposes practically painless, and at the same time

guarantees the safe return of the patient, the use of such an agent is preferable to one which gives an element of risk.

For the horse in chloral hydrate we have an agent possessing this property, and for the dog we have morphia and mixtures containing this drug.

Chloral Hydrate.

Readily soluble in water, it is used as a narcotic for the horse, either given by the mouth as a draught, or *per rectum* (in mucilage) as an enema.

It can be used intravenously, but, except for dissection subjects or demonstration purposes, this method is inadvisable on account of its dangers. Should any, even only a little, of the fluid find its way under the skin, the result is to produce a very violent irritation, followed in many instances by great swelling and even necrosis; and of course there is always the risk of introducing air into the veins.

Given as a draught it should always be dissolved in plenty of water, on account of its irritant property, the dose varying from ½ to 1 ounce for a pony or cob to 2 ounces for a cart horse or for the adult ox.

Given as an enema, the dose first dissolved in water and then mixed with mucilage (either that of gum or linseed gruel), on account of the local irritating effect on the mucous membrane. It requires to be given from half an hour to an hour before the time fixed for the operation, and the rectum should be emptied before administration.

It has also been used as an intraperitoneal injection, ℥ss.-℥i. dissolved in physiological saline or glycerine solution, but its results are not certain enough to warrant its universal recommendation or use. It acts in about an hour.

Morphia.

Morphia is the chief alkaloid of opium, and its effect upon the varieties of patient which come into the sphere of the veterinary surgeon is curiously different. For example, in the horse and cat the general effect of what ought to be a narcotic dose is really that of an excitant, whereas in the dog, as in man, it is one of the most perfect narcotics possible. It is a perfect instance of the inadvisability of reasoning by analogy that because a drug acts in one particular way upon one animal, it must, of necessity, act in the same or a similar manner upon another species or upon man.

For our purpose, in this book, it is sufficient to say that for the dog we have, in morphia, a drug which will enable the veterinarian to perform fully three-fourths of the operations of daily practice with a minimum of pain, and with perfect safety to the patient. The idiosyncrasy of the dog to morphia is so peculiar that, although the animal will readily become completely narcotized, it is almost impossible to produce poisoning,* so great is the range between the narcotic and the toxic dose, even in the small toy-dog breeds. For hernia and such-like cases where a complete relaxation of muscle tissue is of advantage, the value of morphia is inestimable; and if complete quietude is not obtained, the addition of a very mild dose of chloroform from an inhaler gives all which is necessary.

For the removal of very large tumours, and even

* Hobday, "A Report upon the Use and Administration of Morphia as an Aid to Surgical Operations in the Dog" (*Veterinary Journal*, 1907; *Veterinary Record*, May 23, 1908; Proceedings of the Central Veterinary Medical Association).

for such severe operations as oöphorectomy and ovaro-hysterectomy, morphia is, in a larger proportion of cases, combined with the use of cocaine, novocain, or one of the local anæsthetics, all-sufficient; and for enabling a vicious animal to be handled quietly there is no drug equal to it. Given hypodermically, the dose is, approximately, one grain for almost any size of adult dog, and I say this from an experience of its use in many thousands of individual instances. One grain will as a rule be as satisfactory in its effects for a Pekinese or a terrier, as for a collie or even a Great Dane, although with the latter and mastiffs or St. Bernards I usually advise two grains.

After the injection the patient should be left quietly to itself, as any noises or caresses are apt to retard the action of the drug. Sharp sounds, such as metal striking against metal, particularly keep a dog roused up. In two or three minutes the effect of the drug begins to manifest itself, and the dog looks as if it felt that something strange had happened. There may be vomition once or twice, or even three times (rarely more), or the bowels may act. As a rule, if neither of these occur within five minutes, they do not occur at all, and after four or five minutes a gradual drowsiness is manifested, the animal settling down as if to sleep. In from one-half to three-quarters of an hour the patient is sufficiently narcotized to be placed on the operating-table; or, if the operation is not a very delicate or severe one, as a rule the restraint of the operating-table even can be dispensed with.

When the operation is over, especially if it has been a prolonged one, or one involving considerable hæmorrhage, care must be taken to wrap the patient up and to put it in a warm place, as the enforced stillness

causes an abnormal fall of body-temperature which would be apt to be deleterious to health if neglected.

Otherwise no alarm need be felt, as it is only a matter of time for complete recovery to take place. As a rule the patient lies in a semi-torpid state for six or eight hours, and will not take food voluntarily for, perhaps, twelve or even eighteen hours, but it will swallow food if put into the lips about eight or ten hours afterwards.

In regard to the **toxic** dose in the dog, it is very large, and I once personally administered 27 grains to an old poodle* suffering from cancer of the throat, the dog recovering some twenty-two hours afterwards sufficient to walk and drink fluids.

For Painless Destruction.—The preliminary use of morphia hypodermically is most excellent when it is necessary to destroy a dog, this being followed up with chloroform inhalation in about twenty or thirty minutes, and finally a dose of Scheele's hydrocyanic acid into the chest when the chloroform has produced unconsciousness.

It is exceptionally painless, so much so that one may consent to the presence of the owner during the procedure—a contingency which is never wise when hydrocyanic acid alone is used. The only bad or annoying symptom which I have ever seen to follow the hypodermic injection of morphia has been that now and again one meets with a dog in which the agent causes a prolonged stage of excitement, and sometimes narcosis is not produced at all. These cases are comparatively rare, but other veterinary surgeons have observed the same.† A further dose should be given, and this generally has the desired

* Hobday (*Veterinary Journal*).

† S. J. Motton, M.R.C.V.S., *Veterinary Journal*, August, 1913.

effect; but I have seen cases where the excitement became quite distressing, although I have never seen one succumb to it.

Scopolamine.

This agent is an alkaloid found in the root or rhizome of the plant *Scopolia Japonica*, or *Scopolia Carniolica*, and in the seeds of *Hyoscyamus Niger*.

It has been used by Continental observers in conjunction with morphia as a narcotic for surgical purposes, and has even been reported upon as of value in this respect to supplement general anæsthesia.

It is prepared in tablet form, usually about $\frac{1}{150}$ grain of scopolamine hydrobromide and $\frac{1}{6}$ grain morphine hydrobromide, and is given hypodermically about three-quarters of an hour before an operation, but is dangerous to use where there is any kidney disease.

The fatal dose for the dog is stated by De Stella to be 0·66 gramme per kilo of its liver weight. In a paper by Professor Iliesco,* of the Bucharest Veterinary School, the following conclusions were arrived at:

Comparing anæsthesia by chloroform alone with that by chloroform and scopolamine, he found:

1. The period of initial excitement produced by chloroform when administered alone, which may be long, violent, and often dangerous, is almost suppressed by the employment of scopolamine.

2. The quantity of chloroform employed in the mixed method of chloroform, with scopolamine, is smaller than in the case of anæsthesia by simple chloroform.

3. The time occupied is shorter with mixed anæs-

* *Veterinary News*, August 3, 1912 (translated for the *American Veterinary Review* by Dr. H. J. Achard, Chicago).

thesia than chloroform alone, and the recovery of the animal more rapid.

Thirty experiments were made, and the scopolamine was administered intravenously, but it may be equally as well used subcutaneously. For these injections the solutions may be made in distilled water. The solutions may be made in the proportion of 1 in 200, 1 in 100, and even 1 in 50.

The dose employed varies according to the weight and temperament of the animal. The effects may be obtained by weak doses; $\frac{1}{10}$ milligramme suffices for the frog, and for the dog and horse 2 to 6 milligrammes per kilo of the body weight.

CHAPTER X

THE TREATMENT OF THE PATIENT WHEN RECOVERING FROM THE EFFECT OF AN ANÆSTHETIC OR NARCOTIC

In the case of local anæsthetics very little needs to be said; as a rule it is only a matter of time, and nothing need be done.

After general anæsthesia in the larger animals, care must be taken not to remove the hobbles or other restraint before the animal can get up properly or stand steadily, as otherwise there may be an accident to itself or the assistants from blundering about. Occasionally, too, a horse will lie for a very long time, and refuse (or be unable) to get up. In such cases, in order to avoid hypostatic congestion of the under lung, the patient should be turned over, and efforts then made to induce it to rise from that side. Cold water dropped over the head from a sponge, or dashed on it from a bucket, or even poured down the ear, are often effectual. Flicking with wet towels, or even the use of a whip or stick, may be necessary with an obstinate animal. A sudden shout close to the ear, or the pouring of water into this organ, will sometimes succeed when other means have failed, and if sufficient strength cannot be obtained to get the animal on its feet, one can only wait until it gets up voluntarily.

In all animals, after either general anæsthesia or narcosis, great care should be taken to restore the

body temperature. The patient should be put in a warm place and carefully rugged up after being made thoroughly dry; in the case of the horse the skin circulation being restored by the use of wisps, brushes, and bandages. In the dog, especially after morphia, the animal must not be put to lie on a stone floor. Wood is much warmer, and if necessary, hot-water bottles should be applied, the body being covered with warm blankets. A small quantity of water may be given, but no solid food should be offered for at least an hour after a general anæsthetic, and this especially applies to the horse, as choking has several times been observed from the eating of the long hay immediately after returning to the stable.

Beyond these hints there is very little to be said, and as a general rule the patient does not appear any the worse for its experience, in so far as the anæsthetic or narcotic is concerned, twenty-four hours afterwards.

Chloroform pneumonia does occur occasionally, and is sometimes very serious, generally in a horse in which there has been a lot of resistance and struggling during the administration, and especially if the animal has lain prostrate for a long time afterwards and the operation has been a prolonged one.

It is possible for it to prove fatal, and its treatment must be on the usual lines of that of acute congestion or pneumonia.

CHAPTER XI

HINTS ON THE CHOICE OF ANÆSTHETIC FOR THE INDIVIDUAL SPECIES OF ANIMAL—SUMMARY OF CONCLUSIONS

For the **horse** and **dog** chloroform is by far the best general anæsthetic both in regard to its utility and cheapness, and also its safety.

It must, of course, like all toxic drugs, be used with discretion and in a skilful and proper manner by a careful anæsthetist.

For the **ox** a good stiff dose of alcohol (such as rum) or of chloral will narcotize the animal.

For the **sheep** and **goat** use chloroform for prolonged operations.

For the **cat** and **monkey** use ether or A.C.E. mixture.

For the **pig,** in cases of dystokia, use chloroform or chloral.

For the **bird** chloroform or A.C.E. acts satisfactorily.

Recollect, above all, that in the case of chloroform it should always be fresh, and not have had prolonged exposure to sunshine or even strong daylight. This will decompose it very speedily, and make it a source of danger.

In regard to local anæsthetics, cocaine is safe if used with proper care; but if stovaine or novocain are obtainable, they are better, because the toxicity is less.

The question of cost need only enter into it where very large numbers of operations are to be performed, as the dosage is so small that the cost cannot amount to much. All solutions should be freshly prepared.

Morphia, however, as a narcotic, acts so well in the dog, and is so safe to administer, that its use has almost superseded chloroform even for very severe operations.

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