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FLEMING'S VETERINARY SURGERY

MACQUEEN & WILLIAMS

SECOND EDITION

A.V. TURNER.
from Allan. 1930.

FLEMING'S TEXT-BOOK

OF

OPERATIVE VETERINARY SURGERY.

FLEMING'S TEXT-BOOK

OF

OPERATIVE VETERINARY SURGERY

VOLUME I

SECOND EDITION

EDITED BY

J. MACQUEEN, F.R.C.V.S.

PROFESSOR AT THE ROYAL VETERINARY COLLEGE, LONDON

WITH 343 ILLUSTRATIONS

LONDON

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PREFACE TO THE SECOND EDITION.

THIS edition of Vol. I. has been revised and, as far as possible, brought into line with the second volume. The text, where considered necessary, has been extended or curtailed, and many new illustrations have been added, but the arrangement of the subject-matter of the book remains as originally planned.

The Editor desires to acknowledge his indebtedness to Mr. John A. W. Dollar, New Bond Street, W., for permission to copy Figs. 311, 315, and 319 from Cadiot's 'Exercices de Chirurgie Hippique'; and to Messrs. Arnold and Sons, West Smithfield, for most of the new illustrations of instruments.

J. MACQUEEN.

December, 1902.

PREFACE TO THE FIRST EDITION.

THE need for a text-book of Operative Veterinary Surgery in the English language has been felt for a very long time—in fact, ever since operations upon animals were systematically practised in this country, in order to render them more useful, or to relieve them from pain and disease. At various times during the last half-century, works of this description have been produced on the Continent of Europe, where the study of Veterinary Medicine and Surgery, fostered and protected by Governments, has made greater progress, perhaps, than in the United Kingdom or in America; but until now no attempt has been made to provide such a book for use in English-speaking countries. In offering this text-book for acceptance, I would venture to state that no pains have been spared to make it complete; and if its completeness is not equal to the requirements of the most exigent practitioner, this must be ascribed to the disadvantages under which I have laboured in preparing the work, and especially to the heavy exactions imposed upon me in the performance of my professional duties.

I have been extremely anxious to assist the student and young Veterinary Surgeon in acquiring and keeping up a knowledge of perhaps the most important, and certainly the most difficult, part of their profession—the manual details of Operative Veterinary Surgery: a branch of their education which can only be perfected by practice, based on exact anatomical, physiological, and pathological teaching. There is little time or opportunity for acquiring this knowledge during their college curriculum, and only too frequently they have to assume the functions and responsibilities of practitioners, while possessing only a very limited acquaintance with the various operations, or the mode of performing them, which they may be required to undertake early in their career.

In preparing the work now submitted, I have availed myself of

every accessible source of information embodied in the various professional journals, as well as in the works more immediately devoted to the subject, among which may be specially mentioned, Brogniez's *Traité de Chirurgie Vétérinaire* (Brussels, 1845); Hering's *Handbuch der Thierärztlichen Operationslehre* (2nd edition, Stuttgart, 1866); Gourdon's *Eléments de Chirurgie Vétérinaire* (Paris, 1854); Toussaint and Peuch's *Précis de Chirurgie Vétérinaire* (Paris, 1876); Degive's *Manuel de Médecine Opératoire Vétérinaire* (Brussels, 1880); and Zundel's edition of D'Arboval's *Dictionnaire de Médecine, de Chirurgie, et d'Hygiène Vétérinaires* (Paris, 1874). To several friends in the Veterinary profession, I am also indebted for valuable hints.

I have made only slight allusion to Surgical Anatomy, as more extensive reference to it would have compelled me to produce a larger work than would perhaps suit the convenience of those busily engaged in practice. If more detail is required, it will be found in my translation of Chauveau's *Comparative Anatomy of the Domesticated Animals* (London, 1873), which is the text-book I have resorted to in the brief anatomical descriptions given.

I confidently hope that the work will be found useful, and that it will assist in promoting Veterinary Surgery, which has for its object the benefiting of man indirectly, and animals largely and directly.

GEORGE FLEMING.

London.

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PART II.

CHAPTER I.

GENERAL OPERATIONS.

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FLEMING'S TEXT-BOOK

OF

OPERATIVE VETERINARY SURGERY.

INTRODUCTION.

VETERINARY SURGERY, as distinguished from Veterinary Medicine, is supposed to occupy itself more especially with the study and cure of all maladies affecting the exterior of the bodies of animals, as well as the repair of injuries to which they may be exposed, and the remedying of malformations and deformities, whether these be congenital or acquired. The study of the diseases for which surgical intervention is necessary is designated Surgical Pathology, while that which is related to their removal or suppression is termed Operative Surgery. Surgery is thus a Science and an Art, as pathology enlightens us with regard to the nature and causes of the changes which take place in tissues or organs during the progress of disease and their course and terminations; while their removal is effected by operation or medicine.

In addition to those objects just alluded to, Veterinary Surgery differs from the surgery of mankind in being called upon to produce, by operation, certain local or general functional modifications in *healthy* animals, which render them more agreeable, suitable, or useful to man, either as companions, servants, or food.

A sound knowledge of Anatomy is of the utmost value for the successful practice of surgery. *Descriptive Anatomy* is, of course, the basis of operative surgery; for *Surgical* or *Topographical Anatomy* is only a special application of it, affording correct notions as to the relative situation of tissues and organs with regard to parts or regions accidentally injured, or about to be operated upon. Besides, Surgical Anatomy yields us indications how operations should be performed, so as to admit of their being executed with facility and ease, as well as safety to the animal, and be productive of the best results. Added to this knowledge of anatomy must be an acquaintance with physiology and pathological anatomy. In operating upon healthy living animals—as in castration—the latter subject does not enter into consideration; but in operating when disease or injury

is present, then an intimate knowledge of pathology and morbid anatomy is indispensable, as this knowledge very often modifies the performance of operations with regard to surgical anatomy.

Dissection of the healthy body of a dead animal does not fully qualify the veterinary surgeon for the efficient performance of all operations on the living creature. The tissues, and often the organs, of a dead creature are generally very different in appearance, volume, colour, consistence, elasticity, and texture, and perhaps even in relative situation and position, from what they were when it was alive. And more especially is this the case when the physical properties and relations of parts are so altered by morbid processes that they can scarcely be recognised during the performance of an operation.

We must, therefore, acknowledge the guidance of *living* conditions in the performance of surgical operations. The condition of life modifies certain physical appearances, and chiefly those affected by *pathological* anatomy. Thus, the colour, consistence, elasticity, and even the size and shape of the various parts of the body, as well as their situation, position, and relation to contiguous parts, are presented to the surgeon when modified by the two-fold conditions of *disease* and *life* combined.

Pathology, conjoined with anatomy, is therefore our guide during the performance of the majority of surgical operations. In proportion as we are familiar with pathological conditions, by so much are we enabled to foresee, and to provide for, the peculiar appearances and conditions which the knife discloses, and to recognise them as they are successively presented in surgical operations.

'Guided by this anticipatory knowledge, our operations are no longer discoveries made by dissection, but *planned* and *methodical* proceedings, conducted on known principles—in fact, an art based on the science of anatomy, supplemented by pathology.'—GANT.

As in clinical medicine, so in surgery, skill in *diagnosing* is an important element of success. This skill can only be acquired by close observation and study of the different kinds and forms of surgical diseases, as the difficulties to be encountered are sometimes many and great, and hesitation in the performance of an operation may lead to serious results, while its premature adoption may be equally unsatisfactory. A great secret to success is to know when to act, and when to abstain.

The veterinary surgeon should also understand the conditions of health, be acquainted with the most suitable periods of the day or year, and also know all about the local surroundings which are favourable or unfavourable to operation. This necessitates a knowledge of the constitution, habits, temperament, and hygiene peculiar to each species, as well as individuals of the same species, in addition to an acquaintance with clinical medicine and therapeutics.

So that to be a good veterinary surgeon—one who is skilled in clinical and operative surgery—a person must possess special knowledge of many subjects, and this can only be acquired by long and patient study under favourable conditions as to opportunities. Manual dexterity is as essential to him as to the surgeon of mankind,

and it must be obtained in the same manner — in the dissecting-room, the hospital, and wherever and whenever an opportunity offers to perform, or assist in performing, an operation of any kind.

But otherwise the surgeon and veterinary surgeon have to act under widely different conditions. The former operates upon his own species, generally with every conceivable convenience and assistance ; his patient is resigned to suffer, or is made insensible to pain by an anæsthetic, and can be placed in the position most favourable for operation ; and, after the operation has been accomplished, the patient can be attended to in every way likely to ensure a successful result. It is not the same with the veterinary surgeon's patients. They may be large and powerful, or small and vicious ; not comprehending the motives of the operator, the pain he inflicts makes them indocile, savage, and dangerous, as they resent with all their force the restraint under which they must be placed, or the torture to which they are submitted ; for an anæsthetic cannot always be conveniently or safely administered, while the position in which animals must be secured may not be the most favourable for operation. Anatomical peculiarities, as well as special conformation, also give rise to marked differences between operations on man and animals ; while the only too frequent lack of accessory facilities, of accommodation and convenience, both during and after operation, much increase the difficulty and responsibility the veterinary surgeon has to encounter. He must, therefore, besides possessing the special kinds of knowledge just enumerated, understand well the handling of animals, so as not only to control them, but to evade their attacks ; and for this strength and agility are, above all, necessary. He must also be patient, cool, and determined ; fertile in expedient, and ready in resource ; with strong arms, firm grasp, and nimble, sensitive fingers ; quick of eye and prompt in action, and capable of using his hands in almost any position ; confident in himself, and able to inspire confidence in others who may be employed in aiding him.

In addition to his scientific and physical attributes, the veterinary operator should be of a kindly disposition. Humanity is largely concerned in the humane treatment of animals, and in relieving them from pain or distress. All *unnecessary* painful operations are acts of cruelty, and should be discountenanced by the veterinary surgeon. Those operations which, after all, are only fashionable mutilations of animals, devised by a morbidly artificial and corrupt taste, should be suppressed, if not by law, at least by the influence of the surgeon.

Veterinary operations are few, when compared with those performed upon mankind, and they are generally subordinate to the economical results they are likely to produce. If they are attended with greater expense than the value of the creatures, if ultimate recovery to usefulness is not assured, or if recovery costs more than would purchase serviceable animals, then, unless sentiment comes into play in favour of the patients, operations are not attempted, or, if they are, dissatisfaction is expressed afterwards. It is only with

what are called 'pet' animals, or creatures destined for certain purposes, as breeding, that restoration to complete health or soundness is not so urgently demanded.

It is very different in the case of man. Let him but retain life, no matter how mutilated and deformed his body may become from operation, nor how useless he is subsequently to the community, the surgeon is not blamed, but rather praised; while the patient is grateful, and his friends are well pleased.

Therefore operations upon animals are not nearly so frequent or numerous as those performed upon man; and yet, as has been said, they demand in the veterinary surgeon special qualifications or aptitudes of as high an order as those possessed by the surgeon who operates on his own species. To operate rapidly is to abridge suffering, and perhaps avert danger; to operate with skill and confidence is to ensure the most favourable results; while accurate knowledge of clinical surgery and pathological processes is a guarantee of final success under ordinary circumstances. For it must be remembered that in exceptional circumstances, and sometimes from causes which could not be guarded against or foreseen, a simple and almost every-day operation may be attended or followed by the gravest accidents—as when excessive hæmorrhage takes place in castration, or that operation is followed by peritonitis or tetanus, when the abstraction of blood from a vein is followed by phlebitis and its consequences, or when a simple incision gives rise to septicæmia.

There are a number of *technical terms* employed in operative surgery which must be alluded to. In all surgical operations on the living animal, the dividing of parts previously continuous is termed *dieresis;* bringing together parts which have been separated is named *synthesis;* the extraction or removal of any part is designated *exeresis;* while the substitution of an artificial for a natural part receives the name of *prothesis.*

With regard to their character, operations are divided into *simple* and *complicated*, *bloodless* and *sanguinary*. *Simple operations* are those of a trifling description, as puncture or incision: for example, opening a superficial vessel or abscess, and cauterization; and *complicated operations* are those in which there is difficulty or delicacy in dissection (as in lithotomy, neurectomy, tenotomy, etc.). *Bloodless operations*, as the designation implies, are those in which there is no hæmorrhage; while the *sanguinary operations* are so named from the occurrence of bleeding. There are also operations of *necessity* or *urgency*, as when a carious tooth has to be extracted, the tongue or penis to be amputated, fluid removed from the thoracic cavity, or tracheotomy performed; and operations for *convenience* or *fashion*, as castration and amputating and 'nicking' the tail.

Operations are also said to be *regular* or *determinate*, when they are practised on normal textures, and according to a fixed procedure; and *irregular* or *casual*, as when they have to be performed according to no fixed rule in occasional emergencies, and complications and varieties of situation are met with, as in the removal of tumours in different parts of the body, extraction of foreign bodies, etc.

In many operations the time when they may be performed is at the option of the veterinary surgeon—*optional operations*, as castration; but there are others when it is necessary to operate without delay, as in acute tympanites threatening asphyxia, strangulated inguinal hernia, etc.; they are then *peremptory*, and the operation is *urgent*.

In those operations in which the anatomy of the region indicates the precise situation where they should be performed, that place is named the *point of selection;* but when it is determined by accident or disease, it is then called the *point of necessity*.

The word *method* is the collective term applied to the principal manœuvres executed in the performance of an operation; and most operations may be performed after several methods. The term *procedure* is applied to the several special manœuvres which may be practised during an operation, in preference to others, according to indications or circumstances; though the terms *method* and *procedure* are often employed synonymously. As an illustration of the meaning of the two terms, it may be pointed out that there are several methods of performing castration—as by ligature, clams, torsion, cautery, etc., while the procedure may vary, according as the testicles are exposed or allowed to remain covered by their membranes—and so on in other operations.

In preparing for operations, it is presumed that it has been decided as to the method and procedure to be adopted, which will depend on a variety of circumstances, such as the anatomical arrangement of the region to be operated upon, the nature of the tissues, extent of lesions or disease, etc. But, as has been mentioned, there is often great difficulty in arriving at a correct conclusion, and especially when disease has been present for some time; so that the plan of operation previously resolved upon may have to be more or less modified in the course of the operation, according as unexpected circumstances arise or conditions appear. The skilful operator knows best at the moment how to change his procedure to meet such contingencies; for he should have calculated and provided for possible complications or accidents that may occur.

In certain operations which are not urgent as to time, some preliminary preparation of the animal may be necessary in the way of dieting, etc.; and, especially when the larger animals are to be operated on, it is generally advisable to keep them without food or water for a few hours immediately before submitting them to operation.

In the choice of *instruments*, *apparatus*, and *appliances*, the operator must be guided by the nature of the operation, the facilities for performing it, and other considerations. The *apparatus* for restraining the animal should be ample and thoroughly reliable, both as to soundness and strength of material, as well as suitability; as the life of the operator, of the assistants, or of the animal itself, may depend upon these, not to mention the facility and rapidity with which the operation may be brought to a successful termination.

With regard to the *instruments*, these should be carefully selected

according to the nature and possible complications or accidents of the operation. It is needless to mention that they ought to be of the best quality, clean, and aseptic. They can be sterilized by dry heat, by boiling for fifteen minutes in a 1 per cent. solution of

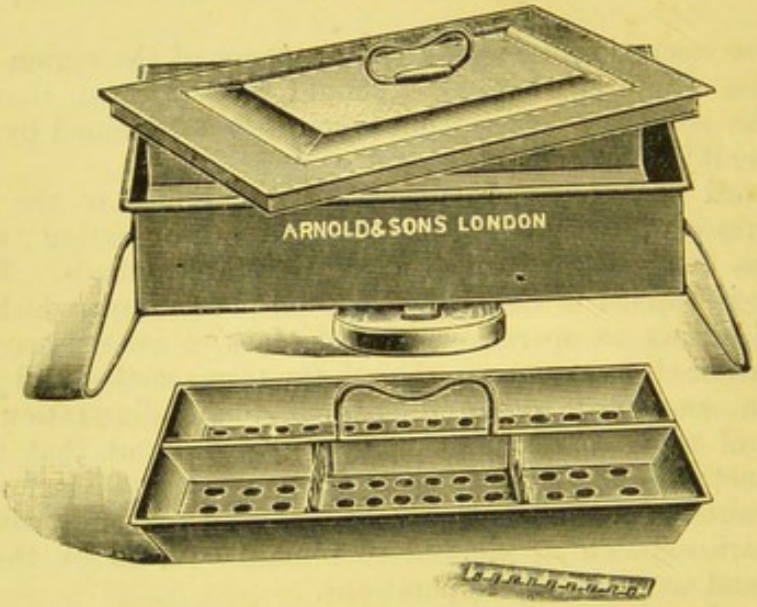

FIG. 1.—PORTABLE STERILIZER FOR INSTRUMENTS.

washing soda, or by prolonged immersion—after washing—in a 5 per cent. solution of carbolic acid. Ligature and suture materials (catgut, silk, etc.) should be placed in 1 to 20 carbolic or in 1 to 500 sublimate solution for an hour or two before operation. Aseptic

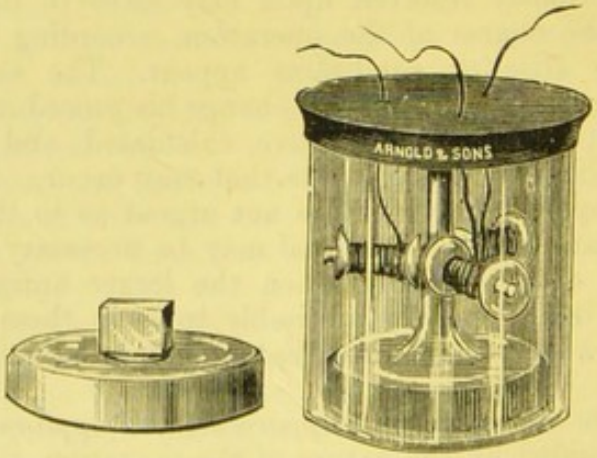

FIG. 2.—ASEPTIC LIGATURE TROUGH.

sponges can be purchased ready for use. Once used, however, sponges are difficult to disinfect, and in many instances it will be found safer to dispense with sponges altogether and to use pledgets of cotton-wool, gauze, or tow, for mopping the wound during operation. Rubber drainage-tubes are little used in veterinary surgery.

For draining wounds in animals aseptic gauze or tow is more convenient.

The instruments should be arranged in a tray containing an antiseptic solution, and held or laid convenient to the operator. Pails containing carbolic, creolin, boracic, or other antiseptic solution for rinsing hands, instruments, and sponges should be within reach, and cotton-wool, gauze, lint, or tow, suture materials, hæmostatic and antiseptic dressings and bandages should all be provided. Much of the success of an operation depends on the preliminary arrangements.

All important operations should be carried out with strict regard to antiseptic precautions. In this connection Lord Lister's teaching cannot be too strongly emphasized. Two conditions are essential in dealing with wounds, whether accidental or surgical: nothing septic must be left in them, and nothing septic must be allowed to get into them. Surgical wounds become septic more often from contact with unclean hands or instruments than from any other cause. The *seat* of operation should be carefully cleansed. After removing the hair by scissors or razor the skin should be thoroughly washed and disinfected. In the more simple and trifling operations

FIG. 3.—CARBOLIZED RUBBER DRAINAGE-TUBES.

little preparation of this kind may be required; but in proportion as they are complicated, so is the necessity for every provision and precaution being adopted in order to ensure success.

In nearly all veterinary operations assistants are required. With the larger animals quite a large number is needed to secure and attend to the patient while undergoing the operation, and one or two more intelligent persons may be necessary to lend immediate assistance to the operator. Each assistant should have a special duty assigned to him, and this should be accomplished silently and steadily. Only too frequently, unfortunately, these assistants have to be improvised from the farm, the stable, or the forge-servants; but in compensation for their lack of skill in efficiently assisting, they are generally robust and accustomed to handle horses or cattle.

Operations should always, if possible, be performed in a good light, and, for the more serious operations, at a period of the day when the operator is not likely to be fatigued or flurried. The morning or forenoon ought, therefore, to be fixed upon as the best time.

The *place* in which the operation is to be performed, especially with the larger animals, should be sufficiently spacious; and if they have to be thrown down, the ground should be soft—as a grass field,

a straw bed, or a floor laid with sawdust, pine-shavings, peat, or tan. If possible, it should be under cover if the weather is bad. In some cases the stable, loose-box, or cowshed must suffice. For the smaller animals an operating-table or bench is most convenient.

The *position* in which the animal must be placed will depend on the kind of operation, it being essential that the region or part to be operated on be as accessible as possible to the hands and instruments of the operator, so as to ensure certainty and precision in the various necessary manœuvres. But, as already remarked, the veterinary surgeon is placed at a great disadvantage in this respect when compared with the surgeon, as from the conformation of animals, and the manner in which they must be secured, as favourable a position cannot so often be obtained as in operating upon mankind.

It is the same with the position of the operator, who ought to place himself in such a manner as to be able to act with freedom and precision ; though he is, nevertheless, very frequently compelled, for the above reasons, to assume positions anything but easy, or calculated to facilitate the performance of serious operations. To be able to use both hands equally well is, if not absolutely necessary, at least of immense advantage to the veterinary surgeon.

In view of the accidents which may occur during, or immediately subsequent to, operations, the veterinary surgeon should not neglect to point out this contingency to the owner of the animal about to be operated upon, so as to protect himself from unjust comments or pecuniary liability.

PART I.

CHAPTER I.

MANNER OF SECURING ANIMALS FOR OPERATION.

General Observations.

When it is decided to perform a surgical operation on an animal, the first condition to be observed is to quiet or secure it in such a manner that it may neither injure itself, the operator, nor those who assist him, during its struggles or attempts to defend itself. For no matter how intelligent, docile, or submissive an animal may be under ordinary circumstances, the infliction of pain, the object of which it can rarely comprehend, causes it to struggle violently and energetically in order to escape suffering, or to retaliate in self-defence. It is, therefore, absolutely necessary to resort to measures which will prevent, or at least diminish to the utmost, the dangers to be apprehended from this source during the performance of an operation.

It is needless to impress upon the operator and his assistants the disadvantages—moral and physical—of resorting to rough, unfeeling, and cruel treatment of animals while these are under restraint and suffering pain; and the benefits to be derived from the exercise of kindness, tact, calmness, and patience in securing and operating upon them. All experience demonstrates that animals which are most refractory and vicious under harsh and violent management, will become reassured and tractable when treated with ordinary kindness and gentleness. Nervous and excitable animals especially, should be dealt with quietly and caressingly, so as to calm them and gain their confidence when they are about to be submitted to restraint and pain. Noise and precipitancy should be avoided as much as possible, and the preliminary stages of applying measures of restraint gone through steadily, intelligently, and with sympathetic hands and voice.

The apparatus should inconvenience or pain the animals as little as possible, and it ought to be readily applicable, reliable when in use, and easily removed when no longer required. Above all things, the respiration should be interfered with as little as possible. The horse, ass, and mule breathe only through the nostrils; therefore these should be kept free. With all creatures the trachea, chest, and flanks

should not be pressed upon, as difficulty in respiration alone will cause violent struggles, and may result in suffocation.

There are three methods of rendering animals submissive for operation : (1) *the benignant method*, (2) *the derivative or painful method*, and (3) *the mechanical or restraint method.*

1. The Benignant Method is that which should be resorted to on every possible occasion. It consists in caressing, stroking, and patting the animal, talking to it kindly and soothingly, and otherwise calming its fears and gaining its confidence. This is best accomplished by allowing the person who usually attends it to manage it during the operation.

Temporary deprivation of vision by blindfolding with a handkerchief, or other article applied over the eyes, sometimes induces an animal to remain more tranquil than it would otherwise do, while it prevents it watching the operator and his assistants, or purposely injuring them.

Stupefying the animal by compelling it to go round in a narrow circle until it begins to stagger, is often employed successfully to render animals, and more especially horses, more manageable and quiet during the less serious operations.

The production of general anæsthesia by the inhalation of chloroform or ether, the application to the part to be operated on of cocaine, or other local anæsthetic, and the administration of opium or Indian hemp, are also to be included among the measures to be adopted in this method.

2. The Derivative or Painful Method.—This method, it may be said, is based on the principle of counter-irritation ; for it is a fact that an animal subjected to an intense pain artificially produced is either intimidated, or there is established a condition which enables it to endure the pain of an operation : the first concealing the succeeding pain, and inducing a momentary paralysis of the animal's powers, while attracting its attention.

3. The Mechanical or Restraint Method.—This method consists in the application of apparatus, suitable for the different species of animals to be operated on, which shall limit their movements, and prevent their injuring themselves or others, while maintaining them in the position most favourable for operation. Restraining appliances, as will be seen presently, differ considerably, not only according to the species of animal and the nature of the operation, but also as to whether the operation is to be performed in the standing or recumbent position. In applying the apparatus, great care and tact are required to avoid injury and prevent accident.

SECTION I.

MANNER OF SECURING THE HORSE.

The horse is the animal most frequently submitted to operation, and, owing to its strength and agility, and the readiness of its means of defence and attack, as well as its value, is perhaps the one which requires most skill, strength, and tact in securing for operation. It may employ the teeth, but most frequently it is the limbs (sometimes limbs and teeth) which are to be guarded against. The fore-limbs can only be extended immediately forwards and backwards, but the hind-limbs—which are the most powerful—can perform a semicircular movement forwards, outwards, and backwards (*cow-kick*), which renders them exceedingly dangerous ; and this danger is increased by the hardness and solidity of the hoofs, which are usually armed, in addition, with iron shoes.

The kind and multiplicity of means of restraint will generally depend not only upon the nature of the operation, but also sometimes upon the disposition or temperament of the horse.

Whether the operation is to be performed in the standing or recumbent position, as already mentioned, the ground should be at least moderately soft and not slippery. If hard or slippery, it should be covered with some soft material, as straw, sawdust, sand, tan, peat, or other similar matter.

I. Standing Position.

When the operation is to be performed in the standing position the horse is either placed with its side against a wall, or with its hind-quarters in a corner, according to circumstances. Castration is now frequently performed in the standing position, with no further restraint than that furnished by blinds and twitch.

The horse is secured for operation by the *head* or *limbs*, or both.

1. The Head.—The head is usually secured by means of a *head-collar*, *bridoon*, *bridle*, or *cavesson ;* and the auxiliary restraints are the *gag*, *twitch*, *mask*, *blinkers* or *blinders*, *cradle*, and *side-rod*.

The employment of the first four does not demand further notice than that they should be of good material, and so attached that they will not readily slip off the head at a critical moment. When a bit is worn in the mouth, care must be taken that it does not injure the tongue or lower jaw.

A strong, active, and experienced assistant or groom should always hold the horse by the head, standing in front, though a little to one side, to escape injury from the fore-feet. One hand may seize the reins or head-collar rope close to the head or under the chin, the other hand holding it near the opposite end. In the majority of cases, a harness bridle with blinkers answers well.

When the horse is to be secured by the head to a wall or any other resisting body, a strong leather head-collar, with one or two ropes, should only be used, and no bit or rope in the mouth, in case

of accident to tongue or jaw. If the anterior part of the body is to be operated on, the head should be tied as low as possible; if the hind parts, as high as convenient.

The *Gag* is most readily formed by the rope of the halter or head-collar passed as a loop round the lower jaw, behind or in front of the canine teeth, and drawn tight. Another form of gag is made by a short piece of round wood, four or five inches in diameter, with a leather strap and buckle attached to the ends. This is placed high

Fig. 4.
Polish Gag.

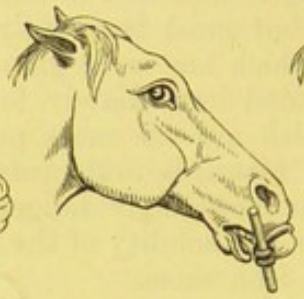

Fig. 5.
Short Twitch.

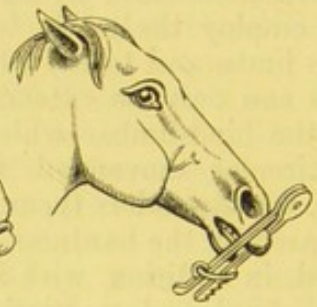

Fig. 6.
Iron Hinged Twitch.

up across the mouth, and the strap buckled behind the ears, thus maintaining the jaws wide apart. A third form is the Polish gag (Fig. 4), which is simply a long loop of rope placed in the mouth and behind the ears, and tightened by means of a long or short piece of stick twisted in it towards the cheek. This is a very potent mode of subjection.

The *Twitch* is a severe instrument of control, and should not be applied unless absolutely necessary. It is generally far too frequently resorted to by grooms and farriers, and applied to horses which would be more easily and humanely managed by gentleness, patience, and tact.

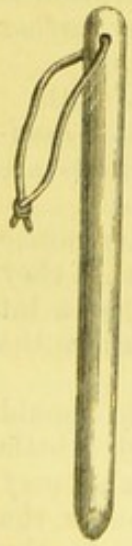

Fig. 7.
Twitch.

The ordinary twitch (Fig. 7) is merely a round piece of wood, from one to five feet in length, and one and a half to two inches in diameter, with a hole at one end, through which a piece of cord is passed and tied in a loop sufficiently large to allow the closed fist to pass through easily. The loop is passed some distance over the upper lip, which is seized by the hand and drawn forward; and the cord is then rapidly twisted by the other hand, or an assistant, to the necessary degree, by the rotatory motion of the wooden handle. Most frequently it is applied to the upper lip, rarely to the lower, and perhaps less frequently to the ear or lower jaw. It acts by severely compressing or squeezing the tissues, and thus produces such a degree of suffering as attracts the attention of the animal from the pain of the operation, and subdues it.

The long twitch is held by an assistant; but for several operations, and particularly when there is no assistant to spare or when the horse has to be thrown down, the short twitch is most

useful. The handle of this is so short that it merely serves to twist the cord, and remains without being held (Fig. 5); or it may be attached to the cheek of the head-collar by a piece of twine or a small strap. Two other forms of twitch, which are self-maintaining, are in use on the Continent. One (Figs. 6, 8) is of iron, and consists of two pieces united at one end by a hinge joint, the other end of one piece having a ring in an eyelet, while the opposite piece has a notched extremity, over which the ring is passed when the lip is embraced by the two

FIG. 8.
IRON HINGED TWITCH.

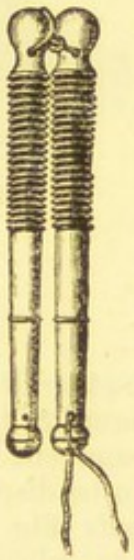

FIG. 9.
WOOD HINGED TWITCH.

branches (Fig. 6). This iron twitch has the advantage over the cord, that it does not so readily cut the skin of the lip. The other twitch (Fig. 9) is composed of wood, arranged in a similar manner to the preceding, one-half of each being furnished with sharp ridges, and the free extremities being tied together by means of a thong when the lip is seized between them. This twitch possesses the same advantage as the last, but it can be made to act more severely.

It may be noted that in Hungary there is a method of keeping horses quiet, which is described as successful. Two musket-balls have a hole made through them, by which they are attached to each other, a short distance apart, by a piece of twine. A ball is placed in each ear of the horse, and this produces so much surprise or fear that the animal remains tranquil.

The *Mask*, *Blinkers*, or *Blinders*. Sudden deprivation of sight often so alarms or stupefies horses that they are rendered quite docile, or at least more manageable; while, if really vicious, they cannot take advantage of a favourable opportunity to injure those around them. It sometimes happens, however, that blindfolding does not produce tractability, but rather the reverse, and may lead to serious accidents, from the horse dashing about recklessly and unguardedly.

Any non-transparent covering will suffice to exclude vision: a hand-

kerchief, towel, or piece of cloth tied across the face from one side of the head-stall to the other; a driving-bridle with blinkers, or the ordinary eye-covers, known to veterinary surgeons as 'bluffs,' or the mask or 'blinders,' will answer. The latter is the best (Figs. 10, 11 *a*),

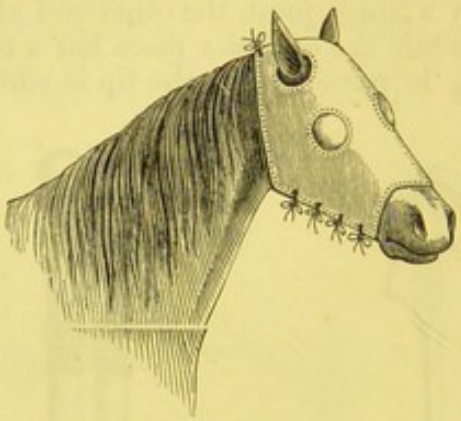

FIG. 10.—THE MASK.

as, being made of leather, it acts as a guard to the eyes and eyebrows during the performance of the operation, particularly when the horse is placed in the recumbent position; and by fitting the head closely it is not so liable to be displaced.

The *Cradle* or *Beads* (Fig. 11, *b*) allows lateral and downward movements of the head to only a very limited extent. It is composed of from eight to twelve round pieces of wood, one and a quarter to

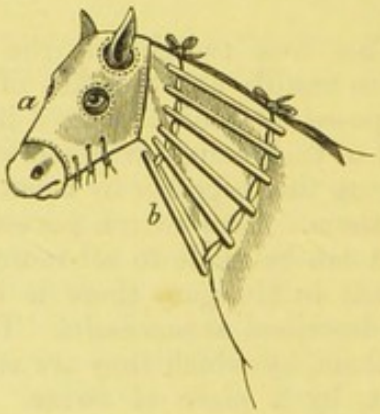

FIG. 11.—THE CRADLE, OR NECKLET—*a*, Mask; *b*, Beads.

one and one-third inch in diameter, and fifteen to eighteen inches in length, pierced at each end by a hole, through which a cord passes. These rods are kept some inches apart from one another, either by knots on the cords or by short pieces of wood perforated from end to end, and strung on the cords between the rods. The ends of the cords are tied on the upper part of the neck; and to prevent this part being cut by them, it is well to place a pad of tow or other soft material between them and the skin.

The *Side-rod* (Fig. 12) is a round wooden or iron rod, from three and a half to four feet in length, with a thong or small strap and buckle at each end. One end (A) is attached to the head-collar, while the other (B)

FIG. 12.—SIDE-ROD.

is fastened to a surcingle firmly secured round the body. It is placed on the side opposite to that on which the operation is to be performed, and prevents bending of the neck laterally, and to some extent downwards.

2. THE LIMBS.—It may be necessary to secure one or more limbs, in order to limit the movements of the horse as much as possible, and prevent injury to the operator or attendants. One limb may be raised from the ground and maintained in a flexed position, or two or three limbs may be secured without elevation; or one may be raised and the others secured, in addition. The flexed limb may be a *fore* or *hind* one, and be maintained in that position by *manual* or *mechanical* means.

a. Fore-limb Flexed.—The fore-limb may be maintained in a flexed position, *manually*, by lifting it in the ordinary way, the assistant then standing upright and firm, his face towards the horse's hind-quarters, and his hand grasping the toe of the hoof, the thumb at the toe of the shoe, and the fingers extending on the front of the wall, holding the limb well flexed, the foot towards the elbow. If it is a left fore-limb, then it is held by the assistant's left hand, and *vice versâ*. Strength, agility, and tact are necessary in manipulating the limbs; and in holding up a fore-leg, the assistant has often need of these qualities, and to a high degree. Attempts should not be made to prevent all motion in the flexed limb, and the hand should follow its swinging movements forwards and backwards, care being always observed in keeping the balance, should the horse bound forwards.

To prevent injury and fatigue, or when an assistant is not avail-

able for this purpose, the *mechanical* method can be adopted. In this a rope or strap is employed to attach the pastern to the forearm. The leg is well flexed at the knee, and the rope or strap is then passed round the forearm and pastern, a complete turn being made, if necessary, for greater security, around the pastern (Fig. 13). A leather strap with buckle is to be preferred, as it is

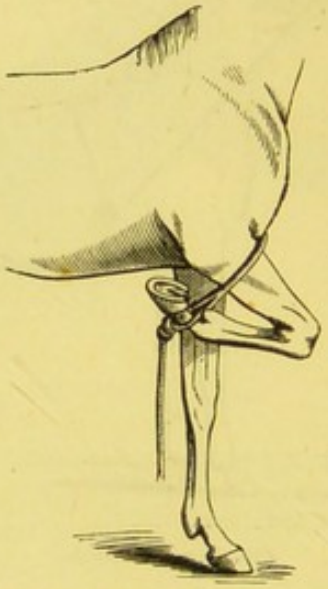

FIG. 13.—FORE-LEG SECURED.

easier applied and removed, and not so likely to injure the limb. To prevent contusion by the hoof, it may be necessary to interpose some soft substance between it and the elbow.

Another mechanical method is by the *Side-line*. This is a long cord, or rather thin rope, or, better still, strong web band, about twenty feet in length, with a loop or hobble strap at one end. The loop or strap is placed round the pastern of the limb to be raised, and the rope or band is passed over the horse's shoulder to the opposite side, where it is held by an assistant after the leg has been flexed; or it is passed in front of the chest, round again to the same pastern, where it is fixed, the weight and strain being thus thrown on the withers.

b. Hind-limb Flexed.—The hind-limb, like the fore one, may be flexed and maintained in that position *manually* or *mechanically*.

Manual flexion of the hind-limb is more difficult and dangerous than that of the fore-limb, owing to the powerful action of its flexor and extensor muscles, and its wider range of movement. A strong farrier is the best assistant in maintaining this limb raised in a flexed position. The horse's leg (or shank) rests on the assistant's thigh, his limb corresponding to that of the horse—*i.e.*, right leg to right leg, and *vice versâ*—his back being towards the horse's head (Fig. 17). As with the fore-limb, the assistant should stand as erect as possible, and not allow himself to be drawn beneath the horse or thrown down. The strain is much relieved, should the limb have to be

held up for a considerable time, if he wears a cross or shoulder-belt with a strap attached, which he passes round the pastern, holding the end firmly in one of his hands; or, if the horse's tail is very long, it may be passed round the pastern, and held in the same way.

Mechanical flexion of the hind-limb—that which is preferable, and in many instances is alone practicable—can be achieved in several ways. The first and simplest method, if the horse has a long tail, is to bend up the hairs into a large loop (Fig. 14, *a*), pass a piece of rope half round this loop (*b*), and both ends through it (*c*, *e*), pulling them tight, so as to close the loop. One end of the rope, close to the tail, has a loop or an iron ring spliced in it (*d*); the other end (*e*), being the longest, is passed completely round the pastern —the limb being raised and flexed backwards—or through the D ring of the hobble, if one be worn; then it is tied to the loop or ring at the short end of the rope. By this means the raised hind-limb is secured as high as may be necessary to the tail, which bears the strain. It may be observed here, that unless a hind hobble-strap is used for the pastern, it is well to have a piece of flannel or cloth wrapped round it, to prevent the skin from being contused or abraded—sometimes a rather troublesome accident when a sharp rope is employed.

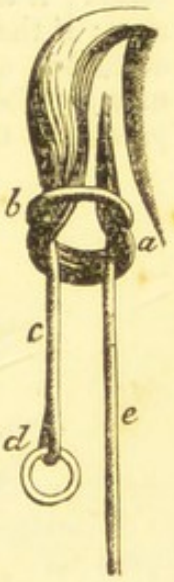

FIG. 14.—TAIL-HOBBLE. MODE OF ATTACHING THE HIND-LEG TO THE TAIL.

The hind-leg may be kept raised either forward or backward by means of a rope, or the side-line already described (p. 16). This can be employed in various ways:

1. Secured to the pastern by one end, the other end is passed through a body-surcingle, and, being pulled by one or more assistants, the leg is drawn forwards and upwards; the rope is then tied to the surcingle, or carried back through it and held there.

2. After securing one end of the rope or side-line to the pastern,

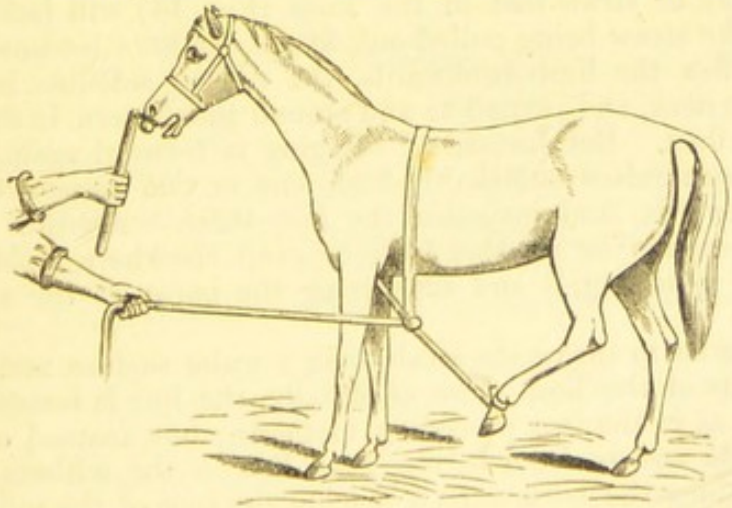

FIG. 15.—SECOND MODE OF SECURING THE HIND-LEG BY SIDE-LINE.

the other end is carried between the fore-legs, across the chest, and back behind the shoulder of the limb on the opposite side, over the back, and down towards the elbow on the same side as the limb

to be secured, where it is passed over the portion beneath the chest, and brought out again, as shown in the figure (Fig. 15). By this mode the horse's back bears the strain.

3. One end of the rope or side-line is tied round the base of the neck by a fixed knot (Fig. 16); the rope is then passed backwards, outside the shoulder, to the pastern of the hind-leg which is to be raised; if this has on a hobble-strap, the rope is passed through the ring; if there is no strap, then the rope is carried inside the pastern, around it, and forward outside. Traction being now made, the leg may be lifted to the required height forward, and a turn of the free portion of the rope around the fixed part, as in the figure, will fix it,

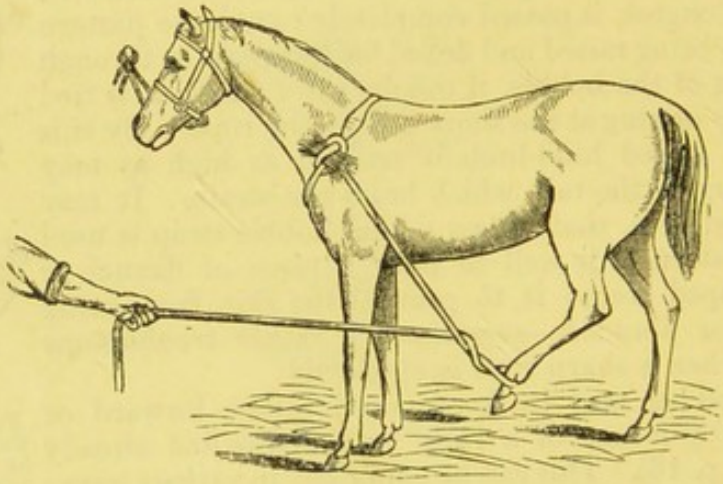

Fig 16.—Third Mode of Securing the Hind-Limb by Side-Line.

one assistant being sufficient to control the movement of the limb. It may be noted that when it is at any time necessary to make a fixed knot in a rope which it is desirable should be readily untied, a small lock of hay or straw tied in the knot (Fig. 16) will facilitate this object: the straw being pulled out, leaves the knot loosened.

4. To flex the limb backwards, the rope or side-line is fastened round the neck, and carried to and around the pastern, in the manner just described. But instead of bringing it forward again, after the leg has been raised sufficiently high, one or two assistants pull the line backwards, and maintain the foot there. Another assistant, if the operation be on this foot, or even elsewhere, holds up the leg, thus steadying it and supporting the horse at the same time (Fig. 17).

5. In order to throw the strain over a wider surface, and limit the movements of the limb more effectually, the line is fastened round the neck, as in the two preceding methods; but, instead of passing downwards and backwards, the knot lies on the withers, the line directed along the back until it reaches the root of the tail; around this part it is passed, then brought down to the pastern of the leg to be raised (Fig. 18). If a hobble-strap is worn, the ring-side is turned to the rear, and the line passed through the ring, when, one or two assistants pulling, the foot may be sufficiently raised; passing the

free portion once or twice round the fixed part secures it. If a hobble-strap is not employed, then the limb should be raised, the line passed round the pastern, and held as described.

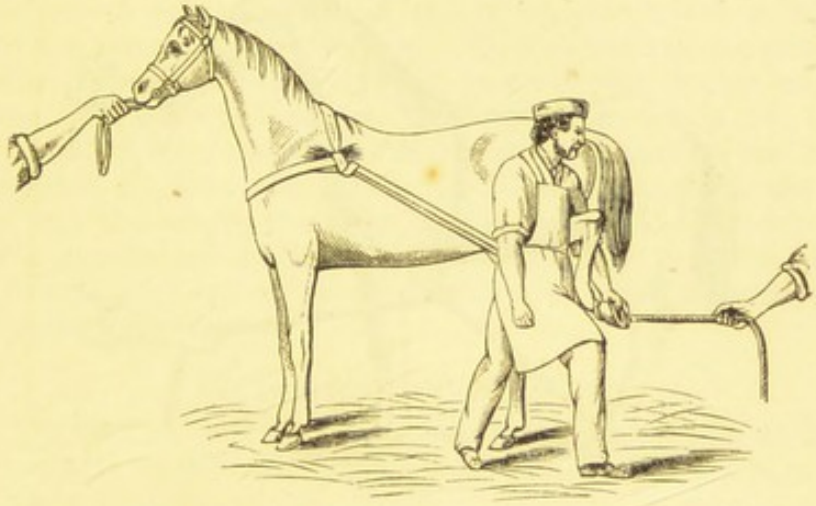

FIG. 17.—FOURTH MODE OF SECURING THE HIND-LIMB BY SIDE-LINE.

To prevent rearing and kicking during the performance of operations, the limbs are sometimes shackled by ropes or hobbles, so that they cannot be raised to any distance independently. To prevent kicking, a hobble or shackle may be placed on each hind-pastern, and a rope (the rope and chain of the ordinary hobbles do very well) is attached to both, but so as to leave a space between the hind-feet.

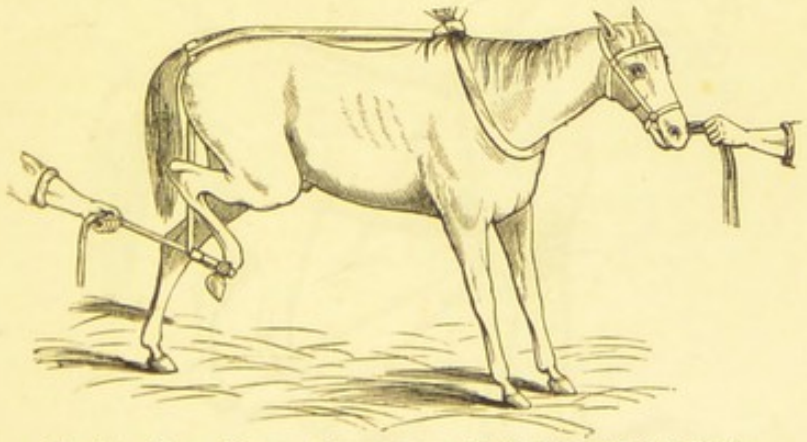

FIG. 18.—FIFTH MODE OF SECURING THE HIND-LIMB BY SIDE-LINE.

The rope is then passed between the fore-legs, over the shoulder, across the back, and round the fixed portion of the line, as in the second method (Fig. 19).

Another excellent method of securing the two hind-limbs, with less risk of throwing the horse down by accident, is by the employment of the Cossack hobbles. Three hobble-straps are connected—two about one and a half or two feet apart, the other three to four feet from these—by strips of raw hide or rope. The two closer connected

ones are attached to the hind-pasterns, while the third is secured above the knee of one of the fore-legs.

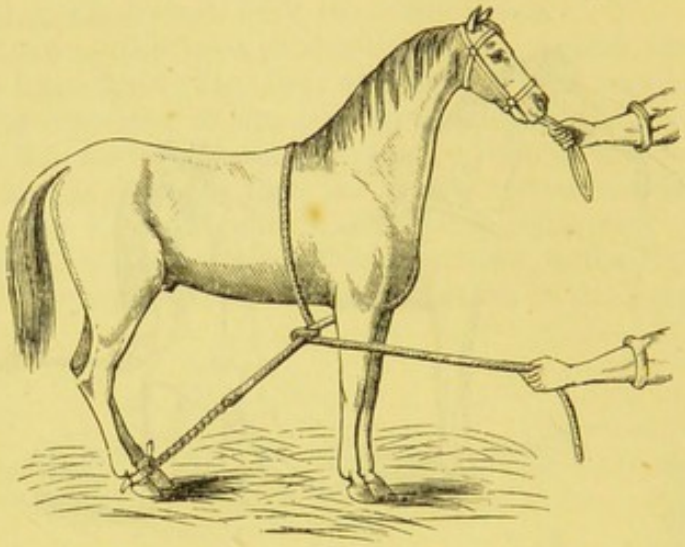

FIG. 19.—METHOD OF SECURING BOTH HIND-LEGS.

The hind-legs may be restrained, and the fore ones limited in their movements, by another method. This consists in using two side-lines—one for each ; these are attached to the hind-pasterns, passed between the fore-legs, round the fore-arms, and underneath and

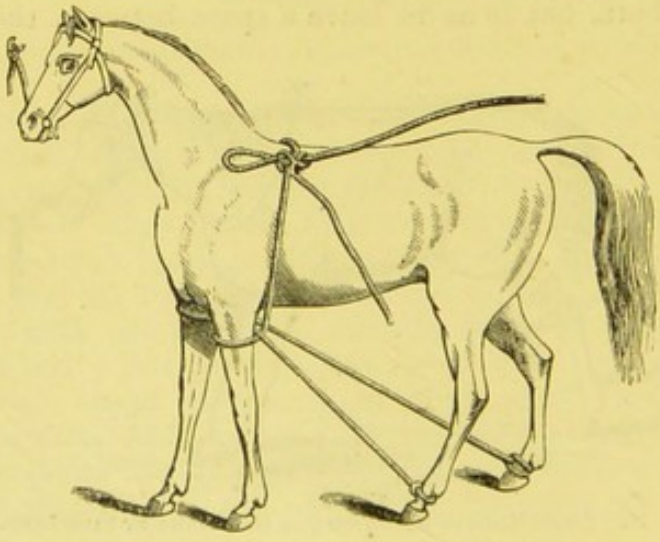

FIG. 20.—METHOD OF SECURING FORE AND HIND LIMBS IN THE STANDING POSITION.

within the fixed portion, and are tied over the back immediately behind the shoulders, as shown in the figure (Fig. 20). The lines may be crossed in such a manner that the one on the left pastern goes to the right fore-arm, and that on the right pastern to the left fore-arm.

Another method is adopted by Legoff. The apparatus required is

very simple, and consists of a hempen rope the usual thickness of the side-line rope, the total length of which is that between the hind and fore limbs of a large-sized horse. It is single at one end and double at the other—Y shaped; each of the three extremities being provided with a running noose or loop. If it is desired to operate on the posterior part of the body, the loops of the double end are placed one on each hind-pastern, the loop of the single end on the pastern of one of the fore-limbs. If the anterior part of the body is to be operated on, then the double loop-end is placed on the front pasterns, and the single one on a hind pastern. If the rope is too long for a small-sized horse, then the bifurcated portions may be twisted round each other as many times as may be necessary to make it sufficiently short.

Hippo-Lasso and Travis.

With the view of still further limiting the movements of horses, and particularly of their limbs, and so rendering them more manageable under operations in the standing position, other means have been devised. These are the *hippo-lasso* and *travis*.

Hippo-lasso.—Butel's hippo-lasso is simply an ordinary side-line and two cords or web bands, from five and a half to six and a half feet in length. Two assistants take the side-line and stand in front

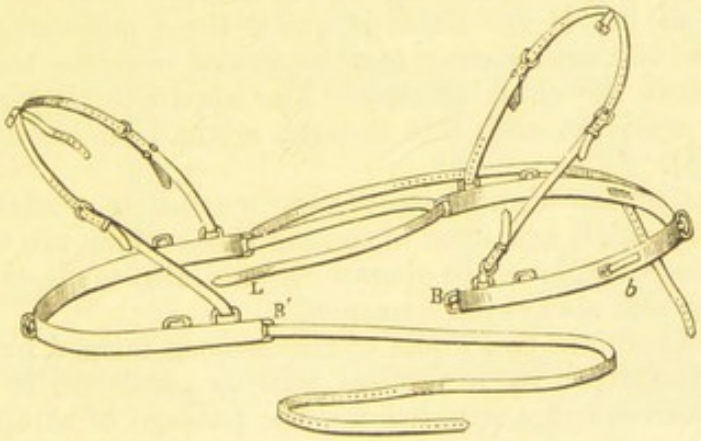

Fig. 21.—Raabe and Lunel's Hippo-Lasso.

of the horse, one on the right, the other on the left side; the line is placed high up in front of the fore-arms, and one of the assistants, who has the long portion, carries it around the animal, above the hocks, to the other side, where the end of the line is passed through the loop in the hand of the other assistant, and there tied. By this means the limbs are encompassed by the side-line, which is now maintained in position by one of the assistants, while the other places the two pieces of cord over the back—one behind the withers, the other over the loins—and attaches them in such a way to the side-line that they keep this in position on each side—about the middle of the fore-arms, and four or five inches above the point of the hocks.

The end of the side-line is now drawn further through its loop, so as to diminish the circle it forms around the limbs; these are gradually drawn together, the horse vainly struggles to release itself, begins to tremble, and stands motionless. The end of the line is then tied in a slip-knot, so that the animal may be easily released or further restrained.

The leather hippo-lasso of Raabe and Lunel (Fig. 21) is a mere elaboration of this simple device—this equine 'strait-jacket.' It is chiefly composed of two portions—a breast-piece or *bricole*, and a breeching—joined at each side by a long strap (L shows the end of the strap, which should be firmly sewn to the breeching at this part) passing through a running buckle at B fixed at each end of the bricole, and returning again backwards to go through a similar buckle at each extremity of the breeching (B′). The apparatus is suspended over the withers and loins by two other straps provided with buckles, so that it can be adjusted to include the fore-arms close to the body, and the hind-legs between the stifle and hock. If the horse is vicious, it is advisable to tie the head high and short. The open part is placed against the chest, the other portions being laid on the back, or held by an assistant, until the bricole has been supported by the wither-strap, and buckled on the opposite side. The breeching is then pushed along the back over the hind-quarters, and secured there by passing the hitherto disengaged strap at B′ through the buckle at B. If the horse is quiet, these precautions are unnecessary, as the wither-strap may be passed over the head and the bricole against the chest at once. The apparatus is tightened by pulling the strap on each side through a small buckle fixed on the breeching (*b*).

The effect of the hippo-lasso is very marked in rendering horses tractable and quiet, and even in taming those which are vicious. It has been much employed in operations, and also in shoeing troublesome horses, and always with success.

Travis.—There are two kinds of travis—one formed by posts and bars, and the other by a vertical wall or partition, in which are apertures conveniently situated for the passage of straps or ropes from the opposite side, whereby to fasten the horse to it; the object in both being to render the animal immovable in the standing position.

The *Post Travis* has been in use by farriers from the earliest times for shoeing vicious horses. It is that most in use, as both sides of the animal are accessible in it. It varies considerably in design. Essentially it is a quadrangular structure, formed by four wooden posts, fixed either in the ground or into a strong platform also of wood, and joined by lateral, and sometimes vertical, bars. The posts, for safety and stability, are nearly always solidly fixed in the ground.

The most approved model is perhaps the following, copied from Peuch and Toussaint's work (Fig. 22). The posts, of oak (P, P′), square, with the angles removed, are seven or eight feet high, and six or eight inches in diameter; the front ones are twenty-six or

twenty-eight inches apart, and the hind ones three feet. They are not only firmly implanted in the ground, but are supported by strong stays springing from a thick floor of oak planks tightly bound together and furnished with six rings—two towards where the fore-feet should be placed, two for the hind-feet, and two between on each side. The sides are formed by two wooden bars (T, T′) four feet long and four and a half inches thick, morticed into the posts ; from these spring two vertical bars (E E′) three feet three inches in length and four inches in diameter, which are fixed into two side-bars connecting the upper part of the principal posts, which are also further connected by wooden bars at the ends of the quadrangle. On the outer side of the vertical bars are attached, by means of iron

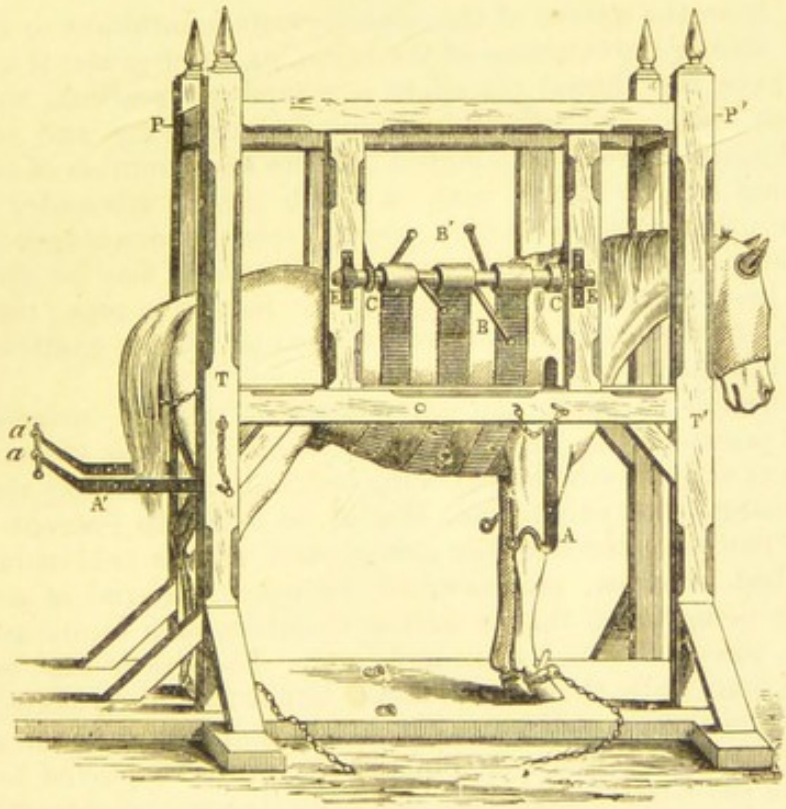

Fig. 22.—Post Travis.

bands, two strong oaken windlasses (E E′), which move in the sockets formed by the bands. Two small iron bars or levers (B, B′) on each side are inserted into holes in the windlass, in order to turn this round ; and each windlass has a small cog-wheel (C) at the ends, surmounted by a check attached to the post. About four feet from the floor, between the front chief posts, is fixed a round wooden bar, with two strong head-collar ropes lashed round it by which to attach the horse to it, or to rings in the posts. The back posts have also, about four feet from the floor, rings for the passage of a chain or rope to close in the quadrangle and prevent the horse backing out of it. For operations on the feet, pieces of iron are fixed at conve-

nient places (A, A′), and in the form shown in the woodcut. A suspensory apparatus, in the shape of bands, two or three in number, is attached to the windlasses on each side, and serves to sustain or raise the horse to a certain height. Four hobbles, with ropes or chains, to secure the feet to the floor, complete the chief features of the travis.

The *Wall Travis*, of which several kinds have been devised, is seldom employed. It is simply a strong vertical partition provided with many holes, through which ropes or straps can be passed to lash a horse immovably against it. A description will be given presently of a vertical wall travis which can also be converted into an operating table.

II. Recumbent Position.

When, from the nature of the operation, its painfulness or tediousness, the vice or nervousness of the horse, or other cause, it is necessary to have the animal placed in a recumbent position, the most convenient, safe, and effective means for throwing and securing it in that position are to be adopted. There are a number of methods of throwing a horse down, each of which has its advocates; while there are other methods which possess special advantages for the performance of particular operations. The means may be simple, or more or less complicated. They may be merely a rope, ropes, or side-lines; or they may be straps and buckles for the pasterns, with a rope to connect them.

The object is to throw the horse down as quickly, securely, and safely as possible. As the fall is always more or less violent, from the bases of support (the limbs) being suddenly and forcibly removed, it is necessary that precautions should be taken to prevent injury, either by throwing the horse on soft ground, as in a field or meadow, or on a bed of straw, tan, sawdust, or other material of a similar kind, care being taken that it does not contain such injurious bodies as stones, pieces of wood, iron, nails, etc. The size of the bed will, of course, vary with that of the horse, but it should measure, at the very least, one and a half times the length and height of the animal.

The strength and dimensions of the apparatus employed to throw and secure the horse will also depend upon its size and strength; but the utmost care should be observed that its various parts are not only well adapted so far as size is concerned, but that they are sufficiently strong and in good order. It should also be so constructed, and of such material, as to injure the animal as little as possible.

The apparatus consists of ropes only, or ropes and one or more straps to go round the pasterns, or a special apparatus known as 'hobbles,' which is most in use. The simplest will first be described.

1. Throwing a Horse Down by Means of a Rope or Ropes.

A. *The Casting-Rope.*—A very common and simple way of placing a horse in the recumbent position is practised in this country, and especially for the operation of castration, by means of a long rope, strong but pliable. This is doubled, and at two or three feet from the bend is tied into a knot, so as to form a loop sufficiently large to

pass over the head and lie on the neck like a collar. The ends of the rope are then passed between the fore-legs : one is carried round each hind-pastern, outside to inside, and underneath in bringing it forward, each rope being passed up through the collar on the same side, and brought back towards the hind-quarters (Fig. 23). Some practitioners prefer to place the knot of the collar-piece at the upper border of the neck and to carry the ends of the ropes back outside the fore-limbs to the hind-pasterns. A powerful assistant holds the animal's head, on which a strong head-collar or halter is placed, and a short twitch on the nose, if necessary. Two or three strong assistants pull, at a given signal or word, each rope backwards, and the result is that the hind-limbs are suddenly drawn forwards and upwards, the animal's balance is lost, and it is then easily pushed over, or falls on

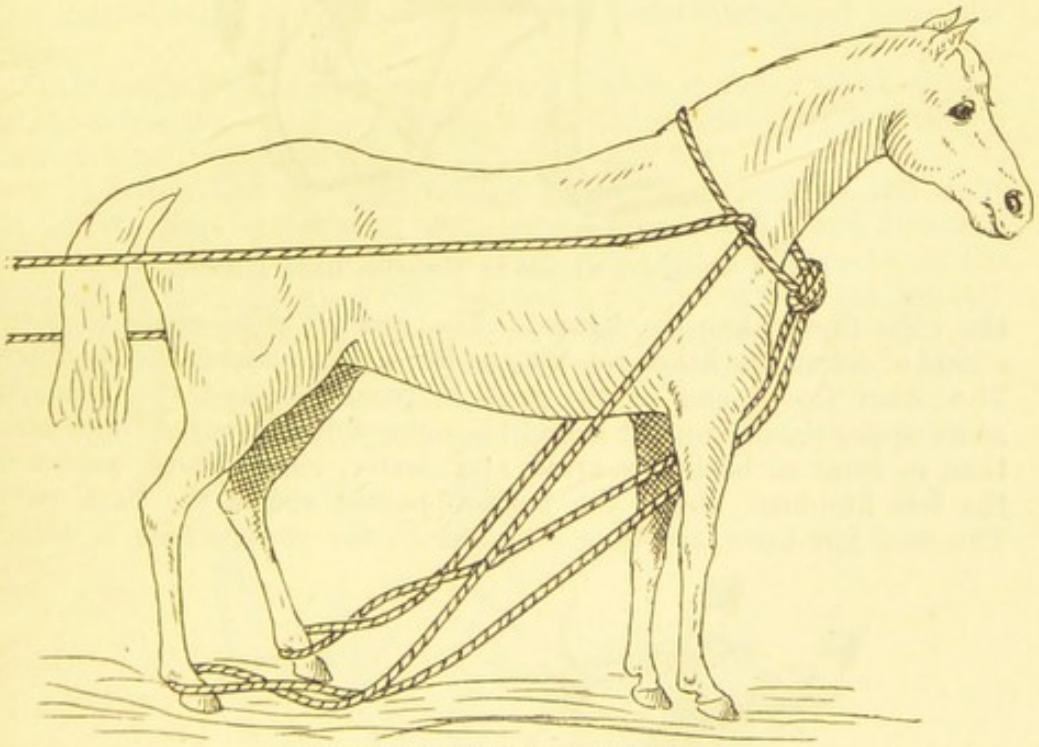

FIG. 23.—CASTING-ROPE APPLIED.

its side, when the ropes can be fastened to the neck portion, and the fore-limbs secured to the hind ones by the same means. For operations on the inferior and posterior regions of the abdomen—as for inguinal or scrotal hernia or castration—this is a good and simple method. Five, six, seven, or eight assistants, according to circumstances, are necessary.

B. *Rohard's Method.*—Another simple method has been proposed by M. Rohard, and is recommended in those cases in which it is necessary to throw down vicious or irritable horses that will not allow the ordinary hobbles to be applied, when these are not procurable, or when assistants are few. A rope about twenty-four feet in length, furnished with a loop at one end, or two side-lines joined end to end, is necessary. An assistant at the horse's head holds the reins of the bridoon in one hand, and one of the animal's ears in the other. Another assistant, or the operator, places himself opposite

the right or left shoulder of the horse—right if the horse is to fall on the left side, and left if on the right side. We will suppose he stands on the left side. At the opposite end to the loop end of the rope, and about eight feet from the extremity, he makes a ring-knot (forming the upper loop seen in Fig. 24), through which the rope runs; and below this a second, a check-knot, which holds

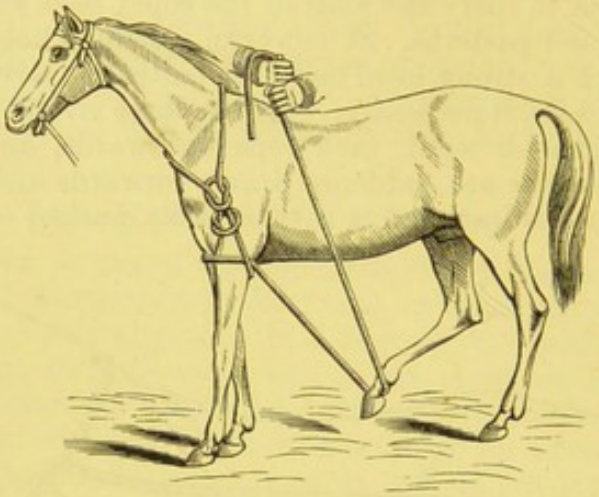

FIG. 24.—ROHARD'S METHOD OF THROWING DOWN A HORSE.

the rope (lower loop in figure). The rope is thus made to form a kind of collar, the knots reaching as low as the point of the shoulder. The other (loop) end of the rope is passed behind the fore-arm at its upper third, brought round the outer side of the right fore-arm, then in front of both fore-arms, and, lastly, on the outer aspect of the left fore-arm, above the portion passed round the back part. The two fore-arms are thus enclosed in the rope, which is some-

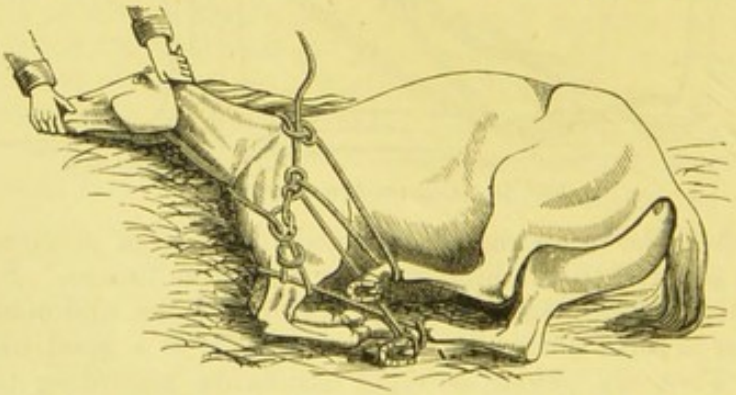

FIG. 25.—ROHARD'S METHOD OF SECURING THE HORSE WHEN THROWN DOWN.

what tightened round them by bringing the limbs close together. An assistant keeps up the portion round the fore-arms, while the operator passes the rope beneath the body to the right side, around the pastern of the right hind-limb (as in the figure), and over the withers on the left side. Keeping the rope in his hand, he goes round to the right side of the horse, stands a little behind the shoulder, rests his two arms—between wrists and elbows—on the withers, so as to gain a firm hold of the rope, his body pressing at

the same time against the horse to steady himself; and then, pulling evenly, he gently strikes with his left foot the horse's right hind-foot, causing this to be lifted. Still pulling steadily and strongly, hand over hand, the hind-limb is raised as high as possible, the assistant shaking the horse's head should opposition be offered, until the animal sinks and falls on its side without danger. The limbs are then secured in the following manner: On the right hind-leg the free portion of the rope is passed round the pastern, but below the other part proceeding from the fore-leg, and there tied, so that this pastern is secured with a double hitch; the remainder of the rope is carried up to the neck portion, hitched there, brought back and around the pastern of the left hind-limb, and finally tied to the neck-rope by a simple knot (see Fig. 25). To release the horse rapidly, the check-knot is to be undone, and the limbs disengaged from the rope.

This method requires some practice, and it is above all necessary, in throwing the horse down, that the hind-leg should be well drawn forwards and upwards.

C. *Bouley's Method.*—Flex the left fore-limb at the knee, and tie it in that position by a cord or strap passed round the leg and fore-arm. The operator, standing on the same side, seizes the reins of the bridoon by the right hand over the neck, and flexes the neck forcibly to the right side until the nose is nearly on the back. By this procedure the body inclines so much to the left that the animal, feeling his balance lost, lies down quietly.

D. *Rarey's Method.*—This is similar to the last, except that a sur-

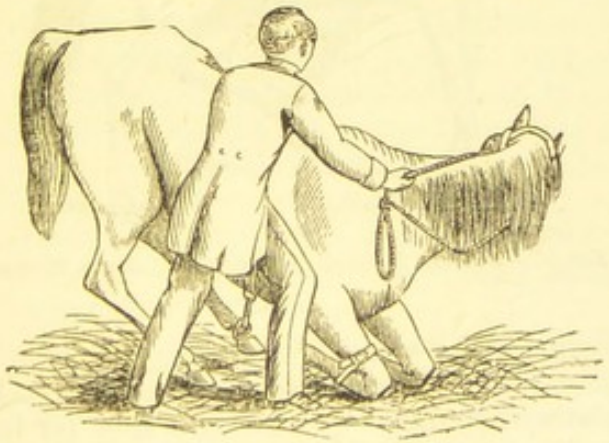

FIG. 26.—RAREY'S METHOD OF THROWING DOWN A HORSE.

cingle is placed round the horse's body with a ring at its inferior part; the right or left fore-leg is strapped up, and a side-line placed on the pastern of the opposite fore and hind legs, the rope of which may pass through the ring in the surcingle. The horse may be made to stand or move about for some time on three limbs, to produce a moral effect, as well as fatigue. The operator places himself on the side on which is the strapped-up leg, and pulling round the head in the opposite direction by means of the rein, as well as exercising traction on the side-lines, the horse falls (Fig. 26).

E. *Vatel's Method.*—Two cords of a certain length are employed, one to tie the two fore-legs, the other the two hind-legs. To each of these a longer cord is tied in the middle, and is passed in an inverse direction—that between the hind-legs being carried forward in front of the horse, the other between the fore-legs being carried behind. Traction being applied to these long ropes by men placed before and behind the horse, and pushing the head and pulling the tail to one side—that on which the horse is to lie—brings the animal down without difficulty. Instead of two long ropes, one may suffice. This is tied in the middle of the cord binding the fore-legs, then over and under that of the hind-limbs, forward, and to the outside. When this is pulled forward by two or three men, all the limbs are brought together and the horse falls. The assistant at the head, and, though not indispensable, another at the shoulder or tail, throw the animal on the side.

F. *The Russian Method.*—What has been described as the 'Russian method' is particularly simple, and requires but little assistance, two persons being generally sufficient. The casting materials consist

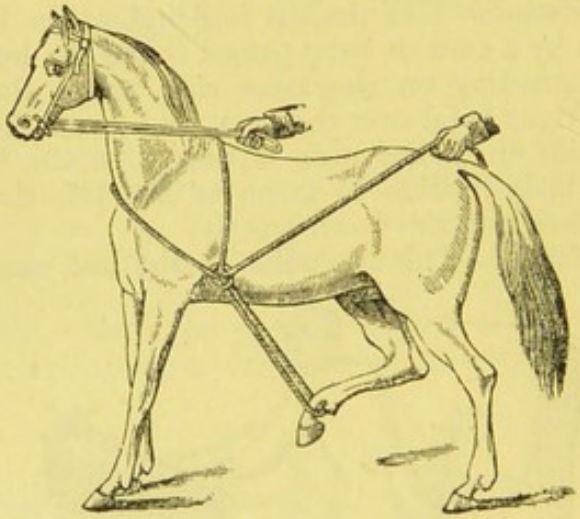

FIG. 27.—RUSSIAN METHOD OF THROWING DOWN A HORSE.

merely of a long leather strap or rope ten yards in length, and a snaffle. Only one man, with an assistant at the head, is necessary. In order to throw the animal on the right side, for instance, a loop sufficiently long to pass over the head and fit the neck like a collar, is made at the end of the rope, and just below the loop a ring is attached to the rope, so that it will hang about opposite to the left elbow. The free end of the rope is then passed under the abdomen, and from without to within round the right hind fetlock, then forwards through the ring and over the back towards the left and right quarters (Fig. 27), where the person stands who is about to throw the horse. This person holds the rope in his right hand, flexes with the left hand the right hind-leg, at the same time drawing it forwards towards the ring; seizing then the rope with the left hand, and resting this on the croup, he takes hold of the snaffle-rein

with the right, and draws the head as much as possible towards the left ; lastly, he pulls simultaneously on reins and rope, throwing at the same time all his weight on the hind-quarters, while the assistant at the head presses this towards the ground. The horse falls, and the rope is passed once more round the right fetlock ; then round the left, through the ring, and there secured. The fore-feet are made fast, and the rope handed to the assistant.

G. *The Hungarian Method.*—This is described by some authorities as the best and most secure, though not the most professional method. A rope, twenty-four feet long, is doubled, and tied in a simple knot at a certain distance from this double, so as to form a fixed loop large enough to pass over the head and lie on the shoulders like a collar. The horse may be thrown down in three ways : 1. If the animal is so vicious that it is impossible to get near the hind-legs, one end only of the rope is passed on the ground behind it, round to the opposite side, through the collar, and then quickly pulled by several men in a backward direction towards the hind-quarters of the horse. By this manœuvre the hind-limbs are drawn under the body, while one or two assistants at the head turn the animal on its side by pushing it and pulling at its mane. 2. If the horse allows the hind-feet to be handled, both ends of the rope are passed between the fore-legs, round the hind fetlocks, through the collar on each side, and then pulled backwards, as already described, for the 'casting-rope' (Fig. 23). 3. To prevent injury, hobbles may be put on the hind-pasterns, and each rope passed through the ring of a hobble. When thrown, the hind and fore limbs must be secured in the manner already noticed.

To Throw Dangerous Horses.—Allusion has already been made to some methods of throwing dangerous horses. One or two others may be noted. A safe and rapid method is to throw a side-line around the body ; then place on the ground the wide-running noose of a rope, and when the animal, blind-folded, is made to place one of its fore-feet in it, the noose is quickly tightened. The side-line is now strongly pulled at one side, as well as the foot-rope, and the head towards the opposite side, when the horse falls. The limbs are then lashed together with ropes.

Another is to make a wide running-noose in a side-line round the body, and allow this to pass adroitly over the hind-quarters around the hind-legs ; another side-line, made into a similar noose, is laid on the ground, and into this the horse is compelled to step with his fore-limbs. At a given signal the loops are drawn tight, and the ropes pulled—that on the fore-legs back, the one on the hind-legs forward —so as to bring all the limbs together. If the movement is well executed the horse falls at once.

In casting with ropes, the limbs can readily be secured by lashing them together, and passing hitches around the pasterns.

2. Throwing a Horse Down by Means of Hobbles.

Placing horses in the recumbent position by means of hobbles is the method generally preferred when circumstances permit, and

occasionally it may be absolutely necessary to employ this apparatus. The hobbles are straps, ropes, or bands, fastened around each pastern, and connected by means of a rope, which, on being pulled, brings the limbs together, and the horse, having its base of support suddenly diminished, can no longer preserve its equilibrium, and falls.

Hobbles, or ' shackles ' (as they are sometimes named), are usually made of leather; but they may be made of other material, or improvised.

Improvised hobbles may be made of four pieces of rope—one for each limb. The rope is passed one or more times around the pastern, and tied on the outer aspect of that part in such a manner as to leave a loop through which the long casting-rope may run easily, or the latter may pass between the pastern-rope and the skin, though there is danger of abrasion in this way.

If four strong iron rings can be procured, a very convenient set of hobbles can soon be made, by fastening one to each pastern with a piece of rope (Fig. 28). The rope may be doubled, and the ring fastened in it by a running loop, the two portions being passed once or twice around the pastern, and tied in an ordinary knot.

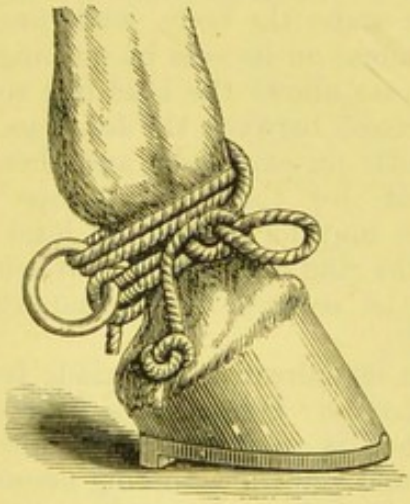

Fig. 28.—Improvised Hobble.

If metal rings cannot be procured, loops may be made on each end of the cord, through which the casting-rope can run, or a loop may be formed in the middle of each piece, with the same object in view.

Hobbles are sometimes made of strong webbing, with a large button, or knot of rope, at one end, and a loop, through which this passes, at the other end, by which each hobble is buttoned, so to speak, to each pastern. But they are generally made of strong and flexible leather, in the form of a wide, short strap, with an iron buckle at one extremity, and several holes at the other, for the tongue of the buckle, and to allow of the strap being fitted to a large or small horse. A short distance from the buckle is solidly fixed a ring—either oval or D-shaped. The strap should be well lined with flannel, or similar soft material, to prevent the skin being injured. It is well to repeat, that too much care cannot be exercised to prevent serious injury to parts which have to sustain the pressure or friction of restraining apparatus. Grave damage is sometimes inflicted when care is not observed. A protection of cloth or woollen stuff (as a portion of a flannel bandage), should always be placed next the skin.

Of the four hobbles, three are detached, or free. The fourth has the casting-rope—about twenty feet in length—attached to it, either directly, or through the medium of a piece of chain, two or three feet in length, spliced into the rope. This hobble may be named

the 'chief hobble,' and the rope may be directly fixed to it by means of a loop through the ring; or if a chain is used, the last link may be attached to this ring (Fig. 29).

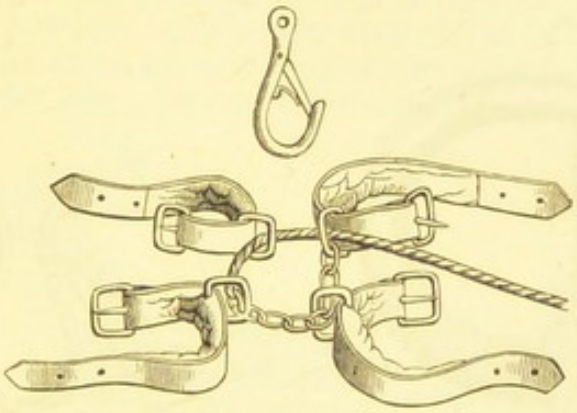

Fig. 29.—Ordinary Hobbles, with Spring-Hook for Chain.

The best hobbles, however, are somewhat more complex in their construction; but they possess great advantages, which will always give them the preference. Each hobble consists of two portions (Fig. 30, *a*, *b*), which are joined by a buckle and holes (*a*, *b*). At the extremity of one piece is a long narrow ring, through which passes a loop-ring when the hobble is adjusted to the pastern.

This loop-ring in the chief hobble (*c*) is furnished with a slot to receive the last link (*d*) of the casting-rope, which is secured therein by a pin screwed through it.

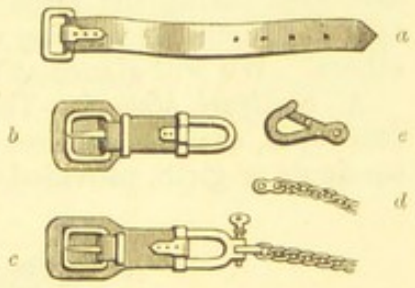

Fig. 30.—Improved Hobble: *a*, *b*, the Two Portions of a Detached or Free Hobble; *c*, the Principal Portion of the Chief Hobble; *d*, the Terminal Link of the Chain; *e*, Spring-Hook.

In using these or the ordinary hobbles, the chief hobble is usually applied to a front pastern, on the side opposite to that on which it is intended the horse should fall. The rope is then passed from it through the other hobbles, in a way to be hereafter described, and finally through the loop-ring of the chief hobble. When the horse is thrown down, to keep the limbs close together several appliances have been introduced, the most common of which is perhaps the spring-hook (Figs. 29, 30, *e*). The limbs being drawn together by the casting-rope, the hook is inserted into one of the chain-links nearest the chief hobble, so as to allow of as little play of the legs as possible.

Some practitioners object to this spring-hook, and therefore another contrivance has been devised, which is on the same principle (Fig. 31).

A very simple, economical, and secure fastening was in use at the Brussels Veterinary School. It is merely a piece of iron bent into a lyre shape (Fig. 32), one branch of which is passed into the link of

the chain as far as the closed part, and a leather thong tied round the neck prevents its falling out.

When it is desired to release the horse from the ordinary hobbles, this is effected almost instantaneously by unscrewing the slot-pin in the chief hobble.

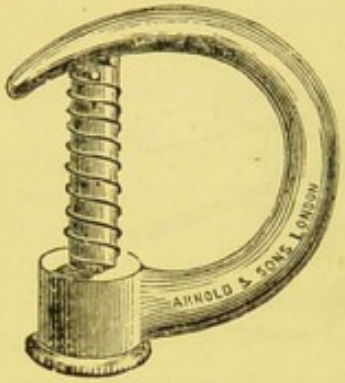

FIG. 31.
MODIFIED SPRING HOOF.

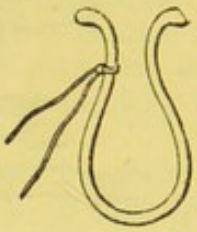

FIG. 32.
SIMPLE RETENTION HOOK.

Hobbles may be employed for only two or three limbs, ropes or side-lines taking the place of the other hobbles. The methods of applying them are various, and each may possess advantages over the others. We will glance at these.

A. *Stuttgart Method.*—The materials necessary for this method are two ropes, each sixteen feet long, one for each side, and a wide leather surcingle or girth, provided with a strap and buckle and two D-shaped

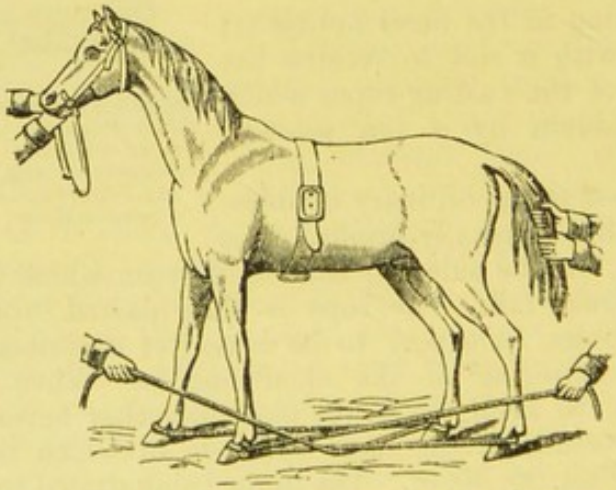

FIG. 33. STUTTGART METHOD OF THROWING DOWN A HORSE.

rings fastened to it at a short distance from each other. The horse should have the eyes covered by the mask, and a bridoon on the head. At one end of each rope is a loop. If the horse is to be thrown on the right side, the right fore-foot is raised and the loop of the rope passed over it; an assistant at the same time placing an ordinary hobble on the right hind-fetlock. On the left side the reverse procedure is carried out—a hobble on the fore-pastern, and

loop of other rope on the hind one. The rope from the right side is then passed through the hobble (from the outside to the inside), on the right hind-foot, and its end laid on the straw towards the left side. The end of the upper or left rope is then passed through the ring in the left fore-foot hobble, from within to without, and brought backwards. The ropes are now crossed, the right being kept under both parts of the left. Two or three men seize hold of each rope,

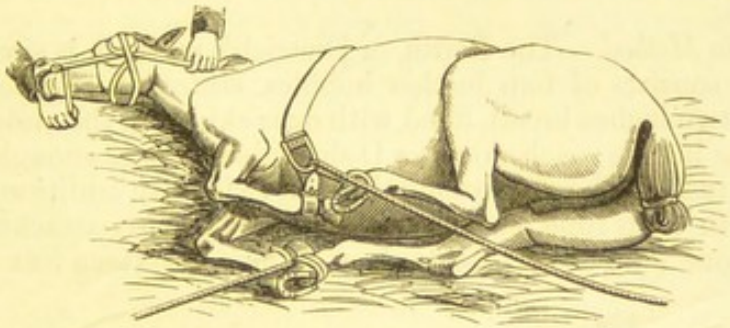

FIG. 34.—HORSE SECURED BY THE STUTTGART METHOD.

one set pulling in a backward direction, the other (those holding the right or under rope), in a forward direction ; an assistant at the tail, and another at the head, pull or push these parts towards the right side (Fig. 33). The horse falls, and the limbs can then be secured in the ordinary way, by hitching and lashing the ropes round the fore and hind limbs.

When operations have to be performed on the inferior part of

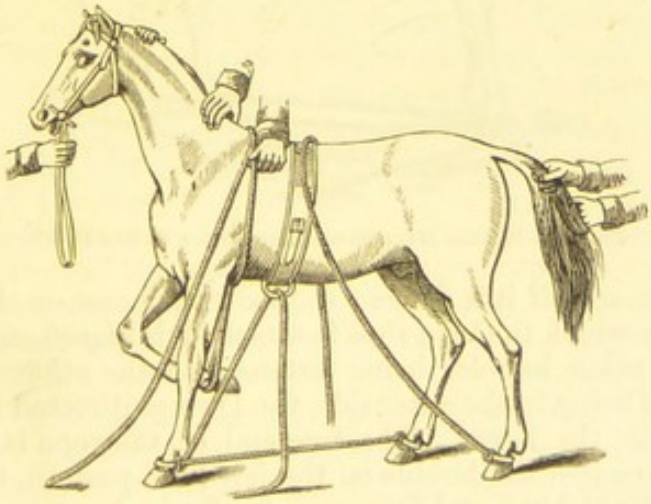

FIG. 35.—DANISH METHOD OF CASTING A HORSE.

the abdomen, penis, or scrotum, after the horse is thrown the uppermost rope should be passed through the D-ring on the corresponding side of the girth, and then hitched round the hind-fetlock of the same side (Fig. 34). By this means the upper fore and hind limbs are drawn close to the body.

B. *Danish Method.*—The Danish, or Abilgaard's method, is somewhat similar to the last. There are required a wide and strong

surcingle, or girth, to buckle round the body, with two iron rings firmly attached to it; three hobbles to which ropes are attached; and a fourth hobble without a rope. The latter is placed on the fore-leg, which is to be uppermost, the other fore-leg, as well as the hind ones, having a hobble and rope. The rope from the opposite hind-hobble is passed through the hobble on the uppermost fore-leg, then through one of the rings in the surcingle (Fig. 35). The feet are drawn up towards these rings, though this is not absolutely necessary in many operations.

C. *Berlin Method.*—The Berlin, or Dietrich's method, is simple. The apparatus consists of four leather hobbles, sixteen to eighteen inches long, and two inches broad, lined with deer-skin, and the ends fastened by a strong buckle; each carries a D-shaped ring large enough to freely permit an inch-thick rope passing through twice. In addition there is a three-fourth inch rope, twelve to sixteen feet long, attached to the D-ring of one hobble, and a side-strap, twelve to sixteen feet long, and

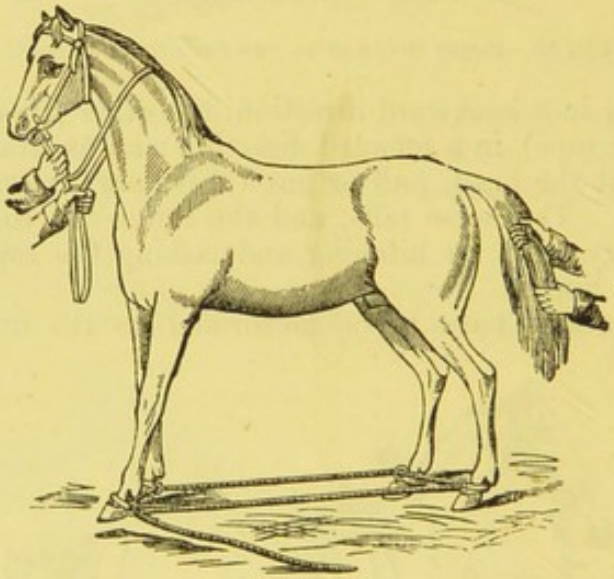

FIG. 36.—BERLIN METHOD OF THROWING A HORSE DOWN.

two inches broad. If it is desired to throw the horse on the right side, the hobble to which the long rope is attached, is placed on the left fore-pastern, the other hobbles being fastened on the other pasterns, the buckles of all being to the outer side, the D-rings directed towards each other beneath the horse. The free end of the rope is then passed through the ring of the hobble on the left hind-pastern, then through that on the right hind and fore, and finally back again through the ring of the left fore-hobble (from the inside to the outside) (Fig. 36). Assistants are placed at the head and tail, and these, pulling simultaneously with the assistants holding the hobble-rope, the horse falls on the right side. If it is required to throw the horse on the left side, the first or leading hobble is placed on the right, instead of the left pastern.

Another Berlin method (Hertwig's) is similar to the preceding. The apparatus consists of four hobbles, with rings and buckles; a rope

sixteen to eighteen feet long, a side-strap, and two side-lines. The hobbles are placed as in the preceding method, and the rope passed through them in a similar manner, with the exception of passing a second time through the first hobble. The side-strap (which has a loop at one end) is placed between the fore-legs, the ends being carried up towards the withers on the side of the shoulder which is to be uppermost, to the other side, where an assistant, standing a few feet off, holds them, ready to pull at the proper time. By this means the horse is thrown down on the desired place, and it serves to prevent or limit the animal raising itself at the moment of casting. The assistant at the tail is instructed to grasp this with one hand, to place the other hand on the quarter, and at the proper moment to push this from him and pull the tail towards him : the object being to throw the horse down first on the fore-quarters, as experience has shown that if the horse is thrown on the entire length of the body suddenly, or first on the hind-quarters, fractures of the pelvic bones, vertebræ, or other serious injuries, readily occur. The feet are secured by doubling the rope, in the neighbourhood of the pasterns, for about three feet, passing the loop so formed between the fore and hind feet from above downwards, and then carrying the remainder of the rope through this loop, into which a firm straw wisp should be inserted. When one of the fore-feet is released, the metacarpal or pastern bone should be placed on that of the hind-foot, and there secured ; the reverse should be done when a hind-foot is released. In castration, however, the right hind-foot should be tied to the fore-leg higher up—say to the fore-arm.

D. *Belgian Method.*—This method is more particularly employed for castration, and requires, as apparatus, two hobbles for the front pasterns, which may be connected with each other by means of two short chains, joined by a somewhat large and solid ring ; a hobble with a rope attached, or a side-line furnished with a loop ; two flat or round side-lines, one of which is for the hind-leg, the other to go round the body or fore-arm. The hobbles are applied to the two fore-limbs, and the hind one, on which the horse is to lie. The end of one of the side-lines is attached to the other hind-leg, and the other end secured around the neck. The other side-line is placed around the chest, or the fore-arm of the limb which is to be uppermost. The rope of the hind-hobble is passed through the rings of the front-hobbles, and traction being applied to this rope, as well as to that on the fore-arm, which has been passed over the withers, the horse falls, a man at the tail and another at the head aiding in the effort.

E. *Norman Method.*—This method is especially resorted to in Normandy for castration. The apparatus is the same as in casting by means of three hobbles. The animal is placed with the right side against a wall, on the margin of a good casting-bed, and the hobbles are applied as in the preceding method. The rope or ropes which draw the limbs together are passed through the two rings of the front-hobbles, and are attached to a ring fastened in the wall, more or less behind the fore-limbs, beneath the belly, or above and behind

the animal. An assistant seizes the head, another the tail, while the operator grasps the mane. The horse, being excited, moves forward, loses its equilibrium by the efforts it makes to relieve itself, and the operator and his two assistants, pulling simultaneously, throw it on its side.

F. *Miles's Method.*—A somewhat complicated, but very safe, method of securing a horse, particularly for castration, was introduced by an American castrator, the late Mr. Miles. The following description of the method was obligingly supplied by the late Captain Russell, F.R.C.V.S., of Grantham.

Miles's apparatus consists of two long ropes, each at least thirty-five feet long, forming the side-ropes; a shackle-rope, sixteen feet long, with a metal loop at one end; two cords, each seven feet long; four shackles, fourteen inches long, with a metal loop at one extremity; a twitch, one foot long in the stick, and a spreader.

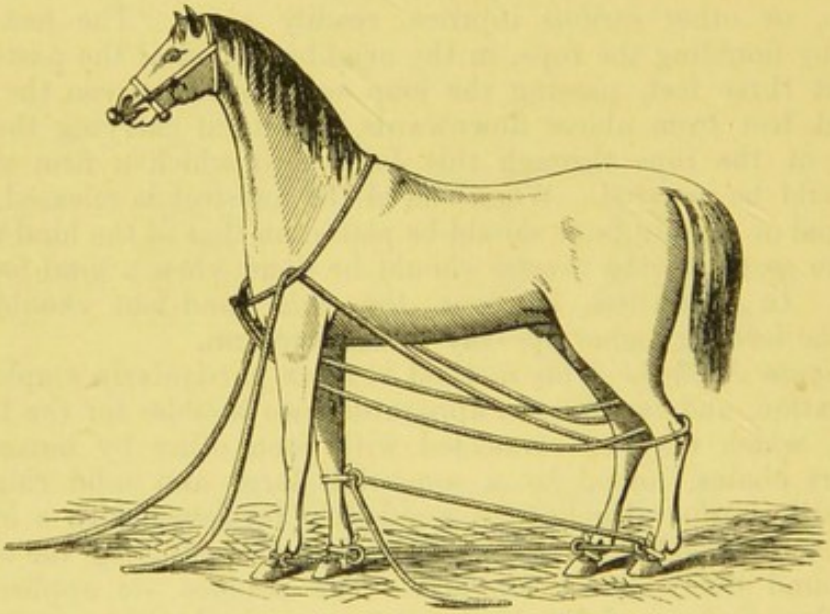

Fig. 37.—Miles's Method of Casting a Horse.

For a stallion: First adjust the twitch on the *off* side of the head, and fasten it to the cheek of the *halter*. Take the long side-ropes, which have been attached together to form a collar; place the loop so formed over the head. Take one rope at a time, say that for the off side; coil it in the left hand; pass it between the fore-legs, back to the hind-legs; here pass it round the off hind-leg from the inside; when round, pass it under the rope along the belly, and take it straight to the collar-rope; pass it under this, and lay the slack of the rope in front of the *near fore*-foot. The loop, where it passes round the hind-leg, should rest just above the hock (Fig. 37).

Then take the rope for the near side; coil it in the left hand; pass between both fore-legs, back inside, and round near hind-leg, and under the belly-rope to the neck-rope; under this lay the slack towards the *near hind*-foot.

The horse must be thrown on the off side; so, to put on the shackles, one is placed just below the knee on the *off* fore, another under the fetlock of the same leg, a third under the fetlock of the off hind, and a fourth under the fetlock of the near hind. (These are put on by passing the metal loop through the other end; the metal loop passing from the outside of the leg.) Then take the shackle-rope; put the loop on the *outside* of the *near* fore-leg, below the fetlock-joint, and pass the rope round the leg, and bring it through the loop, drawing all the slack through; then pass the end through the *bottom* loop on the off fore, thence to off hind, and through to near hind, thence to the loop under the knee on the off fore-leg, from the outside to inside, back to the near side.

One man has hold of the halter. Four others now take hold of this rope, and stand at a *right angle* to the body of the horse, ready to pull at a signal. The operator takes the side-rope on the near side, and having passed the loop hanging above the hock into the hollow of the heel, he draws up the slack, and holding the rope in his left hand, he pushes the hind-legs of the animal well under its body, by lifting one at a time, and the men draw up any slack of their rope. When ready, the operator seizes the horse's tail, and at the same time he gives the word 'Ready,' or 'Pull,' drawing the tail downwards, and to the off side; the horse sinks upon the off quarter, and quietly, without any struggling or jumping, falls upon that side.

To secure the horse: One man, say No. 1, places himself upon the animal's head and neck. Another man, No. 2, takes the side-rope of the near side and holds it firmly in position—the loop now being under the fetlock. Men Nos. 3, 4, and 5 hold the shackle-rope. The operator, placing himself in front of the legs, directs Nos. 3, 4, and 5 to slacken their rope; so soon as this is done, he draws the rope out of the two nearest shackles, which are that of the *near hind*, and that just under the knee of the *off fore*; when this is done he gives it back to Nos. 3, 4, and 5, to hold tight, while he fastens the near hind-leg, which is only now held by the side-line. He takes the rope from No. 2, and, without altering the position of the leg, with his right hand he takes off the shackle; he then passes the rope once round the fetlock, and then makes a half-hitch round the same joint; the rope is now outwards over the horse's loin and under the off croup. No. 2 here seizes it, and at the same time that the operator bends the leg on the stifle and hock joints, and so towards the belly, he pulls in the slack and retains it in that position. The operator seizes the rope, passes it between the hind-legs, and twice round the fetlock-joint, and then twice more, making a half-hitch knot each time. He then gives the end of the rope to No. 2 to hold, who stands over the croup, while to prevent the knots from becoming loosened, he places his knee against the rope where it crosses the loins, and so prevents it from slipping.

The operator, now standing opposite the near fore-leg, orders Nos. 3, 4, and 5 to again slacken their rope; this being done, he loosens the rope in the metal loop, and removes it altogether from the near fore-fetlock. Nos. 3, 4, and 5 pull up the slack and hold

fast. This leg now is quite unsecured. Taking one of the seven feet cords, he doubles it, and passing the doubled end round the fetlock-joint, he passes the ends through the doubled loop; he now bends the leg on the knee, and pressing the fetlock well up close to the elbow, one cord he passes under the arm between the legs, the other he passes under the side-ropes, and meets the other end in *front* of the limb, close up to the lower extremity of the humerus, and fastens securely with a double or single bow, leaving the ends in the *middle* of the limb.

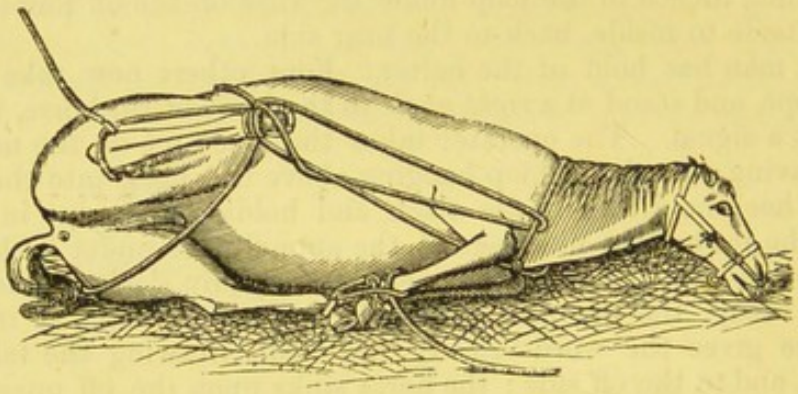

FIG. 38.—MILES'S METHOD OF CASTING A HORSE.

The near side being secured, the animal must now be turned over. To do this, the operator instructs No. 1 to turn with the horse, and when he is turned to again lie upon his head and neck. No. 2 simply retains his hold, and sees nothing slips or slackens; the operator taking up the side-line attached to the off side (which, when the horse was standing, was placed opposite the near fore-foot, and should now be lying under, or near, to the knee), places the loop under the fetlock of the off hind, and draws up all the slack. At the word 'Go,' Nos. 3, 4, and 5 pass by the rear of the horse, keeping their rope taut, and as soon as they are on the other side, by sheer pulling, without any jerking, they heave the animal over. No. 2 steadies the horse as it turns, by holding the hock of the already secured hind-limb. No. 2 remains in the same position as before, still holding the rope attached to the near hind-leg. No. 3 now takes the side-line of the off hind-leg from the operator, and holds it securely, taking care not to alter the position of the limb. Nos. 4 and 5 let go their rope; the operator seizes the metal loop of that rope, and draws it out of the shackles of both the off fore and off hind fetlock-joints; he then removes the shackles. Then taking the side-rope from No. 3, he secures this leg exactly in the same manner as he did the near hind-leg; when fastened, No. 3 holds the end. He then secures the off fore-leg exactly as he did the near fore, with the other seven foot cord. He then takes the shackle-rope, and passing one end under both ropes where they cross the loins, and the other end under the neck-rope at the withers, he draws through the slack, and secures

them together with an ordinary loop-knot, so as to prevent the ropes from slipping over the croup if the animal struggles (Fig. 39).

When required to be used, the 'spreader' (an instrument to keep the hind-legs apart) is thus attached. Loosen the cord loops at its extremities sufficiently to pass over the hoof, place one over the near and the other over the off hind-feet; then Nos. 2 and 3 assistants depress or elevate their respective legs, until there is space between to put the arms of the spreader about the coronet of either foot; straighten it, and push down the leather connection. Then draw up the cords, and fasten round the hoof tightly and securely. No. 2 will stand towards the animal's fore-legs with his rope; No. 3, with his rope, immediately behind the operator to the rear.

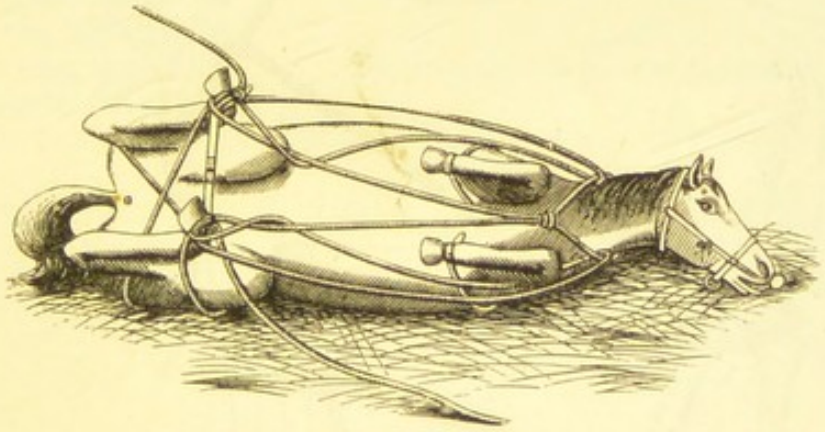

FIG. 39.—MILES'S METHOD OF CASTING A HORSE.

To loosen an animal thus secured: Nos. 2 and 3 loose their hold of the two ropes. The operator unties and removes the spreader. He then removes the shackle-rope from the back; then unties and releases both fore-legs; then the off hind, and afterwards the near hind; takes off the twitch, and removes the collar-rope—either before the animal gets up, or afterwards, as he pleases.

With practice, an animal may be prepared, cast, tied up, and released again in from ten to twelve minutes. Five active men are sufficient to assist. If the twitch has been properly applied, there will not be a movement on the part of the horse from the beginning to the end of the securing and untying.

To secure a colt: The animal is cast on the *near* side at once, as it is not turned over. First adjust the twitch on the off side. The side-line is adjusted on the off side as before. The shackles are put on thus: one under the knee of the *near* fore, and one under the fetlock of the same leg, one each under the fetlock of both hind-legs. The shackle-rope is passed round the off fore under the fetlock, then through the bottom loop of the near fore to near hind, thence to off hind and back to the loop under the knee of near fore, and thence to the off side. Four men only are required. Pull it down exactly as before, only on the near side at once.

When down, No. 2 takes the side-rope and holds it steady, while

the operator releases the off hind-leg in the same way he released the near hind before; he then secures it in exactly the same way. He then takes the shackle-rope from Nos. 3 and 4, and, holding all tight, makes a hitch-knot round the off fore-leg just above the fetlock-joint, to hold all fast; or, should the colt struggle, it might tear the rope out of the hands of Nos. 3 and 4 with the near hind-leg. Nos. 3 and 4 then hang on to the end of the rope. Then he takes the end of the side-rope, and hitches it over the cap of the hock of the off

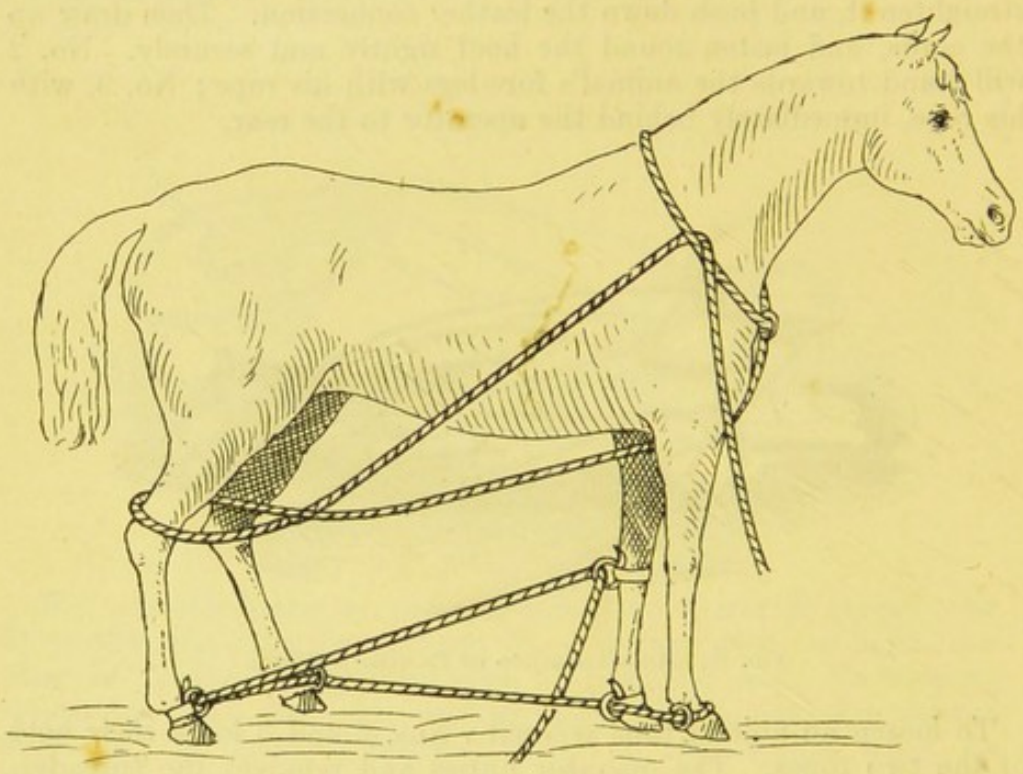

FIG. 40.—MILES'S METHOD OF CASTING A COLT.

hind-leg, and No. 2 seizes it and draws the leg away from the horse outwards, and so exposes the parts to be operated upon. I always attach a cord from the collar to the rope crossing the loins, to prevent it from slipping.

To release a colt: Untie the rope at the back, unhitch the shackle from the off fore-leg, loosen the rope and take it off the off fore-foot, then pull it through the other two shackles, remove the shackles, loosen the hind-leg, take off the twitch, and the animal can get up.

A colt may be secured, cast, tied up, and released in five or six minutes.

G. *The English Method.*—This method, which is that perhaps most generally adopted, consists in the application of the hobbles already described, or more or less modified (Fig. 41). The apparatus required is a set of hobbles, side-line or web-rope for the fore-arm, mask or leather blinds, a head-collar or snaffle-bridle, and for certain cases a surcingle and twitch. The head-collar or bridle being securely fixed on the head, the horse placed conveniently on the bed of material upon which it is to lie, the blinds put over the eyes, and, if necessary, the twitch applied to the nose, and the surcingle fastened

round the body, the hobbles are put on. Five or six persons (with a large and powerful horse even more) are required—one, a strong active man, or two, for the head, two or three for the hobble-rope, one for the arm-rope, and another, perhaps, for the tail. The horse is placed with the limbs as close together as possible, and the chief hobble—that to which the chain is attached by the finger screw—is put on the left or right fore-pastern, according as it may be desired to have the horse lie on the right or the left side. If we suppose the

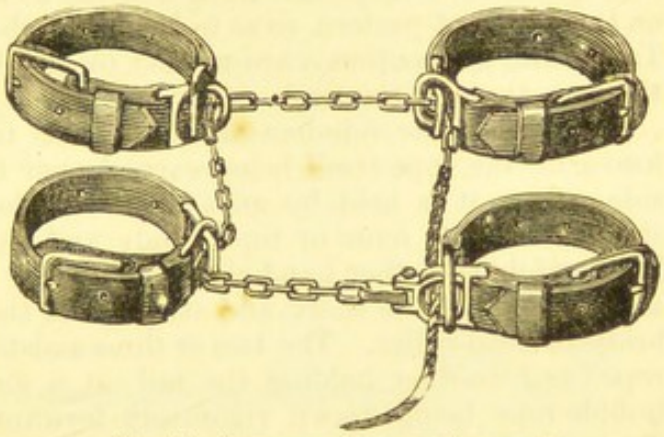

FIG. 41.—IMPROVED ENGLISH HOBBLES.*

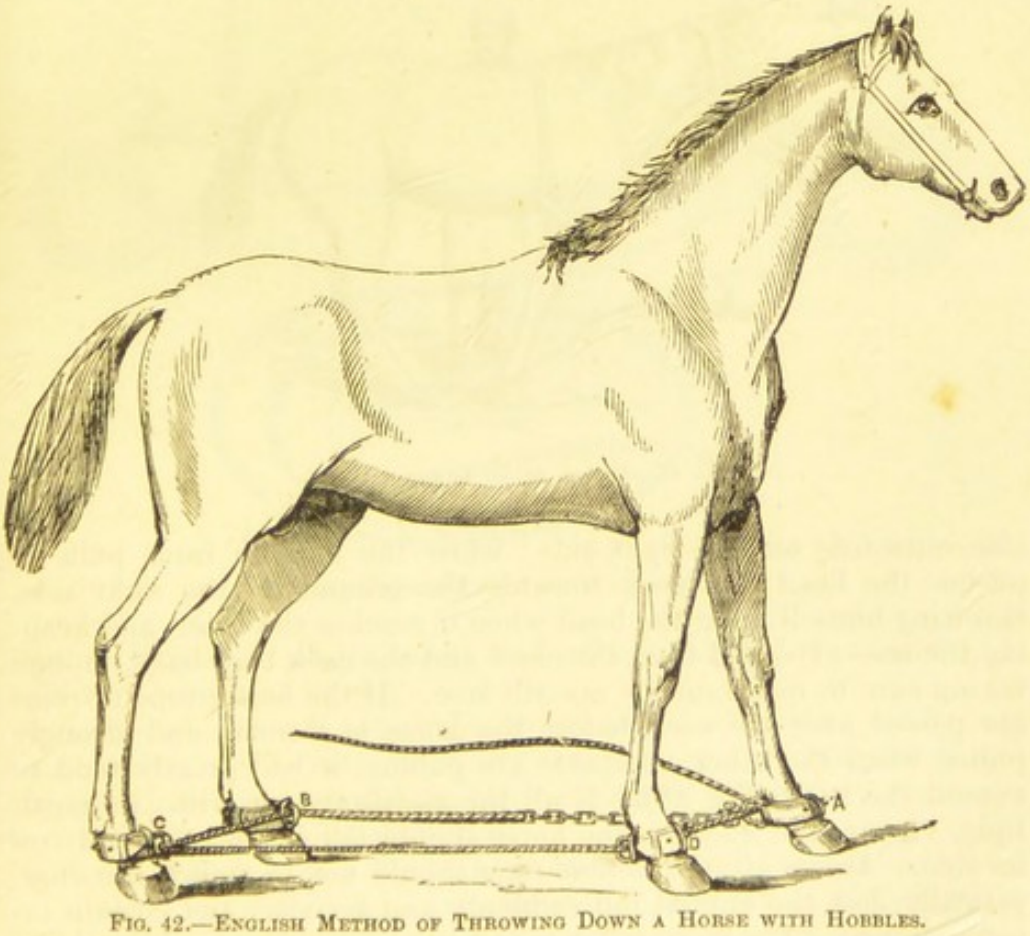

FIG. 42.—ENGLISH METHOD OF THROWING DOWN A HORSE WITH HOBBLES.

chief hobble to be placed on the left fore-pastern (Fig. 42, A), then the rope should be passed through the ring (from outside to inside)

* In drawing this cut, which represents the hobbles placed to throw the horse on its left side, the artist has made a mistake in the position of the two upper or left side hobbles. They should have been the reverse way: the buckle and the end of the strap outwards, as in the lower hobbles.

of that on the left hind-pastern (B), through that of the hobble on the right pastern (C), forward to that on the right fore-pastern (D), through which it is passed from without to within, through the ring on the left front-pastern, so as to lace through all the hobbles (Fig. 42). Tact, care, and patience are needed to put on the hobbles and pass the rope through the rings.

One end of the side-line or web-rope is fastened around the left fore-arm, the rope itself being carried over the withers to the right side, where it is held by an assistant. The assistant at the head should hold the reins or rope firmly and close to the head by one hand, while the other hand should grasp the left ear. If a twitch is used, it ought to be short, and attached to the left cheek-strap of the bridle or head-collar. The two or three assistants being at the hobble-rope, and another holding the tail, at a given signal all pull, the hobble-rope being drawn vigorously forward or outward (Fig. 43), the tail pulled backward and to the right side, and the fore-arm rope

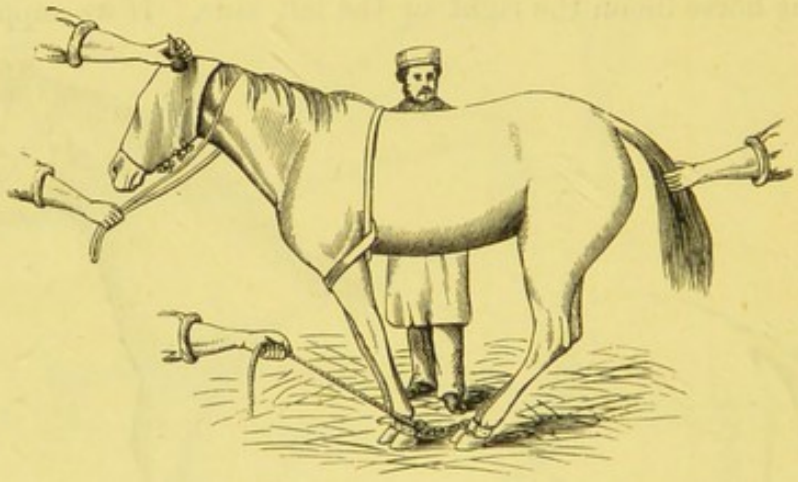

FIG. 43.—HORSE BEING THROWN DOWN.

also outwards on the right side; while the man in front pulls or pushes the head and neck towards the ground on the right side, throwing himself upon the head when it reaches the litter, and keeping the nose extended from the chest and the neck bent back, though taking care to maintain the nostrils free. If the halter-rope or reins are passed over the neck before the horse is thrown, and strongly pulled when the other assistants are pulling, it will greatly tend to extend the head (Fig. 43). If all the assistants act with promptitude, vigour, and address, the horse should fall somewhat gently on its side. Above all, the hobble-rope should not be pulled too energetically, lest the animal fall suddenly and heavily, and sustain internal injury. The fore-arm rope and the man at the head should be chiefly instrumental in causing the horse to fall, when the limbs are being steadily drawn together by the hobble-rope.

The animal being thrown, and the hobble-chain pulled through the rings as far as possible, the spring hobble-hook is passed into one of the links nearest the hobbles, and the limbs are then secured.

The hobbles (Fig. 44) introduced by Mr. James deserve greater popularity. They are portable, weighing under five pounds, not bulky, very simple and reliable, and as all parts likely to chafe are protected, they are very durable.

When greater security is desired, in order to prevent accidents, or when it is necessary, for greater convenience in operating, to release one of the limbs from its hobble, what are called 'cross-hobbles' are placed on the hind and fore limbs (one of each) above the hock and knee, and the diagonal limbs, or those of one side, can be drawn closer

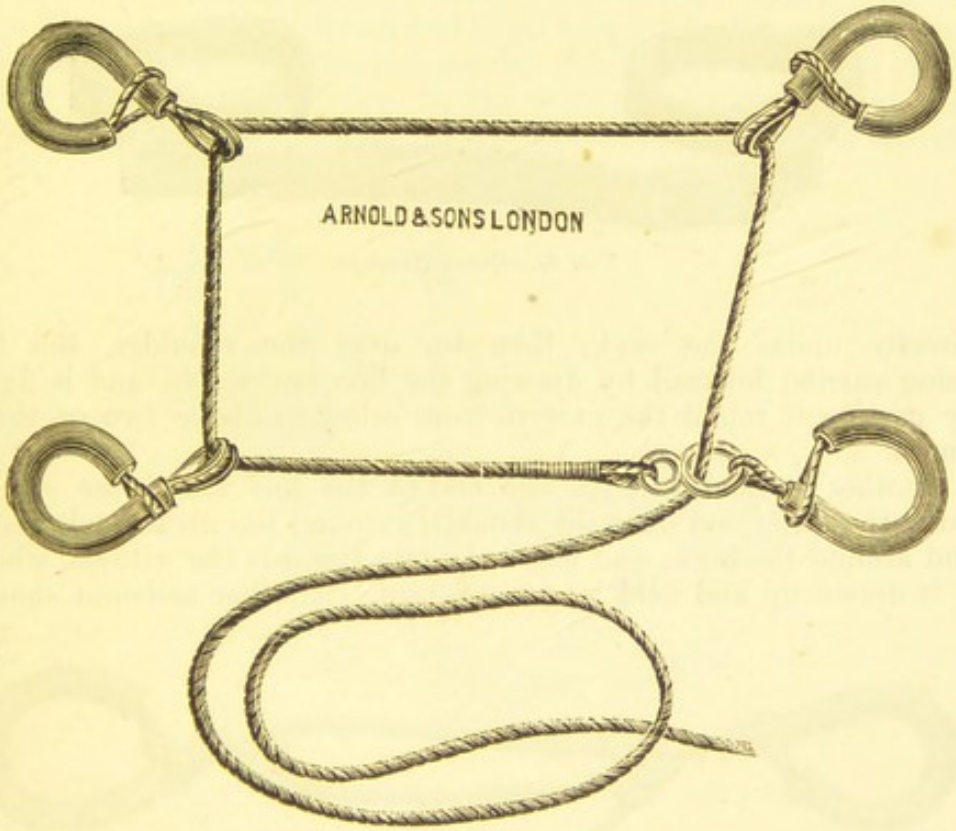

Fig. 44.—James's Patent Casting Hobbles.

together by means of the strap and buckle towards the middle of these hobbles (Figs. 45, 46).

In some cases the cross-hobbles do not afford complete security, or do not maintain the limbs sufficiently steady; and in order to obtain this, and also to fix a particular fore or hind leg in a certain position, other arrangements must be made.

When it is necessary to flex a hind-limb to a considerable extent—*i.e.*, to carry it forward so as to expose the inner aspect of the opposite leg, or the inguinal and pubic regions—it may be fixed to the neck, the chest, or the fore-leg.

(*a*) *To the Neck.*—Supposing the left hind-leg the one to be flexed, it is released from the hobble (if the cross-hobble is on), and the loop of the web side-line is placed on the pastern or around the shank; the rope is then passed over the shoulder, round and beneath

the neck ; and if the cross-hobble is not on, the end is given to an assistant who stands towards the horse's nose, while the leg is unhobbled. While the assistant pulls the line so as to bring the leg forward and up towards the shoulder, the operator assists by pushing the hock. When the foot is as high as the elbow or point of the shoulder, the line is passed two or three times around the pastern from above to below, then carried back and held by the assistant in such a way as to keep the hock in a state of semi-flexion. Or the line, instead of being passed first over the shoulder, is passed

FIG. 45.—CROSS HOBBLES.

directly under the neck, then up over the shoulder, the leg being carried forward by drawing the line backwards, and is fixed by passing it round the pastern from below to above two or three times.

Another method is to fix one end of the line round the shank, carry the other end over the shoulder, around the neck, back under and around the hock, and forward again towards the withers, where it is drawn up and held by an assistant. Another assistant should

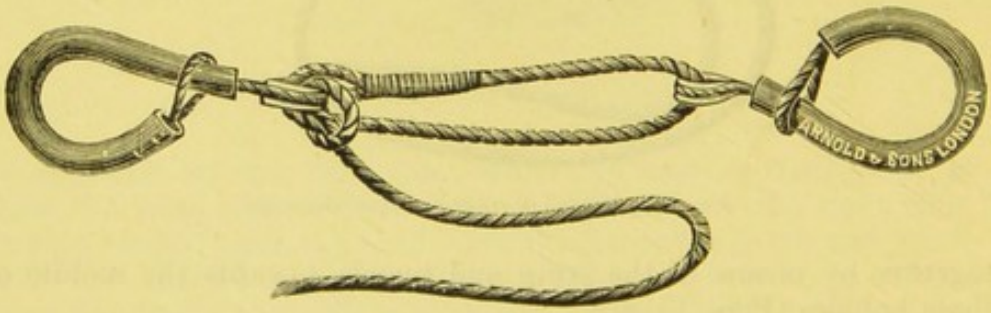

FIG. 46.—JAMES'S PATENT CROSS HOBBLES.

be placed towards the chest, to pull the line upwards and backwards (Fig. 47).

(*b*) *Around the Chest.*—The web-line being attached by one end to the hind-pastern, the other end is passed between the fore-limbs, beneath the lower shoulder, and given to an assistant placed behind the back, who pulls tightly, so as to bring the foot towards the chest, while the hobble is taken off. The line being then drawn towards the withers, until the foot is at the elbow, it is passed two or three times around the pastern, and then carried backwards, where it is held.

(*c*) *To the Fore-leg.*—The hind-leg may be fixed to the lower part of the fore-arm, or middle of the shank of the fore-leg of the same or the opposite side. When attached to the opposite fore-leg, it is better to select the shank than the fore-arm, as the position is less forced and injury is not so likely to occur. In both positions the mode of fixation is almost the same.

Suppose it is desired to attach the left hind to the fore-arm of the left fore-leg. One end of the web-line is fixed to the hind-pastern or shank, the other end is passed above and round the knee, back to beneath the left hock, round which it is carried, and the end given to an assistant standing at the withers. The hobble is taken off the hind-leg, which is then drawn and lifted forward by the assistant and operator, until the hind-pastern reaches the knee or lower part of the fore-arm, when the line close to the pastern is crossed round this, then passed transversely beneath the fore-arm and above it, making

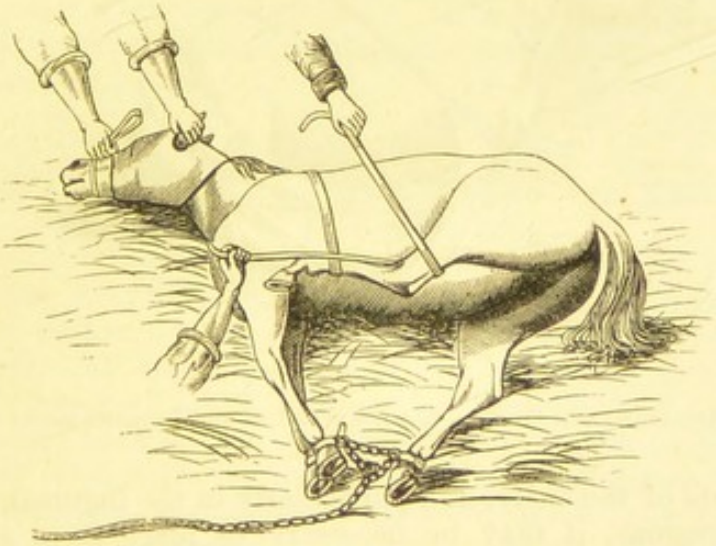

FIG. 47.—FLEXION OF THE HIND-LEG IN THE LATERICUMBENT POSITION.

another cross-turn, so as to intersect the preceding turn in X fashion, being finally carried beneath the fore-arm, around which and under the pastern it is passed horizontally, so as to secure the other turns. The end of the cord is tied at the pastern or given to an assistant. The same procedure will serve to fix the hind-limb to the shank of either of the fore extremities.

When it is required to flex or fix a fore-limb to a hind one, this may be done by attaching it either to the lower end of the leg or to the shank of the latter. The method of doing this does not differ from that described for fixing the hind-limb. The line is attached at one end to the shank or pastern of the fore-leg, the other end is passed back around the hind-leg, then forward beneath and around the fore-arm (Fig. 48), where an assistant, standing at the croup, holds it until the pastern has been released from the hobble; this done, the fore-leg is pulled and carried back until the pastern lies

above the hock (or on the shank, as the case may be), when the line is passed twice round the limbs, cross-ways, and then tied, or the end given to an assistant to hold (Fig. 49).

To Maintain the Animal in the Dorsicumbent Position.

Hitherto the horse has been lying on its side (latericumbent position), and secured in that position. But for operations on the

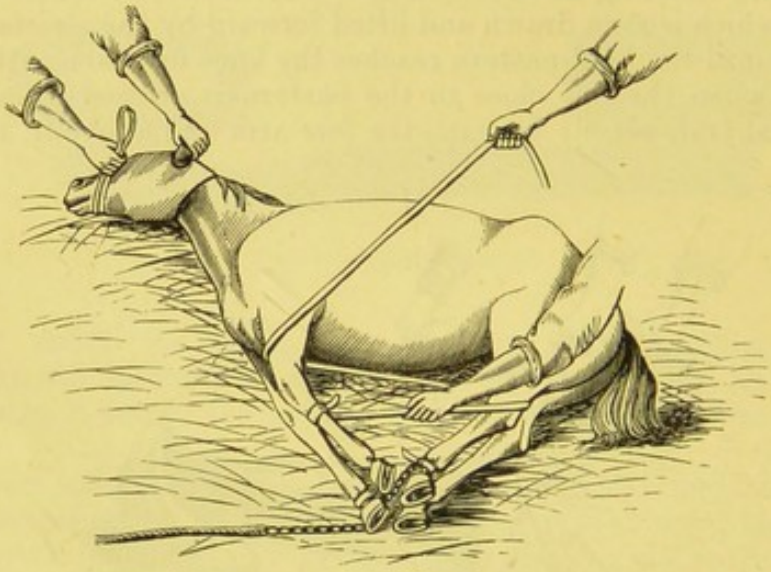

Fig. 48.—Attaching the Fore to the Hind Leg in the Latericumbent Position.

inferior parts of the body, and particularly in the inguinal, pubic, or pre-pubic regions, it may be necessary to place it in the dorsal

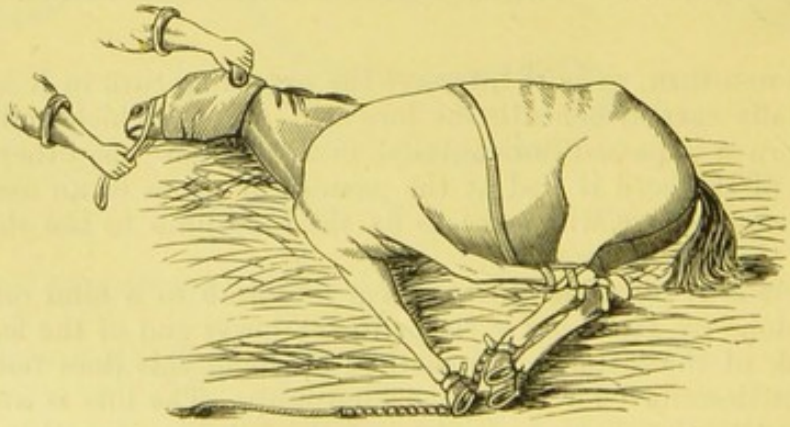

Fig. 49.—The Fore attached to the Hind Leg in the Latericumbent Position.

position. This is ordinarily accomplished by pulling the animal half over by means of the hobble-rope, and bolstering each side of

the body—towards the shoulders particularly—with trusses or bags of straw.

Another plan is to pass a long and somewhat strong piece of wood below the hobbles, between the fore and hind feet; a rope being also tied to the chain there. The rope is pulled to one side so as to raise the animal on its back, in which position it is maintained by holding up the piece of wood, at the same time the rope is pulled on one side, and that of the hobbles on the other—the body being propped up by bundles of straw at each side.

A third method is to flex the four limbs against the trunk, two and two together—the fore and hind leg of the same side—at the level of and behind each elbow, to two iron rings joined by a strong strap or rope placed across the back. Or each end of a back or loin strap or rope may be placed on the shank bones (previously bandaged to prevent abrasion) of the hind-limbs; the more this is shortened, the closer these limbs are drawn to each side of the body, and consequently the wider apart they are. If a narrow strap or a rope is employed, it is well to have a thick blanket over the back, next the skin, to prevent bruising.

Releasing a Horse from the Casting and Restraining Apparatus.

Nearly as much care is necessary in releasing a horse from the apparatus, with which the animal has been thrown and secured, as in applying it. All ropes and straps, besides the hobbles, should be cautiously loosened, and disengaged legs returned to the hobbles. If the horse has been in the dorsal position, it should be placed on its side; then remove the twitch and mask. To unfasten the hobbles from the pasterns, the operator stands facing the soles of the hoofs, so as to be out of danger, and unscrews the pin which attaches the chain to the chief hobble; this undoes all the hobbles, which fall off, and the horse is allowed to get up, care being taken that there is sufficient litter where the feet are to be placed.

Accidents Incidental to Throwing Horses Down.

The accidents likely to occur in throwing horses down for operations, and while they are down, are various, and may occur through neglect of ordinary precautions, or from unforeseen circumstances.

They may be due to (1) insufficient securing of the animal; (2) too much force employed in the application of means to limit its movements; (3) insufficient precautions to prevent injury from surrounding objects, restraining apparatus, or falling on the ground; (4) obstructed respiration through the restraining apparatus, or the carelessness of assistants; (5) throwing down immediately after feeding or watering, or at an advanced stage of pregnancy.

In the standing position, abrasion or wounds of the skin may be

produced (1) by the twitch, the hobbles, or side-line, or falling; (2) fractures from struggling; (3) or muscular lesions, also from severe struggling.

To prevent these, the twitch should be carefully and humanely applied; the horse should stand on a non-slippery floor or bed of litter, and wear knee-caps; flannel or cloth should be interposed between the hobbles or side-line and the skin; and, if possible, a thick rug should cover the body.

In the decumbent position the same accidents may occur, and also (1) luxations, (2) temporary or permanent stiffness or paralysis of a limb, limbs, or body, (3) rupture of viscera, and (4) asphyxia. Luxations and fractures are always more or less serious, and are often unavoidable. Fracture of the vertebræ will be noticed hereafter; fracture of the bones of the limbs and pelvis is not unfrequent, and is to a large extent preventable. Temporary stiffness or paralysis is observed when the animal gets up after the operation; it is due to pressure on or fatigue of muscles, compression of nerves or blood-vessels of the limbs by the restraint, or by the cramped position of the limbs. This may disappear in a very short time, or it may continue for a long period. If muscles are bruised or lacerated, abscess may form. Ordinary precautions may avert such an accident, and especially keeping the animal under restraint as short a time as possible. If the operation is to be a long and painful one, anæsthesia should be resorted to. To prevent rupture of viscera, operations should be performed when the animal is fasting. Asphyxia is generally due to obstruction of the nostrils by the litter, the twitch, or assistants, to pressure on the windpipe by the throat-strap of the head-collar or ropes around the neck, or by compression of the chest or belly by the assistants. To mention the causes of this accident is sufficient to indicate means for its prevention.

Fractures, as has been stated, are generally the most frequent and serious accidents, and they may occur under several conditions—as when the hobble-chain does not run quickly at the moment the rope is pulled, through the assistants not being sufficiently expert or vigorous, or from the violent struggles of the animal when it is decumbent. But, as Professor Dieckerhoff, of the Berlin Veterinary School, justly observes, 'Of all the injuries produced in throwing down and securing horses for the purpose of veterinary operations, fracture of the vertebral column is the most frequent.'

He also judiciously remarks:

'The occurrence of this accident has been often registered in the literature of the past thirty years. In my own experience it has happened fourteen times, and aside from this I have knowledge of seven others not otherwise recorded, which have occurred in the practice of colleagues, and been communicated privately. In all of the aggregate twenty-one cases, the fractures were distributed among five vertebræ, involving either the last two dorsal, or the first three lumbar. Of my own fourteen, eight involved two vertebræ simultaneously: in one case the 17th and 18th dorsal, and in two the 2nd and 3rd lumbar vertebræ were broken together. In the other cases

of double fracture, either the 18th dorsal and 1st lumbar, or the 1st and 2nd lumbar vertebræ had been broken in common. Never were more than two bones involved.

'Of the six horses in whom but one vertebra was affected, this was the 1st and 2nd lumbar in two cases each, and the 18th dorsal and 3rd lumbar in one case each.

'In all these cases the bodies only, never the arches or processes, were fractured.

'Of my fourteen cases, thirteen occurred while the horse was on its side, the fourteenth while it was on its back. It must be here remarked that I perform but few, relatively, of my operations with the horse on its back. Of the seven cases otherwise communicated to me, two occurred in this latter position.

'My cases occurred with the following numbers in various kinds of horses: One was a heavy dray-horse, two English thoroughbreds, seven half-breed blooded stock, and four were of the blooded country stock. Age appeared to make no difference. The youngest horse, a thoroughbred English stallion, was three; the oldest, a coach-horse (stallion), was twenty-one years old.

'It is understood, of course, that the character of the operation itself has no influence whatever on the causation of vertebral fractures; but to be exhaustive, I will mention that—

'One case occurred in castration.

One	,,	,,	operation for fistula of the vas deferens.
Two	,,	,,	extraction of a molar.
Four	,,	,,	neurotomy.
Four	,,	,,	firing.
Two	,,	,,	spaying.

'The occurrence of the fracture, which is always at the moment when the horse resists manipulation violently, is recognised by a dull crackling, sometimes even grating, sound. The sound is so characteristic, though difficult to describe in words, that the expert instantly recognises its fatal import. But still it cannot be regarded as pathognomonic, for occasionally a similar sound is produced by horses in extending the lateral muscles of the thigh when the ligaments of the hip-joint are put upon the stretch, and yet the animals have sustained no injury.

'Immediately after a fracture has occurred, profuse perspiration takes place, the flanks and thorax exhibiting this especially. Even here it must be recollected that individual horses may, purely from fright incident on the throwing, manifest more or less sweating. Therefore this is not a pathognomonic sign either. The fracture can be recognised as such with absolute certainty only when the animal is loosened and encouraged to get on its feet. It will then be found that it prefers to remain lying on one side, and although it may be made to rise on its fore-feet, it will soon fall back. Some horses are instantly paralyzed in the hind-quarters, and cannot even raise themselves from the ground. The majority, however, especially if well supported by the tail, can stand up; some of these

soon fall again. Others can even walk with assistance, their hind-legs dragging more or less, usually one of them more so than the other. In one case, I knew a horse to stand six, another twelve, hours in the stall; then they lay down, never to rise again. Finally, one horse, with fracture of the 2nd lumbar vertebra, was able to go alone to its stable (exhibiting the dragging of the hind-legs), and could stand for two days without aid. It fed but little, however, and showed feeble respiration and pulse. On the third day it was down, and could not be raised, even with assistance.

'All horses affected thus exhibit profuse sweating, especially of the head and neck, and while lying down execute violent movements with the fore-limbs.

'The different reactions exhibited by horses suffering from fracture of the vertebral column depend on the condition of the spinal cord. If the latter is seriously compressed by spiculæ of bone or extravasated blood, instant paraplegia is the result. Such animals exhibit, as a rule, no sensibility when pricked in the hind-quarters.

'In other cases, it is either feeble hæmorrhage or inflammation of the cord which determines the paralysis.

'All the cases occurring in my experience, as well as those communicated to me by others and registered in our literature, were incurable. This unfavourable result is readily explained by the fact that the fracture always involves the *bodies* of the vertebræ, and therefore directly implicates the spinal canal. From this I believe myself justified in stating that all fractures of the vertebral column produced by muscular action during the throwing of horses, *must* be fatal.

'The mechanism of the fractures under discussion is attributable—as the French writers, and later Hertwig, Hering, and others have shown—to the muscular exertions made by the animal with the object of liberating itself from its constrained position when thrown.

'Hering, in his "Operations lehre," gives as the principal cause the convex bending of the vertebral column, resulting from the binding together of all the four legs, and the force exerted by the animal to overcome this uncomfortable position.

'According to my observations, three factors are active in the causation of these fractures.

'In the first place, the animal must have some object as a *point d'appui* for one hind-leg, which point must be connected either with one of the other extremities or directly with the trunk. As, owing to the manner in which the horse is secured, the hoof itself is always left free, the point of support must be either the fetlock or metatarsus of the other hind-limb. Since the animal, when lying sideways, has no free extensor power over the hind-limb nearest the ground, only the forcible extension of the upper or free limb comes into play. If the horse is on its back, the forcible pushing against the foot is possible for both hind-limbs. Horses lying on their backs have both their hind-limbs to jerk up alternately, and with each such movement the pelvis is slightly raised.

'Secondly, the horse must make the vertebral column tense. This is effected by the contraction of the spinal extensor muscles, which are supported in their leverage by the fixation of one or both of the hind legs, as just described.

'Thirdly, the horse must, simultaneously with the extension of the hind-leg and that of the vertebral column, draw its pelvis to one side. This is effected by a forced contraction of the *quadratus lumborum*, its congeners, and the *longissimus dorsi*, as well as the *glutei* muscles. If the horse is on its side, this lateral flexion of the pelvis can only take place towards the side which is uppermost. And it is also observed that if the horse, while on its back, bends the pelvis to one side, the stretching of the hind-legs always takes place towards the *opposite* side.

'No one of these three elements in itself will produce a fracture, they must all concur. By reason of the jerking lateral flexion of the extended lumbar and last dorsal vertebræ, the vertebral bodies are pressed against each other on that side where the lateral flexion takes place. Since, owing to their spongy structure, these bodies are unable to resist this one-sided pressure, disunion must occur in one or two of them. As a rule, the vertebral bodies break into several, even as many as five, eight, or more pieces. The fissure always extends into the spinal canal, although a dislocation of the fragments does not necessarily take place. That the fracture only occurs at the two last dorsal and first three lumber vertebræ, is due to the fact that only these five vertebræ can be flexed sideways.

'The most important of the three etiological factors is the pressure against the foot of the outer (free) hind-limb. Fracture may occur in horses whose outer or upper hind-limb is not even loosened. I saw, in two of my cases, fracture taking place, Bracy Clarke's method and apparatus (improved hobbles) having been employed, and the four limbs being held together by a lock and fetlock rings. Such a fastening is too strong, and does not "give" sufficiently.

'Still more dangerous is the loosening of the outer hind-limb by carrying the rope around the thigh, then over the neck, and back over the withers, and with this pulling the fetlock towards the thorax and fixing it in that situation. The action of this fastening is supported by an assistant kneeling at the thorax of the animal, bending the toe back, and holding it thus. The object of this method is to keep all the joints of the outer hind-limb in a flexed position. Were this feasible, the method would have great advantages; but, unfortunately, I have found that the rope thus secured, *plus* the assistant, are unable to prevent the sudden extension of the limb, and I have several times had fracture occur under exactly this condition. The prejudicial influence of this mode of fastening is explained by the fact that the horse, by extending its back, gains so much room for play within the rope that it can bring the fetlock of that hind-leg down to the carpus of the outer fore-leg, and thus press the latter limb with considerable effect against the fetlock.

'The danger is much less when the outer hind-fetlock or metatarsus is secured to the outer metacarpus. Even here, however, the strain-

ing cannot be entirely prevented. In one of my cases (spermatic fistula), in which I operated in the dorsal position, and the animal suffered a fracture of the vertebral column, I had employed this method as recommended by Hertwig.

'The next most important factor is the extension of the vertebral column. Horses are particularly addicted to this movement, which is facilitated when the back lies on a higher plane than the limbs; also when the bedding is not elastic enough. Hering insisted that the head and neck should be kept extended, and Gerlach has made the same suggestion.

'But I have found that this procedure has very little effect, for even two trustworthy and expert assistants may fail to keep the head well extended in powerful horses. The sudden flexion of the head often takes place so unexpectedly that it cannot be prevented, and before the head can be adjusted an accident may have happened. And again, even a well-maintained extension of the head is not sufficient in all horses to neutralize the extension of the *longissimus dorsi*, and still less the extension of the *glutei* and long *vastus* muscles through straining. I do not go so far as to say that the procedure of extending the head is entirely valueless as a prophylactic against vertebral fracture, but I would from experience warn others against a too exclusive reliance on its efficacy.

'The third causal factor, the lateral flexion of the pelvis and lumbar vertebræ, is the keystone of the etiology, and is facilitated by the fact that the horse in the lateral position cannot be loaded to any extent, or with any considerable weight. Frequently it cannot be avoided that the assistants sitting on the trunk glide off, so that the benefit of their weight — a very questionable one under any circumstances — is entirely lost. I will add that the lateral flexion of the pelvis, like the vertebral extension just described, is much facilitated by hard or inelastic bedding.

'Having thus examined into and explained the specific causes of vertebral fractures, I was enabled to apply a rational prophylaxis, and have found the measures subjoined in this article useful in this direction:

'A. *Prophylactic Measures to be Employed when the Animal is Operated on in the Lateral Position.*—1. The bedding on which the horse is thrown must be as elastic as possible. The best place is a litter heap, but where this cannot be had, a thick layer of straw should be provided.

'2. During the operation, the animal should lie lower with its back than its limbs.

'3. The head of the thrown animal should be kept as much extended as possible. As I have already explained, I do not lay any great stress on this measure; still, to a certain degree it has the effect of preventing the animal from attempting to liberate itself from the fastenings.

'4. Should the horse be thrown with four pastern-straps, the too

close union of the four rings by the chain and hook (or lock) is to be avoided. It is better to fasten the rope by means of a small wisp of straw, which has the advantage of depriving the animal of the power of straining its limbs.

'5. The best preventive measure I have found to be the application of a hobble to the free hind-limb. Since nearly two years, I have been in the habit of passing a thick, soft rope around the outside or upper hind-*leg*, above the hock, and twisting it by means of a stick about four feet in length. By this means the *tendo Achillis* is pressed so closely against the bones that the horse loses the power to strain the leg from any part of the foot. It can make short jerking movements, but is incapable of performing any considerable extension.

'The use of this apparatus, so frequently used in the manipulation of horned cattle, has not been mentioned in any text-book as applicable to the horse. But this simple measure deserves a general trial. I never knew it do any damage. That a thin rope should not be used is clear, as by it the skin might be cut.

'There are operations in which it is almost impossible to succeed without tying the upper hind-leg to the corresponding fore-leg, or to a strap passed round the chest or neck. The hobbles are a very good safeguard in the adoption of such methods. At the same time, it has, like the twitch applied to the nose or jaw, the effect of subduing the viciousness of some horses. In case the operation is to be performed on the hobbled limbs, the additional advantage of a more or less bloodless operation is gained, since the bloodvessels are compressed by the rope, as by a tourniquet; in fact, it is a sort of rude tourniquet.

'6. Instead of the customary methods employed for securing the outer hind-leg, the disadvantages of which I have frequently experienced, I employ the following simple and commendable procedure. I first slip a strong surcingle, about two hands-breadth, over the hock of the upper leg. This being secured, it is passed forwards between the two fore-legs, *under* the neck, and up around the withers back again. Then I bring the rope under the loop, between the two thighs, passing backwards, giving it another turn over the hock. The end is held by two assistants standing near the lumbar region of the horse. The hobble-strap of the upper hind-foot is unfastened. An assistant seizes the rope at the withers, and another the part which passes round the hind-leg. Both by steady pulling bring the hind-leg forwards. Their task may be assisted by a third assistant, who, kneeling at the thorax, draws the foot towards the costal margins. As soon as the foot is far enough forwards, the assistants give the rope a strong pull. Generally, I make the third assistant bend the hoof backward with his hand, although this is by no means essential.

'With this ready method, the foot proper (tarsus, metatarsus and phalanges), remains free from any appliances. The horse cannot, therefore, use that foot in straining the limb; with the loss of that power the most dangerous of the elements producing vertebral fracture is abolished, and the additional advantage is gained, that

the portion of the surcingle around the leg has the same action as the hobbles. I have performed many castrations and other operations with this method, and without a single accident. I am convinced of its great advantages, and do not doubt that its general introduction would prevent many vertebral fractures as well as fractures of the thigh-bone.

'B. *Prophylactic Measures to be Employed when the Animal is Operated on while on its Back.*—Where it is necessary to place the horse in the dorsal position, all fastening of the hind to the fore limbs should be avoided, if possible. Where such fastening is necessary, it will be well to place the animal slightly under the influence of chloroform—that is, sufficiently so to stupefy it. It is sometimes of advantage to apply the hobbles around both hind-legs, and further to keep the animal directly, and not obliquely, on its back; so that if its legs are jerked, they jerk upwards only.

'C. *General Prophylaxis.*—1. Depriving the animals of both food and drink before throwing them, has been recommended by Gerlach. The object of this is to render them more docile. But the starving of spirited well-bred horses for only twenty-four hours does not suffice to subdue them, and this object is only attained, to any extent, when this has been done for from forty-eight to sixty hours. Even with this, it must not be supposed that all risk is obviated, for high-bred animals will resist, even after receiving absolutely no food or drink for several days. The veterinary surgeon should also bear in mind, that horses starved for any length of time often lose their appetite, and this fact should teach him to resort to such a harsh measure only with vicious and high-tempered horses; for this class alone has Gerlach recommended it.

'2. In general, as regards the avoidance of fracture, RAREY'S method has unquestionably this advantage: that the horses are tired out completely, and after being secured, are therefore less inclined to strain and resist. But this method is not always applicable. On the whole, however, I consider it to fulfil the same indications, without causing so much suffering as the starving method.

'3. The twitch applied to the upper or under lip, seems in many cases to diminish the sensibility of the horse with regard to operations, but it has no special or noteworthy value in preventing the occurrence of vertebral fracture.

'4. Chloroform narcosis would be an excellent preventive, if it could be produced *before* the animal is thrown. But this is not practicable. And then, again, horses at the beginning of the anæsthesia do not *lie* down, but stagger about from side to side, and then finally *fall* down. Should the surgeon, on the other hand, try to narcotize the horse when the latter is on the ground, he will find that during the first stage of the inhalation—and with few exceptions—the horse will struggle very violently. Therefore, the administration of chloroform does not enable us to dispense with the other aids, particularly the hobbles.

'That chloroform does prevent severe muscular exertion, and thus is of great value in preventing fractures of the vertebræ, must be

evident, however. I therefore, besides the above-mentioned method of fastening and the hobbles, employ also this anæsthetic agent, and through its employment am enabled to meet one other indication, namely, to keep the limb altogether quiet and relaxed in cases of subcutaneous operation.

'Both objects are accomplished without administering chloroform to the horse, so far as to render it entirely unconscious. In fact, I may say, collaterally, that absolute narcosis, which is attended with danger, is rarely necessary or indicated in the case of the horse.'* To diminish risk in casting, or from struggling when down, the horse

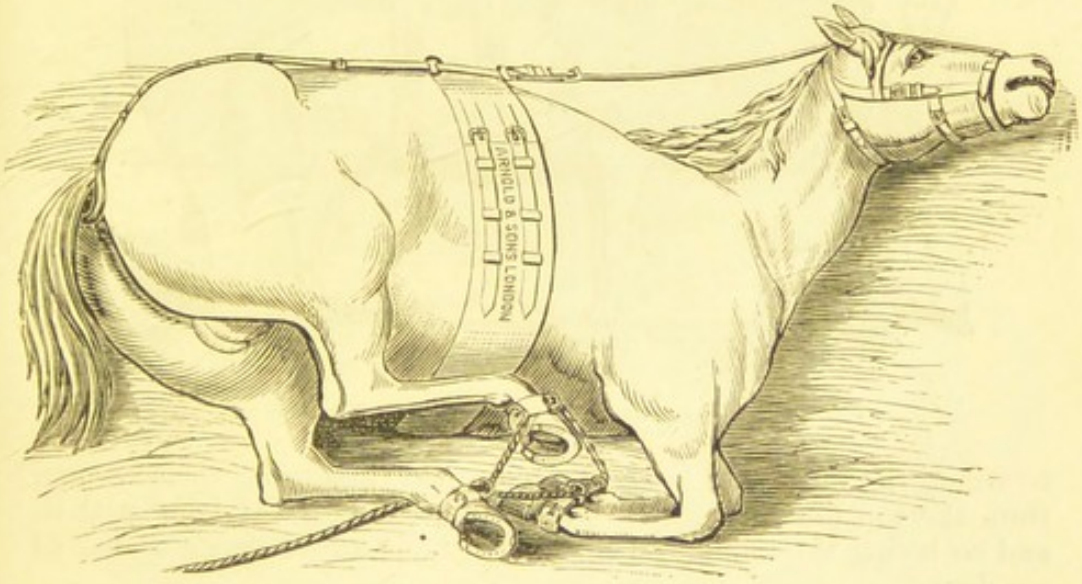

Fig. 50.—Head and Neck Extending Apparatus.

should be given a narcotic half an hour before the hobbles are applied.

Notwithstanding Dieckerhoff's opinion as to the questionable utility of maintaining the head and neck extended, with the view of preventing injurious struggling, I am convinced, from long experience and observation, that it is a most useful precaution. It is true that it is sometimes almost impossible, by *manual* force, to maintain extension of the head and neck; but this can easily be done by *mechanical* means. For instance, it can be effected by placing a stout girth or surcingle round the chest; on each side of this is a buckle, to which a strap is fixed, these straps meeting in the middle towards the withers, form one strap, which passes up the ridge of the neck to the head-collar, on which, between the ears, is a buckle to receive the strap. By this means the head can be drawn back as far as may be necessary. Or the strap may pass singly from the top of the surcingle to the head-collar, while another in the form of a crupper passes from the surcingle to the tail (Fig. 50). This apparatus, introduced by Mr. E. Cooper Smith, M.R.C.V.S., answers well.

* 'Wochenschrift für Thierheilkunde und Viehzucht.'

For facility in operating, and also to prevent accidents in throwing horses down, various contrivances have been introduced from time to time at veterinary schools and establishments where operations were frequent. They have generally been based on the plan of the machine first brought to notice by Hœrdt, and improved by Fromage de Feugre, Kersting, and Owen, which consisted of a vertical table

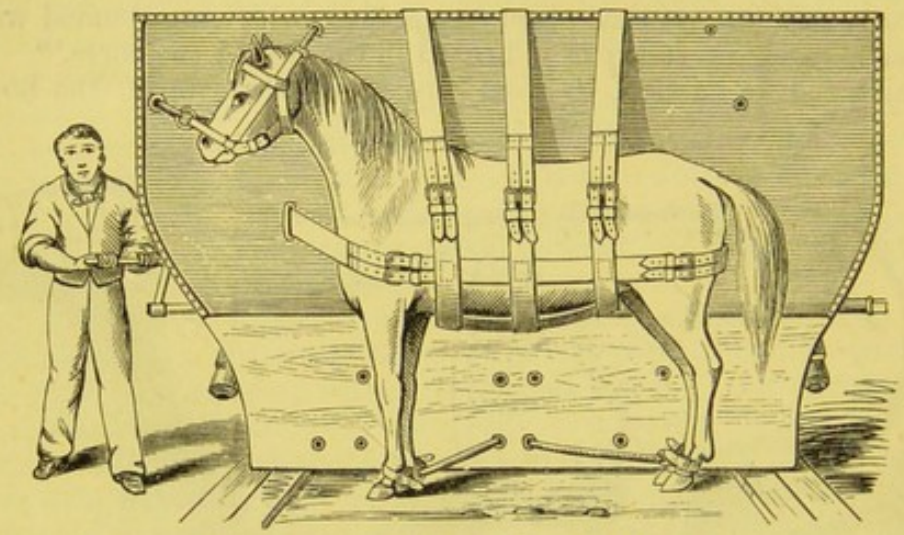

Fig. 51.—Operation Table: Vertical Position.

to which the horse was fastened as it stood, this being then lowered from the top until it became horizontal—carrying the horse with it, and so laying the animal on its side without any violence or risk of accident.

This machine has been still further modified and improved, until

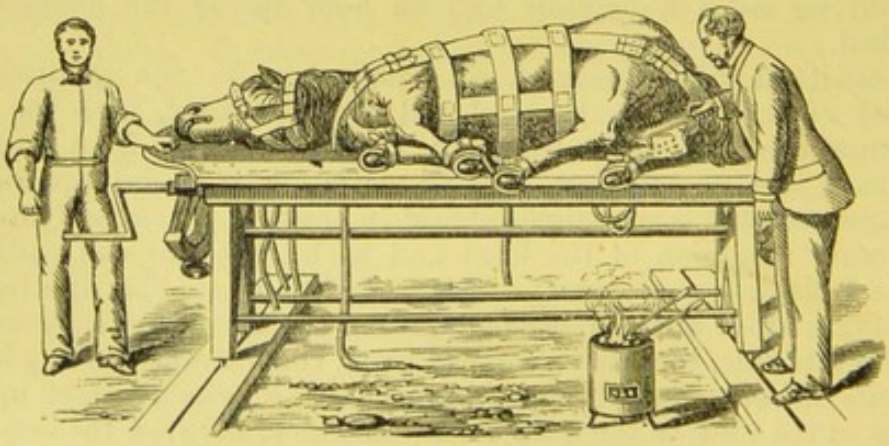

Fig. 52.—Operation Table: Horizontal Position.

now it is almost perfect. Occupying but a small space, it is composed chiefly of ironwork, with a large oak platform, which is covered with well-stuffed cow-hide leather, and furnished with head-collar, girths, hobbles, etc., necessary to secure the horse. The machine is fixed or movable; in the latter case it can be moved on rails; in the former it may be fixed in a convenient situation.

Fig. 51 represents the machine with the horse attached to the platform, all that is required being to tighten the hobble-ropes on the other side. So easily is the apparatus worked that a lad can readily bring the platform and horse to the horizontal position.

In Fig. 52 the platform is shown in the horizontal position, and the horse secured and placed for operation, without any necessity for assistants. By means of openings through the platform in various places, the animal can be laid on its right or left side, and the limbs disposed of in any direction necessary for particular operations.

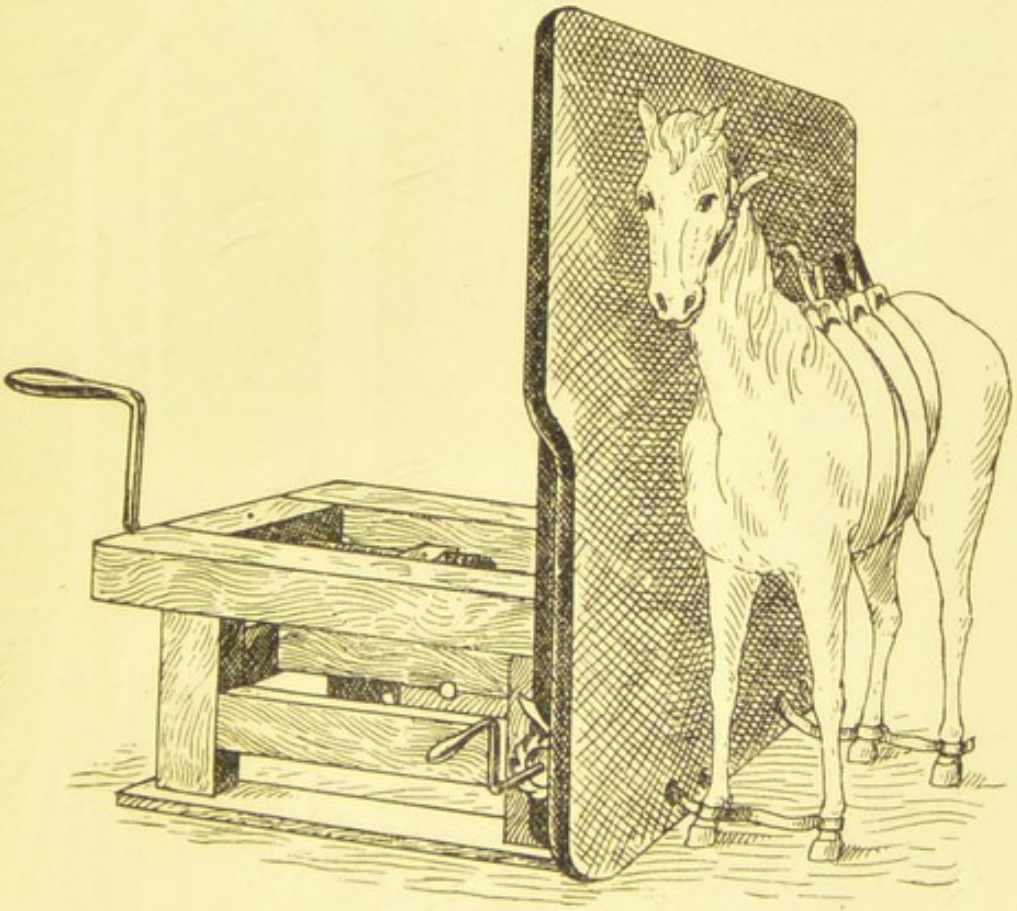

FIG. 53.—PRICE'S OPERATION TABLE.

Price's table (Fig. 53) is made of two-inch planks, matched and grooved. It is nine feet long by six and a half feet broad, covered with heavy canvas, and stuffed to the thickness of three or four inches. This table works on a strong frame, which is firmly fastened to the ground, and is operated by a screw, which is attached to a handle in the rear. A neck-strap is provided at each end, so that the horse can be placed either side next the table. The animal is secured to the table by three heavy girths furnished with patent cam-buckles, which, regardless of weight, permit of rapid buckling and unbuckling.

Figs. 54, 55, and 56 represent operation tables introduced by Messrs.

Vinsot and Dollar, and Trapp. The advantages of such machines in practice may be summed up as follows: (1) Avoidance of the dangers attending the ordinary system of throwing horses down.

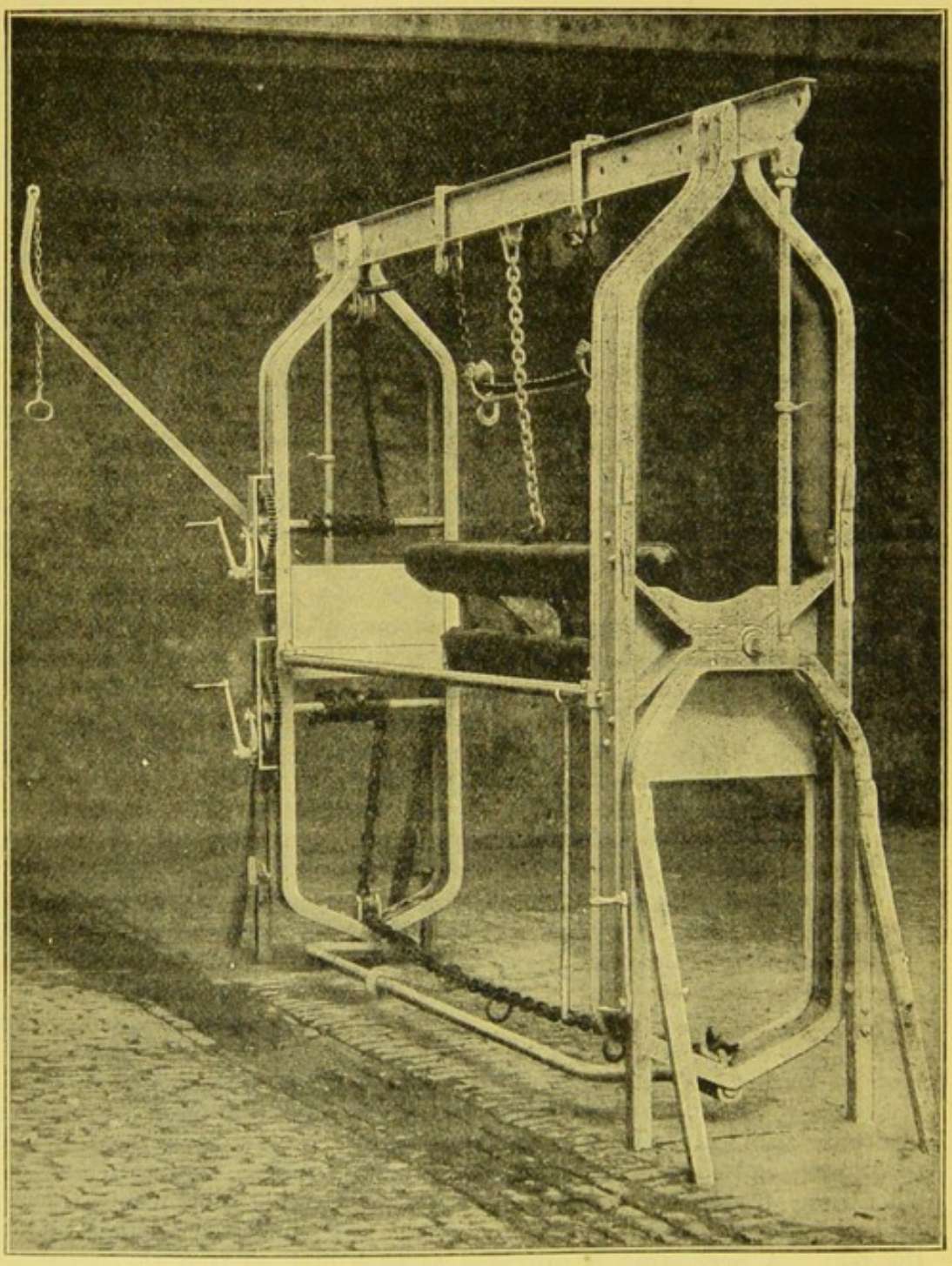

Fig. 54.—Vinsot and Dollar's Operation Table.

(2) Allowing the horse to get upon its feet again easily and without accident. (3) Perfect safety of the operator, who can work easily and comfortably. (4) Assistants, and, if necessary, anæsthesia can

FIG. 55.—TRAPP'S OPERATION TABLE.

be dispensed with. (5) Saving of time for the operator. (6) Economy in space and litter. (7) Greater cleanliness and better surgery.

SECTION II.

MANNER OF SECURING THE OX FOR OPERATION.

I. In the Standing Position.

The majority of operations are performed on the bovine species in this position, and the means of restraint are various. The ox is not so amenable to the influence of the voice and caresses as the horse, and these cannot therefore be relied upon.

To secure the head is the chief object, as this prevents attacks and struggles; in all operations, it is achieved as follows:

1. An assistant places himself on one side of the neck—the left

for instance—and with the corresponding hand seizes the horn on that side of the head, while he passes the other hand between the horns down to the nose, inserting the thumb into one nostril, the first and middle finger, into the other, and firmly seizes the septum.

In many cases a tap on the horn with a stick will render the animal more docile.

2. One end of a long cord is tied round the base of the horns ; it is

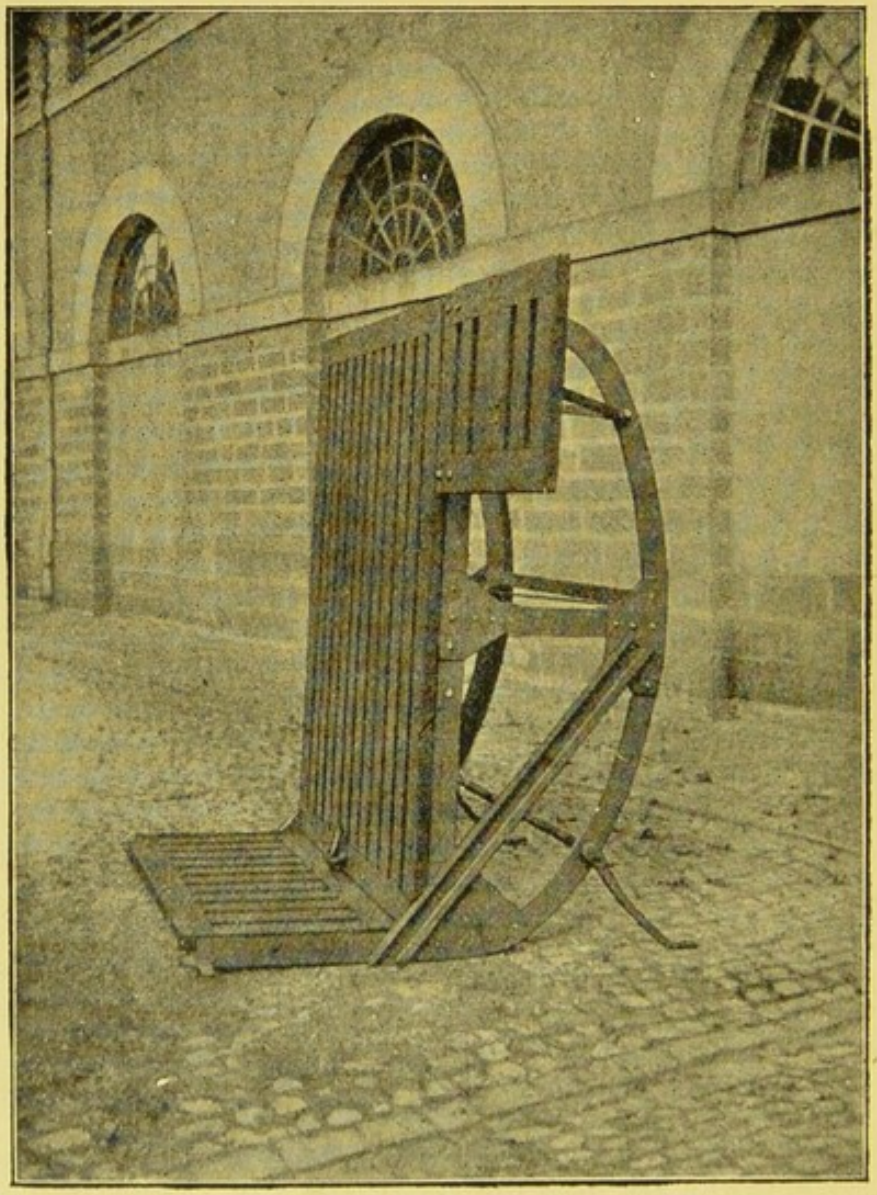

Fig. 56.—Trapp's Operation Table.

then passed backwards, forms a turn round the chest, another round the loins, and is fastened to the root of the tail, so as to elevate the head in such a way that when the animal attempts to lower it, the cord induces so much pain and discomfort that it desists.

3. Tying the head to a pillar, post, or tree, by means of a cord fastened round the base of one horn, then round the other horn, around the neck and the first horn, and around the post back to and

around the second horn, again round the post, and finally around the nose, where the end is held by an assistant. There are other methods of tying the head, but they are all on the same principle, and are adapted to special operations.

4. Applying the 'nose-clamp' or 'bull-holder.' This is an instrument for seizing the nasal septum in a more powerful and secure manner than can be done by the fingers. It varies somewhat in construction, but in principle it is the same. In some patterns it

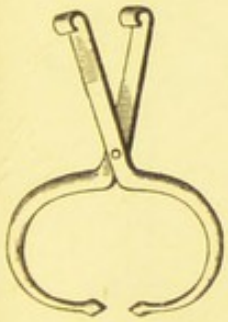

FIG. 57.
SIMPLE NOSE-CLAMP.

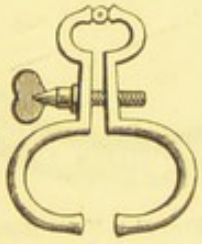

FIG. 58.
SCREW NOSE-CLAMP.

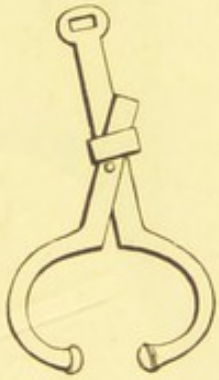

FIG. 59.
NOSE-CLAMP, WITH KEEPER.

is merely hinged, and the hand maintains it closed (Fig. 57); in others it has a screw (Fig. 58), or a sliding keeper, which keeps it closed (Fig. 59), and this may be supplemented with a spring (Fig. 60). The latter is a good model, though there are others with screw and spring, or rack and spring, to which the preference is sometimes given.

It may be remarked that bulls, and sometimes troublesome cows,

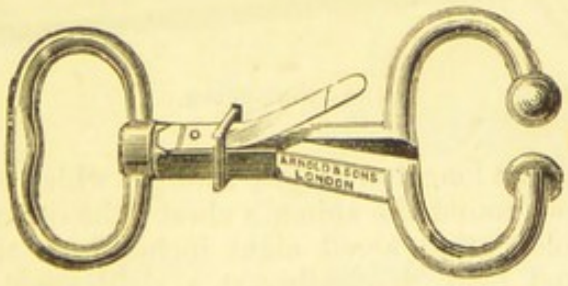

FIG. 60.—NOSE-CLAMP, WITH SPRING AND KEEPER.

wear a nose-ring permanently, which is very advantageous in seizing and handling such animals. This ring is of iron or copper, and jointed, so as to be easily introduced into and removed from the nose (Fig. 61). A round piece of the nasal septum is cut out by means of the nose-punch (Fig. 62), leaving a hole for its reception. This ring may have a small additional ring within it, in order to attach a rope or the hook of a long pole; or it may have an eyelet

or hole in its side for the same purpose. The Alsace ring (Fig. 63) is of this description, and the eyelet may allow the passage of a strap, which is joined by means of a buckle to two other straps passing around and between the horns (Fig. 64). There are various other patterns of rings, but in all the principle is the same.

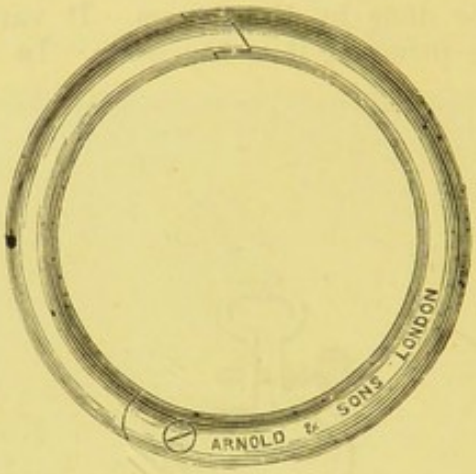

FIG. 61.—NOSE-RING.

With certain bulls or cows, a rope passed through the nose-ring would be insufficient to lead or control them. A long pole is therefore employed, this being furnished with a spring or spiral hook to hold the ring.

A modification or improvement in this controlling apparatus is that introduced in France by Vigan. This is a pole furnished near one

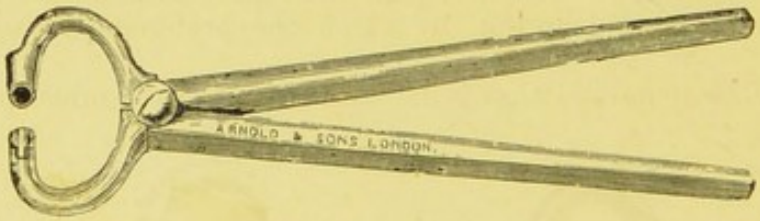

FIG. 62.—NOSE-PUNCH.

end with a somewhat long, low staple, through which passes a leather surcingle that goes round the animal's chest; the other end is armed with an iron prolongation, about eight inches from the termination of which is a fixed hook descending at a right angle, and which is inserted into the nose-ring, while at the very end is a loop or ring sufficiently large to admit the hand easily (Fig. 65). A strap passing around the horns and this pole, attaches it still more firmly to the head. So potent is this instrument as a constraining and restraining apparatus, that a young person can easily control a very vicious and vigorous animal.

These means of restraint applied to the head, are sufficiently potent to enable the majority of operations to be performed on the bovine species in the standing position. In special cases, however,

the operator has to protect himself or assistants from injury by the limbs (particularly the hind ones) of these animals, and various methods may be resorted to with this object. The principal are :

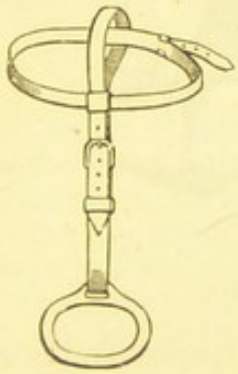

FIG. 63.
ALSACE NOSE-RING AND HEAD-STALL.

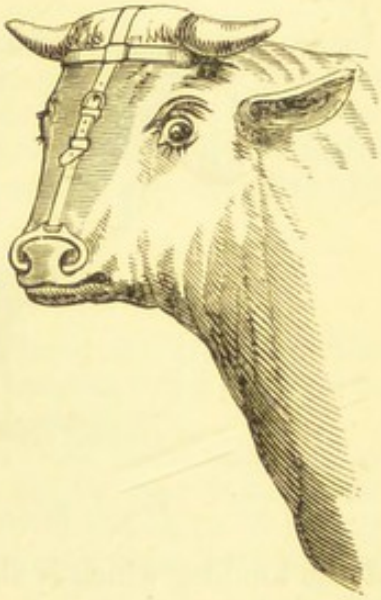

FIG. 64.
ALSACE NOSE-RING APPLIED

1. Attach the hind-legs to each other by means of two hobbles or a piece of rope applied above the hocks.

2. Carry the tail inside the hind-leg which threatens danger, bringing it round the front of the thigh (Fig. 66), where it is firmly

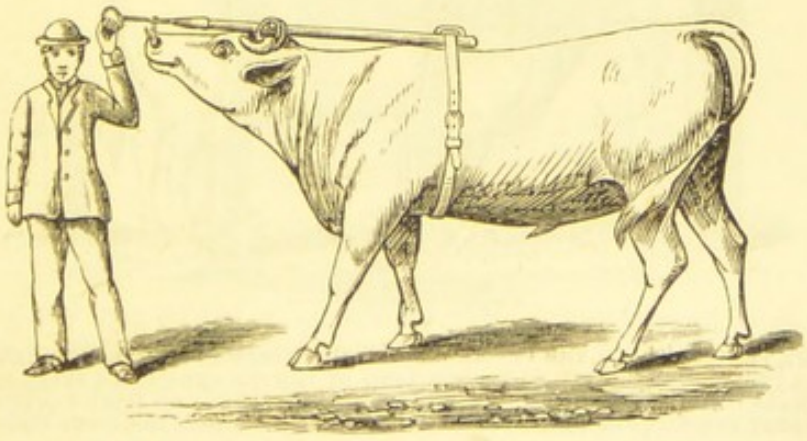

FIG. 65.—VIGAN'S CONTROLLING APPARATUS FOR OXEN.

held in the hand of an assistant, who stands against the animal's hind-quarter. Or a sack or long and wide piece of cloth may be passed round the front of the hind-leg, which is by this means held back by one or two assistants.

3. Place a tourniquet, made of a rope and a piece of wood, or even a twitch, above the hock of this limb, around the gastrocnemii tendons, and compress these until they are in contact with the tibia. The pain and restraint prevent the forward and outward movement

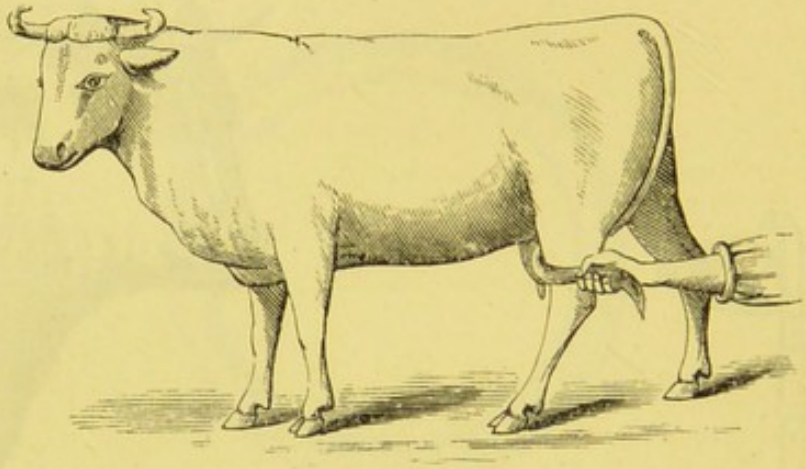

FIG. 66.—SECURING HIND-LEG BY MEANS OF THE TAIL.

of the hind-leg which is almost peculiar to the ox species, and is so difficult to guard against.

4. The hind-leg may be attached, by means of a side-line round the fetlock, to the fore-arm of the same side, round the neck, or round the horns.

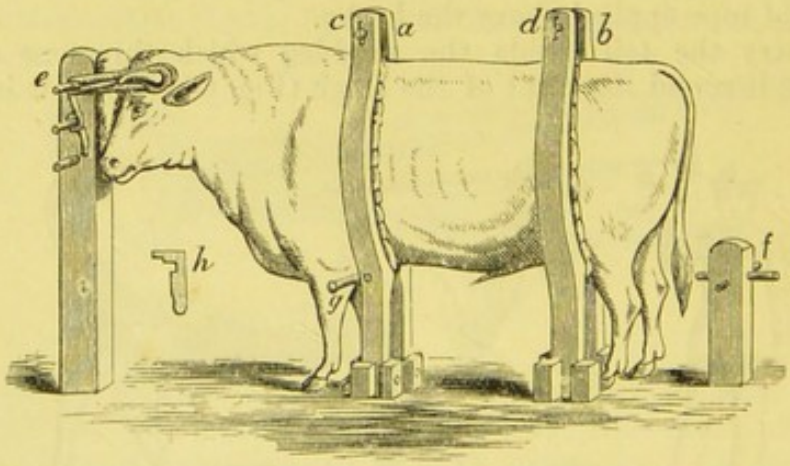

FIG. 67.—OX TRAVIS. *a*, *b*, *c*, *d*, THE FRAMEWORK FIRMLY FIXED IN THE GROUND, THE UPRIGHT LATERAL POSTS BEING CURVED TO FIT THE BODY OF THE OX, AND *c* AND *d* BEING THE TRANSVERSE BARS UNITING THESE; *e*, *f*, POSTS TO WHICH THE HEAD AND HIND-LIMBS ARE TIED; *g*, A SUPPORT FOR THE FORE-LIMB; *h*, SHAPE OF THE KEY WHICH JOINS THE POSTS *a*, *c*, AND *b*, *d*.

5. A pole or plank placed underneath the belly, in front of the hocks, the ends being held by an assistant on each side, prevents the hind-limbs being carried forward. Or one end of the plank may be placed on the ground underneath the ox, the other end being held by an assistant, who uses the plank as a lever to press the animal against a wall, at the same time it prevents the extension of the

limbs. Placed between the hind-legs, this lever will serve to raise either of the hind-legs.

6. The ox may be secured against a wall, by means of a rope passed through a ring fixed therein, about the level of the chest, and carried outside the body to another ring inserted in the wall behind the buttocks.

7. On the Continent of Europe, where oxen are shod, and where, in consequence of being employed as draught animals, they are frequently submitted to operation, a 'travis,' or stocks, is used to fix them in when they are uncontrollable (Fig. 67). This differs somewhat from that in use for the horse, though on an emergency the horse 'travis' may be tried.

II. In the Recumbent Position.

The ox is easily thrown down and secured for operation, the recumbent position which it so frequently assumes being often made available for fettering the limbs.

The apparatus in use for throwing down the horse may also be employed for the ox; but, as a rule, a simple rope is sufficient. Precautions must be taken to prevent fracture of the horns, by having a thick bed of litter or bundle of straw to protect them from contact with the ground.

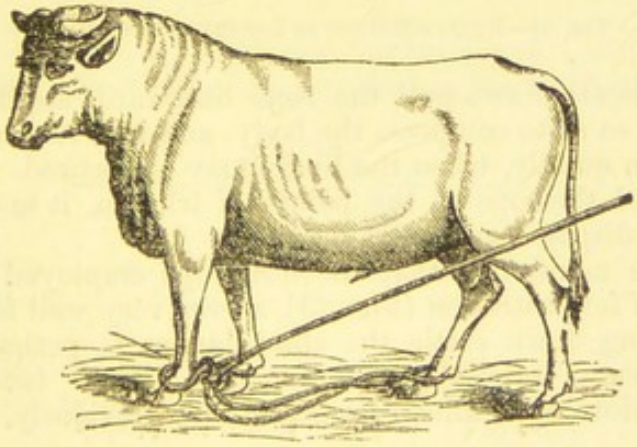

FIG. 68.—THROWING DOWN AN OX BY MEANS OF A ROPE.

In all cases the head is furnished with a halter, and it may be necessary to apply the nose-clamp.

There are various methods of applying the rope, but only two or three will be alluded to here. It may be remarked, that if there is any difficulty in placing or maintaining the hobbles or rope around the pasterns, they may be placed immediately above the fetlocks.

The rope may be provided with a running-loop at one end; this is placed on one of the front-pasterns; then the rope is carried round the other pastern, back around a hind-pastern, forward and around the portion between the front-pasterns, and back towards the opposite hind-quarter, being disposed throughout as in Fig. 68.

Two strong assistants are often needed for the head, while the rope is pulled backwards by two or three others.

Rueff's method is practised by means of a rope about thirty feet in length, at one end of which is a loop that is passed over the horns; the rope is then passed between the horns and along the neck, around which it makes a turn; over the withers, where it makes another turn round the chest; along the back, where it makes a third turn around the flanks; the free end is then carried back on either the right or left side of the hind-quarter, according as it is required to throw the ox on its right or left side. One assistant controls the head of the

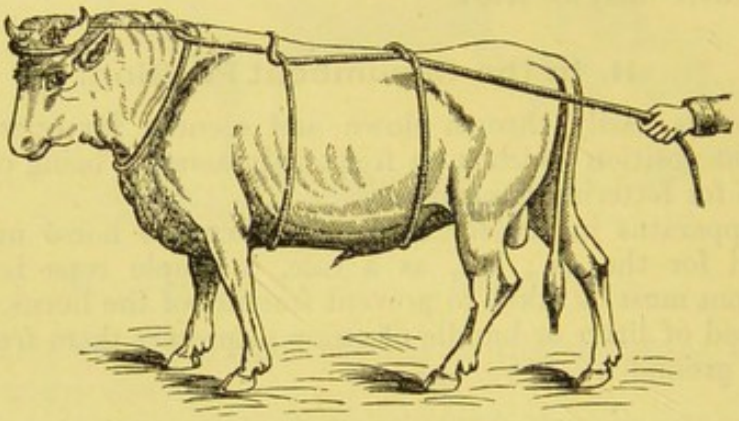

FIG. 69.—RUEFF'S METHOD OF THROWING DOWN THE OX.

animal, while other two pull the rope backwards steadily and without jerking, so as to compress the body, and in a few seconds the ox will lie down quietly, when the limbs may be secured. To facilitate the gliding of the rope at the points of friction, it may be greased. The rope is disposed as in Fig. 69.

It may be mentioned that the neck-rope employed for throwing down horses for castration (Fig. 23), serves very well for cattle.

In throwing down cattle the chief danger is, perhaps, rupture of internal viscera, especially the stomach. Their food and water should therefore be withheld for some time previously.

SECTION III.

MANNER OF SECURING THE SHEEP AND GOAT FOR OPERATION.

The sheep and goat are easily and readily secured for operation.

When it is required to operate on the head, the animal is seized by a strong assistant, who conveniently seats himself, with the body of the creature firmly held between his legs, and the fore-limbs grasped in his hands. In this way the head remains free. In some instances the operator may advantageously hold the animal himself.

Or the animal may be secured by tying the limbs in pairs—fore and hind of the same side, or two fore and two hind. In the former, the limbs should be so placed that the cannon-bones may be parallel, and so tied. The sheep may then be placed on a table or bench for operation.

SECTION IV.

MANNER OF SECURING THE PIG FOR OPERATION.

The pig is not an easy animal to manipulate, especially if of large size. Smaller, or young pigs, are less difficult.

The animal may be seized by the limb, or by an ear, or both, and thrown on its side. When it cannot be caught otherwise, food may be placed in a deep vessel, and when it is engaged in eating this, it may then be captured. Or a stiff piece of cord, with a loop or running-knot upon it, may be tied to the end of a stick, and a piece of bread or solid food in the loop. When the pig opens its mouth to seize the morsel the loop is passed over the nose, and tightened in direct proportion as the animal tries to disengage itself. Or the pig may be caught by laying the loop of a cord on the ground and allowing it to place one of its feet in it, then drawing the cord tight.

For vicious animals, a twitch may be employed. This is made of a piece of wood between one and two feet in length, flattened at one

FIG. 70.—GAG-SPECULUM FOR THE PIG.

end, which has two holes for the passage of a cord that forms a loop. This loop is passed over the upper or lower jaw, or around both jaws.

To throw down a large pig, two assistants are necessary. One seizes a hind-leg above the hock ; the other, standing to one side, the two ears. By a combined effort the creature is then thrown on its side, and kept in that position by placing the knee on its neck.

To open the mouth of a pig, a piece of wood should be placed between the jaws, or a gag-speculum may be used for this purpose, as well as for rendering the animal more manageable and less dangerous. This instrument is a piece of wood with a large, round, or oval opening in the middle, and small holes at each side of this, in which are cords to tie round the head, behind the ears, and so keep the gag in position in the mouth (Fig. 70). The projecting ends of the gag are very serviceable in allowing an assistant to control the pig.

SECTION V.

MANNER OF SECURING THE DOG AND CAT FOR OPERATION.

Of all the smaller domesticated animals, the dog and cat require most careful handling, in order to guard against injury; and the

FIG. 71.—TAPE MUZZLE FOR THE DOG.

operator cannot be too circumspect, both in seizing and operating on these creatures.

In operating without anæsthesia on the dog, the mouth should

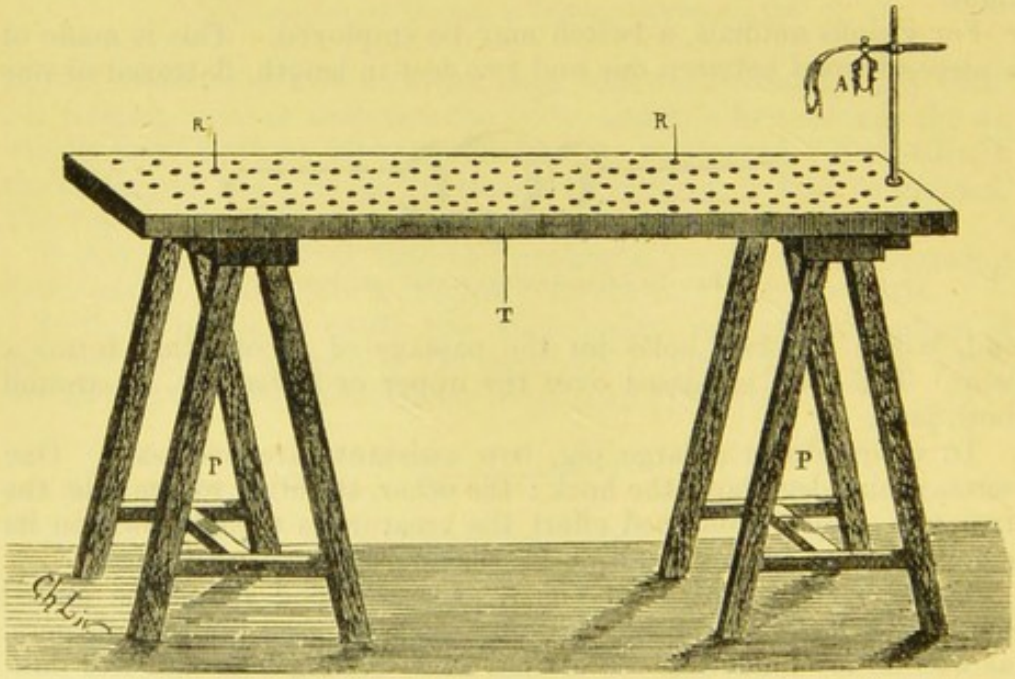

FIG. 72.—LIVON'S OPERATION TABLE (*Manuel de Vivisections*, Paris, 1882).

always be kept closed by a proper muzzle, or at least a piece of strong tape passed once or twice round the jaws, and tied securely behind the ears (Fig. 71).

With some vicious dogs, or even animals otherwise docile or quiet

with the majority of persons, the operator (especially if he has operated on the same animals previously) incurs great risk in going near or catching them, and it may be necessary to have them blindfolded before he appears. The safest part by which to seize a dog is the skin on the nape of the neck. But with very savage and dangerous animals there may be risk in this, and the seizure may be more safely effected by means of a long pair of pincers or tongs, the

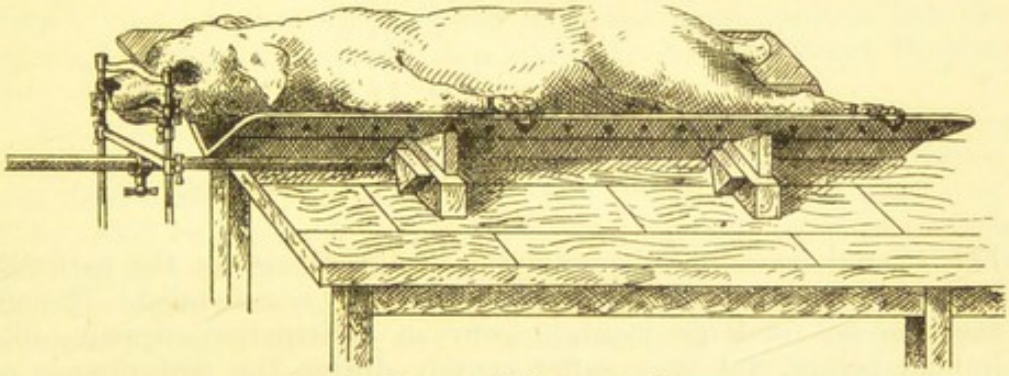

FIG. 73.—BERNARD'S OPERATION TABLE.

jaws of which are made circular, so as to grasp the neck like a collar; or a stick four or five feet in length, provided with a long wire or stiff cord, forming a running noose at the end, will suffice, the noose being passed over the head, and tightened sufficiently to secure the dog, while keeping the latter at a safe distance.

For the more important and complicated operations the dog should be secured on an operating table. Figs. 72-74 represent

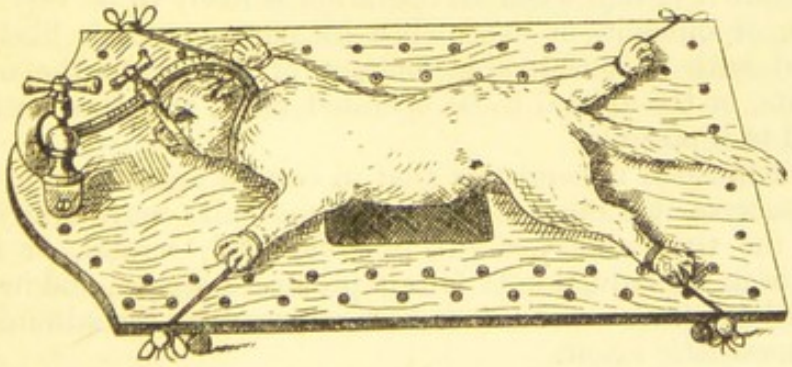

FIG. 74.—OPERATION TABLE FOR THE CAT.

very convenient tables with head-holders, which were introduced many years ago in France by Livon and Bernard.

The claws, no less than the teeth, of the cat have to be guarded against; and this can only be effected by enveloping head, body, and limbs in a piece of strong cloth or canvas, and uncovering only the part to be operated on. If this part be towards the posterior region of the body, the head, chest, and fore-limbs may be placed in the leg of a Wellington boot. Otherwise, the cat can be fixed on a table provided with a holder for the head, as shown in Fig. 74.

CHAPTER II.

THE EMPLOYMENT OF ANÆSTHETICS.

For several reasons, the production of anæsthesia for the performance of operations upon animals is to be highly commended. Though they do not undergo mental agony in anticipation of pain, like human beings, yet they suffer acutely during the performance of certain operations, not only from the pain produced during these, but also from the necessary restraint imposed upon them. They being unconscious, of course, of its utility or necessity, are therefore destitute of the hope or consolation which serves to nerve and sustain a man under such circumstances. Not only this, but the pain and restraint cause animals to struggle, and this is not only productive of risk to the operator and his assistants, but also to the animal itself, while it protracts the operation, and renders it much more difficult, and often unsatisfactory.

Therefore it is that when an operation is likely to be very painful, delicate, or difficult, or even when its performance is likely to be attended with a considerable amount of danger to the operator, assistants, or the animal to be operated upon, anæsthesia should be resorted to if possible.

And it must be remembered that in certain operations, in order to ensure success, it is most essential that muscular contractility should be for the time abolished—as in abdominal, scrotal, or inguinal hernia, or in the reduction of certain prolapsed organs, and in dislocations and fractures—and this is best achieved by the administration of an anæsthetic agent.

On the score of humanity, utility, and often of economy, then, anæsthesia should be produced whenever possible or convenient, in operations on animals.

Now that experience has so fully shown, not only that anæsthesia may be easily produced in the horse, but also that it is effected with almost complete immunity from danger to the patient, it can scarcely be justifiable to withhold this ready means of rendering the performance of all surgical operations on it absolutely free from pain.

Vicious horses, to which casting hobbles or ropes cannot be applied without risk of accident, can be partially anæsthetized in the stand-

ing position by placing cotton-wool containing a few drachms of chloroform in an ordinary muzzle, which is then put on the head in the usual way. The horse should be securely held for a few minutes, when the casting apparatus can be applied without danger. The same object can be attained by subcutaneous injection of morphia, or by giving a narcotic electuary half an hour before the time fixed for the operation.

Up to the present time, chloroform is, *par excellence*, the agent which best answers the purpose with the horse, and is the one which is almost exclusively employed. It should always be pure and well rectified.

There are many anæsthetic *mixtures* in use, in addition to the *single* agents—such as chloroform, ether, alcohol, etc. For instance, one fluid ounce of pure chloroform, half a fluid ounce of pure ethyl ether, and half a fluid ounce of pure or absolute ethyl alcohol, is perhaps the most usual form of combination of these combined anæsthetic substances. The substitution of methylene for the chloroform is an improvement, and Dr. Richardson, in his early experiments in the introduction of methylene, used it successfully in combination with absolute ethylic alcohol without ether, and with more success still when pure methylic was used instead of ethylic alcohol. His formulæ were : methylene, one fluid ounce and a half ; absolute ethyl alcohol, half a fluid ounce. Or, methylene, ten fluid drachms ; absolute methylic alcohol, six fluid drachms. The last-named mixture, though a little slower in action than methylene itself, is considered by Dr. Richardson to be 'the safest known anæsthetic when the methyl alcohol is absolutely pure.'

Some other mixtures are as follows :

	Ether	3 parts.
	Chloroform	1 part.
Or—		
	Chloroform	30 parts.
	Sulphuric ether	10 parts.
	Absolute alcohol	10 parts.
Or—		
	Chloroform	2 parts.
	Ether	3 parts.
	Alcohol	1 part.

No member of the veterinary profession probably has administered chloroform to horses so frequently as Mr. Roalfe Cox, F.R.C.V.S., of London, whose custom during more than twenty years has been to perform all operations under its influence ; and he informs me, that out of hundreds of cases, he has not only never witnessed a death from the inhalation, but has never seen a horse injuriously affected by it.

I have heard of contrary results, but probably in these instances the agent was less at fault than the method by which it was administered.

The plan which Mr. Roalfe Cox has adopted answers the purpose very effectually, and is embraced in the following description furnished by himself :

The horse should be previously cast on a soft bed, and this is a rule admitting of no exception.

The administration of the anæsthetic should never be attempted while the horse is standing, as the first stage of excitement which attends the inhalation would render the animal unmanageable ; while the next effect, which quickly follows, deprives it of all control of voluntary movements, and the staggering and inevitable fall might be attended with disastrous consequences.

The horse being cast, the chloroform bag is to be applied.

This bag may be made of any strong material—waterproof canvas answers well. It is open at each end, with a running cord or tape at both extremities to close them (Fig. 75). A convenient size, suiting the average number of horses, is twelve inches in length from end to end, and twenty inches in circumference.

It is to be drawn within the mouth as far as the angle of the lips,

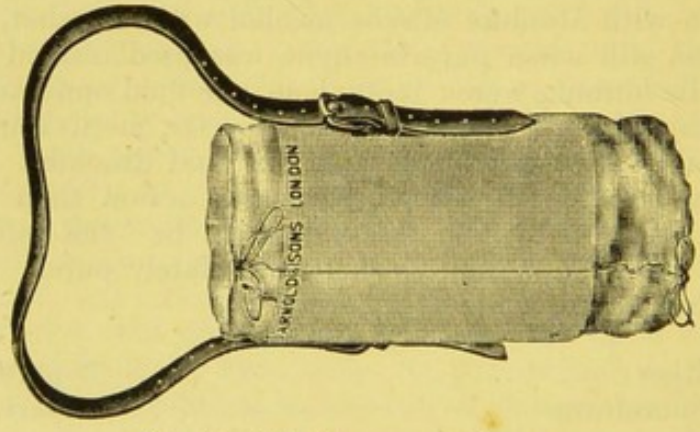

Fig. 75.—Cox's Chloroform-Muzzle.

and tied moderately tightly, the strings being again tied to a loop on the front of the leather blinds, which effectually prevents any displacement during the restlessness of the horse, and which nearly always occurs at first, partly, it may be, from resistance, and partly from the chloroform.

The bag being adjusted, half an ounce of chloroform is to be sprinkled on a handkerchief or something of the kind, and introduced loosely within the bag and near to the nostrils, and the opening of the bag partly closed by the strings.

A piece of unbleached calico, about half a yard square, answers the purpose well, and it is practically a good plan to damp it slightly, just as much as by dipping the fingers of one hand in cold water and wiping them on it ; the expedient seems to retard the evaporation of the chloroform, and to allow it to be inhaled more equably.

In about two minutes and a half, more or less, the calico may be withdrawn, and a second half ounce of chloroform poured on ; and again after about the same interval, a third and a fourth, if need be.

If the horse resists and struggles, and breathes energetically, the chloroform will be expended so much the more quickly, and a less volume will be retained in the circulation, rendering it necessary to replenish earlier; the horse which breathes slowly and deeply, wastes less, and is also retaining more.

The character of the breathing, therefore, is a guide as to the need to replenish sooner or not. You can also inform yourself on this point at once, by withdrawing the handkerchief for an instant, to ascertain by a whiff if there be any chloroform on it.

Be careful not to omit the repetition of the dose in time, or the effect will be passing off, and lengthen the procedure, whilst rendering the result less decided; bearing in mind that anæsthesia depends on the quantity of the agent retained in the system at a given time.

The average quantity will be found to be an ounce and a half; in some cases an ounce will suffice, and even less has, in exceptional instances, answered the purpose; whilst, on the other hand, where there has been much resistance and waste, or from peculiar insusceptibility, two, or even three or more ounces may be requisite.

The first effect on inhalation is excitement and resistance, and if struggling occurs *immediately* on introducing the chloroform, it is well to withdraw it, and allow the horse to take a few inspirations of fresh air, and then recommence with the agent.

This *immediate struggling* appears sometimes to be due to the sudden impression on the respiratory function, and is generally at once overcome in the way recommended.

After this, further struggling will be in part due to temper, and in part to the primary exhilarating influence of chloroform. It is, therefore, now best to push on the administration, and to close the outer opening of the bag by holding a cloth across it, removing it occasionally at an expiration—once in three or four.

In the next stage, the struggling will have ceased, and the breathing become more calm, tremor of the muscles ensues, and at this point of 'going off' the horse will often neigh, apparently enjoying itself in dreamland.

The less number (a small proportion) will scream loudly just before going off (this is allied to the hysterical condition). There is no cause for alarm in this; it soon subsides, and the indication is to increase the dose.

While the process is going on, look to the tongue, withdraw it gently, and let it hang outside the mouth; this is the best indication of the state of the patient, and is the easiest to watch.

So soon as there is no power to retract this organ, and it falls placidly over the side of the mouth, and there is no reflex movement when it is gently pinched between the finger and thumb, the patient is in a condition for operation. There is no necessity for hurrying, as there is ample time now, and the horse will even be still more completely calmed in a few minutes when it becomes, as it were, saturated with the agent, although no longer breathing it.

It is advisable to leave the bag *in situ*, withdrawing the handker-

chief in case of need to repeat the dose, which of course will depend on the duration of the operation.

The operation completed, there is yet caution to be observed, and the horse must on no account be prematurely awakened, or hastened to arise, as in the more haste may be the less speed.

The animal may be from five to twenty minutes, or longer, in throwing off the effect, and if allowed to rise too soon, would stagger and perhaps fall; therefore bear in mind the following rules: *Do not remove the blinds* (the sudden effect of light is to alarm and arouse) until the tongue responds and is withdrawn with some degree of force, the mouth responds to the movements of the finger placed within it, and a little cold water dropped into the mouth from a sponge is sucked and swallowed.

FIG. 76.—GRESSWELL'S CHLOROFORM NOSE-CAP.

Until these reflex movements are readily performed, it is neither prudent nor safe to allow the horse to rise.

The hobbles may be taken gently off the pasterns, but the blinds should be the last to be removed; the horse should then be gently stroked and spoken to, and allowed to get up of its own accord, and not frightened up.

It is not usual for nausea to supervene; indeed, the horse generally looks for food, and commences to eat the litter on returning to the box. It is well, however, not to allow food for an hour or so, except just a handful of hay to nibble at, and to make the animal feel at home again. There is a peculiarity noticed on the day after chloroform has been given in a disagreeable odour from the fæces—probably from some interference with the action of the liver—but it is not usual for the horse to show any other indication of disorder.

Many contrivances have been introduced for administering the anæsthetic; but the bag used by Mr. Cox, the ordinary stable-muzzle, or the nose-cap designed by Mr Gresswell, will be found as efficient as more expensive and complicated articles. The latter (Fig. 76), though less portable than the canvas-bag, is yet more durable. It is a wise nose-cap, made of leather, fitting over the nostrils and mouth (the latter rather a disadvantage), and furnished with a strap to fasten it on the head; at the bottom of the cap is a perforated metal plate or valve, under which is placed a layer of sponge. On the outer side is a small opening directly communicating with the sponge, through which the anæsthetic agent can be introduced as often as may be required without removing the apparatus.

Close attention is necessary in administering the anæsthetic agent, so as not to exceed the stage when sensibility has been totally

abolished, and otherwise painful operations can be painlessly performed. If the administration of the narcotic is pushed beyond this stage, there will be danger, the approach of which is indicated by stertorous respiration, cold limbs, small irregular pulse, and all the signs of syncope, which will soon lead to those of death.

The duration of anæsthesia, or narcosis, is variable—from five to ten minutes—but it may be prolonged for a considerable period by renewing the supply of the anæsthetic at short intervals, when consciousness appears to be returning.

In case of syncope, asphyxia, or 'anæsthetic sideration,' as it has been termed, the inhalation of the narcotic must be stopped at once, the tongue pulled forward, the head extended, and the air allowed to freely circulate about the body; cold water must be dashed on the head and along the spine, amyl nitrite, or solution of ammonia, may be held to the nose, friction applied to the limbs, especially

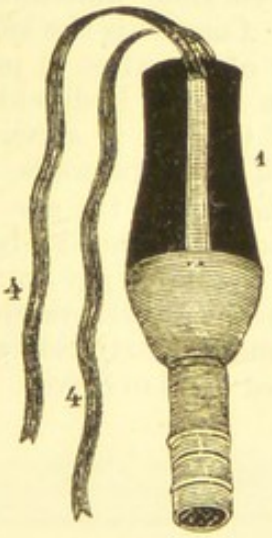

FIG. 77.—LIVON'S INHALER FOR THE DOG.

directed towards the heart, and attempts at artificial respiration should be made.

With regard to animals other than the horse, all are amenable to the influence of anæsthetics, and all are more speedily narcotized than that animal. All require to be placed in the recumbent position, and secured, previous to the administration of the agent. The same apparatus will serve for the ox as for the horse; and, for the smaller animals, a piece of lint, tow, sponge, or other imbibing material, saturated with the anæsthetic, placed at the bottom of a cup or small vessel, and held close to the nostrils, will suffice. The dog is secured on a table, and the anæsthetic may be administered through an inhaler, such as Livon's (Fig. 77). During anæsthesia free respiration by the mouth should be insured by separating the jaws with a bit of wood. The cat may be placed in a box, under a belljar, or inverted bucket, enclosing cotton-wool saturated with chloroform.

The absence of sensation in these creatures may be tested by

pricking them with a pin, touching the cornea—when, if sensibility is present, they will wink—or pulling out or pinching the tongue.

As a rule, anæsthetics may be administered in all surgical operations, except those in which the standing attitude is essential to their proper performance, or those in the mouth or air passages, when hæmorrhage into the bronchi might induce asphyxia.

Local Anæsthesia.

In order to diminish suffering without depriving the animal of consciousness, the part to be operated on, if limited and superficial, may be partially or totally deprived of sensation. This can be effected by reducing the temperature of the part by means of ether spray, ethyl chloride, very cold water, ice, or frigorific mixture (composed of pounded ice and salt in a muslin bag); by strong pressure on the vessels and nerves supplying the part, or by the application of cocaine, eucaine, holocaine, antipyrine, iodoform, carbolic acid, or aconite. Cocaine is the local anæsthetic now generally preferred. The seat of operation is painted or injected with a 5 to 10 per cent. solution of the hydrochloride until the requisite insensibility is secured. Cocaine is serviceable in the opening of abscesses, the removal of small tumours, in neurectomy, tracheotomy, firing, and in operations on the eye. A few drops of a 5 per cent. solution applied to a mucous surface will abolish sensation over a limited area for about twenty minutes. In operations involving section of the skin the anæsthetic should be *injected* along the line of incision. To promote penetration when *painted* on the skin cocaine should be dissolved in oil of cloves.

CHAPTER III.

ELEMENTARY OPERATIVE VETERINARY SURGERY.

In this chapter will be considered what may be designated the 'elements' of operative veterinary surgery. These consist of *incisions, dissections, punctures, arrest of hæmorrhage, closure of wounds, and dressing and bandaging.*

SECTION I.

INCISIONS.

Incisions are made by cutting instruments. These are usually *scalpels* and *bistouries, drawing-knives* or '*searchers,*' *scissors, and forceps.*

Fig. 78.—Aseptic Scalpel, with Curved or Straight Dissector.

Fig. 79.—Aseptic Scalpel, with Scoop.

Scalpels and *bistouries* are composed of two parts—blade and handle. The blade may be immovably fixed in the handle, or hinged so as to shut, and with a spring to maintain it open; and it may be straight, convex, concave, or curved on the cutting edge, and probe or sharp-pointed. These knives vary in length, breadth, and strength, according to the requirements of the operation. Incisions are also made by special instruments in particular operations—as in tenotomy, neurectomy, herniotomy, etc.

For cutting through dense or hard tissues—as cartilage—a strong short scapel or an arthrotome, which is a strong double-edged scalpel, is employed.

The *bistoury* may have a free or a concealed blade (*bistoury caché*,

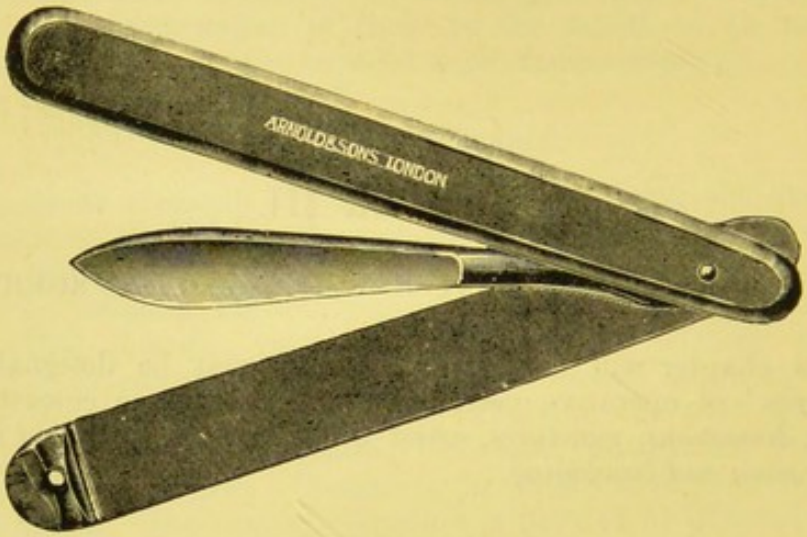

Fig. 80.—Aseptic Operation Scalpel.

Fig. 82)—the latter is employed for opening fistulæ and sinuses; and it may have a sharp or a blunt point—probe-pointed (Fig. 84).

The *drawing-knife* and *searcher* only differ in size, the latter being the smaller. The blade terminates in a lateral curve or bend to the

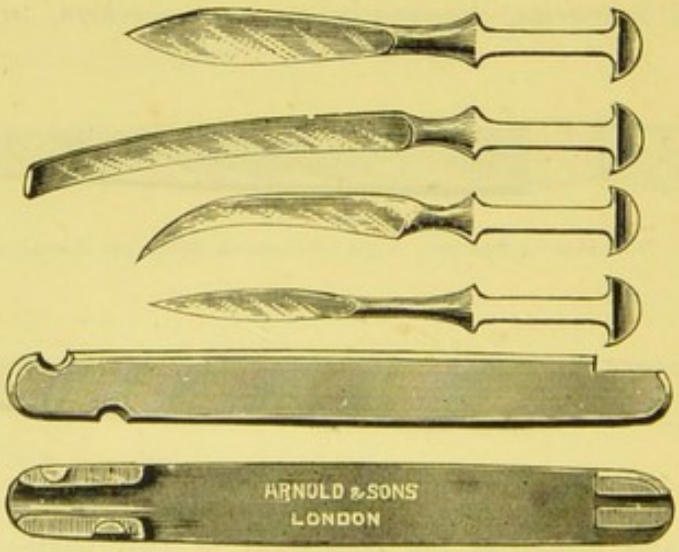

Fig. 81.—Aseptic Knife, with four Blades.

left side, and may have a double cutting edge (Fig. 86). This knife is most useful in operations on the foot, when it is necessary to remove a portion of the hoof, to trace the course of a puncture, or to afford an exit for pus.

The *scissors* are of various sizes and shapes. Large strong scissors

(*trimming scissors*) are necessary for the removal of hair from the part about to be operated on. The smaller scissors for operations

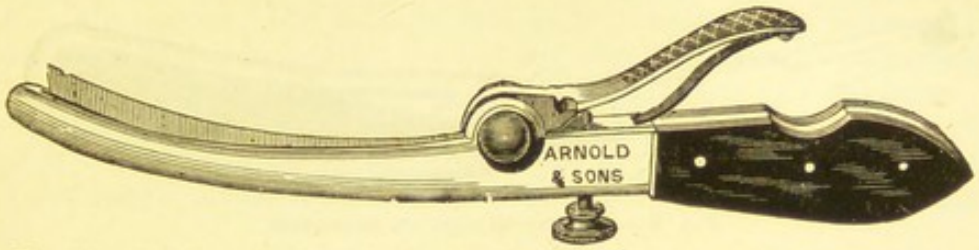

FIG. 82.—BISTOURY CACHÉ, WITH REGULATING SCREW, TO CUT ANY REQUIRED DEPTH.

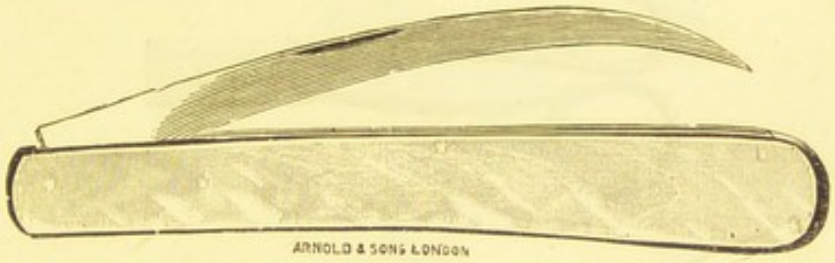

FIG. 83.—BISTOURY, SHARP-POINTED.

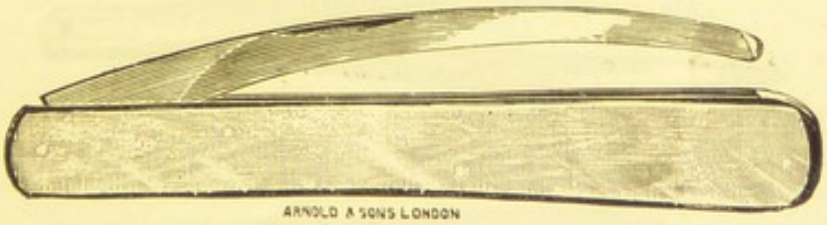

FIG. 84.—BISTOURY, PROBE-POINTED.

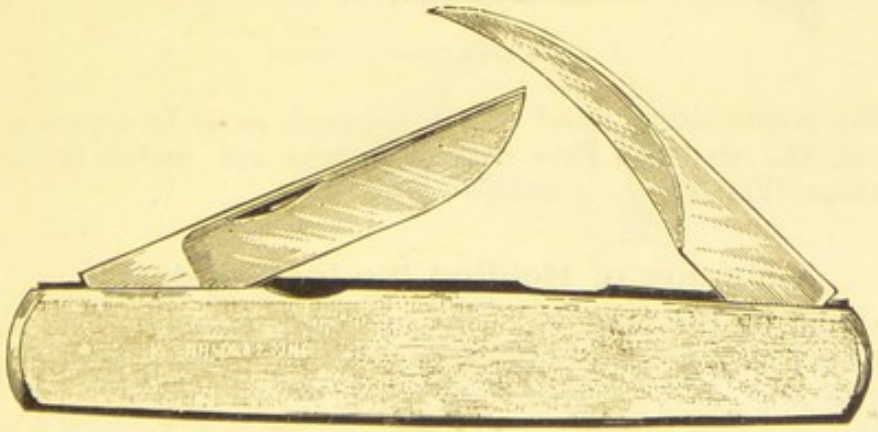

FIG. 85.—ASEPTIC SCALPEL AND ABSCESS-KNIFE.

(*dressing scissors*) are straight or curved, probe or sharp-pointed, and have open or close shanks.

Scissors are often preferable to the knife for making incisions.

A special form of scissors named *rowelling scissors*, or rowelling *bistoury*, is in use for particular operations, as it is sufficiently strong, and so arranged that it cuts the skin to a certain depth (Fig. 87).

The *forceps* are of various kinds, but the ordinary dissecting forceps is that generally used (Fig. 88). They should be moderately strong,

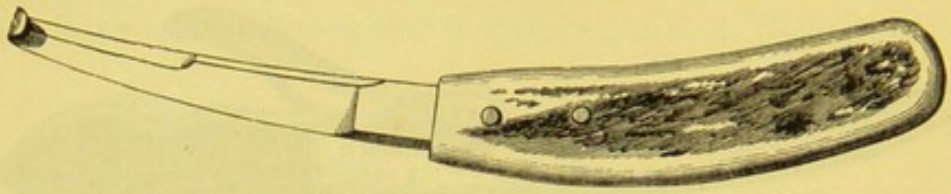

Fig. 86.—Drawing-Knife, or Searcher.

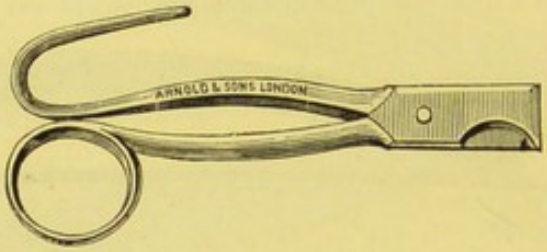

Fig. 87.—Rowelling Bistoury.

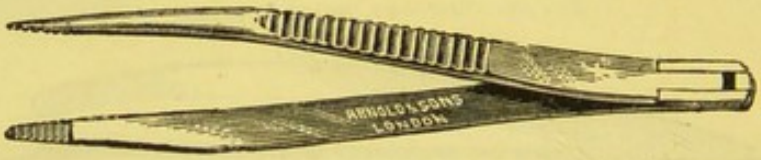

Fig. 88.—Aseptic Forceps.

Fig. 89.—Fine Curved Forceps.

and the points sharply and deeply serrated, so as to secure a firm hold of the tissues. Fine curved forceps are useful in certain operations (Fig. 89).

Manner of Holding the Instruments.

Manner of Holding the Scalpel or Bistoury.—The scalpel or bistoury may, for convenience, be held in various ways during the

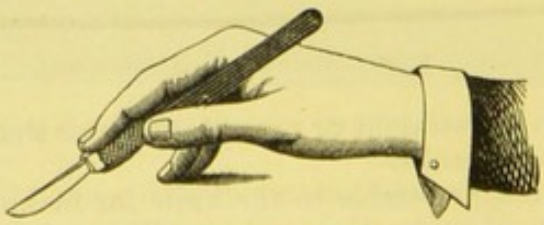

Fig. 90.—First Position.

performance of operations, but the principal positions are seven or eight in number.

1st Position.—The first position (Fig. 90) is that which is most frequently adopted in delicate and slight dissections of inconsiderable dimensions; the knife is held as if it were a pen, between the pollex, index, and medius, the cutting edge towards the palm, while the hand is steadied as it rests upon the annularis and minimus.

2nd Position.—In this position (Figs. 91, 92), the knife is held as is the bow of the violin, in order to have greater freedom and a wider range of motion; but it requires a firmer hold of the knife,

FIG. 91.—SECOND POSITION.

FIG. 92.—SECOND POSITION.

and greater dexterity, than the first position, as the hand cannot be steadied on the neighbouring parts. This position is the best for the excision of large tumours, or for making extensive incisions.

3rd Position.—This only differs from the first position in the cutting-edge of the knife being directed upwards towards the knuckles,

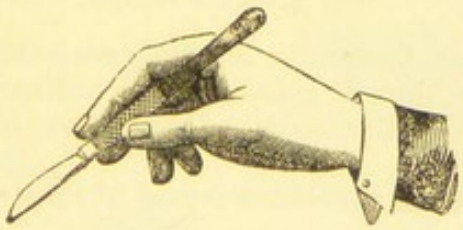

FIG. 93.—THIRD POSITION.

(Fig. 93) instead of downwards towards the palm of the hand, and, like that position, is adapted for delicate and limited dissection.

4th Position.—This also only differs from the second position, in

FIG. 94.—FOURTH POSITION.

the edge of the knife being in the opposite direction (Fig. 94), as in that position greater freedom of movement is obtained.

5th Position.—For laying open fasciæ or aponeuroses by the aid of the grooved director, this position is the best. The knife is held nearly vertical between the pollex and index and medius, the cutting-

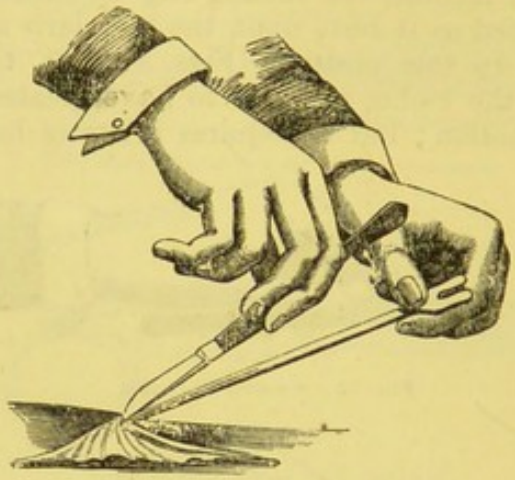

Fig. 95.—Fifth Position.

edge of the knife being directed towards the operator, and the left hand manipulating the director (Fig. 95).

6th Position.—When the tissues are somewhat resisting, and a certain degree of force is necessary to overcome this resistance—as

Fig. 96.—Sixth Position.

in dividing tendons, ligaments, or cartilages—this position (Fig. 96) is advisable. The knife is grasped as an ordinary dinner-knife, the index being placed on the back, at the junction of the blade with the handle.

7th Position.—When a stronger degree of force is required, and the

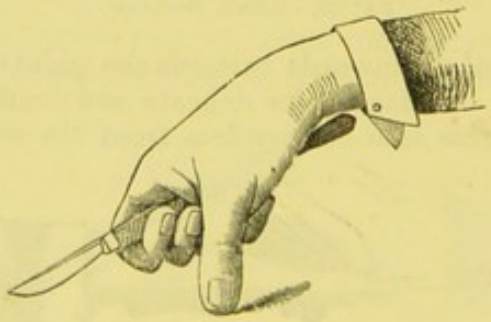

Fig. 97.—Seventh Position.

movement is limited, but must be steady and strong, the knife is firmly grasped in the hand : this rests on the pollex (Fig. 97), which forms a fulcrum as well as a support for it.

8th Position.—When a sweeping cut has to be made, as in certain extensive incisions through thick, dense tissues, or in circular

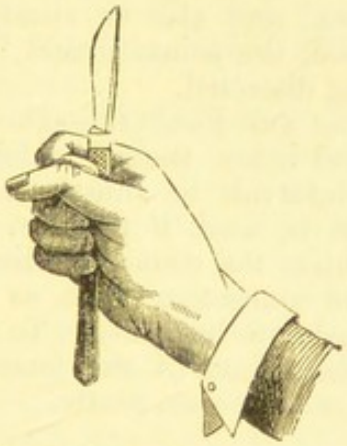

FIG. 98.—EIGHTH POSITION.

amputations, the knife, which may be long, is held in the full grasp of the hand, blade upwards, and nearly vertical (Fig. 98).

MANNER OF HOLDING THE DRAWING-KNIFE OR SEARCHER.—For this instrument, the use of which, from the resisting nature of hoof-horn, requires a stronger grasp and wrist than the scalpel and bistoury usually do, the positions are two.

1st Position.—The handle of the knife is grasped firmly in the hand, the blade toward the minimus and the cutting-edge toward the wrist (Fig. 99). In this position, in order to cut, the knife is

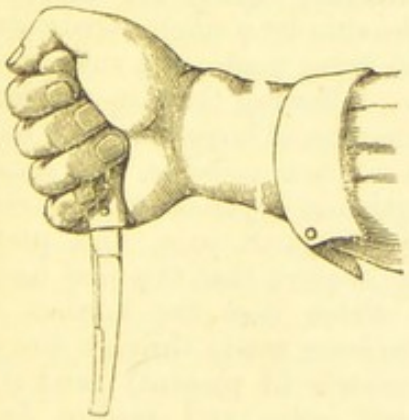

FIG. 99.—FIRST POSITION.

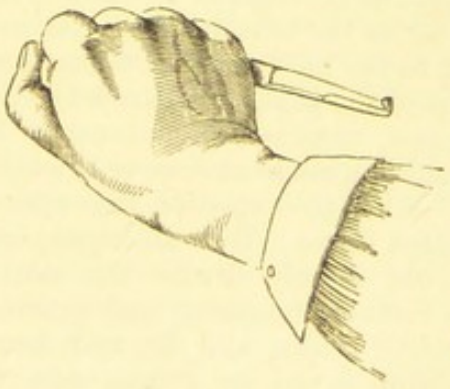

FIG. 100.—SECOND POSITION.

drawn towards the operator. When the resistance is very great, both hands may be employed to grasp the handle, or the left hand may exert pressure on the back edge of the blade.

2nd Position.—In this position the manner of holding the knife is somewhat different. The palmar surface of the hand is directed downwards, and the cutting-edge of the knife outwards or forwards, the hand being pushed from the operator in cutting (Fig. 100).

Manner of Holding the Scissors.—There are no special directions for holding or managing the scissors. It is well to hold them between the pollex and medius, using the index to assist the latter in opposing the pollex, and also to steady the scissors. When curved scissors are used, the points should be turned upward from the part which is being dissected.

Manner of Holding the Forceps.—The forceps is usually held between the pollex and index, though in long-continued dissection the medius may at intervals be substituted for the latter. The instrument should not be used, if possible, upon muscles, vessels, or nerves, but only upon the connective-tissue coverings of these. Upon skin, fasciæ, and connective tissue, as well as upon abnormal growths, it may be used with impunity. To separate small muscles, vessels, or nerves, the points of the forceps should be inserted between, and then allowed to open gently.

Directions for making Incisions and Dissections.

Cutting instruments should be as clean, smooth, and sharp as possible.

If the skin covering the part to be operated on is covered with hair or wool, which may impede the operation, embarrass the operator, or retard recovery, this should be removed by ordinary scissors, or, after soaping the skin, shaved off by means of a razor or scalpel. This is more easily done if the hair is wetted. Before incision by the knife, the skin should be made tense over the part, by the tips of the left index and medius placed on each side of the line of incision, or in any other convenient manner; grasp the scalpel like a pen, at an angle of 45°, and divide the skin by a single steady stroke as far as the tension exists, the incision being made, as a rule, according to the nature of the operation—*i.e.*, following the larger or longer axis of the part, and parallel to the direction of large nerves or blood-vessels, muscles, or cutaneous folds. When possible, the incision should be made at once to the full length and depth deemed necessary in order to expedite the operation, diminish pain, and prevent jagged edges. But circumstances may require that this first incision should merely divide the skin; in which case the borders may be further separated and a similar incision made through the connective tissue, and fat and dermal muscle (if present); and if the incision is to be a long one, the left index and medius fingers must be shifted, and the operation repeated to the end of the line. The separate strokes should join each other accurately, so that the entire incision may be straight and smooth-edged. At the beginning and end of the incision, the scalpel should be held nearly perpendicular, so as to avoid making a needless shallow cut.

Direction of Incisions.

Incisions may be made toward or from the operator, from left to right, or right to left, or from above to below. They may also be made, 1st, from the skin inward; 2nd, from the deeper tissues toward the skin; 3rd, subcutaneously; and 4th, by a scraping or slight drawing movement.

1. *Incision Inward, or toward the Operator.*—This incision is made by pressure on the knife, the skin being made tense either by the left hand of the operator, by an assistant, or both. The knife is held vertically in the first or sixth position (Figs. 90, 96), pressed—as in puncturing—to the necessary depth through the integuments, then inclined to an angle of 45° in making the incision, and vertical again in completing it. This mode of incising may be practised when the part is somewhat firm, and great care is not required. When, however, it is necessary to be cautious, owing to the importance of the parts immediately beneath the skin, the knife may be held nearly horizontally in the first, second, or sixth positions, according to the degree of pressure necessary, and the incision made without changing the horizontal direction of the instrument. Or a fold of skin may be raised in a transverse direction to that which the incision is

Fig. 101.—An Incision Director.

to follow, held by an assistant, and cut across to the required depth by the knife held in the second or sixth position, or by scissors.

This incision is that most frequently resorted to in making simple sections—straight, curved, or compound; but it demands care when made in the immediate vicinity of important nerves and blood-vessels.

2. *Incision Outward, or from the Operator.*—The *outward*, or cutting-up incision, may be made with or without the assistance of a metallic director (Fig. 101) or the finger, to guide the knife. The knife or bistoury may be held in the third or fourth position (Figs. 93, 94), and its point inserted vertically into the tissues; then the hand should be lowered until the back of the knife is at an angle of 45° with the skin, the incision being now made until near its termination, when the hand and knife are raised to the vertical position to complete it. To make the skin more tense, rest the cubital part of the left hand on it, near the right hand. Or a fold of skin may be raised and held tense, with the aid of an assistant; then the knife, held in the fourth position, is pushed through the base of the fold, and in being withdrawn cuts upward through the entire fold.

When a wound or incision already exists, this is enlarged by inserting the bistoury in the fourth position (Fig. 94) to the necessary depth, the edge being carried into the required direction;

lowering the hand, the tissues are cut through by forward or upward pressure.

The direction given to the knife decides the depth of the incision; when vertical, it penetrates deeply; when very inclined, it only makes a superficial incision; and at a moderate angle an extensive incision may be made without withdrawing it. So that as it is desired to make a superficial or a deep cut, the hand must be held at a more or less acute angle, the back of the instrument toward the surface of the part.

The outward incision is necessarily simple and straight, and in making it the finger or director is often employed to guide the knife, if the cut is to be deep.

To make an incision to one side, right or left, the knife is held so that the flat of the handle and blade are toward the palm, between the pollex and index, the other fingers supporting the blade; entering the point vertically, the knife is then inclined and moved along, assisted, if need be, by pressure from the left index, terminating the incision by carrying the knife from right to left, or *vice versâ*.

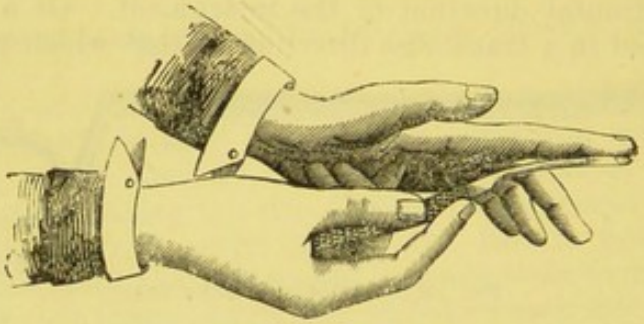

FIG. 102.—MANNER OF DIRECTING THE BISTOURY, OR SCALPEL, BY THE FINGER.

When a long or deep incision has to be made, and there is danger of wounding neighbouring parts, the button, probe, or pointed bistoury, or the scalpel, is used, and the director or index of the left hand. In using either the index or the director, a natural or artificial opening must be already in existence; and if the former is employed, it covers the extremity of the knife, being first introduced carefully into the cavity, and the flat of the blade then passed along it as far as may be necessary, when the edge is turned in the direction of the proposed incision, which is made either by pressure or a sawing movement.

For narrow cavities or openings, or in laying open fasciæ or aponeuroses (Fig. 95) the director or cannulated sound is most useful (Fig. 101). It should be introduced as far as the incision is to be made; then the point of the knife, which is to be held in the third or fifth position (Figs. 93, 95), is placed in the groove, the blade pushed along it at the angle of 45°, incising until it reaches the end of the groove, when it is raised vertically, and the incision is completed; the director and knife are then withdrawn. Or when the director has been introduced, the knife may be held in the fourth position (Fig. 94), and pushed along to the end of the groove; then

raise the edge and the point, and complete the incision in withdrawing the cutting instrument.

In order to make a counter-opening, the director is introduced to the necessary distance, and its point moved about until its extremity is felt underneath or it raises the skin, when it is cut down upon, and the point of the knife being inserted in the groove, the incision may be made the required length, the knife being held in the third position (Fig. 93). Two directors may be employed in this procedure: the ordinary one, which is first introduced, and a sharp-pointed one, which is passed along its groove and pushed through the tissues at the desired distance, when the first director being withdrawn, the knife is placed in the groove of this one, and the incision made.

3. *Subcutaneous Incision.*—This is practised in some operations, and should always be preferred when possible; it is made either by means of the rowelling or bistoury scissors, a narrow-bladed scalpel, or a small trocar. If made with the scissors, a small fold of skin is raised and snipped through; if with the scalpel or trocar, the point is passed obliquely beneath the skin, and the operation completed with the same or a special instrument.

4. *Scraping or Shaving Incision.*—Sometimes it is necessary to gradually thin or cut through the parts to be removed, especially in delicate operations, and this is accomplished by holding the knife in such a way—first or second position (Figs. 90, 91, 92)—as to scrape, shave, pare, or dissect the part by short fine cuts. In order to do this, the overlying part is raised and held by forceps, and the knife lying nearly flat on its surface, the edge in the direction of incision, a thin layer is cut through or shaved off by a sawing movement. If necessary, the knife is held in the seventh position (Fig. 97), the hand being steadied by resting it on the pollex on the neighbouring parts. This kind of incision is frequently resorted to in operations on the horse's foot.

Form of Incisions.

Incisions vary not only in their direction and extent, but also in their form, according to the nature of the parts operated on, the form and situation of tumours or other growths, and the anatomical structure or relation of parts. Therefore it is that there are (1) *simple* or *straight* incisions, and (2) *special* or *composite* incisions. The latter may be (*a*) *curved*, (*b*) *elliptical* or *crescentic*, (*c*) *circular*, (*d*) *crucial*, (*e*) T-shaped, or (*f*) V-shaped (Fig. 103).

1. Straight Incisions.—These are the simplest kind of incision, and are usually made to expose parts, open abscesses, allow the escape of natural or foreign bodies, etc.

2. Composite Incisions.—All these are made by the first procedure of simple incisions; and though there is no absolute rule with regard to making them, yet it is generally recognised that when two incisions reach a common point, the second should terminate on the first, so as to allow of the skin always being kept tense. There are no fixed proportions between the dimensions of a

composite incision, their extent varying with the diameter of the part to be exposed. When two joined incisions have to be placed one above the other, the lower should be made first, to prevent the effused blood concealing the parts beneath. The easiest incisions should generally be first completed, as the others, falling upon it, are shorter and more readily made. Thus, in making a reversed incision, the right branch is first made, and when there is a transverse incision in an operation this is first made.

a. Curved Incisions.—These really belong to the circular or elliptical incisions, of which they are a variety, and are employed in the same circumstances.

b. Elliptical Incisions.—An elliptical incision should be made in two cuts, each making one half of the ellipse, the part to be incised being maintained tense. The knife is held perpendicularly in the first or eighth position (Figs. 90, 98), and as if to cut from without to within or towards the operator, keeping to the curved direction, which may previously be traced on the surface by chalk, paint, singeing, or cutting the hair. Make one incision in this manner, then

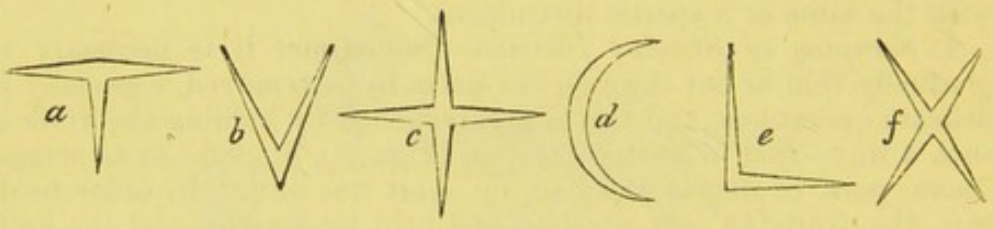

Fig. 106.—Form of Incisions: *a*, T-Shaped Incision; *b*, V-Shaped Incision; *c*, Crucial Incision; *d*, Crescentic Incision: *e*, Rectangular Incision; *f*, X-Shaped Incision.

a second at a short distance from the left extremity of the first, terminating it at the same distance from its right extremity, so that the skin at the points of intersection shall be completely divided. The *crescentic* incision is made in the same way, there being two curved incisions, the inner of which describes a larger curve than the outer, and both meeting by their extremities. These incisions are resorted to when a portion of necrosed skin, or superfluous skin adherent to a tumour, is to be removed; also in subcutaneous removal of tumours.

c. Circular Incisions—These are made in the same manner as the elliptical, and are formed by two semicircular incisions, meeting at their extremities.

d. Crucial Incisions.—These are composed of two straight incisions, crossing each other at a right angle at their middle. The transverse incision should first be made, then at its middle commence the lower half of the second incision, and at the same point the upper half incision is made in the opposite direction. Or the second incision may be commenced at its extremity, and, intersecting the first, terminate at the other extremity. When the crucial incision is completed, each angle of the triangular portion of skin should be seized by the fingers, or blunt forceps, and dissected from the parts beneath.

taking care to leave as much connective tissue adherent to the skin as possible, and thus expose the adjacent parts or organs. X-shaped incisions are made in the same way.

e. T-shaped Incisions.—These are made by two straight incisions; one being transverse, and the other, commencing at its middle, being perpendicular. It is a crucial incision *minus* a branch, and is preferable to it when it is not necessary to expose a large surface, inasmuch as there is a smaller wound, and only two detached portions of skin, instead of four. It is a good incision for the escape of pus, particularly if the transverse incision be inferior, as union takes place more readily, because the pus does not hinder it,

f. V-shaped Incisions.—These are formed by two straight incisions, a little inclined, which meet at an acute angle. The first incision being made, the second is commenced at one of its extremities, and gradually diverges as it is continued. The portion of skin included in the angle of the incision should always be completely divided. Sometimes it may be necessary to reverse the V, or to make an L-shaped incision. In some cases, three or more V-shaped incisions may be required, or incisions of other geometrical forms.

SECTION II.

DISSECTIONS.

Dissections are made by means of the scalpel, bistoury, or scissors, and forceps and director, and are necessary for the division or removal of connective tissue, so as to expose or separate organs, and to remove these or other bodies.

Dissections may be delicate or coarse, simple or complex. When it is desired to dissect away a piece of feebly adherent skin, this may be seized by forceps, or between the left pollex and index, raised as much as possible, and the knife being held in the first position, the connective tissue is divided by a series of cuts beneath the skin, and somewhat parallel to it, each cut extending to the breadth of the portion of skin to be detached. When the connective tissue is loose, the finger, handle of the scalpel, or moderate traction, will break it up, as in the enucleation of tumours, and thus diminish the tendency to hæmorrhage.

In dissecting away shreds of tissue, the knife is held in the same position, and the extremity of the blade is chiefly used in removing the thin layers, which are seized by the forceps, and raised from the subjacent tissues.

SECTION III.

PUNCTURES.

Puncturing is an operation which consists in plunging a sharp instrument through tissues, usually with the object of reaching a natural or artificial cavity, and withdrawing fluid or gases therefrom, injecting fluid into it, or exploring a tumour. In making an incision, puncturing is the first procedure.

Punctures are made with the scalpel or bistoury, lancet, fleam, trocar, exploring-needle, subcutaneous injection syringe-needle, aspirator-needle, various kinds of inoculating and acupuncture-needles, and the conical cautery.

1. *Puncture with the Scalpel or Bistoury.*—The scalpel or bistoury is usually held in the first, second, or sixth position, according to

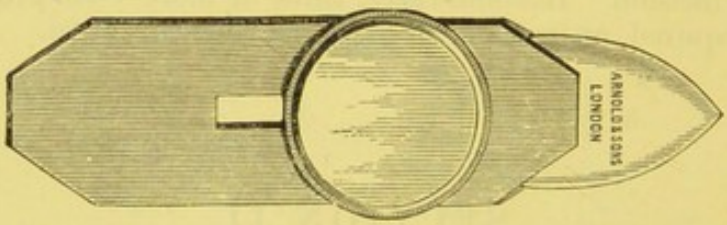

Fig. 104.—Aseptic Lancet with Regulating Slide.

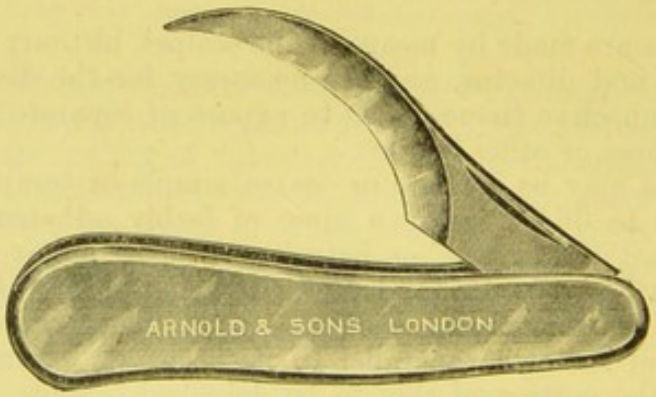

Fig. 105.—Abscess Knife with Aseptic Handle.

the amount of force required, the depth to which the blade is to be passed being regulated by the index-finger, which is placed on it at a certain distance from the point. Penetration is effected by a single thrust or push, the instrument being withdrawn by the opening incision, unless it is desired to make a larger incision.

2. *Puncture with the Lancet.*—The lancet is most frequently used for puncturing. It is in reality a small bistoury, consisting of a blade and handle, the former being double-edged for some distance, and pointed, and the latter hinged and double, or as a case with regulating slide (Fig. 104). The extremity of the blade is variously

formed—*oat-grain* and *barley-grain* blade being the usual form; the abscess lancet or knife has only one cutting-edge, which is concave, the blunt edge being convex (Fig. 105).

To use the ordinary lancet, it may be firmly held like the knife in

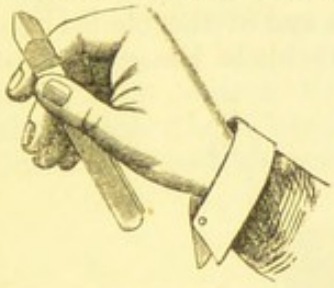

Fig. 106.
Manner of Holding the Lancet.

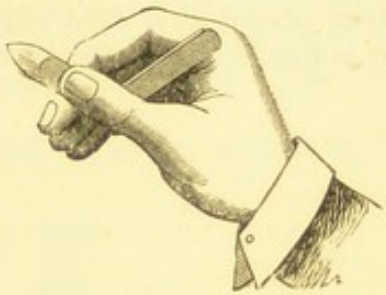

Fig. 107.
Another Manner of Holding the Lancet.

the first or second position (Fig. 106), the index on the blade regulating the depth to which it must penetrate. Or the handle may be bent on the blade at a right angle, and the blade seized between the pollex and index, which are more or less advanced, according to the

Fig. 108.—Aseptic Bleeding Lancet.

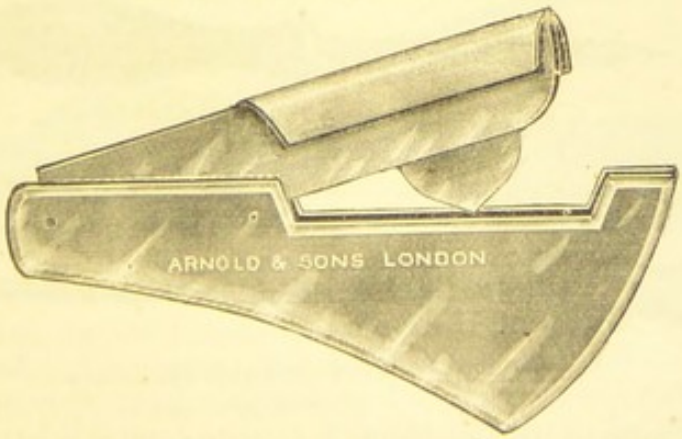

Fig. 109.—Fleam with Aseptic Handle.

depth to which it is to be plunged, the other fingers being slightly flexed (Fig. 107). The lancet with the regulating slide is convenient for ensuring puncture to a certain depth. The abscess lancet or knife is held in a similar manner; being pushed to the requisite

depth, the puncture may easily be converted into a more or less extensive incision, by cutting outward with the concave edge.

3. *Puncture with the Fleam.*—The fleam is a modified lancet, usually a set of two or three in a handle or case, the cutting portion being placed at a right angle toward the end of the blade (Fig. 109). In consequence of this arrangement, the blade has only a certain

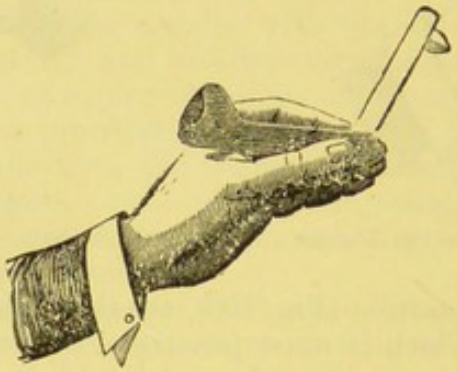

Fig. 110.—Manner of Holding the Fleam.

depth of penetration—a circumstance which makes it useful in certain operations, as phlebotomy or blood-letting.

To use it, one of the blades, armed with a lancet of the required size, is placed at a more or less obtuse angle to the handle. The latter is held in the left hand, the pollex on one side, the index on the other side, and the remaining fingers as in Fig. 110, or they may

Fig. 111.—Trocar for Puncturing the Rumen.

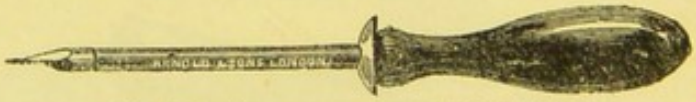

Fig. 112.—Trocar for Puncturing the Chest.

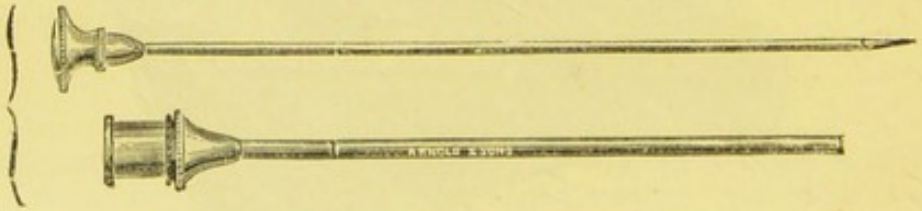

Fig. 113.—Trocar for Puncturing the Bowel.

serve as a support to the hand, by resting on the adjacent parts. The lancet being laid vertically on the point to be punctured, the back of the blade opposite is struck smartly and steadily with a piece of wood sufficiently heavy to drive the lancet home to the base.

4. *Puncture with the Trocar.*—The trocar is an instrument for puncturing cavities, and withdrawing fluids or gases therefrom. It

consists of two parts—stylet and cannula ; the stylet being a round or slightly flattened piece of steel, terminating at one end in a triangular or pyramidal point, the other being fixed in a metal handle, which is sometimes provided with a vent. The cannula is a closely-fitting metal tube, covering nearly the whole of the stylet, the pointed portion only being left exposed ; the tube fits so close at this end that it offers no obstacle to the penetration of the stylet. The end next the handle has a cup-shaped flange.

Trocars vary considerably in length and diameter, according to

Fig. 114.—Manner of Holding the Trocar.

the purpose for which they are employed—the larger size being used for puncture of the rumen in the ox (Fig. 111), medium for the chest (Fig. 112), and the smaller for puncture of the intestine in the horse (Fig. 113), and the exploration of tumours or cavities.

However closely the cannula may fit the stylet, the latter should, nevertheless, be easily withdrawn from it.

To use it, the handle is held firmly in the palm by the three last fingers of the right hand, the pollex on the cannula near the handle, and the index as near the point as possible (Fig. 114). The instru-

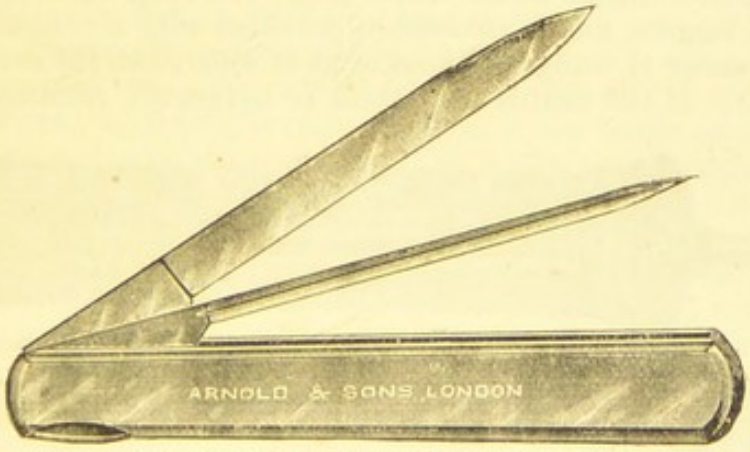

Fig. 115.—Aseptic Exploring Needle and Abscess Knife.

ment is then pushed through the tissues by a slight rotatory motion until all resistance ceases ; the stylet is now withdrawn through the cannula, the left hand maintaining the latter in the cavity to allow the escape of the fluid or gas. Should the cavity be multilocular—as in some cysts—before the stylet is withdrawn, it should be moved about in various directions. The trocar is more easily introduced if smeared with carbolized glycerine ; or the skin may be previously incised, to lessen the resistance. Should flocculi of lymph or other matters obstruct the cannula, a long probe should be passed through

it. Care must be taken not to press the end of the cannula against the wall of the cavity, as this will obstruct the evacuation of the gas or fluid.

To withdraw the cannula, one hand makes pressure on the parts around it, while the other pulls it steadily outward.

5. *Puncture with the Exploring-needle.*—The exploring-needle is employed in the examination of tumours, for the detection of fluid

Fig. 116.—Aseptic Exploring Needle.

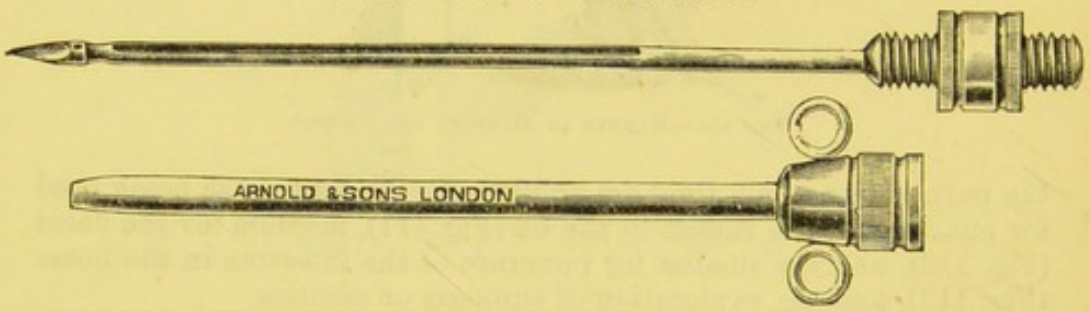

Fig. 117.—Aseptic Trocar with Exploring Needle, Director, and Milking-Tube.

in cavities, and in diagnosing certain morbid conditions. The needle is a long, thin, and narrow piece of steel, sometimes triangular, the blade of which is fluted or grooved on one side, pointed at one end, and fixed in a handle at the other (Figs. 115-118). It is of various sizes and lengths, and is sometimes provided with a cannula.

The manner of using and holding it is somewhat the same as for the trocar. If the skin is very thick or indurated, endangering the

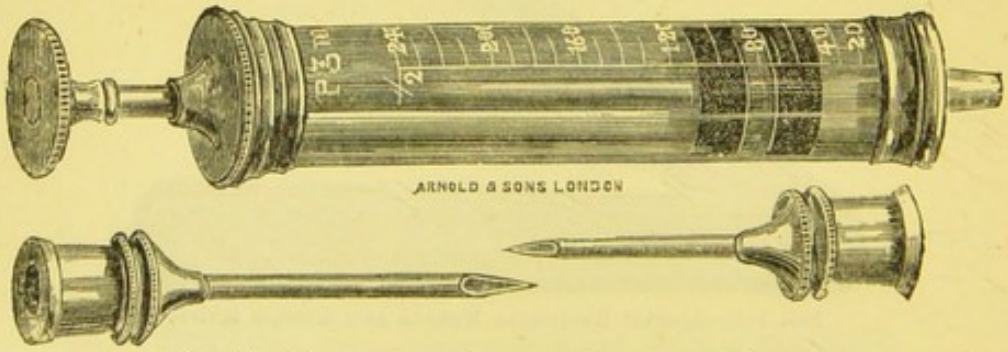

Fig. 118.—Subcutaneous Injection Syringe and Needles.

needle, it may be punctured or incised by a lancet or bistoury, and the needle then introduced slowly, and by steady pressure, as with the stylet of the trocar. It is withdrawn in the same manner as that instrument.

6. *Puncture with the Subcutaneous Syringe-needle.*—This differs but little from puncturing with the finer exploring needle. With thick-skinned animals, it often expedites the operation, and prevents injury to the needle, if a small incision is made through the skin by

means of a lancet or a snip with sharp-pointed scissors. If the needle, however, is provided with a trocar point this is not necessary, all that is required being to raise a fold of skin, push the needle through the base of it, beneath the level portion into the subcutaneous connective tissue ; then screw the syringe into the socket of the needle, and steadily push down the piston until the instrument is empty. Then slowly withdraw the needle and syringe, and pass the hand over the skin to diffuse the fluid beneath it.

7. *Puncture with the Exploring-needle and Aspirator.* — Aspiration, introduced by Dieulafoy for removing fluid from cavities, which is effected by a suction instrument invented by him, is of much value in exploratory puncture, and especially in withdrawing fluid from tumours, abscesses, synovial capsules or bursæ, and serous cavities. The instrument consists of a glass bottle provided with a stopper, from which arises a bifurcating tube, each branch being provided with a stop-cock. To these are attached two long pieces of india-rubber tubing, at the end of one being an appliance for receiving an exploratory or hollow needle, while the other piece of tubing has a similar arrangement, to which an air-pump or exhausting syringe can be fixed, and by which the bottle can be emptied of the air it contains (Figs. 378, 379, vol. ii.). When the bottle is rendered a vacuum by pumping out the air, the stop-cock on the pump side is closed, and the pump removed. The instrument is then ready for use. The needle (which may have a stop-cock) is passed, in the way already described, into the cavity from which fluid is to be drawn, and the end of the second piece of tubing is then attached to the needle, the stop-cock on that side opened (it had been closed while the air was pumped from the bottle), when the fluid is sucked through and passes into the bottle. When the latter is full, the needle stop-cock is closed, the tubing is removed from it, the bottle emptied, and the process repeated, if necessary. This is the usual procedure, but modifications in the aspiration instrument may slightly vary it. A great improvement consists in the addition of an escape-tube at the bottom of the bottle, provided with a stop-cock (Fig. 379, vol. ii.), by which the receptacle can be continuously emptied without removing the cork, by immersing the end of the escape-tube in a vessel of water.

The hollow needles are of various sizes, and require careful handling to prevent their being bent or broken. The skin should be incised before the attempt is made to introduce them. As they are liable to be obstructed by flakes of fibrin or inspissated pus, it is necessary to have a fine wire to clear them. This can best be done without withdrawing the needle, by removing the tubing, and passing the wire from without to within.

The occasions on which the aspirator may be usefully employed will be alluded to hereafter.

8. *Puncture with the Actual Cautery.*—Puncture by means of the actual cautery has long been practised on animals, chiefly for evacuating abscesses in regions where there is danger of excessive hæmorrhage if the lancet is employed. The cautery used for this

purpose being pointed or conical, yet blunt (Fig. 119), is less likely to wound large vessels, while its escharotic action arrests capillary bleeding along the track it makes; in addition, it is less likely to cause accidents than the knife, should the animal struggle, and the wound remains open for a longer time, and thus allows the escape

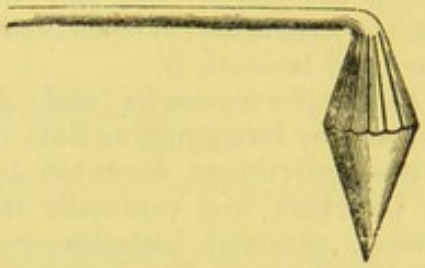

FIG. 119.—PUNCTURE CAUTERY.

of any subsequent formation of pus. The iron is heated to a white heat, the point applied to the surface to be penetrated, and pushed steadily through with a slightly rotatory movement, until, by the cessation of resistance, it is felt the cavity has been entered. The iron is then withdrawn by the same track. Sometimes it is necessary to apply a longer or a thicker cautery, to complete the operation commenced by the first. Other kinds of punctures will be described hereafter.

SECTION IV.

PREVENTION AND ARREST OF HÆMORRHAGE.

The *prevention* and *arrest* of hæmorrhage are of great moment in the performance of operations or in repairing accidents, in order to spare the strength of the animal, or even to save its life. Besides, an escape of blood during an operation is liable to protract it, by staining and concealing tissues, rendering instruments less easy to manipulate, and confusing the operator. In serious hæmorrhage, quick and certain aid is urgent, and a successful result imperative. Under no other circumstances, perhaps, are the self-possession, skill, and resources of the veterinary surgeon more required than in dangerous bleeding.

The *prevention* of bleeding is effected by external compression exerted on the surface of the part or member operated upon, and is made especially on the course of the larger bloodvessels. The *arrest* of bleeding may be accomplished in various ways—by compression (provisional or permanent), ligature, torsion, acupressure, forcipressure, plugging, cautery, styptics, etc.

Compression and *ligature* are the principal means, though the others

are useful in certain cases. Compression is mediate or immediate, according as it is exercised on bloodvessels through the medium of the soft parts, or without the intervention of these. It may be exercised directly on the divided portion of a vessel, along its course, or on the part containing it.

Prevention of Hæmorrhage.

The prevention of hæmorrhage is effected previous to, and its arrest accomplished during or after operation, by cold, compression with the fingers, ordinary bandage, tourniquet, or Esmarch's elastic bandage. It is always of much importance to prevent escape of blood; as not only does it embarrass the operator by concealing tissues and important organs which should be recognised during an operation, but if abundant it may lead to serious results, either immediately or subsequently. Hæmorrhage is serious in proportion to the size of the injured vessel, and is more urgent in arteries than veins —though its gravity in both greatly depends upon the character and direction of the wound. For instance, hæmorrhage from a torn artery is much less copious than from one which is incised, while a longitudinal wound in an artery is often more dangerous than a transverse one. Venous hæmorrhages rarely require the application of ligature, except occasionally in the case of large venous trunks; besides, ligation of veins is attended with a certain amount of danger.

1. The application of cold, in the form of cold water, ice, refrigerating mixtures, or ether spray, is sometimes resorted to for the prevention or diminution of hæmorrhage in certain operations. These act by causing contraction of the arterioles and capillaries, and so repelling the blood from the part about to be incised.

2. *Digital Compression.*—The flow of blood in main vessels can be diminished or suppressed, if these are superficial and in the vicinity of bones, by squeezing them firmly with the tips of the four fingers placed immediately over and along their course. This pressure may be made by an assistant, or by the operator himself; and when the fingers of one hand are tired, those of the other may be employed. The advantage of this digital pressure is, that it can be graduated easily and quickly.

3. *Compression by the Elastic Bandage.*—An elastic bandage, applied tightly and evenly around a limb—commencing at the distal part and terminating towards the body—is a convenient means of preventing, or, at least, diminishing, bleeding during an operation, as it drives the blood out from the bandaged parts. If a tourniquet is applied to the limb, before the bandage is removed, operations below the knee or hock can be performed without bleeding.

4. *Compression by the Tourniquet.*—A tourniquet is an apparatus by means of which an elongated oval piece of wood, cushion, or leather pad, is pressed against the tissues over an artery, this again being pressed against a bone, through the medium of a twisting,

screwing, or buckling mechanism. The pad, which moves on a band, is applied exactly over the part corresponding to the vessel to be compressed, and opposite to the screw or buckle; then the band

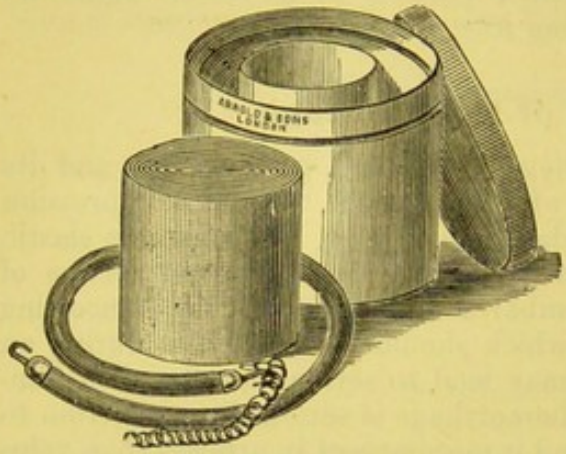

FIG. 120.—ESMARCH'S BANDAGE AND TOURNIQUET.

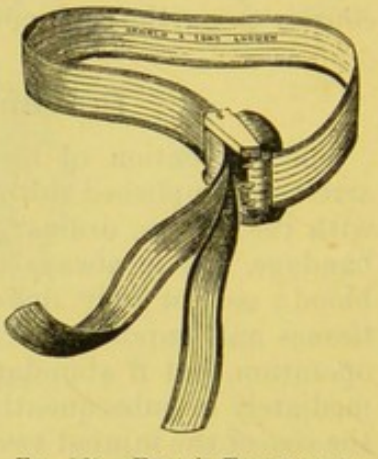

FIG. 121.—FIELD'S TOURNIQUET.

is buckled round the limb, and it and the screw draw the pad tight till the subjacent artery ceases to pulsate.

Field's veterinary tourniquet (Fig. 121) consists of a strong webbing strap with brass fastener, through which the strap is drawn to tighten

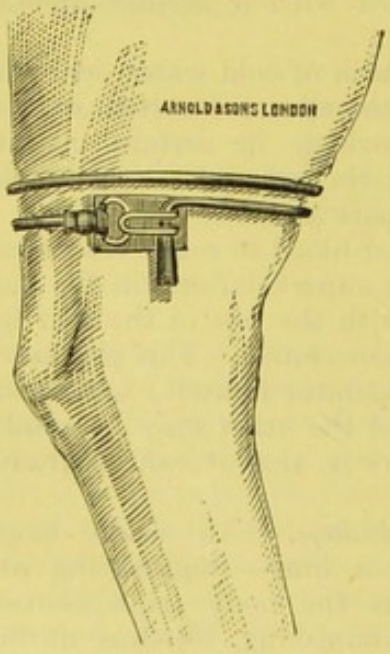

FIG. 122.—RELIANCE TOURNIQUET.

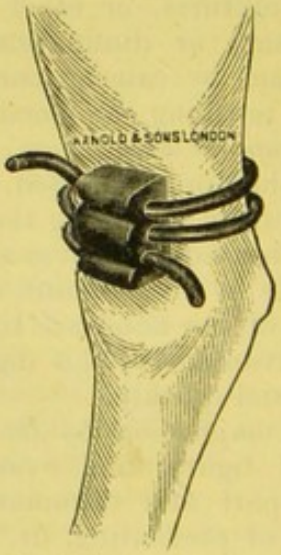

FIG. 123.—TOURNIQUET USED AT THE R. V. COLLEGE.

it, three sharp projecting points securing it. This renders it easily fixed and released. It is provided with the ordinary tourniquet pad to make pressure on the artery.

A very effective and simple tourniquet is made from a thin india-rubber cord, known as 'round-cord,' eighteen inches in length, provided with a hook at one end, and a 'thimble' at the

other. This is wound, as tightly as possible, three or four times around the limb, above or below the knee or hock, as circumstances may require, and the hook fixed in the thimble.

With a piece of wide bandage and a round block of wood, or a roller bandage and cord—the thickness of the little finger—and a short stick, an effective tourniquet is readily improvised. The cord is tied loosely around the limb, and the stick passed beneath it and twisted round until the necessary degree of compression is attained ; the flow of blood in the vessels is checked and sensation diminished by this appliance, which answers very well, especially in operations on the lower part of the limb. A bandage may be passed round the cord and stick, to maintain the latter in place, without being held. The tourniquet must not be kept on too long, as necrosis may result.

5. *Compression by Elastic Band.*—Compression of a limb by bandage, to prevent hæmorrhage during operation, has long been resorted to in human surgery ; but some years ago, Dr. Silvestri, of Vicenza, recommended elastic bands for this purpose, and in operations applied a thick elastic tube several times around the limb.

Subsequently, Esmarch popularized this hæmostatic procedure, by which long operations may be accomplished without much, or any, loss of blood, limbs being rendered almost bloodless for a comparatively long time without impairing their vitality. To produce complete ischæmia, the constriction must be equal in force to sixteen pounds in horses and five pounds in dogs.

Various kinds of elastic apparatus have been devised to expel blood from the periphery and extremity of the limb towards the body, besides the elastic tubing proposed by Esmarch ; but in principle they all act in the same manner. An elastic bandage, two or three inches wide, and three yards long, has been successfully employed with horses ; it is applied in the same way as the ordinary bandage : commencing at the pastern, close to the hoof, it is passed round the limb, tightened firmly at each turn until it reaches above the knee or hock, when an ordinary tourniquet, the elastic cord or tubing, or even an ordinary cord twisted by means of a stick, is applied where the compression terminates, to prevent the blood flowing back to the limb. The bandage is then taken off, and the limb is ready for operation.

After removal of the tourniquet, on completion of the operation, there is sometimes hæmorrhage ; this should be provided for during operation, when all divided or wounded vessels which are visible should be secured. If hæmorrhage is serious after removal of the compression, it must be arrested by one of the methods to be described presently.

By placing the animal in the dorsicumbent position and holding the limb vertical for a time before applying the elastic tourniquet, there will be less secondary hæmorrhage on removal of the compression.

Arrest of Hæmorrhage.

The same means that are employed for the prevention of hæmorrhage, *temporarily* or *provisionally*, may be resorted to for its arrest until *permanent* or *definitive* measures are adopted. As the result of an accident or during an operation, vessels of several kinds—arteries, veins, and capillaries—may be divided, and the blood flowing from these may not only vary in quantity, but also in colour; that from the arteries being bright red, and jerked from them in isochronous jets corresponding to the pulse, while that from the veins is continuous in flow and dark red in colour. When the colour is intermediate to dark and bright red, and the blood flows smoothly, it comes from veins and arteries. When it oozes from the surface in more or less considerable quantity, it is escaping from the capillaries; and this kind of bleeding may cease spontaneously, from the formation of a clot on the divided tubes, or the retraction of the incised tissues.

The escape of blood may be arrested by *physical*, *chemical*, or *surgical* means. Rest is a most valuable adjunct to these.

Physical Hæmostatics.

The physical means are *refrigerants*, *stimulants*, and *absorbents*.

Refrigerants.—Agents which produce cold—as cold water, ice, snow, ether, chloroform, etc., will in certain cases—as in trifling hæmorrhage—arrest bleeding, by their action on the soft parts and the vaso-motor nerves of the vessels; the consequent pressure and tonic contraction of the muscular fibres of these leading to their contraction. Water may be applied in a stream or *douche*, or by means of cloths or pads. Snow and ice are directly applied, or enclosed in a bag or bladder.

Cold applications are most eligible for the arrest of general hæmorrhage from a large surface, or in persistent general bleeding—especially where this proceeds from an internal cavity, as the mouth, rectum, or vagina. Sometimes the application of cold at a distance will check bleeding, as cloths steeped in cold water placed over the loins, or cold water injected into the rectum, for hæmorrhage from the spermatic artery after castration.

Stimulants.—Stimulants are sometimes employed to check hæmorrhage. Injections of hot water at a temperature of 130° to 160° will temporarily arrest bleeding from such organs as the vagina and uterus. Creosote and oil of turpentine are also good hæmostatics, though they secondarily produce intense inflammation. Strong alcohol acts in a similar manner.

Absorbents.—A number of substances are employed as absorbents in checking hæmorrhage—such as tow, lint, charpie, sponge, flour, punk, etc. In veterinary practice, fine tow is generally preferred.

Absorbents are of little value, except in capillary bleeding; they act in promoting the formation of clot. They are laid on the bleeding surface, or if the hæmorrhage is from a deep wound, this is

plugged or filled with them. In slight venous, arterial, or parenchymatous hæmorrhage, for instance, a *tampon* or *plug* must be applied. This consists of aseptic tow or cotton-wool pressed into the wound, and pressure made upon it by means of a bandage and compress.

Chemical Hæmostatics.

The chemical agents for arresting hæmorrhage are astringents and caustics. There are many of these, as all coagulants act as styptics, but only a few are of frequent use. They act by constringing or contracting the tissues and coagulating the effused blood.

Perhaps the best of all the chemical hæmostatics is the *liquor ferri perchloridi*, which forms with the blood a dark leathery *magma* or clot, that adheres very closely and tenaciously. Aseptic tow, lint, or charpie is soaked in it, and the blood having been gently sponged from the wound, the dressing is placed on or in it for from two to five minutes; if the first application does not succeed, the dressing may be repeated a second or third time.

Nitrate of silver and caustic potash are sometimes resorted to.

Milder styptics are solution of alum, tannin, tincture or infusion of matico, vinegar, styptic colloid, etc. These may be applied by means of a brush or a fold of lint soaked in the fluid, and laid on the bleeding surface. The objection to the employment of styptics is that they often fail to stop the bleeding.

Cauterization.—Chemical or *potential* caustics are not often employed in veterinary surgery, as the actual cautery or hot iron is simpler, more potent, and convenient. It is most in use, and acts by charring the mouths of the vessels, tissues, and blood, thus forming an eschar or scab.

The iron should be applied to the wounded surface or bleeding vessels at a *white*, not a *red* or *black* heat, the blood having been previously sponged off; it should also be applied perpendicularly with a regulated degree of pressure, according to circumstances, from a moment to a few seconds only, so as to prevent removal of the resulting eschar, by its adherence to the iron. The iron may or may not be of a special form, and can be heated in an ordinary or a forge fire; but it should be made *white* hot.

Paquelin's thermo-cautery (to be described hereafter) is of great service in this way, and is very convenient. By a hand-bellows, a stream of benzine vapour is thrown against a platinum cap which has been previously heated in a spirit-lamp; when it has reached a red or white heat, it is easily kept at that degree by the vapour. It is readily used, and its application is not painful when it is white hot. Middeldorpf's galvano-caustic (platinum heated by the galvanic battery) acts in the same manner, but is generally inconvenient.

Internal styptics cannot be much relied upon in surgery, as their action is far too slow for the bleeding usually met with in accidents or operations. However, in certain cases they may be employed as accessory means, together with rest, prescribed diet, and, if necessary, narcotics.

Surgical Hæmostatics.

The chief surgical measures for arresting hæmorrhage are five in number: *compression*, *ligature*, *torsion*, *forcipressure*, and *acupressure*.

Compression.—This consists, either in closing the wound in the vessel by exercising pressure on its walls at the seat of incision, or checking the flow of blood in it at some convenient distance from this part. Compression may be *direct*, *lateral*, *immediate*, or *mediate*; it may also be *provisional*, when it is only resorted to until it can be determined how the bleeding may be permanently arrested.

1. *Provisional Compression.*—This may be made either by pressing the bleeding vessel in the wound against a bone, if possible, or by squeezing the central part of the vessel against the bone at some distance from the wound. The former is resorted to when a ligature is to be applied to the trunk of the vessel; the latter, when the wound is to be examined, and the end of the vessel tied. In treating of ligatures, this kind of compression will be again discussed.

2. *Direct Compression.*—This is applied directly to the part from which blood is flowing, and may be effected by filling up the wound with plugs of aseptic tow, lint, or cotton, and bringing the borders together by means of *sutures* (*interrupted*, *twisted*, *continuous*), or a *circular bandage*, according to the region or character of the wound. Thus, in one part—as in the neck and the inguinal region—the twisted or interrupted suture may be employed; while in the limbs, a bandage will often suffice.

In many cases, physical or chemical means are combined with compression, especially where the actual cautery or ligature cannot be employed to arrest bleeding from arteries. But care is necessary, in order that the sutures may be drawn sufficiently close to check hæmorrhage, yet not so close as to cut through the skin or lead to necrosis.

3. *Lateral Compression.*—This may be exercised on the wounded vessel (*immediate lateral compression*), or the parts covering it (*mediate lateral compression*). In the first, if the wounded vessel is not sufficiently exposed, the wound must be enlarged, in order to exert compression over a wider surface, and then pledgets of tow, either dry or moistened with a styptic fluid, are introduced; after which the wound is closed, as in direct compression. In some cases, lateral compression of a wounded artery may be effected by pressure of the fingers upon it for some hours, assistants relieving each other; and by this measure, those accidents which are due to extreme compression—such as sloughing of the skin, and gangrene—are avoided. If digital compression is found to be insufficient to stop the hæmorrhage, lateral compression or ligature must be adopted. Immediate lateral compression is of great service in accidental puncture of the carotid.

Mediate lateral Compression may be practised on the open vessel, or the tissues covering it, by means of pledgets of dry or wet tow, firmly applied by means of a bandage. If the pressure is to be

increased in certain parts, a piece of wood, roll of cloth, or strong cardboard, may be interposed between the tow and the bandage. This compression is serviceable when superficial vessels situated near bones are wounded, as the latter afford support. The bandage employed to render compression effective should not be allowed to remain in position any longer than may be necessary to ensure permanent arrest of bleeding—a period which may vary from a few

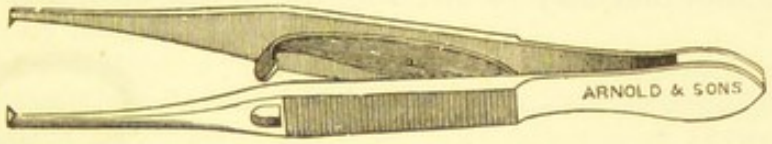

FIG. 124.—ARTERY FORCEPS.

hours to one or two days; otherwise, the interference with the circulation and innervation of the parts by the mechanical constriction may have grave results. The compression should be as diffused as possible. In the limbs the bandage should be applied as for the prevention of hæmorrhage, in order to avoid venous congestion.

Plugging is only a modification of the foregoing, and consists in introducing into a wound, or natural cavity, a quantity of dry or medicated tow or cotton in order to stop bleeding. From the readi-

FIG. 125.—IMPROVED ARTERY FORCEPS.

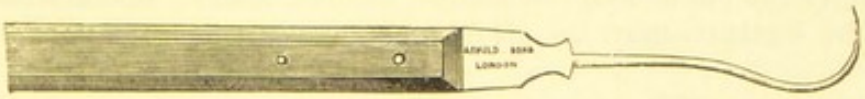

FIG. 126.—TENACULUM.

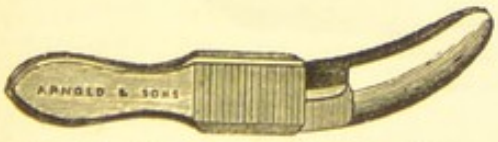

FIG. 127.—DIEFFENBACH'S ARTERY CLAMP.

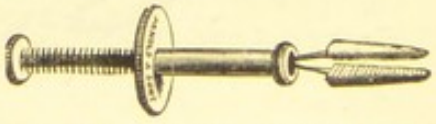

FIG. 128.—IMPROVED ARTERY CLAMP.

ness with which it may be practised, it is frequently resorted to in veterinary surgery—as in epistaxis, bleeding from abscesses, tumours, the uterus, vagina, foot, etc.

LIGATURE.—Ligation of a bloodvessel consists in tying an aseptic thread or cord around it more or less firmly, so as to constrict, occlude, and obliterate it. Temporary ligation is scarcely ever resorted to. Arteries are the vessels which are generally ligated. Ligation of veins is seldom required; it is, however, necessary in the case of large veins, or where pressure cannot be applied. A bandage and compress, or cold applications, are usually all that is necessary to check or arrest bleeding from veins.

The ligature may be applied in three ways: *immediately*, as in ligation of isolated bleeding arteries in a wound; *mediately*, as when the ligature includes the neighbouring soft parts, as well as the vessel; or when it is applied in the *continuity of the vessel*, as at some distance from the wound. The latter is the most difficult, as it requires not only a knowledge of the anatomy of the vessels, but also their exact position and direction, as well as an acquaintance with the common abnormalities that may be met with during the operation, so as to

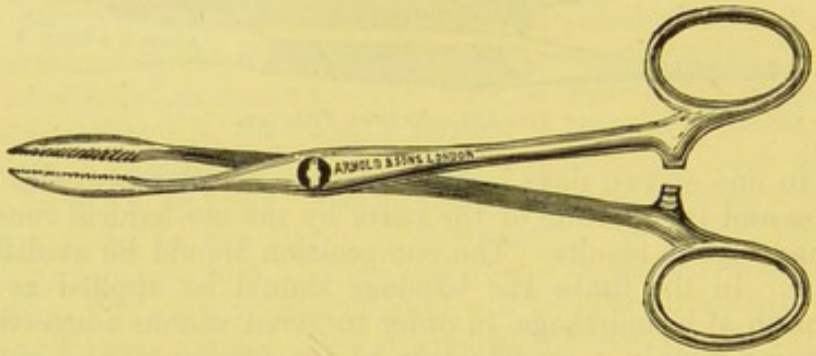

Fig. 129.—Aseptic Artery Forceps (Pean's).

escape embarrassment should the parts not present their usual arrangement.

The instruments required are: *ordinary dissecting forceps* (Fig. 88); *dissecting scalpel* (Fig. 78); *artery forceps* of various kinds, provided with springs which cause them to retain hold of the vessel (Figs. 124, 125); *artery clamps* (Figs. 127, 128); *tenaculum* (Fig. 126); *aneurism needle* (Fig. 130); *steel director*, with the groove opening at its extremity (no *cul-de-sac*); *retractors*, or *blunt hooks*; *ligature materials*. The ligature may be of prepared cat-gut, chromic-gut, plaited

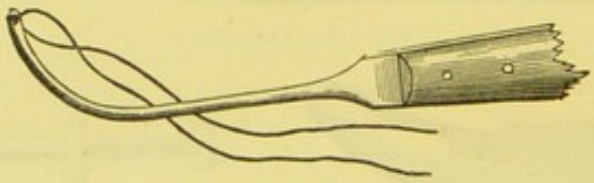

Fig. 130.—Aneurism Needle.

silk, twist, horsehair, or other aseptic ligature material. Before using, it should be plunged into a 5 per cent. solution of carbolic acid.

Some operators prefer round ligatures, others flat; the first more readily divide the inner coats of the arteries, while the second are supposed to bring them in contact, and cause their adhesion, without dividing them immediately, if the constriction is sufficiently strong.

1. *Immediate Ligation.*—This signifies applying a ligature to a bloodvessel (artery) only, and is the most certain, and often the easiest and most advantageous mode of arresting hæmorrhage, especially from large vessels. The vessels may be completely or

partially divided, or merely punctured. We will suppose, however, that the vessels are cut completely across, as in an operation.

To enable the operator to discover the bleeding vessels, it may be necessary to check the flow of blood, and remove that which has escaped, by gentle pressure on the wound with a sponge or pledget of tow. Then the vessel to be tied is seized with dissecting or artery forceps, gently drawn out, then isolated as much as possible from the surrounding tissues—especially nerves. This isolation may be effected by a second pair of forceps.

The artery forceps is best adapted to seize the artery, as the spring ensures a fixed hold, should the operator accidentally allow it to slip from his fingers. Besides, if he has not an experienced assistant, he may allow the forceps to hang loose, while he employs both hands to apply the ligature (Fig. 131). Whether or not there is an assistant, the artery is occluded by placing the middle of the ligature below it; then, carrying up both ends, make first a simple knot (Fig. 131), and tie it tightly just in front of the forceps, then tie a second knot (forming a reef-knot). If the vessel is in a deep wound, the index-fingers may be employed to push the first knot, before it is tightened, over the forceps on to the vessel, and to tie the thread (Fig. 132). It is necessary to form the knots properly, as in Fig. 133; if they are tied as in Fig. 134 they may become untied, and serious results ensue.

If the thread is sufficiently strong, two simple knots, one over the other, to form a reef-knot, should suffice; and if the ligature has been properly applied, when the forceps are loosened there should be no bleeding from the vessel.

When the wound has to be closed, both ends are cut off when the ligature is tied, the portion remaining becoming absorbed. Aseptic catgut and silk ligatures can be safely left in the wound.

In some cases, after injury the artery retracts, and cannot be seen or seized by the forceps. Then the tenaculum must be passed through it, in order to withdraw it, when it can be tied.

Whenever the bleeding artery can be seen in the wound, the hæmorrhage is to be arrested by ligature; but in those cases in which blood spouts from the arteries of the periosteum or bone, ligature is impossible, and other methods—as compression—must be adopted.

The larger the arteries are, the more attention is necessary in ensuring their isolation, by seizing them, scraping back the surrounding tissues with the scalpel, and then ligating them carefully and accurately.

2. *Mediate Ligation.*—It is not always possible to isolate the bleeding vessel in order to tie it. Occasionally it retracts so deeply into the tissues—especially into the muscles, or dense connective tissue—that it cannot be withdrawn therefrom. Under such circumstances, it is difficult to complete the ligation securely, as there is the risk of including the points of the forceps in the ligature, even if the vessel should be seized. Then mediate ligation must be resorted to. This consists in including a certain portion of the surrounding

tissues in the ligature; and for this purpose a curved needle (held in a needle-holder, if necessary), armed with a single or double

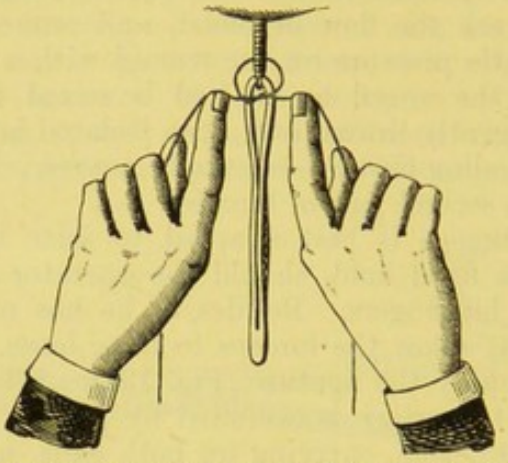

Fig 131.—Ligating an Artery: Simple Knot.

thread, is passed, or made to 'dip' through the tissues which have been drawn forward by forceps or the tenaculum. The needle being

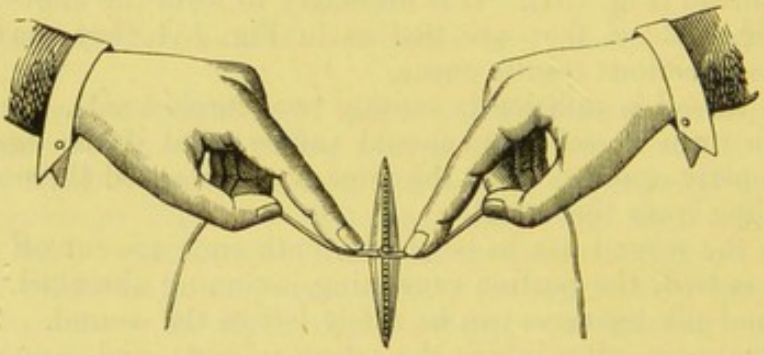

Fig. 132.—Applying a Ligature to an Artery.

withdrawn, the ligature is brought round the part so as to enclose the entire end of the artery, and tied firmly, as above directed.

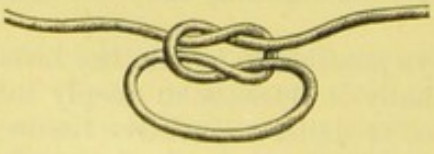

Fig. 133.—Ligature Properly Tied.

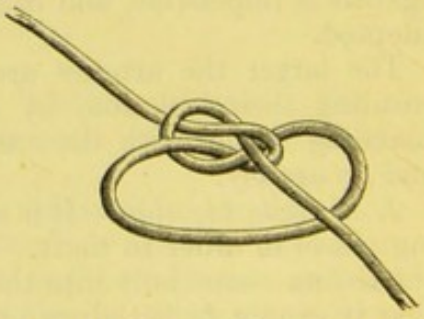

Fig. 134.—Ligature Improperly Tied.

Mediate is not so certain or satisfactory as immediate ligation. and can only be regarded as an exceptional proceeding. It is only

resorted to in hæmorrhage from the smaller arteries. Care should be taken not to include any nerves in the ligature, as this would cause great pain.

3. *Ligation of an Artery in its Continuity.*—This operation consists in dividing the textures lying above an artery, and applying a ligature around the vessel. The operation is much less frequently performed on animals than on mankind. The same instruments are

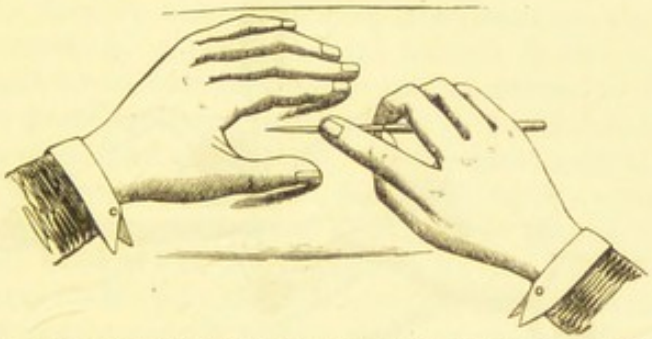

FIG. 135.—METHOD OF MAKING AN INCISION OVER AN ARTERY.

required as in the other kinds of ligation, and, in addition, an aneurism-needle with ligature silk or catgut.

The same rules are to be observed as in ligating arteries in general. The knife should be used only for cutting, and not for scraping the sheath of the vessel; it had better be laid aside as soon as the sheath of the artery has been fairly opened. When the direction and length of incision have been determined, the integuments should be

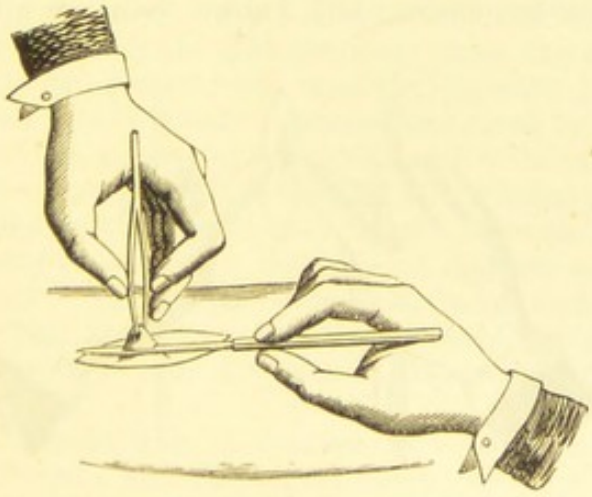

FIG. 136.—EXPOSING AN ARTERY.

slightly stretched by the middle finger and thumb of the left hand, placed on each side of the line of incision (Fig. 135). The scalpel should be held in the first position (Fig. 90), or in a slight modification of that position (Fig. 135).

When practicable, the first incision is always made immediately over and parallel to the course of the vessel to be tied, and it should not divide more than the integuments. The length of the incision

should be proportionate to the depth of the artery which has to be reached, thence varying from one to three inches or more. Each successive cut should be of precisely the same extent as the preceding; these cuts should be perfectly made through the subjacent superficial and deep fasciæ—division of these being best made on the director (Fig. 95), which is inserted through a small hole made by pinching up the parts with the forceps, and cutting with the blade of the knife

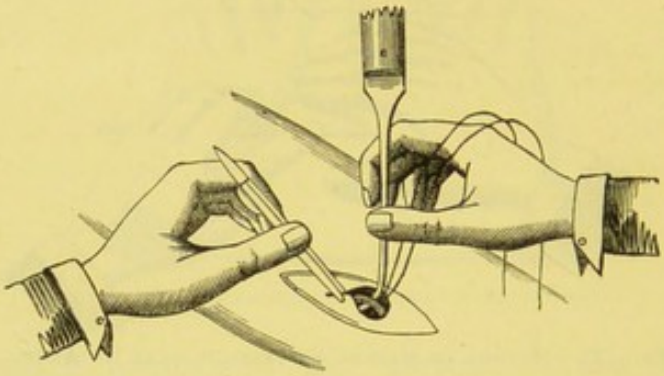

Fig. 137.—Passing the Ligature under an Artery.

on the flat (Fig. 136). Muscles may also have to be divided, but this should be avoided, if possible; muscular interspaces, if large, are most conveniently separated with the forefingers or handle of the scalpel, contiguous tendons with the point of the director. It is important to avoid opening the fasciæ of muscles and the sheaths of tendons, since wounds of these may be followed by diffuse suppuration and its consequences; any known veins or arterial branches

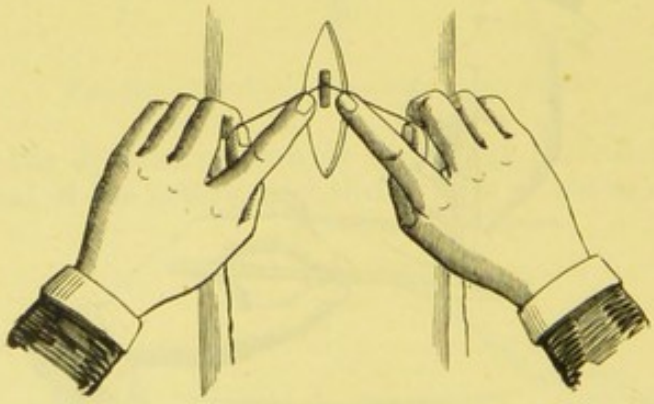

Fig. 138.—Ligating an Artery in its Continuity.

should also be avoided, if possible, or hæmorrhage from them controlled by pressure, torsion, or ligature. Adjoining the artery a nerve may be found, lying by the side of the vessel, but outside its sheath, or several nerves may surround the latter. Any small superficial vessels, the border of a muscle or tendon, or nerves, are conveniently drawn to one side and protected; the wound is made more open, if needed, by retractors, which can be managed by an assistant

as the textures are successively divided, and also during the passage of the ligature-needle around the artery.

The sheath of the artery having been reached—as denoted by its dense cellular character, and the pulsation of the enclosed vessel immediately beneath the finger—that structure should be slightly raised with the forceps, and the knife being laid flat under the pinch of the forceps, a small hole is made as in opening a fascia (Fig. 136). The margins of this aperture being alternately seized with the forceps, the point of the director should be insinuated between them and the coats of the vessel, by a gentle lateral motion of the point. This separation ought to include the whole circumference of the artery, but as little as possible of its length, so as to avoid injuring to any great extent its small nutrient vessels ; for the same reason, the artery should never be raised from its bed, nor the forceps applied directly to it, or to any large nerve or vessel that may be exposed during the operation. The artery will be recognised by its whitish-yellow or fawn colour, and by its side lies the small, blue, companion vein or veins (*venæ comites*), one on either side—in relation to a second-sized artery. A nerve may also be enclosed in the sheath, but it has less immediate relation to the artery.

An aneurism-needle, with a more or less wide curve, and armed or not with a ligature (Fig. 130), is introduced beneath the vessel, the point being inserted between it and neighbouring vessels and structures, and turned round the latter (Fig. 137), by the operator seizing one side of the already separated sheath with the forceps held in his left hand, and pushing gently with a slight to and fro movement. Should any of the loose connective tissue of the sheath be carried before the point of the needle, this is divided with the scalpel, cutting on the needle with the blade directed away from the artery. The end of the needle being now freed, and the operator having ascertained that the artery is the only structure embraced by it, may now draw the ligature from the eye of the needle, and withdraw the latter ; or, if it has not been armed with a ligature before being passed under the artery, the end of the thread may be put through the eye, and the needle withdrawn, carrying the loop of ligature along with it beneath the artery. The needle being unthreaded and the ligature left in position, this should be tied transversely round the vessel (Figs. 131, 138), as an oblique direction of the noose would be liable to loosen.

A single knot should first be formed, and the ends of the silk grasped by the thumbs and forefingers passed down as near to the vessel as possible (Figs. 132, 138) ; the knot may now be drawn moderately tight, so as to divide the two inner coats of the vessel, and then the thread tied again over it as a reef-knot (Fig. 133). It is essential to pass the fingers down to the vessel before tying the ligature, in order to avoid disturbing its connections, and also the more accurately to appreciate the amount of force applied ; and the vessel should be compressed between the finger before tying the knot, to ascertain if the circulation is controlled and that the ligature has been applied on the right vessel. Particular care should be taken

not to ligature any extraneous structure instead of, or along with, the vessel—as a nerve or a portion of the sheath. The finger placed on the *distal* portion of the artery will at once discover whether pulsation is stopped and the vessel secured.

The ends of the ligature are then cut off close to the knot on the vessel, and the wound closed by a few points of suture, or by a bandage and an appropriate dressing. It is to be noted that the part of the artery selected for ligature should, if possible, be one free from bifurcation and large collateral branches.

With regard to the ligation of an artery at the seat of a wound, the vessel being also incised, the wound itself corresponds to the incision leading down to the artery. If the wound is narrow—as in a puncture—it may be necessary to enlarge it; and much difficulty may be experienced in seizing the vessel if there is infiltration of surrounding textures with blood. The artery may be found punctured or completely divided, and in either case the mode of arresting the hæmorrhage is the same. A ligature must be applied on each of the apertures or to either cut extremity—this double ligation being necessary to stop the bleeding from the distal as well as the cardiac end of the artery; as the former would otherwise continue to bleed, owing to the anastomotic supply of blood from above the ligature. In these cases compression or a tourniquet should be applied to the main trunk of the vessel, to control the hæmorrhage.

Puncture or division of an arterial branch close to its origin from the trunk, is equivalent to an aperture in that vessel of equal size to the branch or the puncture in it. The same treatment is therefore necessary—ligation of the trunk above and below the branch.

Effects of Ligation.—The application of a ligature to an intact artery puckers up its walls and brings them into contact; and as the degree of constriction ought to be sufficient to divide the inner and middle coats, the thread, when firmly tied, only includes the external coat. The ligated vessel thus represents a double cone, the apices of which are towards the ligature, and the bases at a short distance from it; and the divided coats are pressed upon by the external one, and partly fill the calibre of the vessel. At first the inner coats are united at their cut margins, and form a small *cul-de-sac* above and below the ligature, fibrin is quickly deposited, and in the course of fifteen or twenty hours there is a clot extending to the first collateral branch; the clot is eventually replaced by fibrous tissue.

The clot which blocks the artery varies in length, according to the distance of the ligature from a collateral branch, where the circulation continues and prevents the further formation of clot a fact which accounts for the danger of tying arteries too near the origin of their branches.

Torsion.—Occlusion of cut arteries by torsion is sometimes a very convenient method of arresting hæmorrhage. It is effected by twisting the vessel in such a way that the two inner coats are lacerated, the external coat remaining as a loose filamentous sheath,

in which the blood forms a plug. Arteries of all sizes may be occluded by torsion—small vessels being readily occluded by a few turns of the ordinary forceps.

Different modes of torsion may be practised, but the best are the following:

a. The artery may be gently withdrawn from the tissues, and isolated for about half an inch by one pair of serrated artery forceps

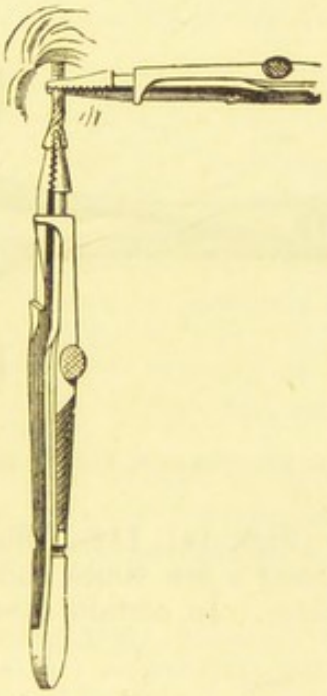

Fig. 139.—Torsion of an Artery.

which seize it somewhat obliquely, while its attachment is firmly held transversely by another pair; the free portion is then twisted through about a dozen turns, steadily made by the first pair (Fig. 139).

b. The end of the vessel is seized in the same manner, and twisted

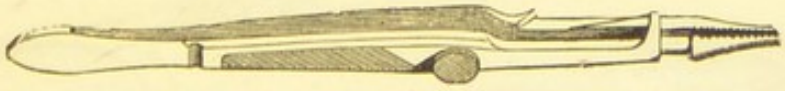

Fig. 140.—Torsion Forceps

several times. The forceps may be left attached to the vessel for a few minutes.

In arresting hæmorrhage by torsion, the forceps should be strong and accurately closing, and the points of the pair which seize the end of the vessel should either be as wide as the vessel itself, or grasp it obliquely, so as to include the entire breadth of it. Forceps are made specially for twisting arteries (Figs. 139, 140).

Effects of Torsion.—At the seat of torsion the two inner

coats of the vessel are torn across and reduplicated up the vessel, perhaps in the form of a complete funicular sheath, one-fifth of an inch in length ; and at the upper or smaller opening or reduplication, or funnel, a conical blood-clot forms, occupying the calibre of the vessel to a certain length.

Forcipressure.—In this method the end of the bleeding vessel is seized and crushed by an artery-clamp (Figs. 127, 128), or by a pair of powerful forceps such as those introduced for this purpose by Spencer

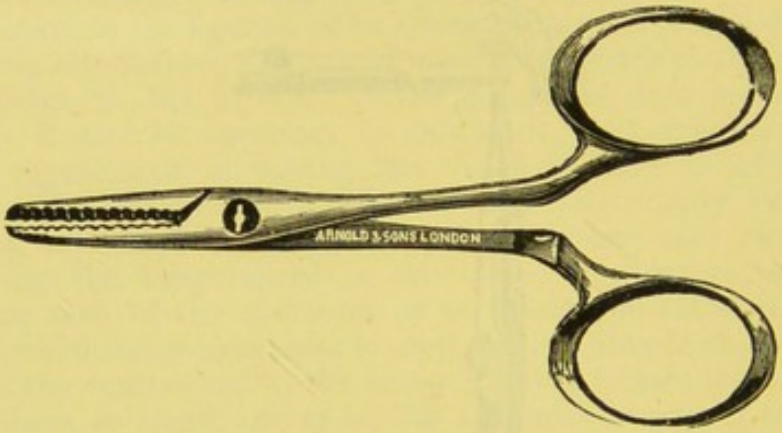

Fig. 141.—Aseptic Forcipressure Forceps (Spencer Wells).

Wells and Greig Smith (Figs. 141, 142). Bleeding having stopped, the forceps may be twisted a few times and then removed, or left in place for a few minutes. In certain cases, as where a ligature

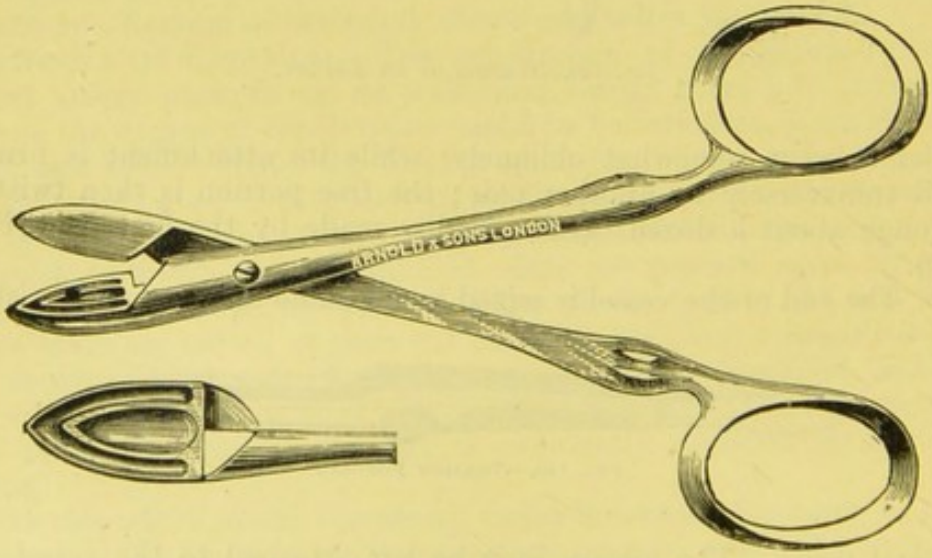

Fig. 142.—Aseptic Forcipressure Forceps (Greig Smith).

cannot be applied, the forceps may be left attached to the artery till next day.

Acupressure.—This is the temporary metallic compression of an artery, and it may be accomplished in three ways :

a. By passing a long needle twice through the sides of a wound,

so as to cross over and compress the mouth of the bleeding vessel or its tube—just as a flower is fastened in the lapel of a coat, the stalk being compressed by the pin which passes twice through the cloth. In this method a long needle is introduced from the cutaneous surface, and its extremities left out *externally*. In both the other methods a common sewing-needle, threaded with iron wire, is used. The needle is introduced on the raw surface of the wound, and is therefore placed altogether *internally*, or between the lips of the wound. The wire is only for withdrawing the needle when no longer required.

b. In one of the methods referred to, the needle is dipped down into the textures a little to one side of the vessel, then raised up and bridged *over* the artery, and finally dipped down again into the textures on the other side. This method, therefore, is the same as the first, except that the needle is applied altogether on the raw surface of the wound and over the artery which it compresses.

c. The third method consists in passing a needle under the vessel, transfixing the textures once. A loop of wire is passed over the point, and fastened round the eye-end of the needle by a single twist, thus compressing the artery and some surrounding tissues between the needle and the wire.

Acupressure is said to be superior to ligature, both with regard to the improbability of secondary hæmorrhage, the probability of healing by adhesion, and the improbability of septic infection of the blood.

Effects of Acupressure.—Occlusion, after acupressure, consists, essentially, in the formation of a conical clot adjoining the transverse line of acupressure or needle. This clot increases in length, extending probably to the first collateral branch ; it increases also in diameter, so as to occupy the lumen of the vessel at, and for some distance beyond, the line of acupressure. The integrity of the artery remains unaffected by the compression thus temporarily applied, the needle merely serving the purpose of preventing the escape of blood as primary hæmorrhage, while, by arrest of the passage of blood, coagulation may be induced, and thus secondary hæmorrhage prevented when the needle is withdrawn.

In a large artery a firm, fibrinous, and inherent clot was found to have formed within five days. This will afford an idea as to the length of time the needle should remain.

Transfusion.

As the result of excessive hæmorrhage (or of disease) the system may be so depleted of blood that death is imminent, or recovery gravely retarded. In these circumstances, great advantage may be derived from transfusing blood from a healthy vigorous animal to the one which is deficient. Though this measure has not been much resorted to in veterinary surgery, yet there often occur cases in which immediate and permanent benefit would be derived from it. There should be no difficulty in practising it, as horses, cattle, and dogs are numerous, and there are no mental or sentimental objections to be overcome in their case.

The operation consists in the injection into a large-sized vein of the patient of a variable quantity of blood, freshly drawn from the

vein of another animal—if possible, the same species. Various kinds of apparatus have been introduced, some of them too complicated and inconvenient—especially for use with animals—the chief object sought being the non-admission of air into the vein of the animal receiving the blood. The following figure (Fig. 143, *a*) shows a transfusor, introduced by Dr. Le Page, which appears to obviate this danger, and yet is simple.

One hand alone is needed to operate the transfusor, and the other hand is at liberty to attend to the efferent tube, whilst the attention of the operator may be divided between the recipient and the donor of the blood. If any portion of air should at first remain in the tubes, and during the passage of the blood be carried along with the stream, its course is with certainty arrested by the glass receiver, into which it must rise.

A small bottle contains a compound powder, composed, say, as follows: carbonate of soda, ten grains; phosphate of soda, two grains; chloride of sodium, thirty grains. One fourth of the powder

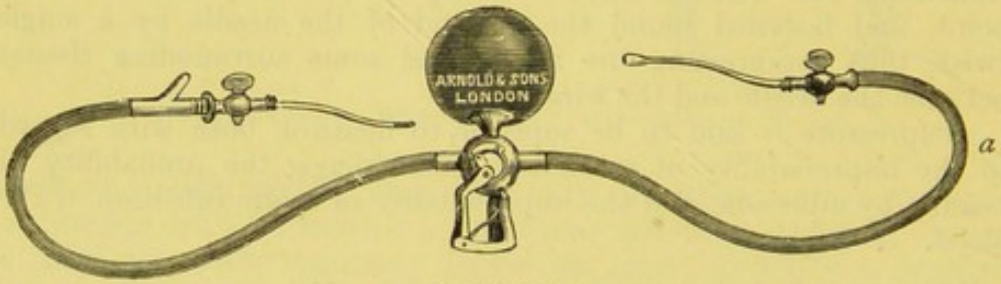

Fig. 143.—Le Page's Transfusor.

should be dissolved in about two and a half ounces of water at a temperature of 100° Fahr.; a few drops of alcohol may be added, and the vessel containing the solution placed in another vessel partly filled with water at a temperature somewhat higher. Then, having attached the receiving and delivering tubes, the two extremities of the instrument must be placed in the inner vessel with the air-chamber downwards. Now press the lever, press the elastic ball; release the lever, release the elastic ball; and after repeating that process once or twice, turn both taps. It is now ready for use. Having inserted both tubes, one into the supplying-vein, and the other into the receiving-vein, turn the taps, and in the same order press the lever, press the ball; release the lever, release the ball, and so on. Precisely one quarter of an ounce passes out each time. It is expedient, having commenced the transmission of blood, to complete the process without arrest, lest coagula should form. If blood cannot be procured, sterilized warm water, or a 1 per cent. solution of chloride of sodium, boiled and cooled to 105° Fahr., may be injected into a vein or into the peritoneal cavity.

SECTION V.

CLOSURE OF WOUNDS.

After cleansing, disinfecting, and entirely arresting hæmorrhage from a wound, by one of the methods described in the preceding section, and ascertaining its character and the parts injured, the next consideration is its closure. The way in which this is to be effected will depend upon various circumstances—as the nature of the wound, the tissues or organs involved, and also the time which has elapsed since its infliction. But the principal object in view is to obtain cicatrization as quickly and completely as possible. This is usually accomplished by means of *adhesive plasters*, *sutures*, *bandages*, and *compresses*, after bringing the sides of the wound into direct and close apposition.

Adhesive Plasters.

Adhesive plasters are often serviceable in veterinary surgery, when aseptic and properly applied; they are particularly valuable in the case of the smaller animals, or in the union of a wound where there is not much traction or movement, where the skin is thin and vascular, and when it is scarcely divided, or the wound does not extend much beyond the subcutaneous connective tissue. They are often most useful auxiliaries to sutures, in supporting these, especially when the wound is deep, and the tension great.

They are composed of substances easily melted by heat or in water, which will adhere quickly and strongly to the parts to which they are applied. Sometimes isinglass-plaster is found useful for simple trifling wounds in small animals, or when the skin is thin; it is strengthened, when applied, by brushing it over with collodion. Sometimes the latter substance is alone used to retain the lips of a wound in contact, and it is made more flexible by adding a few drops of castor-oil to it. Or strong diachylon-plaster may be employed; this, when freshly prepared, adheres tolerably well in these cases.

But when stronger adhesive plasters are required, recourse must be had to Venice turpentine, Canada balsam, Burgundy pitch, yellow resin, etc., spread on linen, cotton, or strong cloth, which is usually cut in strips of variable width. A good adhesive plaster is composed of black pitch and Burgundy pitch, two parts of each, and Venice turpentine one part. The first two ingredients should be melted in a ladle or iron pot over a fire, and the third added while they are still hot. They should be well mixed. Oil of turpentine or olive-oil is usually added to these resinous substances, when they are melted, to render them less brittle; and while melted they are spread upon the strips of cloth, and at once applied to the skin, from which the hair should be closely removed, if it is long. Ordinary carpenter's glue is sometimes very serviceable when used as a plaster, spread on strips of calico, cotton, or canvas. A solution of starch or gum-acacia may be employed under certain circumstances.

There are various methods of applying adhesive plasters or bands, the length and breadth of which may vary according to the requirements of different cases.

The sides of the wound being held in exact apposition by an assistant, the strips of bandage or adhesive plaster are laid across the wound, to some distance on each side of it. The edges of the pieces may overlap, or spaces may be left between them, and they should be sufficiently tense to keep the lips of the wound well together.

For the limbs, the bands should be sufficiently long to make a complete turn and a half around the part. The middle of each piece should be applied on the opposite side of the limb to that on which the wound is ; then the two ends are passed across the wound, one above the other.

An excellent bandage or plaster for large wounds which are likely to swell considerably, which require frequent dressing, or in the case of sutures which need support, is made by fixing an adhesive band on each side of the wound, parallel to it, and a short distance from its lips. Each band may be a little longer than the wound, the border nearest this being left non-adherent. To each of these borders tapes may be sewn, and tied to a convenient tightness over the wound on to one side of it ; or a number of holes may be made in them, through which a tape or piece of cord may be passed to lace them together, or each pair of opposing holes may have their own tape-fastening.

Sutures.

Sutures are employed to bring together, and maintain in apposition, the borders of wounds until union has taken place between them, either by primary adhesion or by granulation ; or to prevent the admission of air into a wound or natural cavity, the protrusion or displacement of organs, the arrest of hæmorrhage, etc. Their chief use, however, is in repairing solutions of continuity, and especially in regions where, in consequence of conformation or movement, it is not possible to keep the lacerated parts in exact contact, and when it is desired to have slight traces of injury remaining.

They are most beneficial when wounds are quite recent, though they may also be useful even when suppuration has taken place, by reducing the space to be filled up by granulation and the surface exposed to external irritation.

Sutures are contra-indicated when wounds are much inflamed, swollen, very deep or irregular ; when there is much loss of texture ; when the parts are contused or gangrenous ; or when there are foreign bodies lodged in the tissues. Nevertheless, they are sometimes had recourse to in these circumstances, when it is advisable to protect at least some portion of the wound from the air, to check bleeding, to hold shreds of skin or other tissues together, and to obtain partial adhesion by this means.

When immediate union is desired, there are certain general rules to be observed in the application of sutures. The principal of these

are as follows: 1. Cleanse the wound from blood and all foreign matters by a stream of antiseptic solution, or by swabbing with pledgets of wool saturated with the lotion, and if the hair is long, clip it away from the sides of the wound; if its borders are not even, or are dry and hard, they should be scraped until they are raw, lightly cauterized, rubbed with tincture of arnica, alcohol, or oil of turpentine, or be trimmed by means of sharp scissors. 2. After each stitch or point of suture, the borders of the wound should be pulled together to ascertain whether they exactly correspond to each other; and wrinkles or folds should be avoided. 3. The sutures should pass nearly perpendicularly through the integuments, as when they are too oblique they have not sufficient hold of the skin. 4. They should be sufficiently deep in the wound not to leave above them a space where pus may collect, and they should not pass between the lips of the wound. 5. Nerves, tendons, ligaments, and vessels should not be injured by them. 6. All the sutures or points of suture should be at an equal distance from the borders of the wound, so that they each bear an equal strain, and support one another without tearing out. 7. The distance between the lips of the wound and the points of entrance and exit of the suture should be at least equal to the depth to which we wish to insert it; the deeper the wound, the greater should be the distance of the suture from its margins. 8. The points of suture should be sufficiently close to prevent the intermediate parts bulging, while the distances between them should be equal, as well as between the last point and the extremities of the wound. 9. When the needle is passed from without to within, the skin should be seized with dressing forceps; when from within to without, two fingers press on the skin on each side of the point where the needle emerges. 10. The first point should be made at the spot where coaptation should be most exact, which is usually the middle part of the wound; nevertheless, if there are free angles—as in wounds of the eyelids, alæ of the nostrils, etc.—the first point should be made near these angles. 11. If the wound is extensive, an assistant should hold its borders together while the operator is applying the sutures. 12. In general, the sutures are not tightened until they are all placed, and the first placed is first tightened. In some cases, however, it may be necessary to secure the first suture before any others are placed. 13. The sides of the wound should not be brought together by traction on the sutures, but by pressure on the soft parts. 14. The suture should not be drawn too tight—the lips of the wound being only in slight contact—as the subsequent inflammation increases the constriction, and if this is already great the parts are strangulated and the sutures give way. 15. The knots should be made to one side, as far as possible from the wound and its least dependent part, so as to escape soiling by the discharges. 16. The most dependent part of the wound should be left free for drainage.

Materials and Instruments.—The chief suture materials are catgut, silk, and wire, of thickness and strength according to the nature of the parts to be united and the extent of the wound; though,

as a rule, the material should not be too thin, as it is then more apt to cut through the parts. Arnold's plaited ligature-silk answers well for sutures.

In veterinary surgery it is sometimes necessary to employ wire, which may be of silver, silver-plated iron, or of soft metal, as lead, and of various sizes—from the thickness of a horse-hair to that of a thick stocking-needle. Lead-wire answers well, as it is very pliable, and should the parts swell inordinately it will break, and thus obviate strangulation of the tissues. Fine telegraph-wire has been highly commended. This consists of a thin copper-thread, coated with gutta-percha; it is soft, flexible, tough, and perfectly unirritating. Soft wire is easily tied. A simple knot is first made; this is drawn together; then two or three short twists are made, and the ends cut off close to this twisted part. Or, instead of a knot, the wire may be simply twisted, in order that it may be untwisted again should the constriction become too great.

Pins are also employed; and these may be the ordinary brass pins of different sizes, or special pins of iron or steel. A suture instrument (Fig. 144) has been devised by Captain Russell, F.R.C.V.S.,

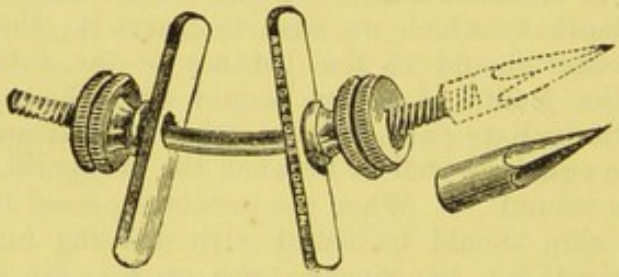

Fig. 144.—Suture Instrument.

which can be advantageously used instead of thread or wire in all large wounds where a deep and strong suture is needed to keep the parts in apposition, and to prevent superficial sutures from being torn out; also to prevent protrusion of the vagina or uterus, and in herniæ of various kinds, etc. Some of the advantages claimed for this suture are, that it does not tear out; if the tissues swell it can be relaxed, and when the swelling abates it may be tightened again. It is also easily and readily adjusted. When required for use, all that is necessary to do is to put one of the plates, with the bevelled edge inwards, over one end of the suture, and behind that a thumb-screw, screwing the stylet-point on the other end. Then push it through the parts as if it were a suture-needle, remove the point, and add a plate and thumb-screw as on the other end; then screw up the thumb-screw to the necessary tightness.

This instrument is made in four sizes or pairs, measuring three and a half, five, six and a half, and eight inches long respectively. They are made of steel wire, about three-sixteenths of an inch in thickness, slightly curved. At each end of the wire a deep thread is cut, upon which fit a trocar-point on one end, and a plate and thumb-screw on the other. For the requirements of the various

sutures, plates of metal of different lengths are provided, viz., four plates with one hole in the centre of each, and two plates with two holes for a double suture ; the former are about two inches long, the latter three and three-quarter inches, the holes being from an inch to an inch and a half apart in the latter. The inside edges of all these plates are bevelled off to prevent undue pressure or cutting. There are two trocar or stylet-points with each set of sutures, which screw on either end of the wires, and four thumb-screws, also interchangeable. The plates are made of steel, the nuts of brass, but all the parts are nickle-plated, to prevent corrosion.

The *instruments* required to pass the sutures through the tissues are suture-needles of various kinds, suture-needle forceps, and pin-holder or forceps.

The *suture-needles* are of different sizes and shapes for special pur-

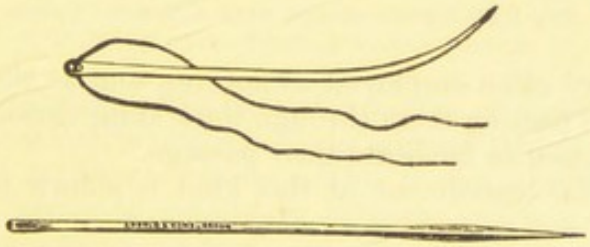

FIG. 145.—SUTURE NEEDLES : SMALL, FOR THREAD.

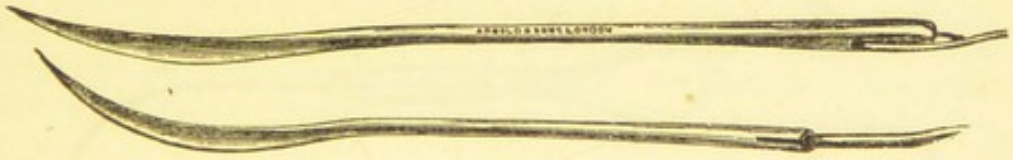

FIG. 146.—SUTURE NEEDLES : LARGE, FOR WIRE.

poses (Figs. 145, 146). Some are almost entirely cylindrical, others cylindrical towards the head, and flattened or triangular towards the body and point ; while they may be straight, or nearly so, or curved in various degrees from the middle or throughout. Some have the eye quite plain ; others have it grooved on both sides in order to prevent the thread projecting beyond the level, and thus facilitate its passage through the tissues. In some the form of the eye is specially formed for metallic sutures, in such a way as to in-bed the double or looped portion of wire on each side of it, or to receive it in a hole at the end (Fig. 146).

The volume of the needles, whatever their form, should vary according to the thickness and resistance of the parts they must traverse, though they should be no larger than is absolutely necessary. Curved needles are most convenient when the fingers have to pass them ; and if the skin is dense and thick, the ordinary needles require to be passed through by special instruments—as dressing forceps, pliers, or needle forceps (Fig. 148), or the eye is at the point of the needle, which is provided with a handle, upon which pressure can be exerted to push the instrument through the tissues (Fig. 149).

When through, the eye or notch at the point is armed with the thread, and in withdrawing the instrument this is pulled through with it.

Other needles of this description have the eye tubular, by which the thread can be more easily drawn through the skin (Fig. 150).

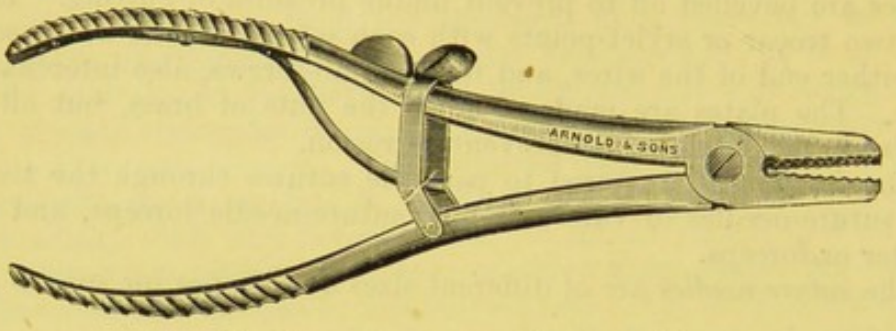

Fig. 147.—Needle-holder with Automatic Catch.

Pins are very often employed as sutures, and as there is difficulty experienced in passing them through thick skin, various contrivances have been devised to facilitate their passage.

A very useful instrument of this kind is shown in the annexed

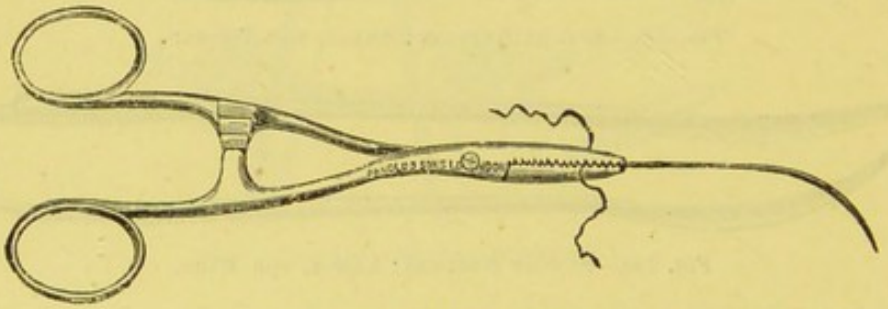

Fig. 148.—Needle Forceps.

figure (Fig. 151). The head is cleft into two portions, the inner surface of which has a horizontal and vertical groove (section *a*), for the reception of the pin, which may be placed in either direction as convenience requires. The jaws are closed on the pin by a sliding-

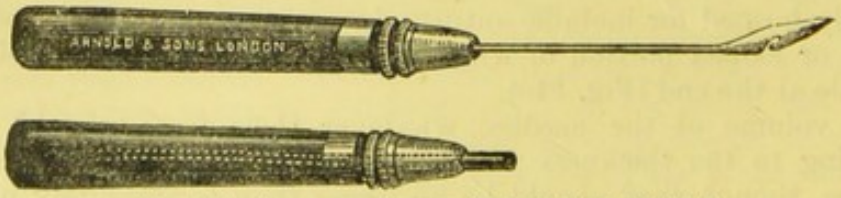

Fig. 149.—Improved Suture Needle with Handle.

ring, and when the pin is inserted in the skin, this ring is drawn back, the pin is released, and the instrument is ready for another.

Different Kinds of Sutures.—Sutures are of various kinds, according to the purposes for which they are required. Some are superficial, others deep; some include a considerable thickness of

tissues in order to hold them together and prevent their retraction; while others are very short, and retain only the skin and subcutaneous connective tissue. With regard to the manner in which they are composed, they are *simple* or *compound*, the former being of thread or wire only, while the latter are made up of the thread and wire and accessory materials.

Sutures are classified as (1) *interrupted*, (2) *looped*, (3) *uninterrupted*, (4) *twisted*, (5) *single pin suture*, (6) *quilled*, (7) *dossiled*, (8) *zigzag*, (9) X, (10) T, (11) *sutures of relaxation*.*

These modified sutures, as already mentioned, owe their intro-

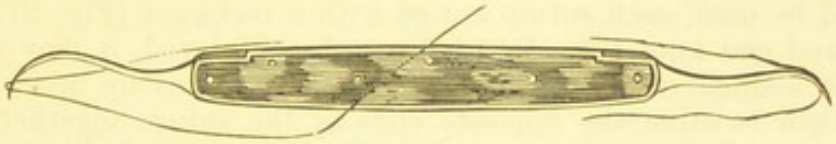

FIG. 150.—FOLDING TUBULAR SUTURE NEEDLE.

duction to the varying necessities of wounds, as these may chance to occur in different parts of the body or present diverse features.

1. *Interrupted or Simple Suture.*—This is the simplest and commonest form of suture in veterinary surgery, and is used for recent wounds, as after removal of tumours, those in which there are partially detached pieces of integument, in large gaping wounds, for the retention of plugs, and where absolute apposition of every portion of their surface is either impracticable or unnecessary. It is formed by separate threads passed between the borders of the solution of continuity, and tied independently. Commencing in the

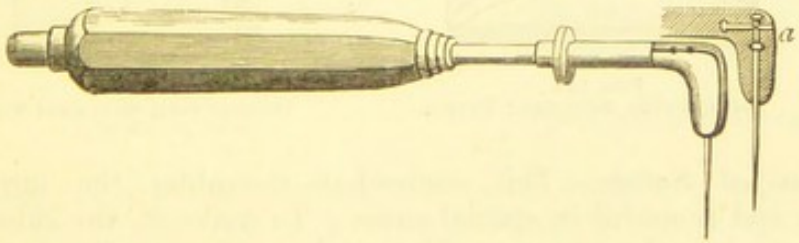

FIG. 151.—PIN-HOLDER.

centre of the wound, in order to judge of the even adjustment of the remainder of its extent, the first suture is inserted by means of a curved needle, armed with silk or wire. Then another is placed alternately on either side, and so on, from point to point, along the wound; but only where necessary to secure apposition. The space between the sutures will depend upon the resistance of the lips of the wound, and their distance from the margin upon the depth of the wound or the traction likely to be exerted upon them. The needle may be armed with a thread or wire in length sufficient to make a number of sutures, and after each complete passage of the needle this thread may be cut, leaving an end on either side long enough to be tied; or

* For Lembert's and other bowel sutures see Vol. II., pp. 345, 352.

as many needles may be employed as there are to be sutures. If a long thread is used, it need not be cut after each passage of the needle, but left in wide loops on each side of the wound; being divided afterwards, there are as many single sutures as there are loops. The lips of the wound may be held together by an assistant, and the needle passed through both at once; but as the skin of the horse and ox is generally thick and dense, it can only be passed through one lip at a time. No suture ought to be placed at the dependent part of an accidental wound, as it might prevent escape of the discharges.

All the sutures having been placed—each being of sufficient length—they are then tied, one by one, commencing at the centre; if silk thread be used, each suture is tied with a reef-knot (Fig. 152), or a bow and end knot (Fig. 153); if wire be employed, it may also be tied in a single or double knot, or, better, fastened by first crossing and then twisting the opposite ends of the suture together. The knots should, if possible, be tied at the most dependent side of the wound (Fig. 153).

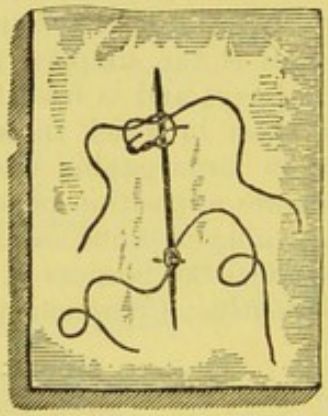

FIG. 152.
INTERRUPTED SUTURES: TYING.

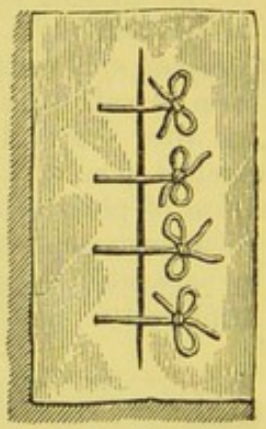

FIG. 153.
INTERRUPTED SUTURES: TIED.

2. *Looped Suture.*—This somewhat resembles the interrupted suture, and is useful in special cases. To make it, the sides of the wound are brought into apposition, and as many needles as there are to be sutures being armed with thread, they are passed perpendicularly through the lips, and the thread in each drawn through to the middle. The needles being removed, all the threads on each side are brought together (Fig. 154), twisted into one cord, and the two tied over the wound as if they were a single suture.

3. *Uninterrupted, Continuous, or Glover's Suture.*—This suture best secures the accurate apposition of thin margins, and is most useful in shallow wounds, as those of the eyelids and nostrils, and other thin parts of the skin. Unless carefully applied, however, it is apt to corrugate the lips of the wound, and has the additional disadvantage that, if accidentally cut at any point, it is loosened throughout. It is simply a continuous stitch, a sewing together of the sides of the wound, the thread forming a kind of spiral around its borders.

If the lips of the wound can be brought sufficiently together to

form a fold, a straight suture-needle may be employed ; if not, then a curved needle must be used. The stitch is commenced at the end of the wound, the needle passed from without to within, at right angles to the surface, and through the whole thickness of the tissue, across the wound, pushed from within to without, withdrawn, brought over to the commencing side, and so on until the other extremity of the wound is reached, an equal distance being maintained between the points of entrance and exit. To prevent its being pulled through, a large knot should be tied at the end of the thread, and when the opposite extremity of the wound is reached, the other end of the thread should likewise be knotted (Fig. 155). If the skin is wrinkled by the sewing, it may be smoothed down before the last knot is tied, by gently pressing or rubbing it.

4. *Twisted Suture.*—The twisted suture, like the interrupted suture, is much employed in veterinary surgery, and particularly for wounds of the eyelids, nostrils, mouth, or cheeks, abdominal wall, etc. It

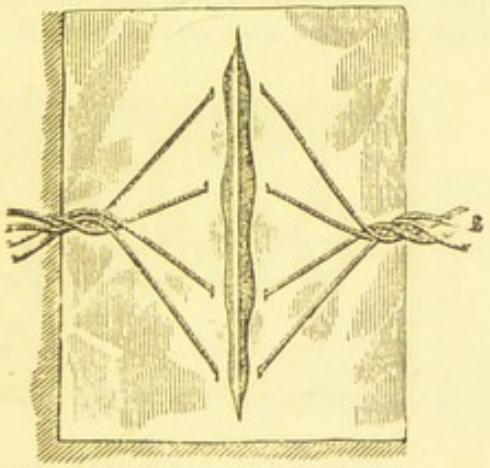

Fig. 154.
Looped Suture.

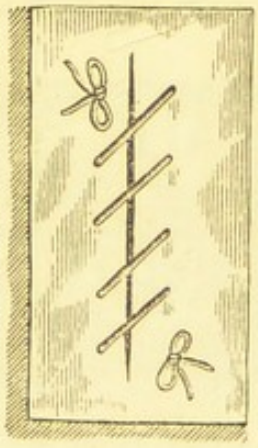

Fig. 155.
Uninterrupted Suture.

will retain, in absolute contact, the entire surface of a wound of considerable length, and is a most serviceable suture in mediate compression, especially in venous hæmorrhage.

It is formed by inserting two or more steel pins of small or large size, needles, small skewers, or other similar articles—according to the depth of the wound—through the lips of the incision, in the same way as the suture-needle, half an inch at least from the margin, commencing at the most convenient part, which is usually the centre. There should be an equal distance between the pins, and the point of each ought to project to the same extent as the head portion. When the requisite number of pins has been introduced, a piece of wire, silk, tow, or tape, according to circumstances, is twisted around them. This twisting begins with the first pin, and the thread is crossed two or three times between the head and point, in a figure of 8 fashion (Fig. 156), so that the point of crossing lies over the line of contact of the edges of the wound. The thread is then passed to the next pin, crossed in the same way, then carried to the next pin,

and so on to the end. The thread may be secured by tying its opposite ends together in a knot, and the points of the pins cut off by pliers or strong scissors, so as to leave about half an inch or more projecting at the end, beyond the thread. The thread is sometimes taken in both hands, and laid parallel to and immediately over the first pin—that is, transversely to the wound; then it is passed under the two ends of the pin from above and drawn, so as to approximate the edges of the wound exactly; now the threads change hands, and with the right thread in the left hand, pass around the left end of the pin from above downwards, and, with the left thread in the right hand, do the same for the right end of the pin; the threads are again changed, and four to six similar figure of 8 turns made, a double knot is tied, and the ends of the thread cut off close. The points of the pins are snipped off to a proper length, so that they may not press on the skin, yet not so short as to allow the thread to slip over. Sometimes only a single crossing on each pin is made with the thread until the last pin is reached, when the thread is brought from this back again to all the pins, and so on until it has

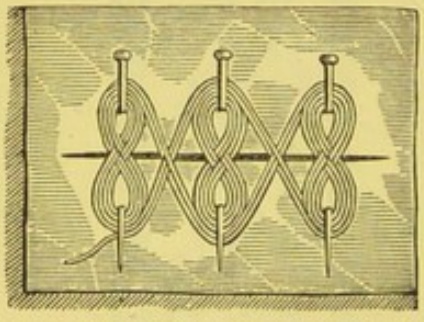

FIG. 156.
TWISTED SUTURE: FIGURE OF 8 TWIST.

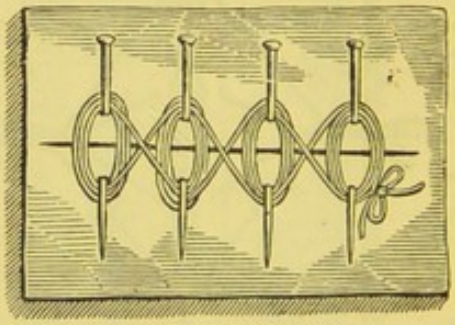

FIG. 157.
TWISTED SUTURE: CIRCULAR TWIST.

been brought backwards and forwards three, four, or more times. Sometimes the thread is passed around the pin in a circular manner, not crossed (Fig. 157).

5. *Single Pin Suture.*—This is a useful suture for a small incised wound, especially over a vein, as after the operation of phlebotomy. The pin is inserted, as in the twisted suture, at the middle of the wound, and a piece of silk or tow being made into a double loop or hitch, the end portions inwards (Fig. 158), this is passed first over the head, then over the point of the pin, the ends are drawn tight, and the suture is completed, after the point has been clipped off. Sometimes a narrow band of fine tow is passed between the pin and the skin in a circular manner.

6. *Quilled Suture.*—The quilled suture consists of a number of interrupted sutures secured, not across the lips of the wound, but on either side, to a quill, piece of bougie, pencil, or other narrow cylinder, placed parallel to the wound, one on each side. This suture maintains the deep parts of a wound, the textures below the surface, in firm and steady contact—an advantage in respect to a deep wound,

as well as in any movable part. Its only disadvantage is its tendency to evert the cutaneous edges.

It is best applied with a strong curved needle, fixed in a handle, and having an eye near its point (Fig. 149). This should be armed with a stout double thread, and having been passed through the wound from side to side, the looped end of the ligature is detached from the eye of the needle, and held with the left hand, while the needle is withdrawn.

The needle should pierce the skin at least an inch from the edge of the wound, should traverse the deep parts, and emerge at the same distance from its opposite margin. When withdrawn there will be a double thread remaining in the wound, having a loop at one extremity, and two free ends at the opposite. Through the loop or loops, if more than one suture be used, the piece of quill, rubber, pencil, or whatever it may be, should be passed, and the thread drawn tight over it, by pulling at the opposite ends; then these ends are tied firmly over a similar 'quill' at the other side of the wound (Fig. 159).

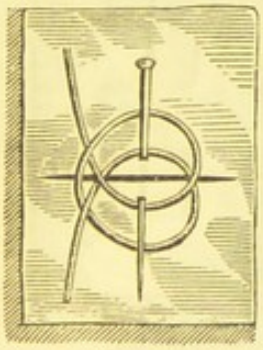

FIG. 158.
SINGLE PIN SUTURE.

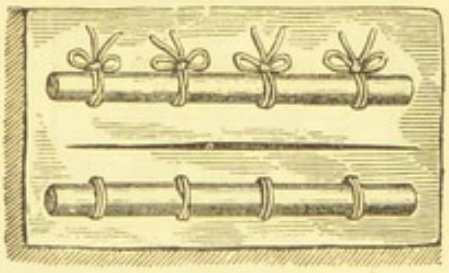

FIG. 159.
QUILLED SUTURE.

To maintain perfect apposition in the more superficial parts of the wound, it may be necessary to add a few interrupted stitches.

7. *Dossiled Suture.*—This kind of suture is sometimes used as a means of dressing wounds, by retaining pledgets of tow or lint in them, with the object of arresting or preventing hæmorrhage—and especially from the jugular vein. It is a kind of interrupted suture, and is applied by means of a curved needle, armed with a double thread, which has a little dossil or bundle of tow at its end. After dressing or plugging the wound, one of the lips is seized with forceps, and the needle is pushed through it and the thread drawn, until the dossil is in contact with the skin; then the thread is cut, leaving sufficient to make a knot. The same procedure is followed on the opposite side, and so on, until the necessary number of points has been made. Then each point of suture is tied in the centre of the wound (Fig. 160), so as to exercise pressure on the plug, and by this means hæmorrhage is arrested.

8. *Zigzag Suture.*—To apply this suture, instead of forming a spiral inclusion by the thread around the borders of the wound, as

in the uninterrupted suture, the needle is passed in a zigzag from one side of the wound to the other. It allows of more regular coaptation of the lips of the wound than that suture, causes less irritation, but, like it, is only applicable when the wound is not very deep. It has been recommended for wounds of the intestine, and has been practised as a retention suture after reduction of umbilical hernia in the horse.

It is applied by means of a curved needle, armed with a single thread. The needle is pushed through both lips of one extremity of the wound, from right to left, then carried a short distance from its point of exit, and introduced again on that side, bringing it out on the commencing side—from left to right; continuing this procedure until the opposite extremity of the wound is reached, when the two ends may be tied together or separately (Fig. 161).

9. *X Suture.*—This special suture is advantageous in some

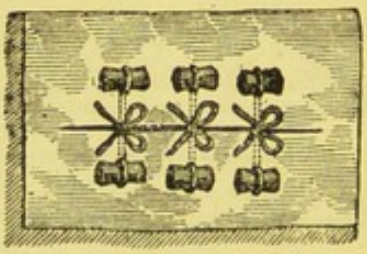

Fig. 160.
Dossiled Suture.

Fig. 161.
Zigzag Suture.

wounds, and is most frequently employed in closing the flank incision made in castrating female pigs. It is applied by a curved needle and thread. The sides of the wound at one end are traversed, together or consecutively, by the needle, which, on being withdrawn, is carried across to the other end of the wound, where it is again inserted (on the opposite side), and brought out transversely. The needle is then removed, and the two ends of the thread tied, the suture being in the form of an X externally (Fig. 162).

10. *T Suture.*—For crucial wounds or incisions, a suture in the form of a T has been employed. It is applied by attaching a needle to each end of the thread, and passing each needle, from without to within, at one of the angles of the incision, bringing them out beyond the transverse cut in the wound. The thread in this way forms a loop, which crosses and closes the inferior or perpendicular incision; the ends are tied together, and thus form a second loop.

Or it may be applied by a single needle, which is passed through the skin, above the transverse incision, coming out below it and to the right of the perpendicular incision. The thread is carried over this incision, and the needle implanted on the left, bringing it out

above the transverse wound, opposite the point where it first entered ; the ends are then tied together (Fig. 163).

11. *Suture of Relaxation.*—A suture has been introduced of late years, bearing this name, which is intended to obviate the giving way of the stitches in wounds, when tumefaction causes great ten-

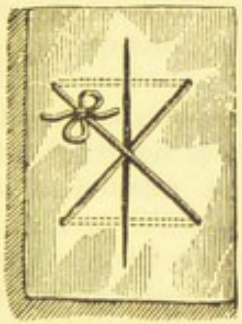

Fig. 162.—X Suture.

Fig. 163.—T Suture.

sion. This suture can be relaxed at will, and to any reasonable extent, thus avoiding tearing through of the integument by the stitches, as well as preventing irritation and pain. Pugh's suture buttons (Fig. 164) are useful for this purpose.

The method of applying the suture is as follows : There are two small oval pieces of sheet-lead, about one-twentieth of an inch thick,

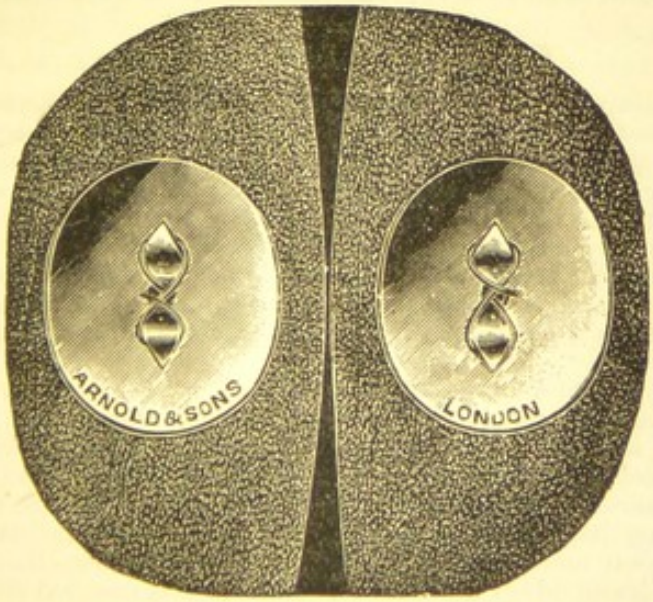

Fig. 164.—Pugh's Suture Buttons.

with a central perforation to receive a moderately thick suture. The latter is first passed as an ordinary suture, except that it is carried at an unusually great distance from the edge of the wound, both as regards surface and depth. Each end of the suture is then passed through the hole in the corresponding leaden plate or button, and secured by being wound once round its short diameter. The

two buttons thus take the place of the tips of two fingers of both hands in giving support to the deeper parts of the wound, while leaving the cutaneous margin free; and when the wound is at all extensive, several sutures, each with a pair of buttons, may be employed, constituting a kind of interrupted quill suture. If it is required to relax the suture, this is done by unwinding it from one of the buttons, allowing the button to slip upon it to any degree to which the tension disposes it, and then fixing it by winding the suture round it.

The button may have a little knobbed stem on each side of the hole, round which the suture can be twisted in figure of 8 fashion; thus it can be drawn, kept in exact position, relaxed at will, and tightened with ease. The sutures may be metallic or chromic catgut—the latter is good, as it has a tendency to harden the tissues, thereby affording a firmer hold, and is more easily managed. The buttons, being pliable, can be bent so as to be adapted to any surface, while the material of which they are composed renders their thorough cleansing easy and certain. Their application is not difficult. If possible, the upper one should be first fixed; when the bottom one is ready, the lips of the wound can be easily brought together by pressure of the thumb and index-finger of the left hand, at the same time gently pulling the wire, or catgut, with the right hand; when in position, the suture can easily be fixed.

In the excision of tumours, and in other operations in which a large amount of skin is involved, this suture is very serviceable.

Consecutive Treatment.

When the sutures should be removed from a wound must depend on circumstances, such as the material employed, its condition as regards asepsis, the nature and thickness of the tissues involved, and the character of the wound. A suture left in too long may cut through the tissues and prevent union; a clean incised wound brought into exact coaptation, will cicatrize more quickly than an irregular or badly adjusted wound; cicatrization is more rapid in young than in old animals, and in a superficial than a deep wound; the skin and connective-tissue are readily cut through by the suture, while fibrous tissue is much more resisting; and pus forms more quickly where there is much connective-tissue and many vessels, than elsewhere.

With a simple wound united by primary intention, the suture may be removed with safety from the fourth to the seventh or eighth day. There is always risk in removing it too soon, and it is generally better not to take away all the points at once—if there are more than one. If there is only one thread, as in the uninterrupted suture, one of the knots may at first be cut; and with the interrupted suture, the least important points are first removed; having extracted one, we may then judge if more can be detached. To remove them, they should be cut close to the opposite side of the cicatrix, and the crusts removed from them; they are then pulled through from left to right, pressing in the opposite direction with the left index and pollex on the point of exit, at the same time holding the lips of the wound together.

Forceps or pliers are useful in removing pins in the twisted suture, and when they are removed the thread may be left in place, as it still affords support; though if the wound is suppurating this precaution is needless.

As the cicatrization of wounds is accompanied by itching, precautions should be taken to prevent the animal biting or rubbing them, not only immediately after the application of the suture, but also when this has been removed.

SECTION VI.

BANDAGING AND DRESSING WOUNDS.

The main object to be achieved in dressing wounds, caused by accident or produced by operation, is to hasten their union, and to ensure this in a satisfactory manner, with as little local and general disturbance as possible. It consists essentially in the methodical application, at regular or irregular periods, if necessary, of topical agents or dressings, maintained by bandages or other suitable apparatus.

The dressing of wounds is, therefore, one of the most important branches of veterinary surgery. Wounds require care and attention. They must be protected from external injury, from sudden variations of temperature, from the air, infection, or septic matter. They must be bandaged and placed in the most favourable condition for cicatrizing; and they must be dressed with agents which keep them healthy, promote healing, and, if need be, allay pain.

It is often upon skilful and careful dressing that the success of an operation depends; while, no matter how expertly this may be performed, if the subsequent dressing is neglected or improperly carried out, the healing process will, at best, be retarded, or serious consequences may ensue.

The indications in dressing are numerous, according to circumstances, such as the kind of operation, the nature and seat of the lesion, the character of the tissues involved, the local and general symptoms developed, etc.

This division of veterinary surgery comprises: 1. *The instruments, materials,* and *apparatus* required for dressing; 2. The *rules for their application;* 3. Their *effects.*

Instruments, Materials, and Apparatus.—The appliances for dressing are somewhat numerous and varied. They are:

A. Instruments.

The instruments usually required are the ordinary curved trimming scissors; dressing scissors (Fig. 166); dissecting-forceps (Fig. 88); dressing forceps (Fig. 165), to remove foreign bodies and old dressings; scalpel (Figs. 78, 79, 80); bistoury (Figs. 82, 83); probes of various sizes, in silver, whalebone, or lead; syringes—large and small—to wash out wounds and inject fluids (Figs. 168, 169)—the former of brass or pewter, with bulbous pipes of two or three sizes, the latter of brass, pewter, glass, or vulcanite, with two or three sized pipes; razor; caustic holder with nitrate of silver (Fig. 170).

B. Materials.

The materials are applied immediately to the surface of the wound, in order to absorb discharges, protect it from infection or other

external influence, maintain warmth, promote healing, afford pressure and support, etc.

The more important materials in veterinary surgery are aseptic tow and cotton-wool medicated with carbolic, boracic acid, or sublimate. Tow should be fine, soft, clean, and free from rough portions. It imbibes fluids, forms a good medium for the application of reme-

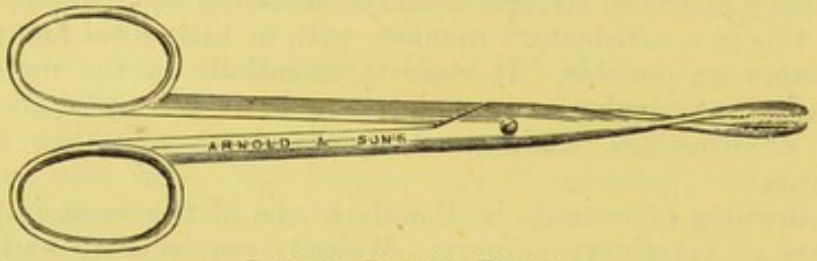

Fig. 165.—Dressing Forceps.

dies, and assists cicatrization. It is sometimes cut up into short pieces with scissors, and applied with an adhesive to superficial wounds which do not require a bandage, or are difficult to secure a bandage to—as wounds of the hock, elbow, or knee.

It is used in the form of *pads* or *cushions*, with which to exert equable pressure on a wound. *Pledgets* or *pellets* of tow are elongated

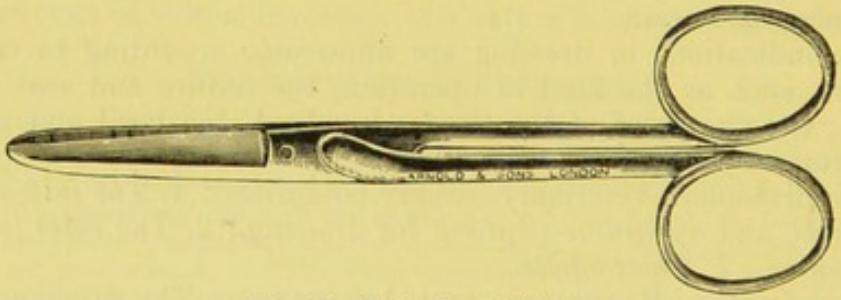

Fig. 166.—Dressing Scissors.

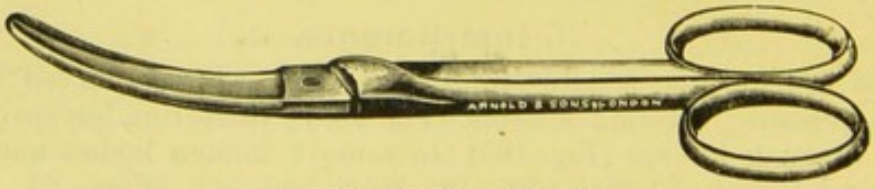

Fig 167.—Trimming Scissors.

or round masses, employed to fill up deep wounds, uneven surfaces, arrest hæmorrhage, and keep down luxuriant granulations. *Dossils* of tow are little, closely-rolled bundles used for sutures, to dilate canals, or keep open cavities. When a dossil has to be deeply inserted, a cord is fastened to it for its withdrawal. *Plugs* of tow are elongated bands, used as a stopping for fistulous wounds; or they may be globular masses (covered by cloth, if need be), introduced into cavities to effect compression on tumours, vessels, etc.

Lint, wood-wool, absorbent gauze, and *charpie,* carbolized or charged with 5 to 10 per cent. of iodoform, chinosol, or dermatol, are sometimes employed, but chiefly for the smaller animals.

Cloth of various kinds is used in dressings, as cotton (usually unbleached), linen, and thin canvas; but the best for bandages or compresses, indeed, for all purposes in veterinary surgery, is linen.

This is usually of the coarser and stronger kind; for certain

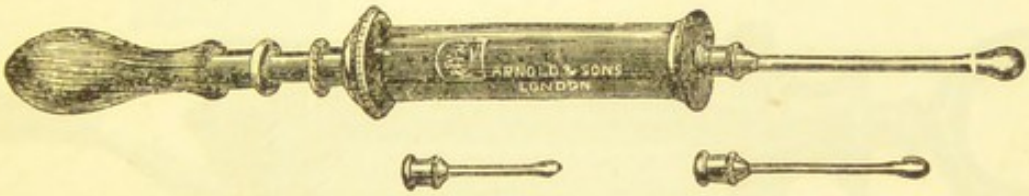

FIG. 168.—SYRINGE FOR WASHING OUT WOUNDS.

purposes it answers better when it has been somewhat worn. It is made into *compresses* and *bandages.*

Compresses.—These are not so much employed in veterinary as in human surgery, pads or pledgets of tow being used instead. They are pieces of cloth doubled two or more times, and offering various forms according to requirements. They may be applied directly to the wound, or above other dressings; but in either case they should

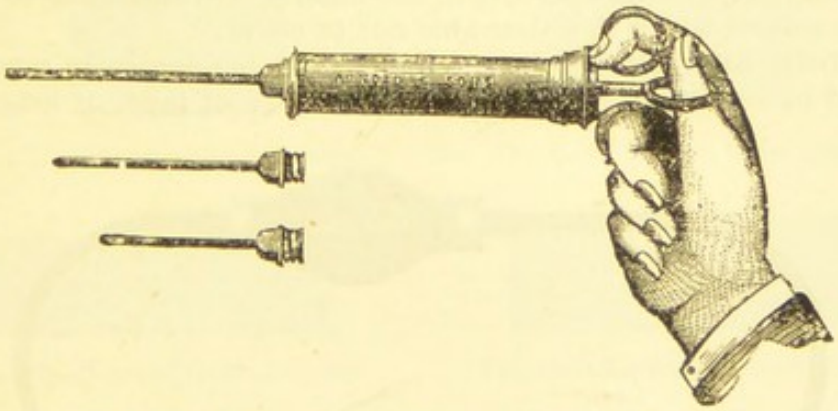

FIG. 169.—SYRINGE FOR INJECTING FLUID INTO WOUNDS AND FISTULÆ.

FIG. 170.—CAUSTIC HOLDER.

be free from wrinkles and their borders should be even, so as to ensure equal thickness throughout.

Their shape is varied. The *square compress* (Fig. 173), as its name implies, is a perfect square, formed by folding the cloth in that manner. The *long compress* (Fig. 175) may be the same piece of cloth folded lengthwise; while the triangular compress (Fig. 174) is the square compress folded so as to bring two angles together.

The *cravat compress* (Fig. 176) is the triangular compress folded two or three times from the apex to the base; and the *Maltese Cross compress* (Fig. 177), and *half Maltese Cross* (Fig. 178), are formed from the square compress—in the first the four angles are divided, and in the second only two. The *double-tailed* (Fig. 179) and *treble-tailed compress* (Fig. 180) are folds of cloth with one or two long cuts at one or both ends. The *graduated compress* (Fig. 181 *a*, *b*) is a long and wide compress doubled several times in a series of gradually

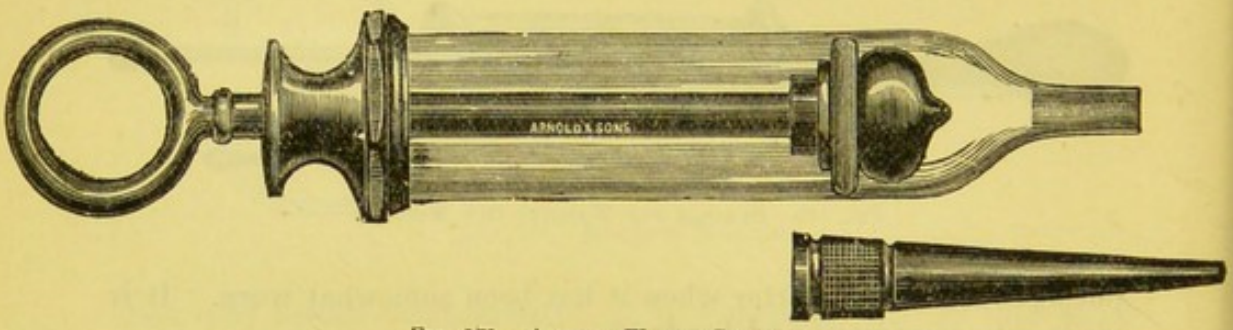

Fig. 171.—Aseptic Wound Syringe.

decreasing folds, to form a kind of prismatic-shaped mass. It is useful to make pressure at the bottom of a wound. The graduated compress may also be formed by several single compresses of diminishing size laid one upon the other. The *perforated compress* (Fig. 182) is a compress with an aperture in the middle, corresponding to a part of the wound which it is desirable not to cover.

Bands and Bandages.—Bands and bandages are much employed in veterinary surgery. *Bands* may be of tape, or long strips

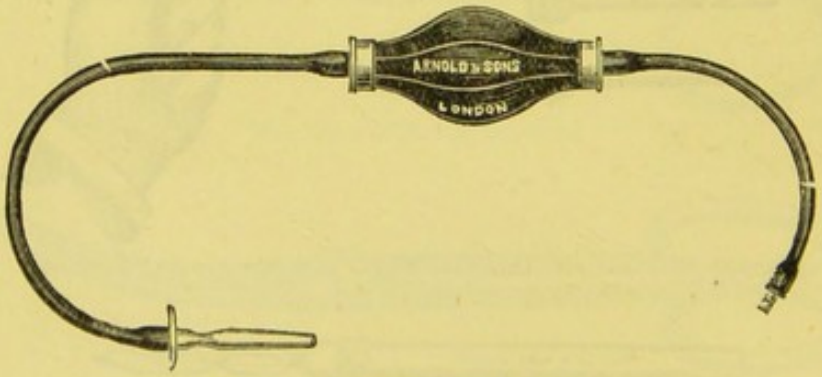

Fig. 172.—Higginson's Syringe.

of linen, calico, or other material, of various widths, but usually narrow. They serve as simple bandages in some cases, to maintain dressings in place; they are also employed to secure larger bandages of diverse forms. Sometimes india-rubber bands are employed with advantage, owing to their elasticity.

Bandages, properly so-called, are divided into three kinds: (A) *Roller Bandages*, (B) *Wide Bandages*, and (C) *Mechanical Bandages*.

A. Roller Bandages.—The roller bandage—that which is most in use, and is best known as the 'horse bandage'—is ordinarily

Fig. 173.—Square Compress.

Fig. 174.—Triangular Compress.

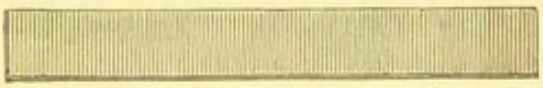

Fig. 175.—Long Compress.

Fig. 176.—Cravat Compress.

Fig. 177.—Maltese Cross Compress.

Fig. 178.—Half Maltese Cross Compress.

Fig. 179.—Double-Tailed Compress.

Fig. 180.—Treble-Tailed Compress.

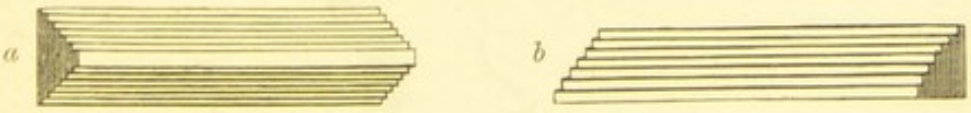

Fig. 181.—*a*, *b*, Graduated Compress.

Fig. 182.—Perforated Compress.

from three to six inches wide, and of variable length—generally two or four yards. It may be cut from the piece of cloth or specially

woven. It may have two pieces of tape fastened to one end, to tie it when it is applied, or the same purpose may be served by splitting one end for a few inches, and tying the divisions in a simple knot so as to prevent further tearing. For special cases woven surgical bandages are frequently preferred. In texture the bandage should be pliable, sufficiently strong to withstand moderate force, and it ought to be clean and dry. A bandage too wide is difficult to apply evenly, as it does not adapt itself to parts unequal in volume or outline.

To apply a bandage easily and well, it should be rolled up ; it may be in a *single* or a *double roll*. The *single-roll bandage* (Fig. 183) has one end free, the other being in the centre of the roll. In the *double-*

Fig. 183.—Bandage in Single Roll.

Fig. 184.—Bandage in Double Roll.

roll bandage (Fig. 184) the ends are in the rolls—one in the centre of each.

To roll up a bandage properly, one end (that to which the tapes are attached, or which is tailed or cleft) should be folded transversely two or three times, so as to make a small cylinder ; the ends of this are held between the thumb and index of the right hand, while the bandage itself lies between the same fingers of the left, the ring and little finger of which maintain the roll in the same hand (Fig. 185).

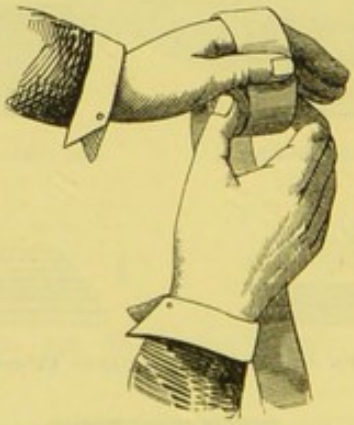

Fig. 185.—Manner of Rolling Bandage.

The two fingers of the right hand turn the cylinder on its axis from left to right, until the whole is rolled in a firm regular cylinder.

The bandage may be applied dry or wet ; sometimes it is impregnated with an antiseptic ; at other times with starch or other

substance which, when dry, will make it rigid. To apply it, the roll is taken in the right hand, the thumb at one end, the medius at the other. The free end is held between the thumb and index of the left hand, and laid on the part to which the bandage is to be applied, and several circular turns are made around it to give the bandage a hold. The cylinder is now passed from hand to hand as the turns are made, care being taken that it is not dropped, that at each turn it is steadily tightened to the necessary degree around the part, and applied evenly and regularly.

When a bandage is applied to a part the volume of which varies —as the lower part of a horse's limb—it is very difficult to make it lie evenly, portions of the border being slack and bulging, while others are tight, rendering the pressure unequal and the bandage insecure. To avoid this, without changing the direction of the bandage, it is necessary to make an oblique half-twist at every turn, at the part which is most prominent towards that which is less so,

FIG. 186.—MANNER OF APPLYING A SPIRAL BANDAGE IN HALF-TWISTS.

the fingers of the other hand preventing the bandage slackening (Fig. 186). The cylinder is seized in an inverse direction after unrolling a certain portion, then slightly relaxing the free portion, the hand is reversed without pulling on the cylinder, so that the upper border of the bandage becomes inferior. This being done, the half-twist is drawn tight, the thumb being passed over it to make it smooth.

The whole of the bandage being applied, it is secured by tying the tapes attached to the end which is now free—these passing round in opposite directions. Or a piece of tape, the end of the bandage itself, or a pin will suffice. When the bandage is very long and its turns are liable to become loosened, they may be attached to each other by pins or a few stitches of thread.

The double-roll bandage is applied by placing the portion between the rolls against the part to be bandaged, one of the rolls being held by an assistant, while the other is passed round the limb. This bandage is sometimes advantageous, as by it compression can be effected primarily over a part, and secondarily on both sides of it, without requiring to use another bandage.

The roller bandage is applied in a *circular* manner, when the turns around a part are exactly superposed ; and in a *spiral* manner when they partially overlap and extend for some distance, as in Fig. 186. It is said to be a *crossed* or *figure of-eight* bandage, when passing in a spiral manner, it goes in the opposite direction, the turns thus crossing each other.

B. WIDE BANDAGE.—This bandage is made up of a broad piece of calico, linen, or other strong but pliable material, of a particular shape to adapt it to different regions of the body, and fixed by means of tapes, straps, or bands. Sometimes it is made of flexible

FIG. 187.
SIMPLE FOREHEAD-BANDAGE
(FRONT VIEW).

FIG. 188.
SIMPLE FOREHEAD-BANDAGE
(SIDE VIEW).

leather or waterproof stuff. It should be as simple as possible, so as to be easily applied ; it should cover, but not press upon the wound, obstruct the circulation in the part, or prevent discharge of pus or other fluid ; and it should lie close to the surface. It may be attached to the mane, tail, or forelock ; to head-collar, crupper, breast-band, or surcingle. There are a large number of wide bandages, but the principal only are here enumerated.

1. *Forehead Bandage.*—This is a square piece of cloth, sufficiently wide to cover the forehead, extending from behind the ears to close above the eyebrows. It is attached by three tapes or bands on each side, in the manner shown in Figs. 187, 188 ; the brow-bands pass through a hole or loop on each of the cheek-bands, which again are fastened, with the upper bands, at the top of the neck.

2. *Compound Forehead Bandage.*—This is a longer piece of cloth than the last, passing from between the ears, down the face, to near the nostrils, and having three bands on each side—upper, middle and lower ; the middle are above the eyebrows, and have a loop through which the upper pass ; the lower cross behind the jaws,

pass through the loops of the middle bands, and, like the others, are tied at the top of the head (Figs. 189, 190).

3. *Monocular Bandage.*—This is a wide, somewhat long piece of cloth, which, when applied to the side of the face, so as to cover one eye, may have a notch cut out of its upper border to relieve the

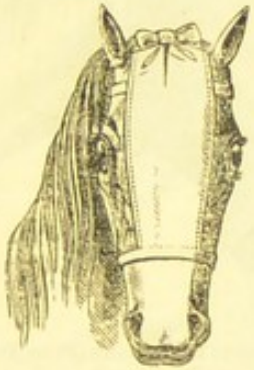

FIG. 189.
COMPOUND FOREHEAD BANDAGE (FRONT VIEW).

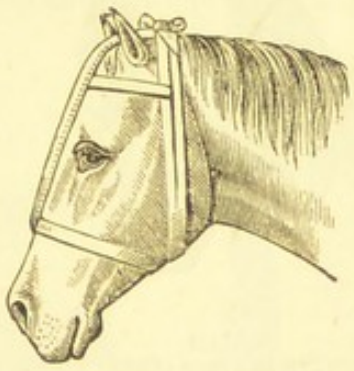

FIG. 190.
COMPOUND FOREHEAD BANDAGE (SIDE VIEW).

root of the ear, and a transverse plait at the side to adapt it to the orbit. It is attached by five bands, the three upper of which are tied to the throat-strap of the head-collar, and the two lower are fastened to the bottom part of the same strap (Figs. 191, 192).

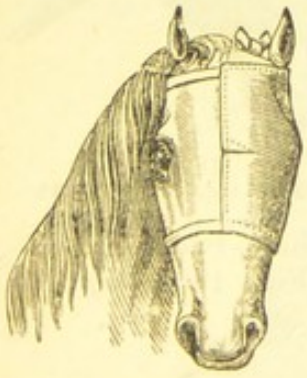

FIG. 191.
MONOCULAR BANDAGE (FRONT VIEW).

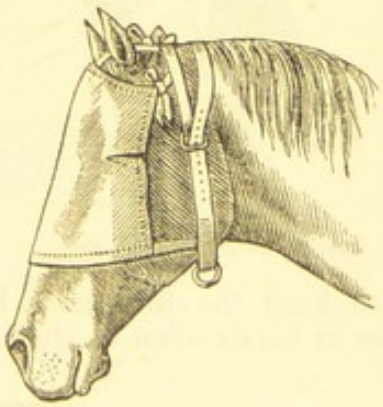

FIG. 192.
MONOCULAR BANDAGE (SIDE VIEW).

4. *Binocular Bandage.*—This is merely a duplicate of the last. One plait above the orbit, and another below, on each side, makes it fit better. It is retained by eight bands, which attach it to the head-collar (Figs. 193, 194).

5. *Ear Bandage.*—This is formed by two pieces of triangular-shaped cloth, the bases of which meet between the ears, and form a kind of gusset for the reception of each ear. It is attached by six

bands; the upper two have each a loop, through which pass the middle bands, and crossing below the throat, they are tied behind

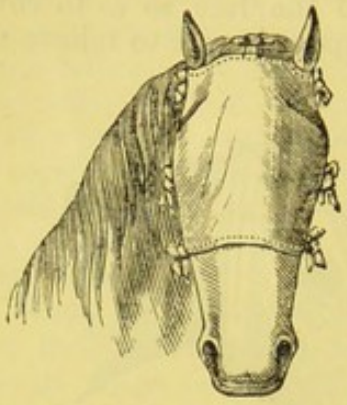

FIG. 193.
BINOCULAR BANDAGE (FRONT VIEW).

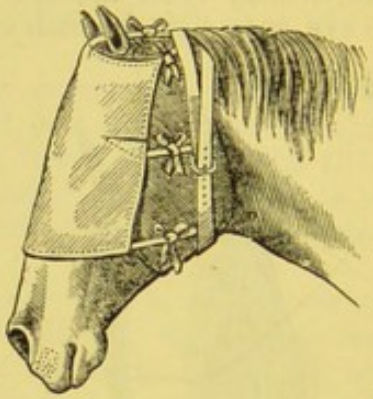

FIG. 194.
BINOCULAR BANDAGE (SIDE VIEW).

the ears. The lower bands cross on the face, and are tied over the nose. The upper portions of the bandage are fastened together, so

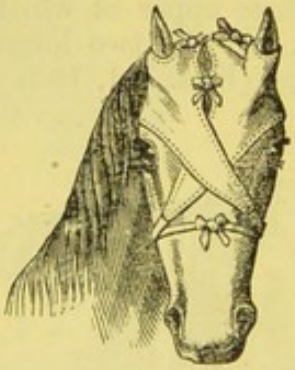

FIG. 195.
EAR BANDAGE (FRONT VIEW).

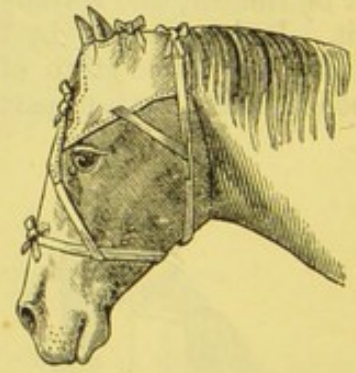

FIG. 196.
EAR BANDAGE (SIDE VIEW).

as to keep the ears erect, by tying together—two and two—the tapes or bands sown on their inner border (Figs. 195, 196).

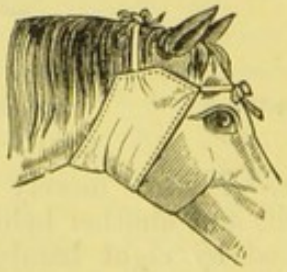

FIG. 197.—THROAT BANDAGE.

6. *Throat Bandage.*—This is a square or somewhat triangular-shaped piece of cloth, the base being cut concave, to adapt it to the

upper part of the trachea. It may only cover the parotideal region, or extend so as to envelop that and the postero-inferior part of the head. It may be attached by four or six bands, to the head, beneath the head-collar, if necessary.

A thick bandage is made by a square piece of cloth, doubled at its angles to form a triangle; between these folds may be a layer of tow, cotton, spongio-piline, or peat-moss, kept in position by quilting.

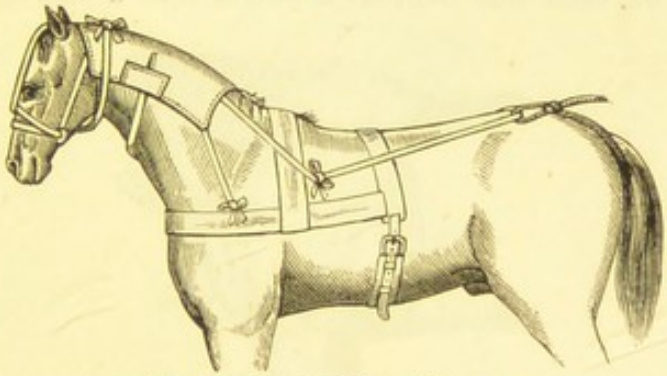

FIG. 198.—TOP OF NECK BANDAGE.

7. *Top of Neck Bandage.*—This is a large piece of cloth, sufficiently long to extend from close to the ears to near the base of the neck, and wide enough to cover the sides of the neck to some extent. The anterior portion is prolonged by a narrow piece or band, which passes between the ears and descends on the face. The bandage is attached by nine bands—two from the anterior part on each side, terminating in loops through which pass other two that cross behind the jaw, pass up the side of the face, and tie on the neck; two on

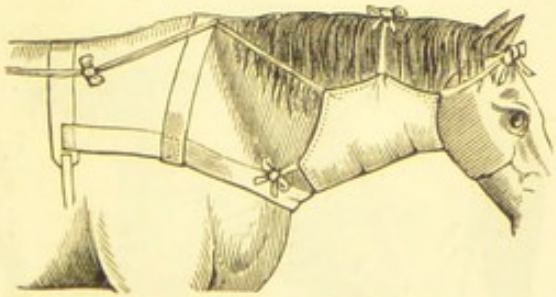

FIG. 199.—BANDAGE FOR SIDES AND FRONT OF NECK.

each side from the posterior end, attached to a breast-strap or bricole to keep the bandage down, the upper one being, in addition, attached to a crupper or surcingle (Fig. 198). These last bands may be more simply attached by bringing the lower on each side to the front of the chest, tying them there, and passing the joined bands between the fore-legs, fastening them to the inferior part of a surcingle, while the upper band on each side is tied to the superior part of the surcingle

8. *Sides and Front of Neck Bandage.*—This bandage is somewhat octagonal in shape, each of its eight angles being provided with a band

—the middle two on each side being fastened on the top of the neck, the anterior two over the forehead to the head-collar, and the posterior two to a surcingle or bricole (Fig. 199).

9. *Bandage for the Withers.*—This is a square piece of cloth. In the middle of its anterior and posterior borders is a fold or plait, varying in length according to the height of the withers, to the outline of which they adapt the bandage.

It is fastened by five bands—two in front, tied together on the chest; one on each side behind, a longer and a shorter, to secure

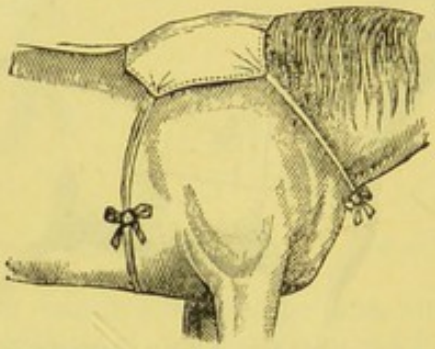

FIG. 200.—BANDAGE FOR WITHERS.

the bandage beneath the chest; and the fifth in the middle of the posterior border to attach it to a surcingle or crupper. A band may be fixed on the middle of the anterior border, to fasten this to the mane (Fig. 200).

10. *Bandage for the Back.*—This may be a wide or long piece of cloth, square in shape, the posterior angles cut off, and furnished with six bands—one for each corner. Two of the bands on each side pass round the chest and abdomen, the posterior two pass

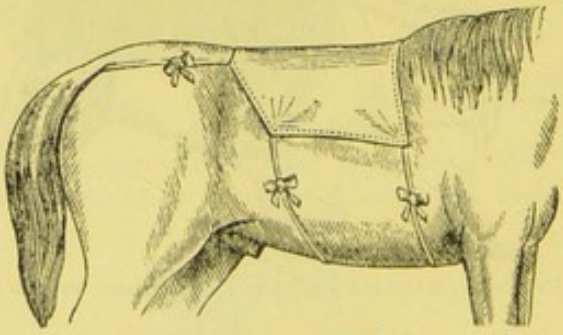

FIG. 201.—BANDAGE FOR BACK.

under the tail like a crupper. Two bands may be attached to the anterior border to be fastened round the neck to prevent the bandage slipping back (Fig. 201).

11. *Bandage for Loins and Croup.*—Similar in shape to the last, sufficiently large to cover the loins and croup, and with a plait in the middle of its borders, except the anterior, to make it fit, this bandage is provided with a band at each angle; the two anterior cross beneath the abdomen, and tie over the loins, the two posterior

pass within the points of the hip, obliquely cross the inner face of the thighs, across the stifle and up the outside of the thigh, to tie to the middle bands towards the hip joint. The bandage may have two bands in front to fasten it to a surcingle (Fig. 202).

12. *Bandage for the Hip.*—This is a large rectangular piece of cloth, covering a portion of the croup and the whole of the hip, the inner border of which is adapted to the perinæum, and the outer to the side of the thigh, where it has a plait; its lower border has

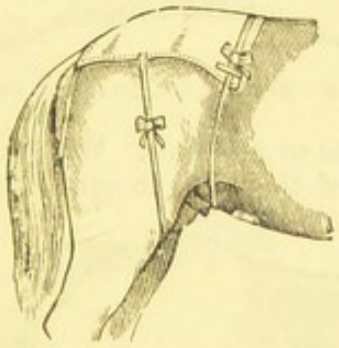

FIG. 202.—BANDAGE FOR CROUP.

also two plaits, and these, with the other, adapt it to the region it covers.

Eight bands attach it—three to the posterior border, which are tied to a crupper; one at the upper border, sufficiently long to tie it to the surcingle; three at the lower border—two pass round the leg in opposite directions and cross each other outside, one goes to the crupper and the other runs upwards to be tied to the surcingle or front part of the crupper, while another passes obliquely inside

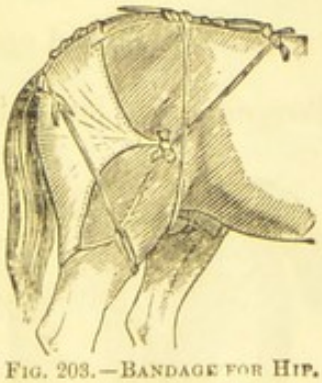

FIG. 203.—BANDAGE FOR HIP.

the thigh, over the flank, and is secured to the crupper. The eighth band is tied to that on the side of the thigh (Fig. 203).

13. *Bandage for the Testicles, Inguinal and Prepubic Regions.*—This bandage is formed by a somewhat triangular piece of cloth, the base or wide portion being placed anteriorly, and the narrow part fitting over the perinæum. It has four bands at each corner, the two anterior (Fig. 204, *a*, *a*) passing upwards outside the flanks to be tied over the loins, while the two posterior (*b*, *b*) are carried up the

perinæum, and are attached to the others (Fig. 205). This bandage may be employed to cover wounds in this region, and as a suspensory

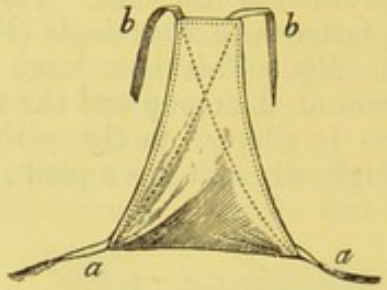

FIG. 204.—BANDAGE FOR TESTICLES, FORM OF.

bandage for the testicles or mammæ. When employed for the latter purpose in the case of the cow, sheep, or goat, it must be made

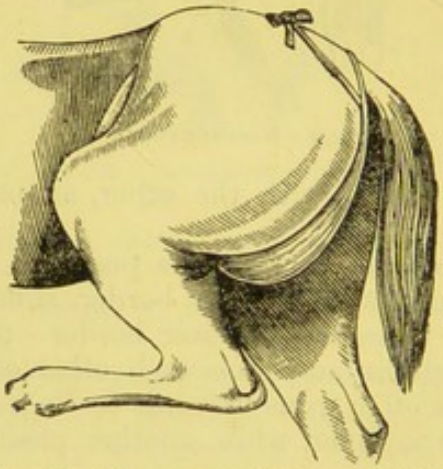

FIG. 205.—BANDAGE FOR TESTICLES, APPLIED.

wider at its middle and anterior part, and openings cut in it for the passage of the teats.

14. *Bandage for the Perinæum.*—A long piece of cloth, with two

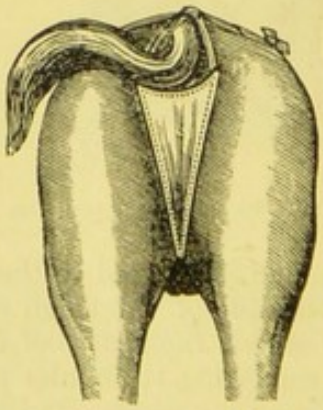

FIG. 206.—BANDAGE FOR PERINÆUM.

bands, and concave on its upper border, to receive the root of the tail, and divided into two portions at its lower end, to which bands

are attached, forms a perineal bandage. The lower band on each side passes up the flank towards the loins, where it is tied with the upper band of the same side, which is carried up by the croup (Fig. 206).

15. *Bandage for the Abdomen.*—A long piece of cloth, twice as long as it is broad, with plaits on its sides to adapt it to the shape of the abdomen, furnished with six bands to attach it, forms this bandage. Two of the bands are tied over the loins, two over the back, and two

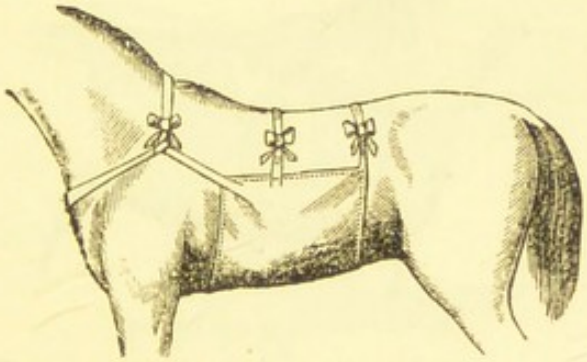

FIG. 207.—BANDAGE FOR ABDOMEN.

on the withers. A cross-band may pass between the latter, across the chest, to keep the bandage forward (Fig. 207).

16. *Bandage for the Chest.*—A bandage for the lower part of the chest is formed by a piece of cloth the width of this part between the fore-limbs, where it may be hollowed out somewhat for these, notched behind the arms to fit the sides of the chest, and provided with six bands—one at each angle, and two in front. The front

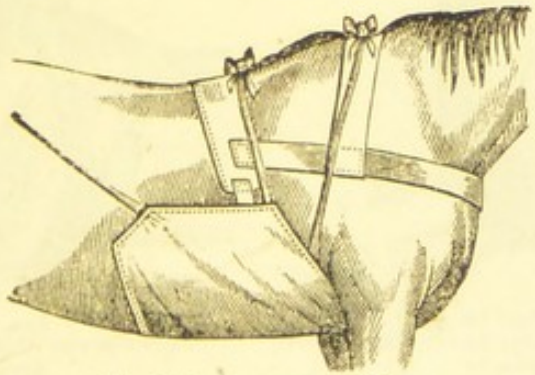

FIG. 208.—BANDAGE FOR CHEST.

bands are tied over the withers, at the root of the neck, the middle pair behind the shoulders, and the posterior pair over the back (Fig. 208).

17. *Bandage for the Breast.*—This bandage differs but little from the last. The ends only are reversed—the wide portion being in front of the breast, and the narrow between the fore-legs. The latter portion has two bands which tie over the withers, and each of the angles has a band—superior and inferior—that fasten the bandage

on each side to the surcingle. The sides have plaits so arranged as to adapt it to the shape of the chest (Fig. 209).

18. *Bandage for the Point of the Shoulder.*—This bandage is large, and pentagonal or trapezoid in shape, or a square *minus* the upper angle. At each of its five angles it has a band, or it may have seven bands, and its anterior border has plaits, which fit it to the shoulder

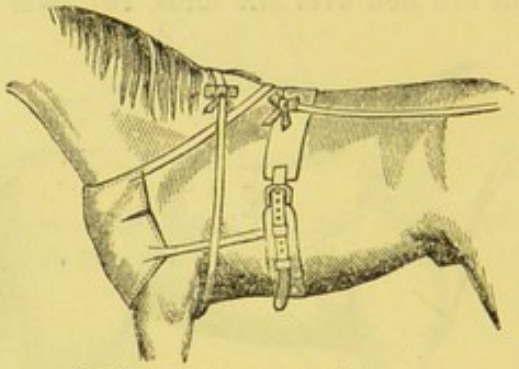

FIG. 209.—BANDAGE FOR BREAST.

and the front of the arm. It is placed obliquely on the shoulder. The two upper bands (Fig. 210, *c*, *c*) attach it at the withers to the two lower bands (*e*, *f*), which first pass around the fore-arm, then under the chest and up the opposite side to meet them ; the anterior band (*d*) is tied to a breast-strap, or to the bands on the opposite

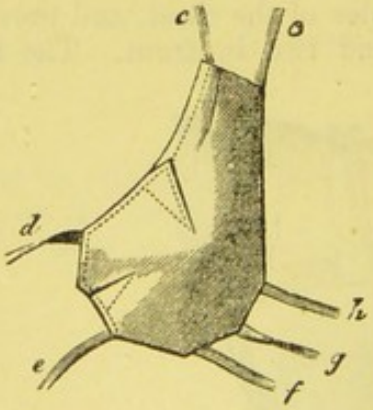

FIG. 210.
BANDAGE FOR SHOULDER, FORM OF.

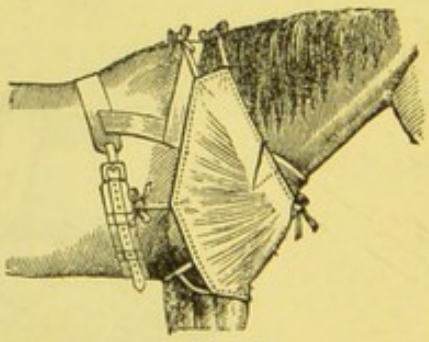

FIG. 211.
BANDAGE FOR POINT OF SHOULDER, APPLIED.

side of the withers, while the two upper posterior bands are tied to the surcingle (Fig. 211).

19. *Bandage for the Shoulder.*—This is a square piece of cloth, with the upper angle cut away, and plaited in several places on its borders. It has six bands—three anterior, one of which passes round the neck to tie with the upper posterior one, two go round the chest to fasten to the surcingle, the third is carried between the fore-legs to be tied to the lower part of the surcingle.

—a superior which is fastened over the neck, and two posterior bands which are tied to the surcingle.

20. *Bandage for Fractured Scapula.*—This is an ordinary roller bandage, three or four inches wide, adhesive, passed around the fore-arm, and carried up towards the seat of fracture; other bandages pass down obliquely from the withers, over the fracture and the shoulder-joint, to be fixed on the breast, and also around the fore-

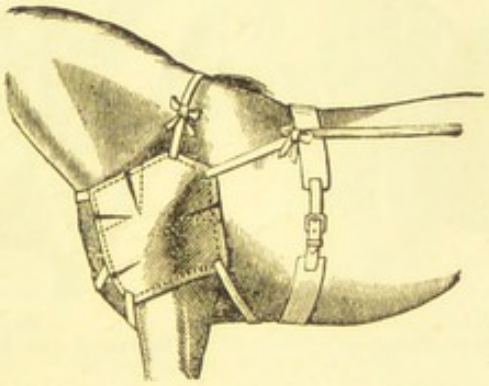

FIG. 212.—BANDAGE FOR SHOULDER, APPLIED.

arm. Above these, again, when they are fixed, are others going round the fore-arm and crossing each other, wider bandages crossing the chest and opposite shoulder, and a broad piece encircling the chest and binding down all the other bandages on that part (Fig. 213).

21. *Bandage for the Elbow.*—This is a difficult part to bandage. A piece of cloth, somewhat triangular in shape, with a wide plait

FIG. 213.—BANDAGE FOR FRACTURED SCAPULA.

at the base, and smaller plaits at each side (Fig. 214), is attached by five bands. The upper posterior one (Figs. 214, 215, *f*) passes to the withers, to tie with an inferior band (*i*), which is carried beneath the chest to the opposite side; two other bands (*g*, *h*) are tied to a breast-strap in front; another (*k*) goes round the back of the fore-arm, between the fore-legs, under the other bands, and is fastened to the breast-strap in front.

22. *Bandage for the Fore-arm.*—This is in the form of a triangle, a portion of the apex being cut away. The upper part is the widest, and is hollowed to fit the arm-pit. Two principal bands, crossing each other, attach this to a breast-strap, while its borders are joined by tapes outside the fore-arm (Fig. 216).

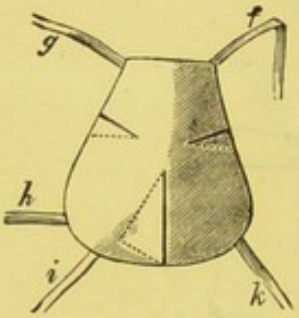

Fig. 214.
Bandage for Elbow, Form of.

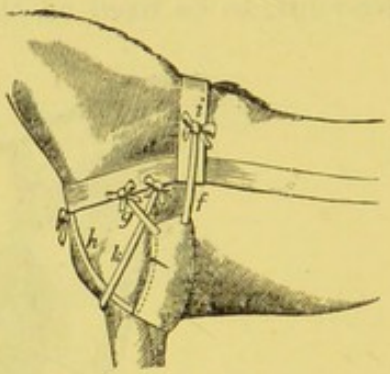

Fig. 215.
Bandage for Elbow, Applied.

23. *Bandage for the Knee.*—For this joint an ordinary knee-cap is often used to cover and sustain a common roller bandage. Otherwise, a square piece of cloth is required, in which a notch is made at the upper part for the reception of the pisiform, and another in the middle for the front of the joint, both notches being filled up by a small piece, so as to form a gusset. A band is attached to the

Fig. 216.
Bandage for Fore-Arm.

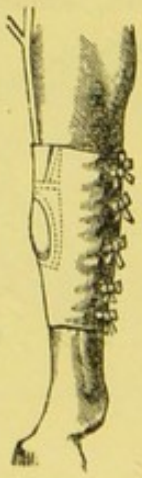

Fig. 217.
Bandage for Knee.

middle of its upper border, and bifurcates before it reaches the neck, around which, or to the mane, the divided portions are tied. The side borders of the bandage are joined by tapes (Fig. 217).

24. *Bandage for the Stifle.*—This is a triangular piece of cloth, the base being very wide, and uppermost. To its three angles it has as many bands. The upper band extends up the flank, and is fastened

at the loins to a crupper; that at the inner angle turns forward inside the thigh, to be tied to the crupper at the tail; while the third is brought round the inside of the thigh in front of the patella, and going round the first band is also attached to the crupper at the tail (Fig. 218).

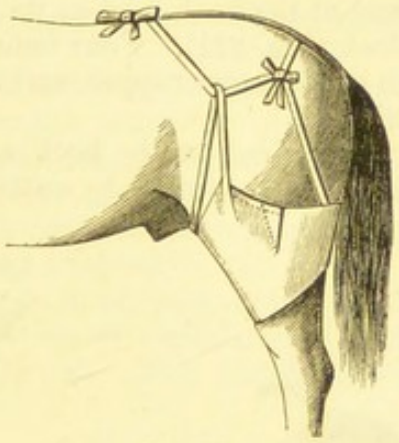

FIG. 218.
BANDAGE FOR STIFLE, APPLIED.

25. *Bandage for the Thigh.*—In shape somewhat like the last, this bandage has three gussets, two of which (Fig. 219, C, D) are on the upper border, and one (I) on its lower border, each side having a plait. There are nine or ten bands—four at its upper border (A, B, C, D), and five or six at its lateral borders. One band (D) passes along the flank, and is tied to the crupper on the loins;

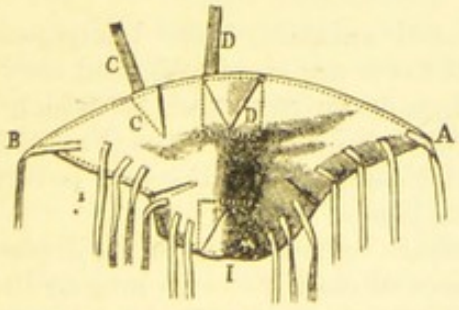

FIG. 219.
BANDAGE FOR THIGH, FORM OF.

FIG. 220.
BANDAGE FOR THIGH, APPLIED.

another (C) turns outwards along the inner face of the thigh, across the quarter, to be attached to the first (D), or to the crupper. Two others (A, B) cross at the lower part of the quarter, above the gastrocnemii tendons, so that one (A) passes to the inner side of the thigh and is tied to the surcingle, while the other (B) is attached to the crupper at the tail. The small bands at the sides are tied in

pairs inside the limb, so as to make the bandage more or less tight (Fig. 220).

26. *Bandage for the Hock and Shank.*—This is formed by a piece of cloth sufficiently long to completely envelop the hock and shank, as low as the fetlock. Its upper border, which is wide, is notched somewhat for the bend of the hock, and at its lower border is a kind of gusset for the fetlock (Fig. 221). Four bands on its upper border attach it to the thigh bandage or crupper, and the sides are joined by tapes in front (Fig. 222).

If a bandage is only required for the hock, a shorter piece of cloth will suffice. This can be well secured by cutting a round hole in its

Fig. 221.
Bandage for Hock and Shank.

Fig. 222.
Bandage for Hock and Shank, Applied.

middle, or to one side, to admit the point of the hock, and tying the sides together with tapes.

Usually, for the hind and fore legs, below the hocks and knees, the roller bandage is employed, and is applied in the manner already described.

For the other larger domesticated animals, these bandages are applicable ; for the smaller animals fewer are employed, and they are modified in form. For the *dog* there is an ear bandage, which is a kind of night-cap fastened around the head by wide tapes (Fig. 223, *a*). Instead of cloth, a cooler and better bandage for the ears is formed by a small, light net tied around the head.

There is also an abdominal bandage, which is useful in disease of the mammæ. It is formed of a piece of cloth twice as long as broad. Near the middle it has openings, through which the hind-legs pass, and the posterior border is notched or tailed to make two bands, which cross over the loins, and are there pinned or sewn together. The sides and front are secured to the body by six bands—two tying in front of the chest, and four across the back (Fig. 223, *b*).

C. Mechanical Bandages.—Bandages which, in addition to the protection they may afford to a wound, have a direct action in curing, are named *mechanical* or *active bandages*. In this sense, the roller or wide bandage may be included in this class ; but the designation is

more particularly reserved for apparatus devised to produce a therapeutic mechanical action on certain parts or organs, by compression, distension, or otherwise. Mechanical bandages are employed for fractures, dislocations, herniæ, deformities, distortions, diseases of the feet, etc. They may be of cloth, leather, gutta-percha, wood, iron, or other metal. These bandages will be referred to hereafter.

Application of Dressings.—The application of dressings has a great influence on the result of operations or accidents, and therefore demands care, skill, and patience.

Before dressing is commenced, everything necessary should be at hand, and the animal properly placed and restrained, if need be—every precaution being adopted in this respect. It only too often happens that the amount of pain animals suffer in having their wounds dressed is left out of consideration, and they are subjected to much needless suffering. This should not be. Animals ought

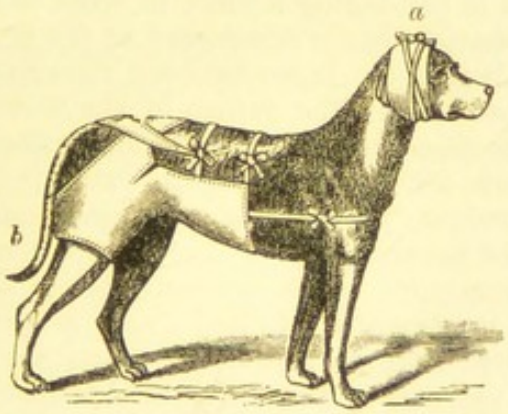

FIG. 223.—BANDAGES FOR DOG: *a*, EARS; *b*, MAMMÆ.

to be as tenderly treated as circumstances will permit; as not only will they be spared unnecessary pain, but dressing is more easily and quickly accomplished, and the dresser and his assistants are exposed to less risk from the violence of the creatures themselves, while gentle manipulation of a wound or diseased part facilitates recovery. For this reason, unless absolutely necessary, fingers, probes, caustics, or plugs should not be introduced into wounds, neither should they be exposed needlessly, nor too long; dressing should be performed quickly, though without hurry or carelessness.

Cleanliness and neatness should also be observed, and particularly the former, otherwise grave results may follow. For instance, should a blood-clot, a piece of necrosed tissue, or foreign matter be allowed to remain in a wound, it will give rise to suppuration or septic infection. Therefore, in proceeding to dress a wound, attention should be particularly directed to cleansing it thoroughly, and protecting it from influences which lead to suppuration and necrosis. The most important rules for avoiding accidental complications of wounds are prophylactic, and consist chiefly in rigid antisepsis, not only in treating the wound, but in the general care of the patient and its surroundings. Not only this, but the instruments, sponges, cloths,

bandages, etc., should be kept scrupulously clean and disinfected. For this purpose nothing is better than a five per cent. solution of carbolic acid.

Therefore, in dressing wounds, the first care should be to free them from blood and blood-clots, tissue fluids, and foreign bodies, by swabbing or injecting them with carbolic, chinosol, or sublimate solution. The skin around the wounds should also be kept clean and free from discharges and crusts.

After the wound has been cleansed and hæmorrhage suppressed, it should be placed in the most favourable condition for cicatrization, by sutures or otherwise, then pledgets, compresses, and finally bandages are applied. The application of these should be so made that the pressure is equable over the whole, and no folds or wrinkles exist; otherwise there may be constriction or strangulation of the part. Bandages and tapes, especially, should not be so tight as to check the circulation, nor yet so loose as to allow displacement of the dressing; and in bandaging a limb, in order to prevent swelling, the compression should always commence at the periphery.

The intervals allowed to elapse between changing or renewing of dressings will depend upon the nature of the wound and other circumstances. In some cases an interval of many days may be allowed to elapse, while in others—as in deep, extensive, and unhealthy wounds, with profuse suppuration—dressing may be necessary every day, or even several times a day. In the majority of cases, however, wounds require to be dressed once a day—unless some special method of treatment is adopted; and, as a rule, it is better to prolong the interval than to shorten it, particularly if there is no suppuration, and cicatrization is going on favourably.

After an operation, the first dressing is not generally removed until the third or fourth day; and in some operations on the foot of the horse, seven to fourteen days may advantageously elapse before the second dressing is applied. On the contrary, when a compressive dressing is applied to arrest hæmorrhage from a cut vessel, this dressing may be removed after twenty-four hours, as by that time the formation of a clot in the tube will be completed.

The effect of the early dressings should be watched, and particularly the first dressing. If after its application the animal is uneasy, symptoms of pain increase in intensity (marked by anxiety, restlessness, attitude), and especially if there is fever, or if this is aggravated, then immediate attention should be given to the dressings, with a view to relax or remove them (or the sutures), if they are too tight or inappropriate, or to discover the cause in the condition of the wound itself.

Discharges should be allowed free escape, and this may be provided for, when apprehended, by a band of gauze or a drainage-tube placed, one end at the bottom of the wound, the other externally, if the position of the wound permits; if not, they should be absorbed by the dressings.

In removing dressings from a wound, certain precautions should be observed. If they have become adherent to each other, to the

wound, or to the adjoining parts, by blood or discharges, the whole should be moistened with tepid medicated water until adhesion has been diminished, when they can be removed without causing pain or disturbing the wound. The bandage should be rolled or folded up as it is taken off, the tow or lint raised gently and progressively and when the wound is exposed it should be cleansed immediately without irritating it or making it bleed. If it require surgical intervention, this should take place as speedily as possible, after which it should again be dressed without delay.

The general effect of a dressing is to protect a wound from the action of the air or contact with external bodies, and more especially

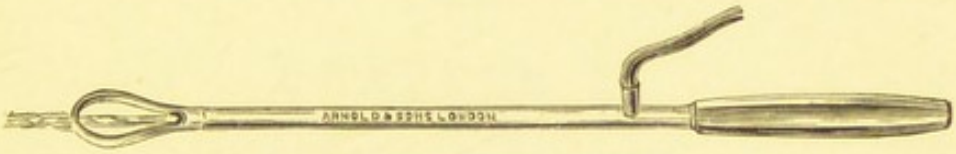

Fig. 224.—Duke's Flushing Curette.

with those bacteria which retard the healing process. Consequently, pain is diminished, the results of inflammation are limited, and repair is accelerated.

The effects of dressings are dependent upon their character and mode of application. In view of the objects of surgery, which are to promote healing of a wound as rapidly and favourably as possible, primary union or healing by first intention, should always be aimed at.

Cleansing of the wound is, therefore, of great moment, as blood and foreign bodies will prevent primary union, while contact with septic organisms may lead to troublesome complications. The admission of pyogenic organisms should be prevented by an appro-

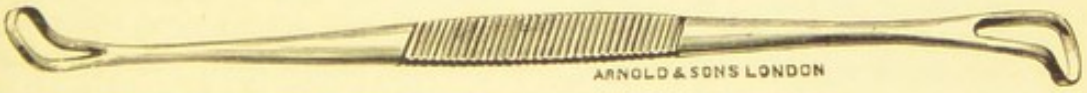

Fig. 225.—Double Curette.

priate antiseptic dressing. Suppurating wounds should be frequently irrigated with an antiseptic solution. Irrigation can be effected by means of a syringe provided with a flexible nozzle, or by using Duke's flushing curette (Fig. 224), which, for this purpose, may be connected to a Higginson's syringe (Fig. 172).

If from neglect or improper treatment suppuration and putrefaction occur—if the borders of the wound and tissues are swollen and infiltrated, and symptoms of septic infection are manifest, the wound should be opened to its full extent, swabbed, and flushed with a strong solution of carbolic, chinosol, thymol, or salol, all necrosed tissue removed by knife or curette (Fig. 225), and counter openings made for drainage; then the whole wound should be thoroughly douched with a germicide, and dressed antiseptically.

PART II.

CHAPTER I.

GENERAL OPERATIONS.

UNDER the head of General Operations, will be included the *operative treatment of dislocations* and *fractures;* the *removal of tumours; cauterization; galvano-puncture* or *electro-puncture; setons; injections; inoculations;* operations on *bloodvessels*, on *muscles*, on *tendons*, on *nerves*, on *fasciæ; amputations; extraction of foreign bodies from wounds.*

SECTION I.

DISLOCATIONS AND FRACTURES.

These accidents will be alluded to briefly, and only in so far as operative procedure is concerned; the different kinds of dislocations and fractures, their nature, causes, and general treatment, not coming within the scope of this work, except in particular cases.

Dislocations or Luxations.

A dislocation consists in the complete or incomplete displacement of the articular surfaces of bones, whereby their natural position and relations to each other are altered; these surfaces no longer corresponding to each other, so as to ensure solidity of union and completeness of function. The displacement of the articular surfaces may or may not be accompanied by laceration or rupture of the capsules, ligaments, or muscles which maintain them in apposition; and this displacement may be *consecutive* or *symptomatic*, when related to pathological conditions, and *accidental* or *traumatic*, when due to external violence or excessive muscular contraction. The displacement may be *complete* or *incomplete*, when disunion is thorough or partial; *single* or *multiple*, according as only one or more than one articulation is involved; and *simple* or *complicated*, when there is only dislocation in the first, or fracture of bones or laceration of soft textures or organs in the vicinity of the lesion in the second.

TREATMENT.—The general treatment of luxations consists in bringing the displaced articular surfaces into normal apposition, retaining them there until permanent reduction has been ensured, and combating the effects of the accident.

Reduction is effected by *gentle* means or by *force*. The *gentle means* includes pressure, disengagement, and propulsion; indirect pressure in one direction upon the most salient portion of one bone, while the other bone is held firmly or pressed in the opposite direction; propelling or pushing back one bone until its articular face is on a level with that of the other, when direct pressure may be employed; disengagement when two bones overlap, two processes or pominences become locked into each other, or a displaced articular surface is fixed among ligaments or muscles.

Force, in the majority of dislocations, is necessary with the larger domestic animals, in order to overcome the powerful muscular contraction, which is greatly increased by the irritation or inflammation that ensues from the injury sustained, and which increases with the time that elapses before reduction is effected. The production of general anæsthesia may be necessary to produce that degree of muscular relaxation necessary for reduction.

Reduction is effected by *extension*, *counter-extension*, and *coaptation*. In some cases *coaptation* is sufficient, and is effected by strong direct pressure in an inverse direction on the displaced articular surfaces; rotary or semi-rotary movement; a lateral or hinge-like movement; or forcible flexion of one of the bones. In resorting to *extension* and *counter-extension*, care should be taken not to compress the muscles passing between the displaced bones, as this prevents their elongation and increases their contraction; and the force employed should be proportionate to the number and size of the muscles whose resistance has to be overcome.

In order to effect reduction, it is necessary in nearly all cases to place the animal in the recumbent position, or at least to secure it in such a way that it may remain immovable while traction is being exercised on the parts. If the animal is large, assistants will be required to produce this traction on the one part, and to resist it on the other. If the luxation is in a limb, extension must be made from the distal extremity, at a point more or less distant from that where reduction is required, so that the muscles surrounding it be left free; and this point should be of such form that it will not allow the bands or ropes fastened around it to slip—as above the knee or pastern joint—and contusions, fractures and secondary dislocations should be guarded against. Where much force is required, extension should be made from the luxated bone itself, *i.e.*, that which, of the two, is farthest from the body. The operator himself, aided by others if necessary, seizes the parts, gives directions as to the extension traction; and while this is being exercised, he brings the bones into their normal position, by making the luxated bone pursue the same course it followed in dislocation, but in the opposite direction. At first traction should be moderate, and in the direction of the displacement, as if to increase it; then it should be gradually and steadily

increased without intermittence or jerking, until the articular surfaces are on the same level, when they may be pushed towards each other. It often happens that muscular and ligamentous action brings about coaptation when extension is sufficiently advanced. When this takes place, it is often indicated by a sharp sound ; otherwise the restoration of the natural form, direction, length, and movement of the part or limb are evidence that reduction has been effected.

In addition to the necessary extension and counter-extension, the operator has frequently to exercise pressure above, below, laterally, forwards, or backwards, in order to effect coaptation.

Sometimes the resistance to reduction is so great, that the first attempt is not always successful, and renewed efforts have to be made, with perhaps variations in the procedure, and in serious cases division of certain muscles or ligaments has been recommended. It may be observed that, of all the domesticated animals, reduction is most easily effected in the dog and sheep.

Soon after reduction has been accomplished, the effects of the luxation begin to disappear, and measures must be adopted to prevent its immediate recurrence. The parts should be kept at rest and immovable (often difficult with animals), and the bones maintained in apposition ; sometimes semi-flexion is advantageous.

In endeavouring to secure quietude in the animal, and immobility in the dislocated or fractured part, the veterinary surgeon is placed at a great disadvantage, in comparison with the surgeon of mankind. The restlessness and impetuousness of animals when suffering from pain or restraint, especially in their limbs, the impracticability of keeping them in the recumbent position for any length of time, the damage inflicted by the weight of the larger animals, when the legs are injured, as well as the difficulty in applying or retaining in position effective apparatus or bandages for maintaining the parts in apposition, are the serious obstacles encountered by the veterinary surgeon, and to overcome them wholly, or even partially, demands the exercise of much tact, patience, and skill.

A very important aid towards this end is found in the apparatus popularly known as 'slings' (Fig. 226), which are employed in medical as well as surgical cases, when the animal is unable to stand, or is less likely to recover if allowed to get up and lie down or move about. This apparatus supports the patient, removes the weight to a considerable extent from the limbs, keeps the animal in one position, and allows the surgeon greater freedom in applying bandages and remedies.

In principle, the slings are a very simple contrivance, and may be readily extemporized from a sack, two pieces of wood and two ropes. Improved slings, however, are more advantageous and convenient, and must be considered as a most essential accessory in the treatment of dislocations, fractures, and some other surgical cases.

According to the amount of injury, local applications are required, and bandages appropriate to the different kinds or seat of luxation must be applied, in many cases, to ensure recovery. These bandages may be of resins, pitch, cloth—specially prepared if need be—gutta-

percha, poroplastin, leather, pasteboard, wood, iron, etc.; they will be described when fractures are discussed. They may or may not require to be removed at certain periods, according to circumstances. Where they cannot be employed, and when compression and rest are necessary, restraining tumefaction and pain can be produced by means of blisters applied over the part. It often happens that anchylosis ensues, if slight movement is not permitted in the course of recovery.

If the luxation is complicated with fracture, and reduction of both cannot be effected at the same time, only one should be dealt with immediately, and that should be the fracture. A few of the more important luxations will now be considered.

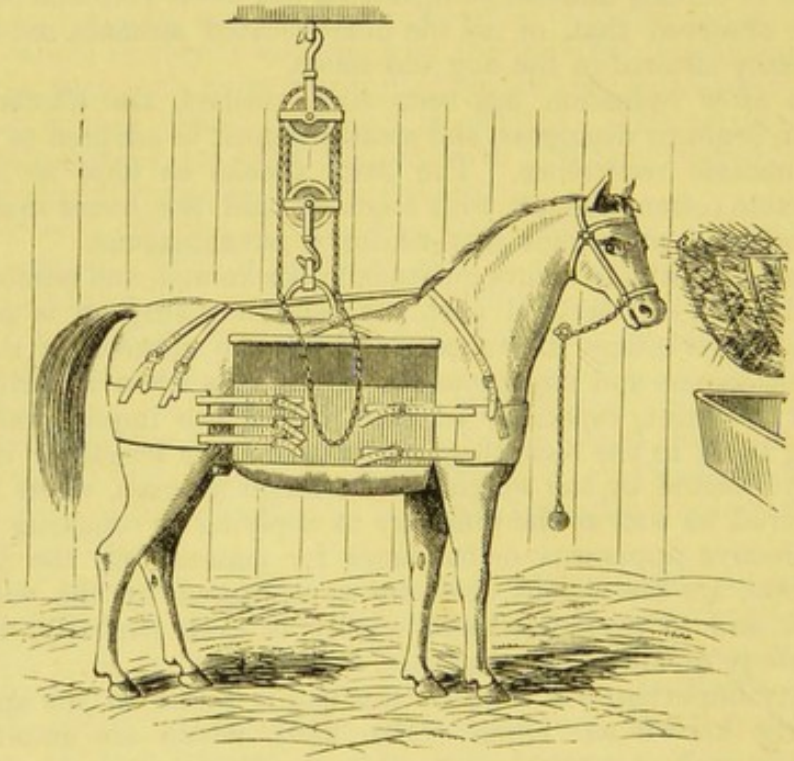

FIG. 226.—HORSE IN SLINGS.

1. *Luxation of the Inferior Maxilla.*—Complete luxation of the lower jaw must be exceedingly rare in the larger domesticated animals, but it has been observed in the dog and cat. The condyles are always displaced forwards; both may be so displaced (*bilateral luxation*), or only one (*unilateral luxation*). In the horse and ox, partial or incomplete luxation has been observed.

In the *reduction* of the bilateral form two procedures may be adopted. In the first, the head of the animal is firmly held by an assistant, and the operator, placing himself in front of it, passes his thumbs as far into its mouth as possible, so as to make downward pressure on the branches of the jaw, the other fingers being placed under the chin, to make upward pressure. The thumbs depressing the jaw behind, and the other fingers raising it in front, it is at the

same time pushed backward, when by the contraction of the temporal and masseter muscles reduction is effected—sometimes so suddenly and forcibly that the operator incurs the risk of being bitten. For this reason the second procedure is perhaps preferable, and is as follows: a piece of wood—as a ruler, handle of a small hammer, etc.—is passed deeply and transversely into the mouth, between the molar teeth, and held there by an assistant, while the chin is slightly pulled forward and upward by the operator either with the hand or by means of a piece of tape passed round the jaw, behind the canine teeth. The upward pressure depresses the posterior part of the jaw, and a push backward then carries the condyles into their articular cavities. A simple bandage around the jaws for a few days, to prevent the animal masticating, completes the cure.

In unilateral luxation, the same procedure is adopted; the side affected, however, is only acted upon.

2. *Luxation of the Vertebræ.*—This is nearly always immediately fatal; and in those cases in which it is not, attempts at reduction are rarely made. In one successful case of reduction of luxation of the atlas or the axis, the procedure was as follows: The animal being in the recumbent position, a side-line was fastened round the neck in front of the shoulder, the other end being tied to a post towards the animal's croup, to produce counter-extension; a rope and pulley secured to a strong head-collar at one end, and a wall at the other, made extension on the head. Three men made traction on the rope and pulley, and when the neck was fully extended the operator manipulated the atlas and axis in such a way as to produce coaptation. A blister applied over the part completed the cure.

3. *Scapulo-Humeral Luxation.*—This has been observed in a complete form in horses, cattle, calves, and dogs, and is a very serious accident, which is further increased by the difficulty experienced in reducing the luxation and preventing its recurrence. Though recoveries have been recorded, yet the result has not always been favourable; and when fracture is present the case may be considered hopeless, especially in horses. Displacement usually takes place forward, the head of the humerus projecting considerably beyond the scapula, though it may also occur backwards or outwards.

In order to reduce this luxation, the animal must be placed in the latericumbent position, a rope or band passed round the armpit, and brought over the shoulder, where counter-extension is made by assistants; while extension is made by placing another rope or band around the lower part of the limb, above the knee or pastern, and pulled by men. A sufficient degree of extension having been effected, coaptation is produced by the operator, and is indicated by the peculiar sound heard at the moment when the two articular surfaces come in contact. To make certain that this is the case, the limb should be slightly rotated. After a certain time the animal may be permitted to carefully rise, and a vesicant should then be applied over the articulation, or the bandage described for fracture of the scapula may be employed.

4. *Humero-Radial Luxation.*—This is rare in the horse; but in the

ox, pig, and dog, dislocation of this joint and of the olecranon, without fracture, is not unfrequent. In the smaller animals reduction is easy if the accident is recent and the creatures are docile; but if there is fracture also, there is little hope. Extension is made from the lower part of the limb, and counter-extension from the body; while the operator makes pressure to effect reduction. It is often necessary to considerably flex the fore-arm, however, before coaptation takes place. The bones are maintained in apposition by an adhesive plaster, or an iron splint hereafter to be described.

5. *Metacarpo-Phalangeal* (Fetlock-Joint) *Luxation.*—This is not unfrequent in the horse in the incomplete form; and cases are recorded of its occurrence in the complete and complicated form, followed by recovery (see *Veterinarian*, 1874).

Reduction is comparatively easy, and apposition is maintained by pads, compresses, splints, and bandages, in the manner to be immediately described.

6. *Coxo-Femoral Luxation.*—This very important joint is somewhat liable to dislocation in the horse and ox, the liability being less in the smaller animals. It may be complete or incomplete, and displacement may be in almost any direction when it is the former.

In the small animals reduction is easy when the accident is recent, and is effected by placing the animal on the opposite side, extending the limb from the thigh, counter-extension being made from the pelvis (one hand being placed on the ischium, the other on the pubis); the limb is at the same time adducted and abducted, and when the head of the femur is opposite the cotyloid cavity, it is drawn into it with a snapping sound, and the limb can be moved as usual. If the accident is recent, nothing more is generally necessary; but it is often prudent to prevent repeated displacement, by applying a hip-bandage or a vesicant.

With the larger animals the same procedure is to be adopted; but, of course, greater force is required to overcome the muscular resistance, for which anæsthesia is to be recommended. For counter-extension, a roll of cloth or a sack, to the ends of which rope is attached, is placed beneath the thigh and over the side of the pelvis, the rope being secured to a fixed point beyond the croup; while for extension, ropes are fastened above the hock and fetlock, and fixed pulleys may be in connection with these. Luxation inwards is more easily reduced if a large body (as a small rolled-up mattress) be placed between the thighs, to act as a fulcrum; while the lower end of the limbs is made a lever in pressing it downwards, by which the head of the femur is raised. In luxation outwards the opposite procedure is advisable: the animal being laid on the same side as that on which the dislocation is, the fulcrum placed on the ground outside the femur near the trochanter, and downward pressure made on the lower end of the limb.

When reduction is effected, provision must be made to prevent recurrence. The animal should be placed in slings (which are necessary in nearly all cases of dislocation or fracture, as well as in those surgical cases in which injury may be done by the animal lying

down and getting up, or moving about at large), and a bandage or other suitable appliance placed upon the limb to ensure retention for some days.

7. *Femoro-Tibial Luxation.*—Dislocation of this articulation is probably not recorded; but that of the patella is by no means rare, especially in the horse. It is generally displaced outwards, luxation inwards being only possible when extreme violence has been exercised. Incomplete luxation of the patella is somewhat common in the horse, but has not been observed in cattle.

There is no difficulty in reducing luxation of the patella. It can often be accomplished by 'backing' the horse forcibly and suddenly, and somewhat diagonally, a few paces. If this does not succeed, then a rope or side-line is fixed around the pastern, the other end passed round the neck, and the limb pulled very much forward —the fetlock nearly as high as the elbow on the same side; the hand can then push the patella (lying outside the articulation) forward and inward with a jerk. If the displacement is inwards, the hand will be scarcely strong enough, and a piece of wood, manipulated with both hands, will be required to raise and carry it upward and outward. Effective reduction is evidenced by the altered and normal position of the limb, and free movement.

Recurrence of the luxation outwards is common; and to prevent it the animal should be kept as quiescent and immovable as possible (in slings, if necessary), and stimulants, vesicants, or plasters applied. If the luxation is due to rupture, atony, or relaxation of the ligaments, powerful and repeated vesicants, or even actual cautery, may be required; or a special splint of iron, to be described hereafter (Fig. 244), may be used to retain the patella *in situ*. For young animals, in which this accident is notoriously common, a bandage formed by a wide piece of cloth, with a hole cut in its middle for the reception of the patella and to retain it in position, and laced behind the limb, may be successfully applied. If this bandage does not remain firmly in place, it may be made to do so by smearing the skin with Canada balsam, which will cause its adhesion. The limb should be kept in a state of extension, for as long a period as possible, by a side-line round the pastern, the other end being secured round the neck.

Fractures.

Fractures of bones are most frequent, perhaps, in the dog; next in the horse, which is liable to them, not only on account of the nature of its services, but also from contact with its fellows, kicks being a frequent cause. Nearly all the bones of the skeleton are exposed to fracture, though not to an equal degree of frequency. The long bones, especially those of the limbs, the superficial bones, and the thin, flat bones entering into the formation of the different cavities, such as the bones of the cranium, face, and thorax, are most exposed.

Whatever may be the *predisposing* causes, the *efficient* or *determining* cause of fracture is external violence or muscular contraction.

Fractures may involve the entire thickness of a bone, when they are said to be *complete*, or only a portion of this, when they are *incomplete*. Complete fractures may be *transverse*, *oblique*, or *longitudinal*, or a combination of these; and they may be *simple* or *unique*, *multiple*, *compound*, or *complicated*. If the fragments be numerous, the fracture is designated as 'comminuted.' The direction of displacement of the broken portions varies considerably, and gives particular designations to fractures.

Incomplete fractures are not rare in the horse, especially in the limb bones, and particularly what are known as *intra-periosteal* fractures, around which the periosteum remains intact, and forms a kind of sheath, which retains the fragments. In long bones the fracture may be *diaphysary* or *epiphysary*, according as it involves the body or extremity of the bone; and in the latter case, if it penetrates to an articulation, it is named *intra-articular*. *Compound fractures* are those accompanied with a communicating wound of the skin or a mucous membrane, and *complicated fractures* are those associated with laceration of soft tissues, rupture of vessels, tearing of nerves, dislocation, etc.

The symptoms and diagnosis of fracture need not be discussed here, except to mention that in forming the latter the animal should be placed in a position which will be least hurtful to it, and at the same time most convenient to the examiner, who should proceed with patience, care, and gentleness to ascertain the nature and extent of the injury, the necessary manipulations being executed with delicacy and tact, so as to cause the smallest amount of additional pain and injury. In some fractures diagnosis is easy; in others very difficult, and only to be surmised. This is particularly the case in long bones, as the tibia of the horse, in which the fracture may remain incomplete for a comparatively long period, and only become complete when the animal has exposed it to untoward strain.

In operative surgery, the *immediate complications* attending fractures have to be recognised and dealt with, as well as those which arise subsequently. The immediate complications may be extremely varied—contusions of all kinds, lacerations, wounds, etc. When wounds do not communicate with the fractures, they are not of so much importance, and may be treated as simple wounds; those due to firearms need not be interfered with unless they lead to fractured bones, when it may be necessary to enlarge the tract to remove splinters. Hæmorrhage is very often a complication, and the blood may escape from the open wound, if there is one, or collect in the tissues, in a natural cavity, or beneath the skin—forming a hæmatoma. Suppuration, gangrene, arthritis, septicæmia, tetanus, traumatic fever, emphysema, and other complications of a more or less serious nature, follow some fractures. The important organs protected by bones may suffer seriously when these are fractured—as the brain or lungs. Laminitis is not an uncommon accompaniment in horses which have sustained fracture in a limb, the feet of the other limbs having to sustain the weight of

the body for a considerable time, one or more of them become inflamed.

The complications and intense pain to which some fractures give rise, sometimes cause serious general disturbance, even death, in nervous animals; while the restlessness induced by pain, and the consequent continual movement maintained in the injured part, has often a most pernicious influence on the fracture and the subsequent reparative process. This process is not alluded to here; neither is the prognosis of fractures. It must be remembered, however, that upon the prognosis depends the fate of the animal, monetary and utilitarian considerations entering largely into the question of treatment. In only too many cases these considerations lead to the determination to destroy the patient, rather than incur the expense and trouble necessary to effect a cure which might, from permanent lameness, deformity, or some other cause, prove unsatisfactory; these considerations would, of course, have no place in human surgery.

But in veterinary surgery, it must be confessed that the monetary and utilitarian view in relation to prognosis is very often allowed too much scope, and animals are destroyed because of fractures which, with suitable treatment, would make a good recovery. There is a strong tendency to condemn to death animals—particularly horses—suffering from factures—and to a less degree, perhaps, dislocations—of the limbs; while in the case of incomplete fractures, these are not seldom allowed to become complete owing to neglect, mistaken diagnosis, or absence of appropriate treatment—as in injury to the tibia of the horse by a blow on its inner aspect.

It may be accepted in principle, and also as a guide in practice, that fractures occupying the middle portion of a long bone are less serious than those of its articular extremities; as these are more difficult to maintain in position, and more or less permanent and complete stiffness of the articulation is likely to follow. A simple fracture is also not so grave as a compound one, and a comminuted fracture is always more troublesome and serious than one which is simple; while oblique are more embarrassing and dangerous than transverse fractures.

The situation of a fractured bone is also of moment in the matter of prognosis and treatment, fracture of those bones which are placed where it is difficult or impossible to completely fix them being always serious. Fractures accompanied by extension, contusion, and laceration of surrounding soft parts; those with splinters of bone penetrating the skin or bloodvessels; those near to or involving joints; dislocation of one extremity of a fractured bone; stripping of periosteum from the bone; splinters embedded in the soft tissues; and some other features in fractures—are to be viewed as very serious in the case of all animals, but more particularly the horse, in which freedom from lameness and deformity is of so much moment, while treatment is very difficult and expensive. Other circumstances also influence the adoption of treatment of comparatively simple and curable cases—as when there are no facilities or opportunity for surgical interference: for example, during war, when it is so fre-

quently and so painfully necessary to destroy horses for injuries which could be successfully treated under more favourable circumstances.

Complicated, compound, and comminuted fractures are generally considered fatal in animals, no matter in what bones they occur. Other fractures, as those of the ribs, transverse processes of the vertebræ, jaws, cranium (if the brain or its membranes are not seriously injured), ilium, face, and some fractures of the bones of the limbs, may be remedied.

The time which elapses before treatment is adopted has much influence on the result, a recent fracture being more easily and certainly repaired than one of some duration. It may be remarked, that while in man it often requires forty days to form a reparative callus, in the horse this is completed in thirty days.

Species and age have also their influence in the repair of fractures, youth being favourable, and old age or debility unfavourable. Repair is generally more easily effected in small than in large animals, for various reasons; and temperament has a considerable influence in the success of surgical treatment.

Treatment.—The indications for the treatment of fracture are three: 1. Reduction of the broken bone—*i.e.*, bringing the displaced portions into their normal position; 2. Maintain them in that position until repair has been effected; 3. Prevent or combat the local and general accidents.

Surgical interference is urgently necessary immediately after fracture, in the great majority of cases, if the fracture be complete and in a limb—more especially if it be accompanied by much displacement; as the movement of the rough portions of bone, either by muscular action or other cause, may lacerate the surrounding soft tissues and vessels, and perhaps produce compound fracture by wounding the skin.

It not unfrequently happens that a fracture takes place at some distance from where the animal can be treated, and it must be removed there. With the smaller animals this is not of much moment, as they can easily be carried thither, and it is only necessary to convey them steadily and gently. But with the larger animals, as the horse, great care is needed to avoid complications and suffering, particularly from the movement of the part below the fracture, if this be in a limb. If no proper conveyance can be procured (or even if it can), a provisional bandage should be applied, so as to keep the broken parts together and make the limb immovable, if these be in the lower portion. The horse should be walked gently, and if possible be sustained by several assistants; a sack or rug, or even a plank, passed beneath the body and sustained at either end by one or two strong men, affords much assistance.

The stall or box in which the animal is placed should have appliances for 'slinging,' so as to prevent it lying down, keeping it quiet, and relieving the other limbs as much as possible from fatigue. For the fractured limb it may be necessary to excavate a hole in the floor; or the opposite limb may be raised by means of a patten shoe.

Small or indocile animals usually only require a comfortable bed; indeed, with the latter animals, it is better not to impose restraint, as this may do more harm than good. Incomplete fractures require rest and soothing treatment. Complete fractures need somewhat similar treatment, in principle, as a wound or luxation—indeed there is a close analogy between a simple fracture and an incised wound. Reduction and coaptation are the primary indications.

Reduction and Coaptation.—Reduction is only necessary when there is displacement, and this is effected as in luxations; it is not needed if the bones are in their normal position. Extension and counter-extension are alone sufficient to bring the fractured extremities of the bone parallel, end to end, in order to produce reduction. This, however, is sometimes difficult, if not impossible, owing to the situation of the fracture and muscular resistance; and if a cure is to be attempted, all that can be done is to keep the fracture as immovable as possible. Extension and counter-extension are only resorted to in fractures of the limbs, and have been already described for dislocations; fractures elsewhere are variously treated, in order to reduce them. Reduction and coaptation should be effected as early as possible, before swelling has become considerable, or inflammation too advanced. But in many cases coaptation is most difficult, either from the character or situation of the fracture, or the muscular contraction. The latter may be overcome by the administration of an anæsthetic; if the inflammation and tumefaction are obstacles, they must be reduced by appropriate treatment before reduction and coaptation are attempted.

Retention.—A solid, firm dressing should be applied as early as possible in all cases of simple subcutaneous fractures of limbs, and everything should be done to ensure the maintenance of coaptation of the fractured portions of bone in correct anatomical position during the process of reparation. This requires a suitable position to prevent re-displacement, and the employment of proper retentive appliances or apparatus. But position is most difficult to command in animals; the semi-flexion and horizontal direction of the limbs which are so favourable to union in man not being available in animals, which must have their limbs in extension and vertical, and consequently the retentive appliances have a tendency to slip downwards. For these reasons perfect immobility is difficult to secure.

Much benefit may be obtained by partially suspending a fractured limb through the medium of a sheath-bandage around it, by means of cords attached to the roof of the stable. This supports the weight of the limb. Sometimes a suspensory bandage is carried over the body to the opposite limb, with the same result.

In order to maintain coaptation, in nearly all cases fixed or immovable appliances are necessary, these remaining on the part until consolidation of the fracture has taken place; they must be sufficiently rigid to prevent movement or displacement in the fracture, and they should not be applied, if possible, until swelling (if there is any) has subsided. When the fracture is compound or comminuted, special provision must be made for certain contingencies.

The retentive appliances may be pledgets of tow, bands or bandages, of linen or calico, agglutinative materials, splints of wood, pasteboard, leather, gutta-percha, block-tin or iron.

Agglutinative or solidifying matters—sometimes combined with bandages or splints, or both—are perhaps most frequently employed, as they form an immovable casing, binding the different constituents and the skin to which they are applied into one mass. The agglutinative matters may be Burgundy pitch, common resin, and Venice turpentine—mixed together over heat, applied to the skin around the fracture, and covered by a piece of cloth; or the mixture may be spread on a narrow strip of cloth, which is bound round the limb. Glue may be employed in the same manner, as also a mastic formed of powdered chalk and white of egg, or calcined alum and sugar of lead beaten up in white of egg. These dry rapidly after having been smeared thickly on the skin, and form a mould around the fracture. Gum acacia, starch, and similar matters, are also employed, especially with bandages. A mixture which has been found very useful with the larger animals is composed of calcined alum, alcohol, and melted glue. This, in solidifying, becomes very hard, and, if covered with tow or shreds of cloth, answers well. Plaster of Paris is not unfrequently employed, being either placed in a mass around the limb, or incorporated with cloth in the form of bandages; the latter is usually preferred, as the former is too heavy and troublesome. A good mixture is plaster of Paris tempered with water and starch. Sometimes a pitch bandage is first applied, and when it has adhered plaster bandages are placed over it. Liquid glass (silicate of potash) has been very successfully employed.

Tow saturated with one of these answers well in fractures of the horns of hollow-horned animals. Splints may be of various more or less rigid materials. Pasteboard is suitable for small animals, and if soaked in water it is made pliable, or if in paraffin and allowed to dry, when warmed it is readily moulded to the shape of the part to which it is to be applied. Splints may also be of wood (thin or thick, according to circumstances), poroplastin, leather, tin, etc. Gutta-percha makes an excellent splint, as when warmed in water it may be easily moulded on the injured region, and hardens again on cooling. It must be cut into splints or pieces of the proper size; then these are dipped into hot water till they become soft and flexible; they are then applied to the limb, and retained by a moist bandage. The advantages of gutta-percha are its accurate adjustment, firmness, and impermeability to water. Stiff leather may be used in a similar manner, but it is not so advantageous. Iron splints are often necessary.

Splints should be as well adapted to the part as possible, before they are secured to it. They should not only, as a rule, cover the fractured part, but extend considerably beyond it; and if there are joints near, they should immobolize these by being attached to the bones distant from them. The number of splints must of necessity vary; for the fractured limbs of small animals two are generally employed, and in the larger creatures, in special cases, sometimes

four. They are placed opposite each other, and parallel to the length of the limb.

Before splints or bandages are applied, the limb is wrapped round with pledgets of fine tow, thickest over the bony prominences, hollows being made level, so as to protect the soft parts against pressure by the splints. The roller bandages should be of somewhat strong material for the larger animals, and not too broad. They should be applied first at the distal part of the limb or organ, and go towards the body, so as to prevent venous engorgement; and care must be taken that they exercise equable and only moderate pressure. They should be rolled in a spiral manner, the borders overlapping, and with no creases. It is generally advisable to bandage the greater portion of the limb.

The most useful are, perhaps, the *starch* and *plaster of Paris* bandages. The former is applied as follows: A layer of fine tow or cotton-wool having been disposed around the limb, short splints of thin wood or softened pasteboard are adjusted above the seat of fracture, and, over all, a roller bandage is applied in the ordinary manner, beginning from below and proceeding upwards. A second bandage is then applied, and the whole limb, thus encased, is smeared and soaked over with thick starch, which is worked in with the hands. A third bandage may be used, if necessary, as additional security. The casing so formed dries into a firm mass in a day or two. An excellent bandage of this kind is made by a material, the so-called 'organtine' or lining gauze, which is coarse-meshed and *sized* —consequently stiff. When soaked in water it becomes soft, then quickly dries and hardens. If several layers are applied, they unite into a firm but light capsule.

The *plaster of Paris bandage* has only one mechanical advantage over the starch bandage—it dries and sets in a few minutes, a considerable advantage with restless animals. But it is heavy, and is apt to crack behind a joint. However, it has been found a most excellent bandage, especially for large animals. It is usually applied in the following manner: After adjustment and coaptation of the fracture are effected, and cotton-wool or tow is applied directly over the injury, and where the skin lies in close contact with the bone, the limb is spirally enveloped in a flannel or soft cotton roller bandage, so as to make regular pressure on it, and cover all the surface that is to be surrounded by the plaster bandage. The latter is made by sprinkling finely-powdered modelling plaster over an unrolled bandage of thin cotton or gauze, and then rolling it up in the manner already described. When required for use, it is placed in a basin of water and allowed to soak through, then applied over the flannel or cotton bandage, like an ordinary roller bandage. Three or four thicknesses are sufficient to give the dressing the requisite firmness. In about half an hour good plaster of Paris is hard as stone, though the time required for hardening depends partly on the quality of the plaster, and partly on the degree of moistening of the bandage. The plaster may be rubbed into the bandage, which makes the dressing rather heavier and firmer. If the bandage

is not sufficiently firm, a layer of plaster may be applied over the dressing—the plaster paste being made with water, and spread very quickly on the bandage with the hand or a spoon. It should not be prepared until required. Separate pieces of bandage may be employed. Fracture of the metacarpal and metatarsal bones (large and small) has been successfully treated by enveloping the limb, from the hoof as high as possible, with a roller bandage saturated with plaster; over this a layer of plaster was smeared to make an even surface; then a second plaster roller bandage, and another layer of plaster; finally, a third bandage, with a thin coating of plaster over all. This soon dries, and though it may crack at the bend of the knee or front of the hock, it is easily repaired by fresh material at these places.

The efficacy of plaster of Paris bandages depends greatly on the quality of the material, as modelling plaster deteriorates if kept for any length of time, unless protected from air and moisture. A material called 'tripolith' has all the good qualities of plaster, without its disadvantages. It is a fine, grayish-black powder, prepared like the plaster, is cheaper, and may be kept for any length of time, even in an open vessel; it is also lighter than the plaster, hardens even more rapidly, and when hardened resists moisture.

The liquid glass, or silicate of potash dressing, is painted on the applied bandage with a large brush, and may require support by means of splints.

In certain luxations or fractures, iron splints (sometimes combined with wood) are resorted to, and these require to be specially adjusted to the parts. Reference will be made to some of them presently.

In applying bandages which become rigid, as well as splints, care must be taken to prevent them injuring the soft parts which are in contact with their ends; these should not extend beyond the soft bandage, tow, or cotton-wool beneath.

It sometimes happens that, owing to unequal pressure, friction, or improper bandaging, swelling, abrasion, irritation, and necrosis of the soft tissues ensue. This retards the reparative process, or renders it impossible. It is then necessary to remove the appliances, either partly or wholly, for some time, care being taken that there is no displacement of the fracture, the parts being appropriately treated until they can be again encased. Derangement of the splints or bandages, either through restlessness of the animal, alteration in the dimensions of the parts, or mal-application at first, should be rectified according to circumstances; but it must be borne in mind that so long as the broken portions of fractured bone are in apposition, and callus is forming and consolidating, interference should be restricted.

The period at which the appliances may be safely removed (consolidation of the callus being complete), will depend upon many circumstances—the species, age, health, and docility of the animal, character and situation of the fracture, etc.; but the average time is, for the smaller animals 25 to 30 days, and 45 to 60 for the larger ones. Consolidation is ascertained by moving the part carefully in different directions, and also to some extent by the freedom with which the animal moves and places its weight upon the limb. Gentle exercise is necessary to complete recovery, and sometimes local treatment may be required for some time after the retentive appliances have been removed; or if there be deformity, particular apparatus may be required to remove it.

¶ In order to remove the retaining appliances, such as adhesive bandages and splints, the former should be cut across, layer by layer,

in the direction of the limb, and close to the splints, if they cannot be otherwise detached without causing too much disturbance. It generally happens, however, that after the subsidence of the swelling and because of the elasticity of the materials beneath the bandages, it is not difficult to incise the mass from top to bottom.

In compound fractures, it is often necessary to enlarge the wound, in order to return the portion of bone projecting through the soft tissues and skin, before reduction can be effected; and it is sometimes even required to remove a portion with bone-forceps or saw, before the fracture can be reduced. When the fracture is compound, but not comminuted, immediately after reduction the wound should be closed in the manner already indicated, and the retaining apparatus applied. When hæmorrhage complicates fracture, it must be stopped, according to the directions given, and in comminuted fracture, detached pieces of bone must be removed, if they are embedded in the soft tissues, before reduction and bandaging.

In applying bandages and splints in cases of compound fracture, apertures should be left at the seat of the wound, in order to allow discharges to escape, and dressings to be applied. Splinters of bone and soft tissues, as well as blood-clots, intervening between the broken ends of a bone, must be carefully removed before apposition is effected.

When fracture is complicated with dislocation, the latter must first be reduced, especially if recent and possible, without causing too much pain and injury to the soft parts. If, however, the fracture is near the dislocated end of the bone, and reduction of the latter cannot be effected and maintained, it is better to reduce the fracture, and wait until consolidation of the callus has taken place before attempting to reduce the luxation.

Particular Fractures.

Only a few particular fractures will be alluded to here.

Fracture of Cranial Bones.—When there is no displacement, surgical interference with the bones is unnecessary. If there is depression of bones, or fracture and depression, the bones must be raised to their normal position, or removed if detached. For this, trepanation is necessary. The skin is incised in a crucial manner in the immediate vicinity of the injury, the angles are dissected off the bone, and with the trephine (to be hereafter described) one or two openings are made in the sound bone, close to the fracture. Through these an elevator or strong metal probe is carefully introduced beneath the depression or fractured portions, and the border of the opening being used as a fulcrum and the instrument as a lever, the parts are raised to the necessary level, or removed. All splinters or foreign matters are removed with forceps. It may be necessary to puncture the envelopes of the brain, to allow extravasated blood or other fluid to escape; this puncture is perhaps best effected by fine-pointed scissors. The angles of the skin-incision are united by points of suture, and suitable dressings applied—the best, perhaps, being pledgets of tow soaked in a weak solution of permanganate of potass.

Fracture of Orbital Process.—This is not uncommon. If complete, and the portions of bone are depressed, these must be elevated by making an incision through the skin at the zygomatic ridge or other convenient situation, passing a strong metal probe through it, beneath the depressed portions, and raising them. The wound is to be afterwards closed by suture, and suitably dressed.

Fracture of Bones of Face.—These are also frequently fractured and depressed. Often simple treatment is quite sufficient to effect a cure, without operative interference. But if the bones are much depressed, then they must be raised to their natural position, if they are not too much broken and denuded of their periosteum, when they should be removed. In fracture of the nasal bones with depression, a short

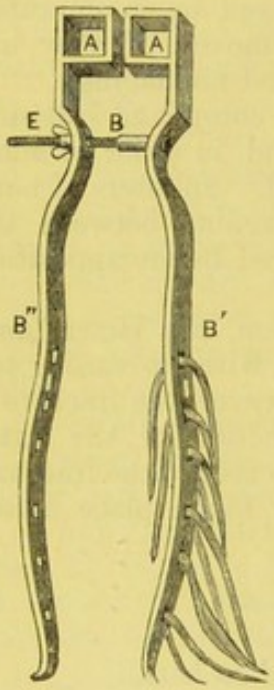

FIG. 227.
APPARATUS FOR FRACTURE OF THE NASAL BONES.

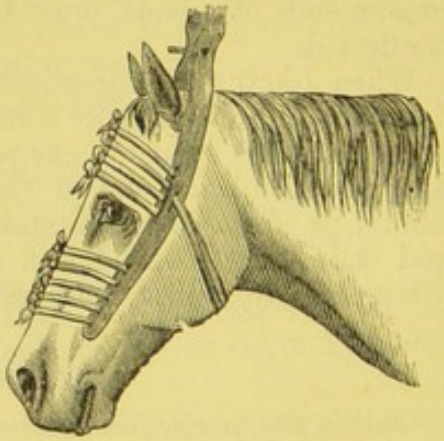

FIG. 228.
APPARATUS APPLIED.

piece of wood, as a ruler, wrapped in a piece of cloth or soft leather, may be passed by one hand up the nostril to the seat of fracture, and the depressed bone raised, the other hand aiding in the operation externally. Or an incision may be made through the skin near the fracture, and an elevator or fine chisel used to raise the fragments—a gouge, brace and bit, or trephine being sometimes required to make an opening in the solid bone for the elevator to be inserted. In other cases, a sharp hook will raise the pieces. All detached portions should be removed. The re-adjusted bones rarely require further treatment, but if they are likely to become displaced, a glue or pitch plaster applied across them and the adjacent bones will generally suffice: if deemed desirable, the nostril may be plugged with a bundle of firmly rolled tow, secured by a piece of twine, the end of which is

allowed to hang outside the nostril, for the removal of the plug when necessary.

For serious fractures of the nasal bones, which might be followed by grave and permanent interference with respiration in the horse, Bourgelat devised an iron apparatus, which has been successfully employed. This consists of two long, narrow plates, thicker at their upper than their lower end, reaching from about an inch above the mouth to four or five inches beyond the atlas, and bent so as to fit the side of the face (Fig. 227). The upper end of each forms a square opening (A A) bent inwards, the opposite sides of both meeting at this part; while a screw (B) about four inches below brings them together by means of a thumb-screw (E). Still lower down, each plate is pierced by six to twelve holes (B′ B″) for the passage of bands, some of which pass across the forehead, and others across the face to retain the apparatus at the seat of fracture, while one passes behind the lower jaw to prevent it slipping forward. The screw tightens the two pieces, so that they grasp the neck, and the bands in front fasten them to the face when applied (Fig. 228). All straps and splints for fractures should be padded.

Fracture of the Pre-Maxillary Bone.—This fracture is generally irregular, and longitudinal or transversal (when the latter, it usually accompanies fracture of the nasal bones). It is often comminuted, and involves the incisor teeth. After removing the detached pieces of bone, if there are any, when the fracture is transverse, a plate of wood or metal, adapted to the shape of the palate, and covered by india-rubber, gutta-percha, or leather, should be employed, the lateral portions projecting beyond the lips at each side, and provided with a hole for a strap and buckle. This strap, passing across the nose, maintains the pad against the pre-maxilla and palate, while another strap from the brow-band of the head-collar, passing through the other, prevents it falling over the nostrils. If the fracture extends to the nasal septum or spine, similar pads may be placed in the nostrils.

For longitudinal or oblique fractures of this bone, apposition may be maintained by wire passed around the incisor teeth. With a fine triangular file, a small but rather deep notch is made on the posterior margin of the canine and on the anterior face of the incisor teeth, and the fracture is then reduced. A rather fine copper or soft iron wire is passed around the canines and incisors, lodged in the notches made in these teeth, and the two ends joined and tightly twisted. Or the wire may be passed between the incisors on each side, and tightened over the fracture. Or a small hole may be drilled in the incisor on each side, and the teeth fastened together by copper or silver wire. It is well, for a few days, to keep the animal (if a horse) on the pillar-reins, and fed on sloppy food. After twenty-five days the wire may be removed.

Fracture of the Inferior Maxilla.—This bone may be fractured at the symphysis, at the neck, or any portion of the rami anterior or posterior to the molar teeth, or at their alveoli; and the fracture may

be simple, compound, or comminuted. The treatment varies with the seat and character of the fracture. A simple retaining bandage will suffice if the fracture is simple, without displacement, and the periosteum is intact; and even when there is fracture of only one branch, surgical intervention may be unnecessary, a vesicant application applied over the part, and sloppy diet allowed, being sufficient. In other cases, however, the fracture must be reduced and coaptation of the broken parts maintained. With the horse this is not so difficult as with the ox, as the former can dispense with mastication for some time, while the latter must ruminate.

In longitudinal fracture through the symphysis, after reduction the best means of coaptation is by wire around the incisor teeth, if these are sufficiently firm in their sockets; they may be notched with a file, in order to imbed the wire, as already described. In fracture of the branches, wire around the molars may also be attempted, though this is most difficult. The usual apparatus is a cage or cradle, which may be more or less modified to contain the lower jaw. One form (that of Changeux) is composed of two rods of half-inch round iron, joined in a V shape in front by a concave piece to receive the chin, and, if need be, another piece projecting from this backward, and furnished with a cushion. Near their junction, these rods have apertures for a strap and buckle to fasten them round the nose and beneath the jaw. At the other end are similar apertures for straps to suspend the apparatus, a brow strap, and another to pass round the face and prevent movement of the jaws. Binz has recommended the use of a piece of wood, the shape of the intermaxillary space, covered with cloth, and furnished with straps to suspend it behind the ears, and attach it round the forehead and face, so as to fill up that space, and render the jaw immovable. Another apparatus (that of Marrel) is a case of a pyramidal form, of thin sheet-iron, and of such shape and dimensions as to contain the lower jaw. Four rings on each side receive straps intended to suspend it behind the ears, the others to keep the jaws together. This case is padded throughout, and hollowed at the upper part to fit the neck, while cushions are provided to protect the soft tissues and equalize compression.

Varnell's apparatus for fracture behind the canines, consists of a 'cradle' fifteen to eighteen inches long, extending back to the angle of the lower jaw, and forward within an inch of the anterior margin of the lower lip; with the sides turning up, so as to embrace each branch as high as the line of the upper margin of the under lip, beyond which they should rise to within a short distance of the zygomatic ridges. Posteriorly, they should incline upwards and backwards, the centre of the underneath surface being pushed upwards to form a ridge filling the space between the branches, as forward as the symphysis. The angles are to be rounded off, and the borders perforated by holes or slits for straps to secure it in place. These straps are to pass as follows: One from a little below the supero-posterior angles round the upper part of the neck; a second from the upper border, across the forehead; a third between these straps to keep them in position; a fourth from the middle of upper border of cradle across the face,

below the eyes; and a fifth across the nose above the nostrils. If the fracture is compound, a hole should be made in the cradle opposite the wound. Should the cradle not fit accurately, padding of tow or cloth must be employed to fill up spaces, in addition to the lining, which should always be present.

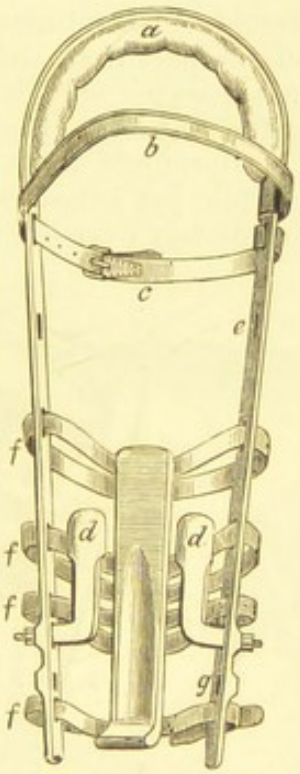

FIG. 229.
APPARATUS FOR FRACTURE OF THE LOWER JAW.

Another cradle (Walker's) has been successfully employed in fracture of both branches of the jaw, behind the canine teeth. It is not unlike that of Changeux, or, in principle, that of Binz. It is com-

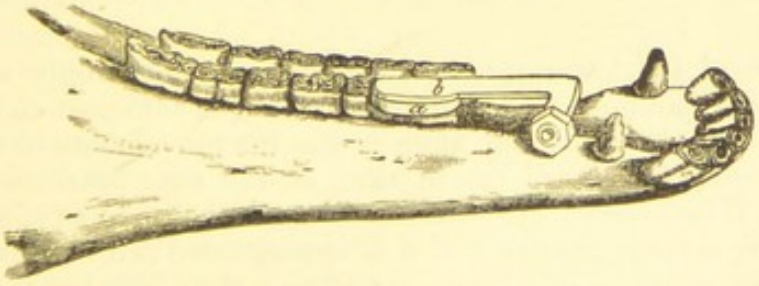

FIG. 230.
ONE FLANGE OF APPARATUS RESTING ON MOLAR TOOTH: *a*, MARGIN IN CONTACT WITH THE CHEEK; *b*, SURFACE FOR CONTACT WITH THE UPPER MOLAR.

posed of two lateral portions (Figs. 229 *e*, 231), fitting to the sides of the face, suspended from behind the ears by a padded strap (Fig. 229 *a*), and kept in position by a brow-band (*b*), throat-strap (*c*), and

jaw-straps (*f,f,f,f*), with a central portion of wood, padded with leather, to fit between the branches of the jaw, and two flanges (*d, d*) to rest on the first molar on each side of it, the side plates having a second hole (*g*) for the flanges. In order that the flanges should have a level bearing and allow the animal to eat, the first molars on which they rest must be shortened by tooth-shears, or rasp (Fig. 230).

All these apparatus should be so adjusted as to lie evenly, and without pressure more on one part than another.

Whatever may be the apparatus employed, it is well to use an agglutinative plaster over the seat of fracture, as additional support; this may be a mixture of Burgundy pitch and Venice turpentine, spread on the skin, and, while yet adhesive, to have finely-cut tow placed on it (thickest immediately over the injury).

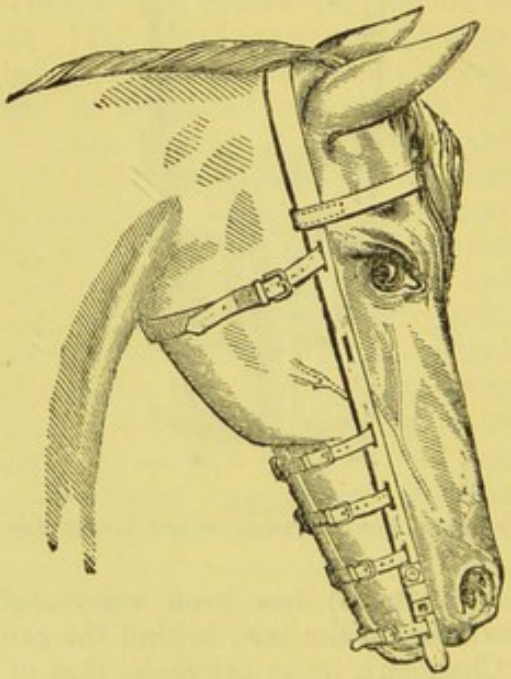

FIG. 231.—APPARATUS APPLIED.

Fracture of the lower jaw is sometimes treated simply with the agglutinative bandage. In simple fracture it is sufficient to apply a few turns of it, so as to limit more or less the movements of the jaw. In more serious fracture (as in that of the two branches), more bandaging is necessary. The intermaxillary space is to be completely filled up by a large firm pad of tow impregnated with the adhesive mixture, so as to support the fractures; then one bandage after another (covered with the resinous mixture) is applied around the jaw, face, and nose. Or strips of bandage may be placed along the inner aspect of each branch, and other strips passed in the same direction on the outer side. These, when the mixture has hardened, act as a cradle.

When the fracture is comminuted and fragments of bone detached, these should be removed; and in applying bandages care must be

taken to leave a space for the removal of other splinters and necrosed portions of bone. The subsequent treatment must be carried out according to circumstances.

The animal may be allowed to drink thick, nutritious gruel out of a wide, shallow vessel; or it may be injected into the mouth or rectum, or both. The standing position (for the horse) must be maintained, and attention be given to the retaining apparatus, that it be not displaced nor cause abrasion.

Fracture of the Horns.—This accident is not uncommon among cattle, sheep, and goats; usually only one horn is involved, and this may, with its vascular bony core, be more or less detached from the head. When serious, amputation may be necessary; but in the majority of cases, if too long delay has not occurred, the fracture may be successfully treated. This is best done by an apparatus which allows the sound horn to support the fractured one.

Pledgets of tow, which may be covered with agglutinative matter or plaster of Paris, are wound round from the end to the base of the

FIG. 232.
SPLINT FOR FRACTURED HORNS.

FIG. 233.
SPLINT APPLIED TO FRACTURED HORN.

horn and continued on the cranium. Then a bandage is rolled spirally around the horn, and continued to the opposite horn, which is enveloped, if need be, in tow towards its base, the bandage being passed in a figure of 8 manner between the two horns on the forehead.

In some cases, however, when the fracture is more complete, a firmer support is necessary; and this is furnished by a light wooden splint adapted to be fixed upon both horns. This is slightly hollowed at the middle of its lower border, to rest upon the neck, channelled on each side to receive the horns, and notched on both borders to retain cords or wires which attach it to the horns (Fig. 232). The splint may or may not be the full length of the horns (Fig. 233), and may be applied without any pledgets or bandages, except in particular cases. The splint is firmly attached to the horns by two or three turns of soft wire or strong cord in each notch, and should be allowed to remain on for about forty days.

Evulsion of the horn, if partial, may be treated in the same way as

fracture, after hæmorrhage has been checked, blood-clots removed, and the horn adjusted on its core.

In treating these cases, it is advantageous to secure the animal to a post by a rope round the neck.

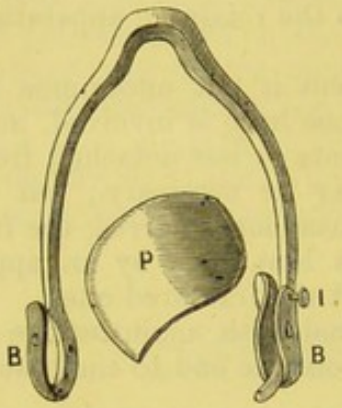

Fig. 234.
Apparatus for Fractured Scapula.

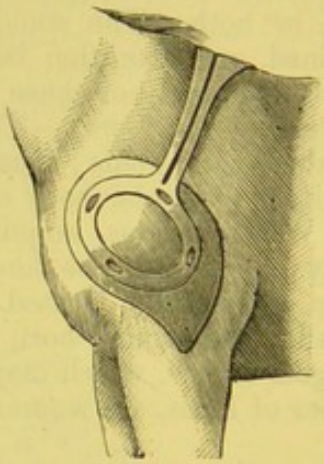

Fig. 235.
Apparatus Applied to the Shoulder.

Collections of blood or pus in the sinuses may be removed by trephining, by depressing the head to one side, or by causing the animal to shake its head by pouring a little water in the ear.

Fig. 236.
Iron Splint for Fracture of Bones of the Fore Limb.

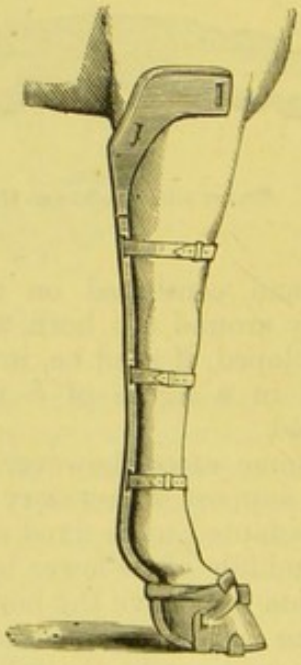

Fig. 237.
Iron Splint Applied

Fracture of the Scapula.—This is rare, and, provided there is no displacement, and the fracture does not involve the shoulder-joint, little more than rest is required. In some cases, however, treatment

must be adopted, and this generally consists in the application of agglutinative bandages (as in Fig. 213). The skin being covered by adhesive matter, the bandage passes obliquely from the withers over the scapula forward to the chest, inside the arm round by the elbow, across the scapula in the opposite direction upwards, over the withers, and down the scapula and round the fore-arm of the opposite limb in the same manner, returning again to the injured limb, when, another layer of adhesive matter being spread over it, the bandage is made to pass round in the same direction for as many times as may be necessary, until the whole has acquired sufficient solidity, when the end of the bandage may be secured round the fore-arm. Another bandage may be passed round the chest and withers,

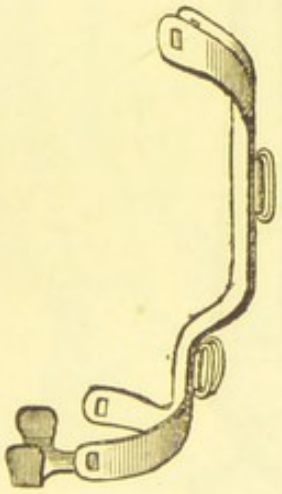

FIG. 238.
IRON SPLINT FOR FRACTURE OF THE LOWER BONES OF THE LIMB.

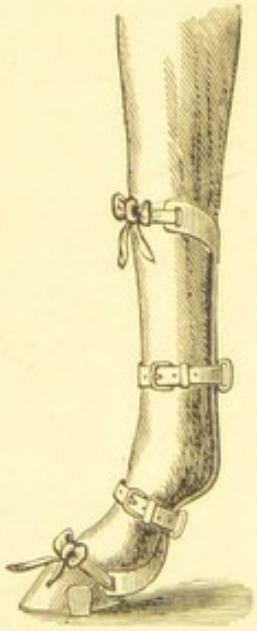

FIG. 239.
IRON SPLINT APPLIED TO THE LIMB.

immediately behind the scapula. The animal, if docile, may be placed in slings; if not docile, then it should be allowed a good bed of some soft material (as moss litter).

For luxation or fracture of the scapula, an apparatus has been introduced by Bourgelat. This consists of a light band of iron bent to fit over the withers and shoulders, and reaching as far as the lower part of the scapula, each of its ends terminating in a wide oval ring (Fig. 234, B, B), corresponding to the scapulo-humeral articulation; and a plate of sheet-iron, concave, and shaped so as to fit on the point of the shoulder (P). The oval rings have four screw-holes, to receive as many thumb-screws (I). These screws are sufficiently long to pass through the holes in the rings into the plate, inside which they are riveted in such a way that they are still movable. It will thus be seen that the apparatus exercises pressure on both scapulæ, at the joints and beyond them, this pressure being increased or decreased by means of the screws (Fig. 235).

With small animals the treatment is somewhat similar. The animal being laid on the opposite side to the fracture, several narrow bandages covered with adhesive matter are passed, one upon the other, beneath the arm and crossed over the injured part to the top of the shoulder, while others, shorter, are rolled round the limb from the knee to above the elbow ; a third series, passing downwards from the upper part of the shoulder, terminate in front at the point of the sternum. In some cases, narrow pasteboard splints, made adhesive

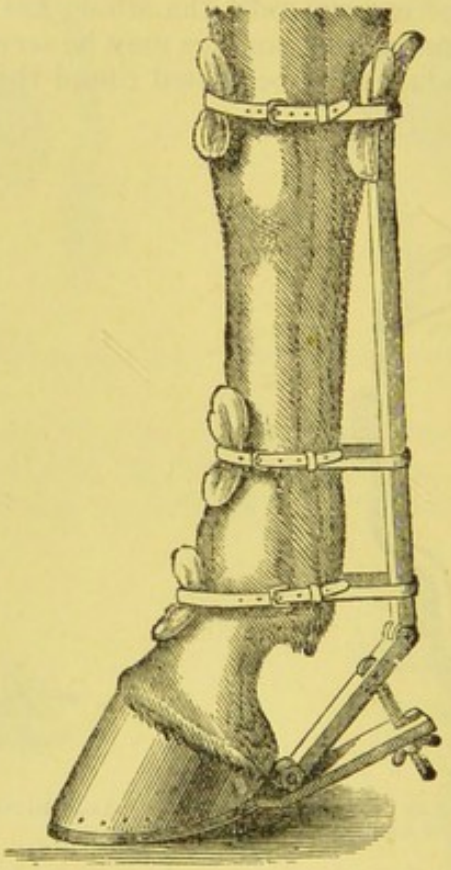

Fig. 240.
Adjusting Splint for Luxations and Fractures of the Limb.

on the surface next the skin, may be applied over the fracture before bandaging the limb.

Fracture of the Humerus.—This must be reduced by extension and counter-extension, if there is complete fracture with displacement, and agglutinative bandages applied as in fracture of the scapula. In some cases, pads or cushions may be necessary between the limb and the sternum.

Fracture of the Fore-arm.—The fracture being reduced, pledgets of tow with adhesive matter, and agglutinative bandages applied in a spiral manner, from the hoof to the elbow, should be employed. Splints of wood or iron, placed over the pledgets of tow, beneath the bandages, and arranged before, behind, and laterally, may be

necessary ; they should be sufficiently long to extend from the upper part of the arm to the hoof or ground, and the anterior should be more flexible than the others, though it ought not to be so long—not reaching the fetlock joint.

For fracture of the radius and ulna, luxation of the elbow joint, or fracture of the bones of the knee or metacarpals, Bourgelat proposed a posterior iron splint, which has been much employed. This is a long rod (Fig. 236), fitting on the plantar surface of the foot by lateral clips and eyelets through which a strap or band secures it ; it is shaped to the posterior contour of the limb, and, passing upwards, it is pierced by a number of slits or slots for straps by which to attach it to the limb. At its upper part, it branches forward into an expanded portion which embraces the elbow. This piece may be movable on each side, and, by means of screws, be made to compress

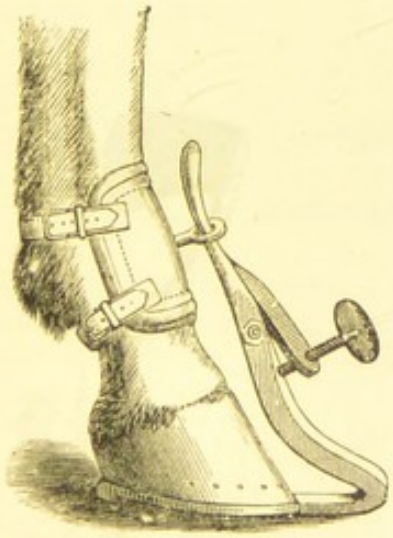

Fig. 241.
Apparatus for Luxated or Deformed Fetlock.

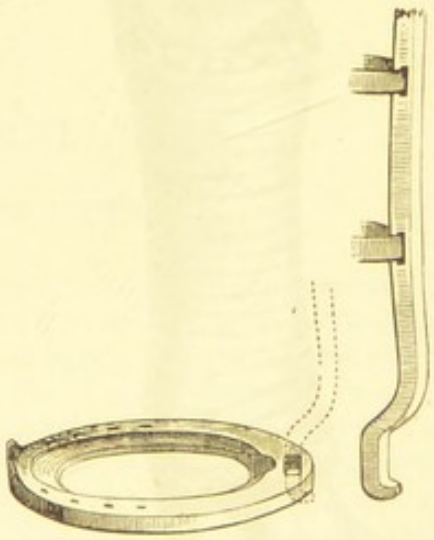

Fig. 242.
Movable Iron Splint.

the upper part of the arm as tightly as necessary ; there are slits on each side for straps to fasten it round the fore-arm (Fig. 237). This splint should be well set-off from the fetlock and knee, and padding between it and the limb, as well as beneath the straps, must be plentiful.

For all fractures and luxations of the lower part of the limbs, anterior and posterior, the same directions apply. The starch or plaster of Paris bandage, and gutta-percha or leather splint, will, in the majority of cases, be found to answer well, if properly applied. In some cases, however, special apparatus may be preferred, in the shape of iron splints, both for luxations and fractures, and these may be long or short, according to circumstances. For luxation of the fetlock, or fracture of the metacarpal or metatarsal bones, for instance, a foot and leg splint may be employed which only extends to the knee or hock (Figs. 238, 239). This may have an adjusting

mechanism, to prevent distortion, while maintaining immobility, of the limb (Fig. 240).

For luxation of the fetlock joint, after reduction, and also for distortion of this articulation, either from fracture, overwork, or other cause, instead of leather straps acting from behind, a shoe may be fitted with an appliance to exercise pressure on the front of the limb, through the medium of a padded iron plate (Fig. 241).

For maintaining the limb in a fixed condition, permitting easy removal, without disturbing the limb or necessitating the foot being raised, the lower end of the splint should fit on the plantar surface of the foot, where it may be retained by lateral clips (Figs. 236, 237,

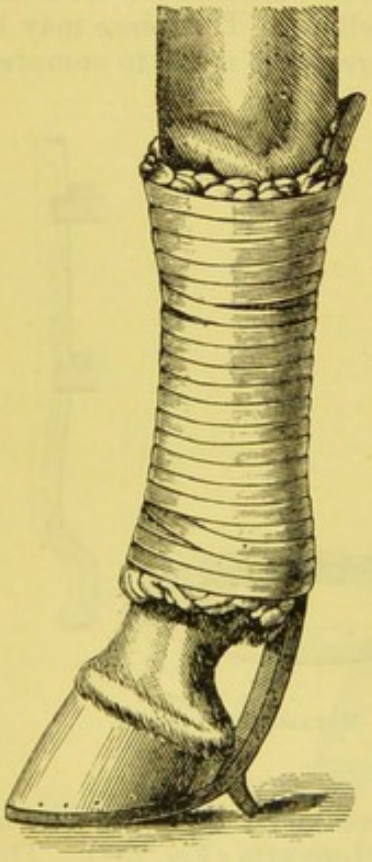

Fig. 243.
Iron Splint Bandaged on the Limb.

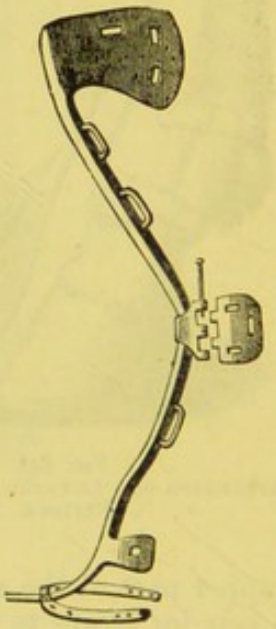

Fig. 244.
Iron Splint for the Hind Limb.

238, 239), through which a strap may be passed around the hoof; or a bar shoe applied to the hoof may have a square hole at the heel into which the lower end of the splint fits, and is held there by a slight acute curvature (Fig. 242). In using these iron splints, the greatest care is necessary to prevent serious abrasions, by placing bandages and pledgets of tow between them and the soft tissues, especially towards their upper extremity (Fig. 243).

Fractures of the Posterior Extremity.—These are generally more serious than those of the anterior limb; though when treatment is decided upon, this is the same in principle in both limbs. In fracture of the femur, this bone is so deeply embedded in muscles,

that appliances can effect but little in maintaining the fractured portions of bone. An active vesicant over the region, agglutinative plasters outside and inside the thigh, and placing the animal in slings, are the surgical measures to be adopted. For fracture of the tibia, tarsal and metatarsal bones, and luxation of the patella, tarsus, or metatarsus, the iron splint introduced by Bourgelat may be tried (Fig. 244). This extends from the ground (inserted into a square hole in a projection at the toe of the shoe) up the front of the limb, as high as the stifle, where it forms two expanded branches, one for each side of this joint. Two clips at its lower part and middle (movable) enclose the fetlock and hock, and there are slots for straps to fasten it to the limb.

Fractures of the bones of the limbs in the smaller animals are best treated, as a rule, by a starch or gum bandage, or a pitch plaster.

Other fractures need not be mentioned here, as the most frequent have been noticed.

SECTION II.

REMOVAL OF TUMOURS.

Tumours (and also organs, or portions of them) are removed by excision, ligature, tearing, or cauterization, according to convenience and other circumstances. Bony tumours require special operation.

1. Removal by Excision. *By the Knife.*—Excision may be effected by the knife, écraseur, or scissors. By the *knife*, when the tumour is of small size and has a narrow pedicle, the operation is very simple; the tumour being seized by means of forceps, the pedicle is divided by a single cut. For large tumours, especially those with a wide base, the operation requires more time and care. The first incision, with superficial tumours, is through the skin, and its form and extent will vary with the size, base, and relations of the tumour, as well as its connections and the condition of the integuments. A *straight incision* generally suffices for subcutaneous tumours which have no adhesions, and can be enucleated. Incision through a *raised fold* of skin is convenient with encysted tumours, to avoid opening them. *Elliptical incision* is resorted to when a portion of the enveloping skin has to be removed, either because it is diseased, too thin and feeble for union, or when it would be in excess after removal of the tumour.

Crucial, T or Y *incisions* are employed when a large tumour has to be removed, but none of the skin covering it.

In all cases, the incision should be prolonged beyond the base of the tumour, in order to allow of greater freedom in dissection and more complete extirpation. The knife (convex edge) may be grasped in the first or sixth position, and held with a light hand, so as not to wound bloodvessels on the surface of the tumour. The latter is dissected by the scalpel or bistoury, held in the most convenient

position (usually the first, second, and third positions), with a free movement, avoiding vessels, nerves, adjoining organs, etc., which may be moved to one side, if in the way ; in this dissection, forceps are, of course, necessary, and if the incision is large or the operation difficult, the sides may be kept apart by an assistant or retractors. The tumour itself may be seized by the hand, forceps, or hook ; or if voluminous, a piece of tape or strong ligature thread may be passed through it, by which it can be better held and moved about. If small, it may be excised at a single cut, and the resulting hæmor-

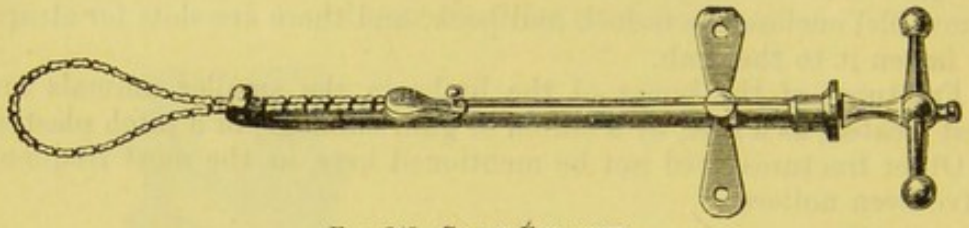

Fig. 245—Chain Écraseur.

rhage suppressed by compression, ligature of vessels, or other means already described. If voluminous, then careful incisions must be made and the vessels secured as they are divided, or even before, if they are accessible and large.

If the tumour is very large and difficult to remove, a portion only may be taken away at a time.

Excision by Scissors.—Tumours of very small size, and especially if the pedicle be narrow, may be removed by scissors—curved are

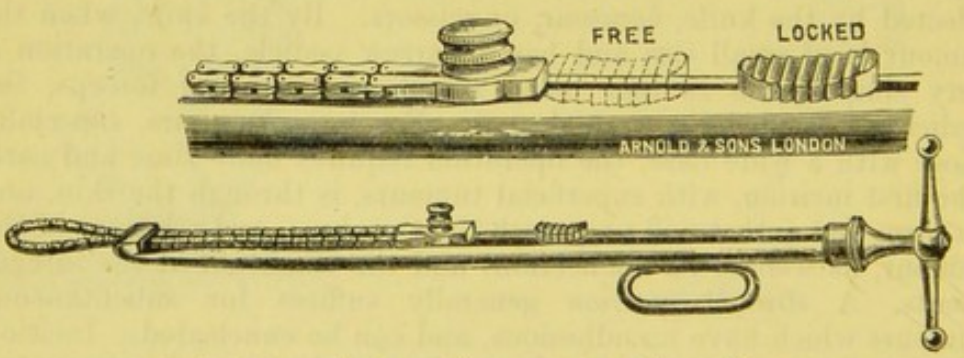

Fig. 246.—Dewar's Chain Écraseur, with Patent Catch.

most suitable, the tumour being held by forceps. The resulting hæmorrhage may be suppressed in the ordinary way.

Excision by the Écraseur.—It had long been observed that there was no bleeding from crushed and torn arteries, no matter how large these were—a circumstance due to complete and spontaneous plugging of the vessels by the curling inward of the torn *tunica intima*, the shreds of the *adventitia*, and also the contraction of the *tunica muscularis*. Observation of this fact led Chassaignac to invent an instrument for crushing off portions of the body, which he designated an *écraseur* (or crusher), and the operation of removal *écrasement*. This instrument, in principle (for it has been much modified), consists

of a strong metallic ligature, composed either of small links forming a chain, or a single strand of wire, which is to be applied around the part to be removed, and then drawn slowly into a strong metal frame by means of a ratchet or screw arrangement.

Some instruments are only constructed for the chain, (Fig. 245), others for the wire (Fig. 247), and others, again, for both chain and wire.

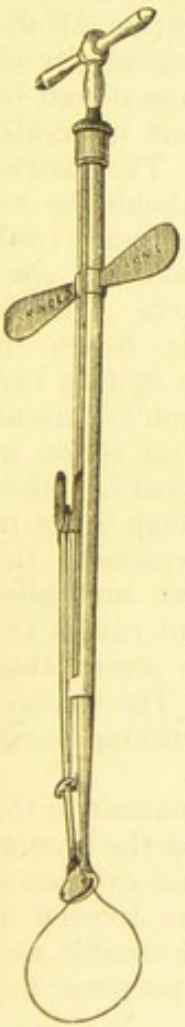

Fig. 247.
Wire Écraseur.

When properly used, the écraseur will remove large tumours without causing hæmorrhage; and it has been observed, in mankind and animals, that wounds caused by écrasement usually heal with very little local or general reaction, while coincident inflammations occur less frequently with this class of wounds than with incised wounds made by the knife; the wounds, besides, are smooth and regular, and little sloughing occurs. In addition, tumours can be removed with ease from situations where it would be most difficult to reach them by other means. For soft, very vascular tissues, if not too dense, and the rivets of the links are strong, the chain is preferable to the wire. But for dense tissues, and especially semi-cartilaginous, cartilaginous, or even spongy bone tumours, the wire (steel), single or twisted, is the best.

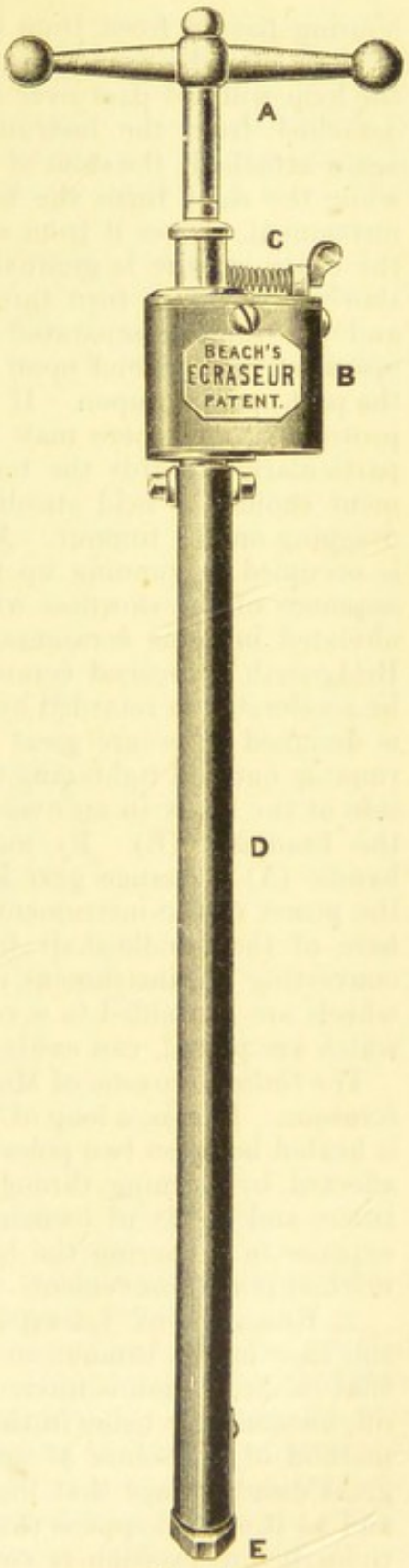

Fig. 248.
Beach's Universal Écraseur.

The écraseur is not difficult to apply. If the tumour is covered by skin, this, in order to abbreviate the operation, spare the instrument, and minimize pain, should be previously incised so as to expose the base, and the neigh-

bouring tissues freed from it; the chain or wire of the écraseur is then placed around the base (if the tumour is so large that the loop will not pass over it, one end of the chain or wire may be detached from the instrument, passed around the tumour, and again attached), the stem of the écraseur being held in the left hand, while the right turns the handle or screw portion, or, if a ratchet instrument, moves it from side to side. By this means the loop of the chain or wire is gradually diminished, the tissues within it are slowly crushed or torn through until they are completely divided, and the tumour separated from the body. The duration of the operation will depend upon the volume, density, and vascularity of the part operated upon. If very vascular, the constriction should be protracted, and there may be a very brief halt at short intervals, particularly towards the termination of the excision. The instrument should be held steadily and firmly, and there should be no dragging on the tumour. At first, it often happens that some time is occupied in running up the loop to the crushing point, in consequence of the slowness with which the instrument acts. This is obviated in some écraseurs, particularly in that of Mr. Beach, of Bridgnorth (universal écraseur, Fig. 248), in which the motion can be accelerated or retarded by a simple contrivance. Beach's écraseur is designed to secure great power, as well as rapidity of action in running out and tightening up the chain, which is attached on either side of the screw in an ovoid tube (D) passing out through a slot in the headpiece (E). By moving a trigger (C) and depressing the handle (A) a change gear is brought into action, which multiplies the power of the instrument, while a further adjustment causes the base of the handle-shaft to engage directly with the screw, thus converting the instrument into an ordinary écraseur. The change-wheels are contained in a compact box (B), and the working parts, which are plated, can easily be removed for cleansing.

The *Galvano-caustic* of Middledorpf acts in a similar manner to the écraseur. In this, a loop of platinum wire passed around the tumour is heated between two poles of a galvanic battery, so that excision is effected by burning through the base—a simultaneous division of tissue and arrest of hæmorrhage. But there is much trouble and expense in preparing the battery, and for veterinary purposes this method is not convenient.

2. Removal by Ligature.—Removal may be effected by tying the base of the tumour so tightly, by means of a cord or ligature, that its circulation is interrupted, and it becomes gangrenous or falls off, hæmorrhage being in this way averted. Though a very common method of procedure at one time, and even now, ligation has the great disadvantage that the tumour decomposes in or on the body; and as it often happens that the ligature must be tightened several times before excision is complete, this may induce severe hæmorrhage. Ligature may be combined with incision, by cutting off the tumour in front of the cord, leaving only a portion to become detached spontaneously.

The ligature may be of lint, hemp, silk, india-rubber, catgut,

tendon, or wire of iron, copper, or lead. For large tumours whipcord is often preferred. The thread or cord should be waxed. Ligation may be either *simple* or *multiple;* and in either the skin at the base of the tumour may be included or previously incised. Ligation is *immediate* when the ligature is applied to the pedicle of a tumour, and *mediate*, or *in mass*, when it includes a portion of the tissues surrounding a non-pediculated tumour.

Simple Ligation.—This consists in passing the constricting band or cord once or twice around the base of the tumour, and tying it tightly, or using it in the form of the double clove-hitch. It may be necessary to re-apply the ligature, if the mass is large or necrosis does

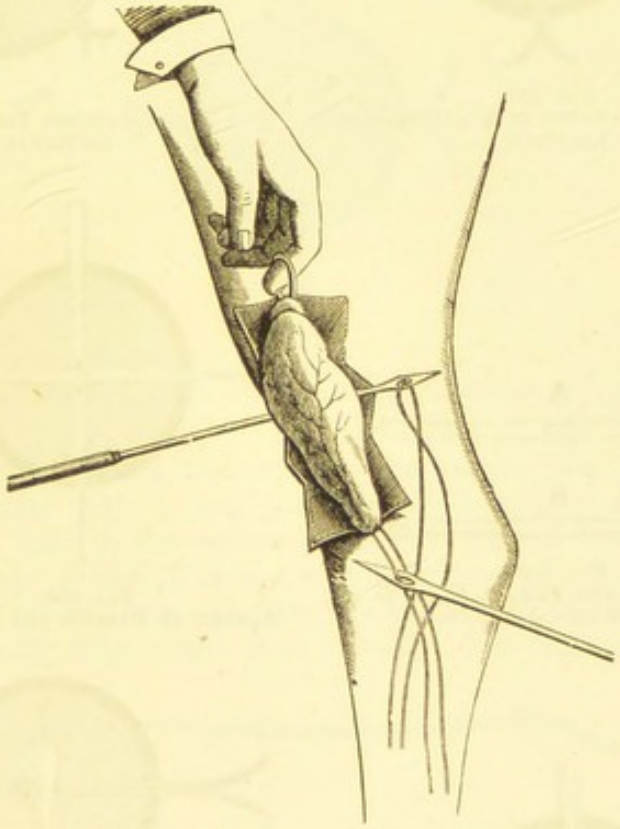

Fig. 249.—Manner of Performing Quadrisectional Ligation.

not rapidly ensue. This is sometimes attempted to be expedited by the application of the cautery or caustic ointment.

Multiple Ligation.—The object of multiple ligation is the removal of the mass in portions, as when the base is too large to be effectively constricted by one ligature, when there would be inconvenience or danger in doing so, or when it is necessary to leave an opening in the middle, as in a tumour around a natural aperture—for example, the rectum. To apply the ligatures, either long and strong suture needles, or special needles, fixed in handles, with an eyelet at the head, near the point, or in the middle, are required.

Double Ligation is effected by passing the needle, armed with a strong, double thread, from one side to the other of the base of the tumour, cutting off the thread close to the needle, when it has

been passed through. This leaves two independent ligatures, which are tied around each section of the tumour. If it is desired to divide the tumour into three portions, two needles are placed on the same thread, which is so disposed as to form three loops, like a capital

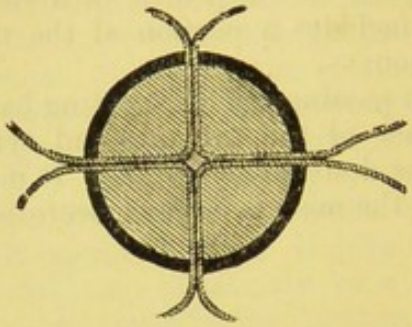

Fig. 250.
Ligatures Separated in Quadrisectional Ligation.

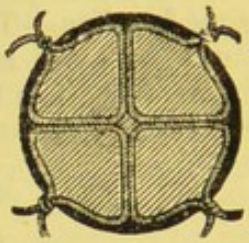

Fig. 251.
Ligatures Tied in Quadrisectional Ligation.

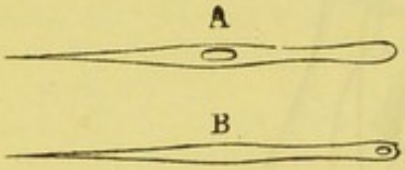

Fig. 252.
Ligating Male and Female Needles for Quadrisectional Ligation.

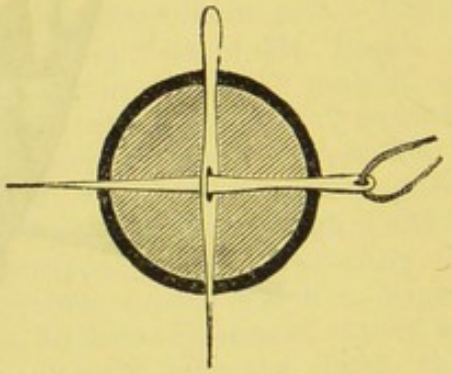

Fig. 253.
Manner of Passing the Needles.

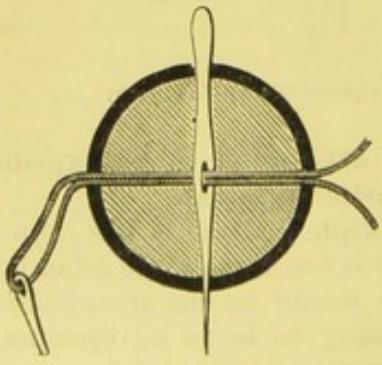

Fig. 254.
Manner of Withdrawing the Male Needle.

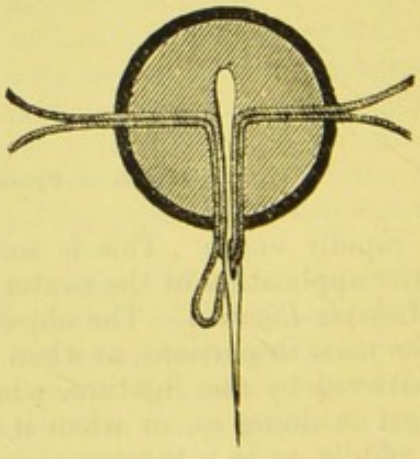

Fig. 255.
Manner of Forming the Double Loop.

M ; the needles are then implanted in the tumour in such a way as to divide it into three equal parts, and when brought out at the opposite side the three loops are divided, leaving three ligatures, which

are then united by tying the ends. To ligate the tumour in four portions, a second double ligature may be passed through its opposite diameter, and cut into two portions (Fig. 249). This leaves four ligatures to include the four divisions of the tumour, and they are tied independently of each other, each around its division (Figs. 250, 251). Another method is to employ two needles, one pierced

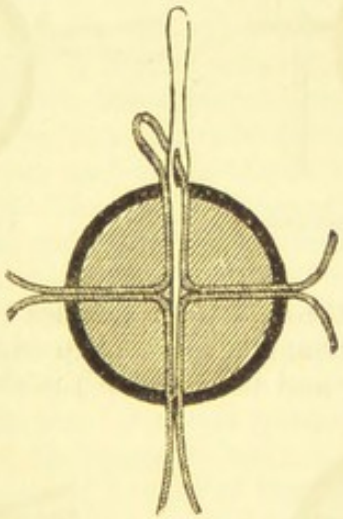

FIG. 256.
MANNER OF WITHDRAWING THE FEMALE NEEDLE.

with an eyelet at the head, the other in the middle (Fig. 252, A, B). The first is armed with a long and strong thread, and when the needle with the hole in the centre (female) is passed from above to below, so that the eyelet is in the middle of the tumour, the other needle (male) is passed through this eyelet (Fig. 253), and brought out at the opposite side, where it is cut off. The female eyelet has

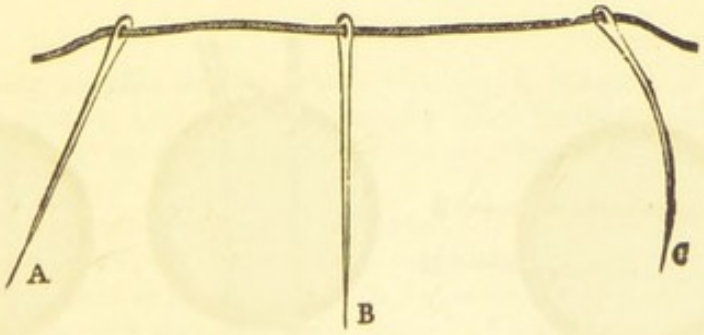

FIG. 257.
NEEDLES FOR MULTIPLE SUBCUTANEOUS LIGATION.

in this way received the double thread of the first (Fig. 254), and is now pushed down through the tumour, carrying four threads with it (Fig. 255), which form two loops externally. One of these loops is divided, and two threads are thus freed from the needle, which is now pushed back through its point of entrance, carrying the remaining loop with it (Fig. 256); this is cut and the needle removed. In

this manner the tumour is divided into four parts by the four threads, as by the other method (Fig. 250), and these are tightly bound round each segment (Fig. 251).

Subcutaneous Multiple Ligation is effected by the use of a long,

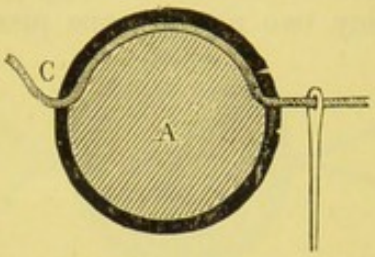

FIG. 258.
MANNER OF PASSING THE SUBCUTANEOUS MULTIPLE LIGATION.

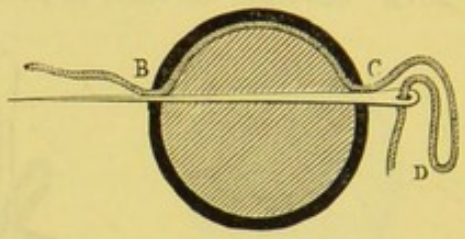

FIG. 259.—*Ibid.*

strong thread passed through three needles (Fig. 257), one of which (A) is straight, and triangular or sharp-edged; the second (B) is straight and pointed; and the third (C) is also pointed, but curved.

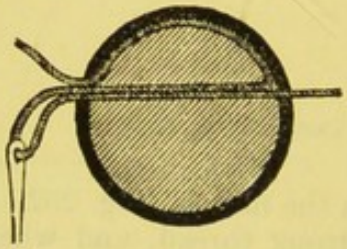

FIG. 260.—*Ibid.*

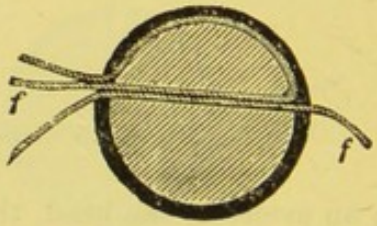

FIG. 261.—*Ibid.*

The tumour (Fig. 258, A) is supposed to be subcutaneous and spherical, and a fold of skin being raised vertically towards its upper third, the first needle (A) is pushed through this. The fold

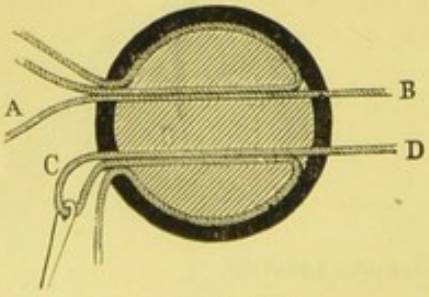

FIG. 262.—*Ibid.*

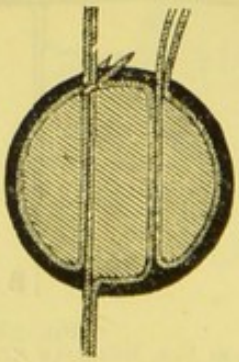

FIG. 263.—*Ibid.*

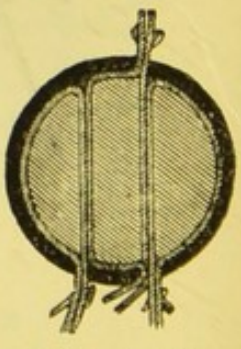

FIG. 264.—*Ibid.*

is let go, and one part of the ligature is passed, subcutaneously, around a third of the tumour (Fig. 258, C). The second needle (B) is pushed into the tumour at the point of exit of the other (Fig. 259, C), and coming out on the other side (B), taking with it the loop (D). The new loop is cut, and the needle removed. The upper third of

the tumour is now enclosed in a loop (B, C, D), the two ends of which issue from the same opening (Fig. 260), while there is a second thread between the upper third and the two lower thirds of the tumour (Fig. 261, *f f*). The same procedure is carried out on the lower third, which leaves the middle third included between two parallel threads (Fig. 262, A B, C D). Each of these threads being attached to the curved needle, the end of one (B) is passed under the skin alongside the tumour, and brought out again (at D), and the end of the other thread (A) passed in a similar manner, and brought out again (at C), where it is tied with the adjoining thread (B). So that the two threads (B, A, C, D) form a loop which encloses the middle third of the tumour, the upper and lower thirds being included in their special loops (Fig. 263). The ligatures being tied sufficiently tight, the ends are cut off, and the operation is completed.

Elastic Ligature.—Simple ligation of tumours by inelastic ligature has to a considerable extent given place to the elastic ligature, which is more energetic and certain, as it exercises continuous pressure, gradually effaces the bloodvessels, and soon induces necrosis of the part beyond the ligature. For this purpose, simple india-rubber tubing, or solid cord of the same substance, of various sizes, from the thickness of a goose-quill to that of the little finger, according to requirement, is employed. The entire pedicle may be ligated at once, in the ordinary way, the ends of the ligature being drawn sufficiently tight and tied. If the tumour is very large, or its base not well defined, it may be ligated in portions, in the manner already described. A good plan is to thrust a trocar and cannula through the base of the tumour, withdraw the trocar, and pass the ligature through the cannula ; in this way different portions may be constricted. The ligature should be drawn as tight as possible, so as to cut off the circulation ; and to prevent it slipping, two long needles may be thrust through at right angles, between the ligature and tumour.

In passing needles or the trocar through a tumour, a bloodvessel may be wounded, and if serious results from hæmorrhage are apprehended, leaving in the instrument for a short time may check or suppress it.

When tumours are deeply situated in natural cavities—nasal passages, pharynx, larynx, vagina—and cannot be reached by the hand or écraseur, it is necessary to have recourse to special instruments to pass the ligature over them. Various instruments have been devised, but the most useful and simple in veterinary surgery is a narrow wooden or metal tube, sufficiently long. The ligature, consisting of wire, or a double thread, is passed through the tube, the looped end projecting beyond, and the tube being carried up to the tumour the loop is allowed to fall over it towards its base ; this being done, the loop is tightened around it by pulling at the ends of the ligature at the other end of the tube, until the constriction is sufficient, when they are tied around a small piece of wood. This rests on the end of the tube, and to gradually tighten the ligature it

is only necessary to turn this piece of wood round several times every day, until the tumour is removed. This procedure is especially applicable for polypi. For the removal of tumours in the nasal passages, it may be necessary, in some difficult cases, to trephine the nasal roof or to slit the nostril, in order to reach the growths.

3. Removal by Tearing.—This procedure is to be recommended for very small tumours only, and may be carried out by means of the fingers or forceps—a slightly twisting movement preventing hæmorrhage.

4. Removal of Bony Tumours.—According to their density and situation, these require particular operative treatment. When very dense, the soft tissues having to be removed from above and around them, the chisel, gouge, bone-forceps, or saw, must be employed. When spongy or cartilaginous, the écraseur, provided with a steel wire, will probably be effective in extirpating them.

Periosteotomy.—For certain bony enlargements in process of formation, the operation of *periosteotomy* is sometimes performed. This is a simple operation. For instance, in the bony growth on the metacarpal bone of the horse, commonly known as 'splint,' the animal may be operated upon in the standing attitude, though it is better in the latericumbent position. The skin is incised immediately below, or slightly above the tumour; this incision is short, and is quickest and most conveniently made by the rowelling scissors, or bistoury (Fig. 87), through a raised fold of skin. A small blunt seton-needle may be passed through the wound, beneath the skin above the growth, in order to divide the connective tissue, and this is followed by a short, probe-pointed bistoury, slightly curved, the cutting edge being convex. This is carried flat over the growth, then turned, so that the sharp edge is in contact with the periosteum, which is incised. The knife is then withdrawn. The object of operation is incision of the periosteum, and, to some extent, of the enlargement. In chronic cases a seton may be inserted over the growth after incision of the periosteum.

SECTION III.

CAUTERIZATION.

Cauterization of the tissues, especially the skin, is very frequently resorted to in the surgery of animals, with a hygienic or therapeutic object. It is distinguished as *actual cauterization* and *potential cauterization*, according to the agents employed to produce it: the first being the application to the living tissues of a heated body—a hot iron or *cautery*, which operates upon the skin; and the second consists in the employment on the surface of the body, or in the tissues, of chemical substances named *caustics*, which act upon these tissues and destroy them. Actual cauterization only will be discussed here.

The value of actual cauterization has been recognised from remote antiquity to the present day as very great, and capable of yielding most important results in veterinary surgery. It is most frequently resorted to in the horse, rarely in the ox, and seldom in other creatures. It responds to many indications, and in the majority of cases constitutes the last, if not the only efficient surgical remedy at disposal. The agents employed for actual cauterization (cauteries)

FIG. 265.—LINE FIRING-IRON.

FIG. 266.—HÆMOSTATIC CAUTERY.

are of metal, usually iron, as it is least expensive, most common, can be heated to a high temperature without becoming fused, and retains heat longer than most other metals. Steel is preferable to iron, as while possessing all the good qualities of this, it 'scales' and oxidizes less readily. Platinum is excellent, but expensive. Cauteries are of different forms, according to the kind of cauterization desired. They consist of a handle of wood, horn, or other bad conductor of heat, a

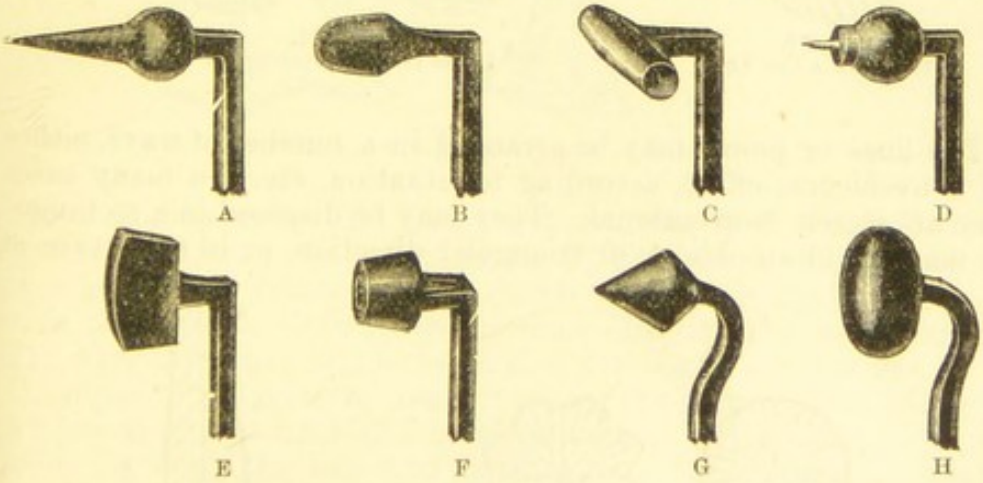

FIG. 267.—VARIOUS FORMS OF CAUTERIES.

stalk or shank, and the cauterizing portion (Figs. 119, 265, 266, 267). The latter is thick at the base, for the retention of heat, and somewhat thin or pointed, and smooth at the other border or apex. This border may be straight, or nearly so, slightly or very convex, and sharp or blunt-pointed; or the cautery may be ring-like.

There are three kinds of cauterization: 1. *Superficial, linear, or*

transcurrent cauterization ; 2. *Objective cauterization*, or by radiation of the heat from a certain distance ; 3. *Penetrant cauterization.*

1. Superficial, Linear, or Transcurrent Cauterization.—This is the form of cauterization most commonly resorted to, and is

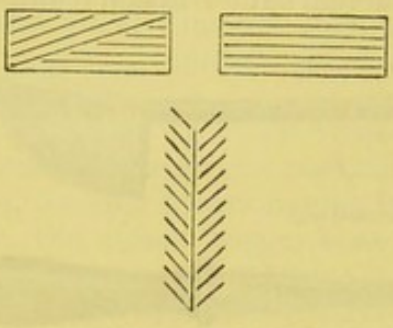

Fig. 268.—Cauterization Designs.

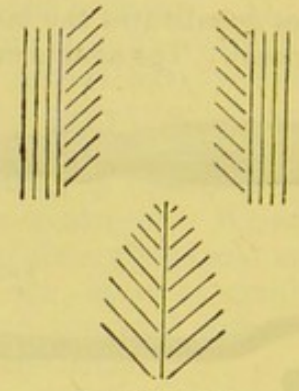

Fig. 269.—*Ibid.*

applied in lines, or points arranged in lines. It consists in passing a heated cautery lightly over the skin of the diseased part, in such a way as not to destroy its entire thickness. The cautery may be convex-edged for lines (Figs. 265), or conical for points (Fig. 267).

Fig. 270.
Lines in a Circle.

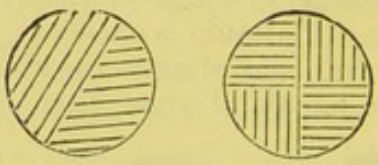

Fig. 271.
Lines in Two Directions.

The lines or points may be arranged in a number of ways, either for convenience, effect, according to situation, etc. ; in many cases they are merely conventional. They may be disposed in a rectangular manner, in an oblique or triangular direction, or in a mixture of

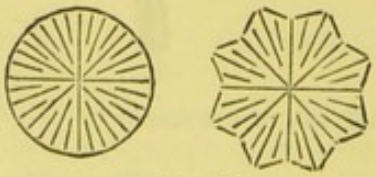

Fig. 272.
Radiating Lines.

Fig. 273.
Lyre-Shaped Design.

these (Figs. 268, 269). Sometimes the lines, passing in one direction, are enclosed in a circle (Fig. 270) ; sometimes they pass in two or more directions (Fig. 271) ; or they may pass in a radiating direction (Fig. 272), or be arranged in the form of a lyre (Fig. 273). These

fanciful designs do not add to the value of the operation ; on the contrary, they often detract from it, and are merely a matter of fancy or fashion.

For certain regions, however, it is found that the lines should pass in certain directions. For instance, on the shoulder (Fig. 274, A), they are parallel, and slightly oblique from before downward. For the point of the shoulder they may be made within a ring which encircles the part, and be arranged as in Figs. 271 and 274 (E). For the withers, two parallel lines alongside the dorsal spines, from which other lines pass parallel and obliquely (Fig. 269), right and left. On the loins the lines may be parallel to the spine, or diagonal on each side (Fig. 274, D), while for the hip-joint they may be the same as for the point of the shoulder (E) ; and for the stifle vertical lines on the front of the articulation, with lines passing obliquely downward on both sides from them (F). For the hock, the lines may be parallel and vertical or oblique, or the central lines may converge above (G) ; and on the knee they may likewise be vertical or oblique (H), or

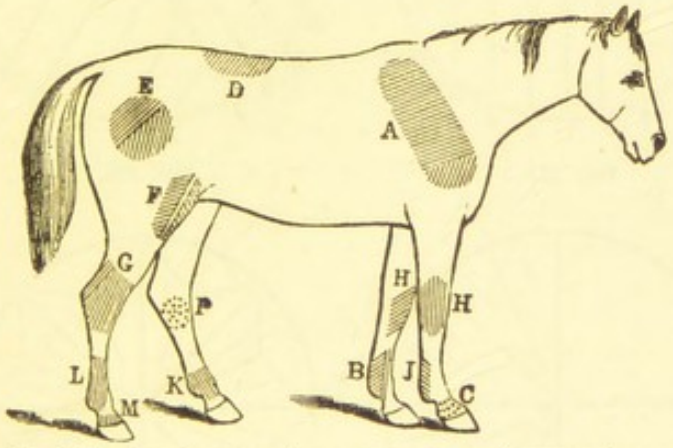

FIG. 274.—THE VARIOUS ARRANGEMENTS OF CAUTERY LINES.

vertical lines in front, and diagonal lines from them on each side. The flexor tendons may be fired vertically (L), but the lines are more frequently drawn transversely or slightly oblique from above downwards (J) ; and the fetlocks in the same direction (B), or vertically (K) ; while they may also be vertical or oblique on the pasterns.

In order to produce the design in a regular manner, the lines are first traced with a light and rapid movement of the cautery, so as merely to singe the hair and faintly mark the epidermis. They are afterwards burned to the proper depth. Or they may be first traced with chalk ; and this is to be recommended to the unpractised operator, especially in circular designs. For these, having marked the centre and traced the circumference, the enclosed space is filled in by the lines, in the order indicated in Figs. 275 to 278.

The design should always be as simple as possible.

The space between the lines will depend upon the condition of the skin, its fineness, etc., but it should be equal, and rectilinear firing should have a direction transverse to that of the hair, or slightly

oblique. Sometimes these two directions are combined, according to circumstances, and in order to regulate the design. Lines made in the direction of the hair have been recommended, as this is the direction in which the skin yields to the movements of the region it covers; so that extension tends to bring the edges of the lines nearer each other, when they are in the direction of the hair, while oblique or transverse lines are disposed to become widened. But if lines parallel with the direction of the hair are likely to have narrower cicatrices, they are not so completely covered by the hair

Manner of Tracing the Lines within Circles.

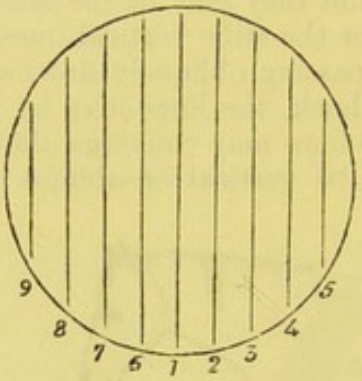

Fig. 275.

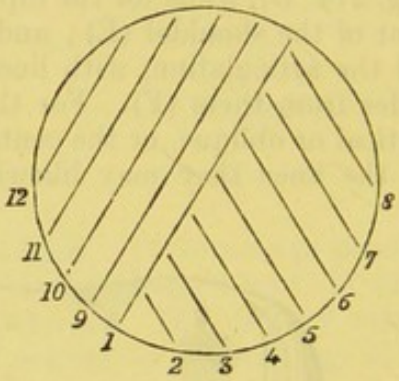

Fig. 276.

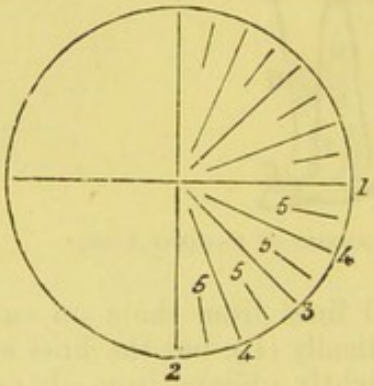

Fig. 277.

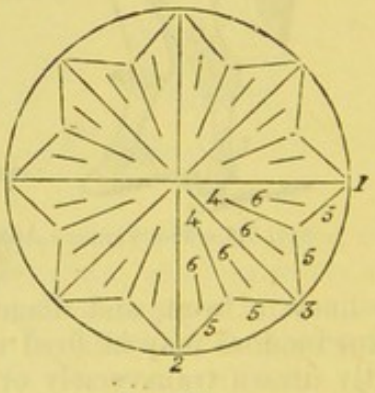

Fig. 278.

as are oblique or transverse lines, and are therefore more apparent afterwards.

The easiest design to trace, and that which is generally most suitable, is the feather or herring-bone pattern (Fig. 269).

As a general rule, the lines ought to be wider apart as the surface to be cauterized is extensive, and nearer each other as it is circumscribed. If they are too wide apart, however, the cauterization has less effect, and if too near there is danger of the skin between the lines being destroyed. No positive rule can be given as to the distance of the lines, but it should not be less than half an inch. Lines running in the same direction should have an equal space between them throughout, and lines passing towards each other

should never intersect each other, nor even approach within at least one quarter of an inch ; all lines should terminate uniformly at the limits of the cauterized surface, so that some will not pass beyond others.

Cauterization in superficial points is often adopted when it is not desirable to resort to lines, as in avoiding blemish, or in certain situations where lines are not easily made. They are produced by the conical cautery (Fig. 267), and should be formed in linear series, those of one series alternating with those of the neighbouring series. A first series being marked in a line—horizontal, oblique, or vertical, and within a circle, if need be—at an equal distance from each other (the points being closer, as it is required to produce a greater effect), a second line of points is formed parallel to the first, at the same distance which separates the points of the latter, each point of the two lines alternating, and in this manner the requisite number of lines are formed in regular order (Fig. 279). As a rule, the points should be distant from each other from three-fourths of an inch to one inch. When it is necessary to produce a powerful effect on a

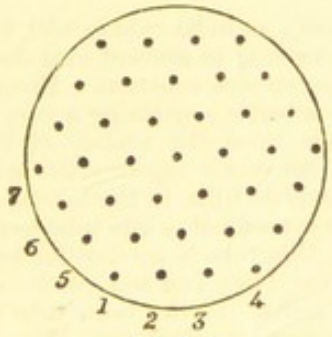

FIG. 279.—CAUTERIZATION IN POINTS.

limited surface, as on the hock or pastern (Fig. 274, P, C), additional points may be made alternately between the series.

The extent of surface embraced by the lines or points should always exceed that of the diseased part ; as when it is too limited, the modifications excited by cauterization are not sufficient to produce a beneficial effect.

Preliminary Precautions.—The hair, unless it be very fine or thin, should be removed from the surface to be cauterized, not only to enable the operator to act more promptly and effectively on the skin, but to prevent undue injury to this from the burning hair. It is, besides, advisable to cleanse the skin by washing and well drying it.

The operation being very painful, the animal should either be placed under the influence of an anæsthetic agent, or firmly secured in a standing or recumbent position. When very docile and not extremely sensitive or irritable, the surface not extensive or difficult to reach, the standing position may be adopted, the twitch being applied to the lip, and, if need be, the opposite limb held up either by leg-strap or side-line, or by a powerful assistant. If the recumbent position is adopted, and the side of the body or external aspect of

the limbs is to be operated on, the animal should lie on the opposite side, so that the side to be cauterized is uppermost; but if a limb is to be cauterized on both sides or all round, that limb should be on the under side, and the operation commenced on its inner aspect, finishing with the outer (which is then uppermost), after the animal has been turned over. In this way the cauterized surface is not injured by rubbing on the ground, which would probably occur if the outer surface was first cauterized.

Operation.—An assistant heats the cautery in a fire—that of a forge is best—and charcoal is preferable to coal, as it does not 'scale' the iron. When sufficiently hot, the 'scale' is removed by means of a file, or rubbing it on a piece of sandstone, so as to clean the edge. The handle is cooled in water (unless it is movable —Fig. 265—when it does not heat so quickly), and the instrument handed to another assistant, who conveys it to the operator, giving the one just used to the first assistant to reheat. Two, three, or four irons are required, to avoid loss of time. An excellent substitute for the fire and these assistants is the thermo-cautery, an instrument which acts as follows:

Air is propelled by squeezing an india-rubber ball, having an ingress valve, into a second ball covered with netting to prevent over-distension; this latter acts as a reservoir and renders the stream constant. From the second ball an india-rubber tube is conducted to a bottle containing a very small quantity of benzoline. The stream of air is thrown upon the surface of the benzoline, and becomes mechanically charged with benzoline vapour; the mixed gases pass out of the benzoline bottle through another tube, to the handle of the operating portion of the apparatus. This latter consists of a fine tube terminating in a platinum end of whatever shape desired; this tube is covered for two-fifths of its length by an ebony handle which joins the ivory cup and platinum point, enclosing the fine tube entering the platinum point. In the brass tube are two perforations to give exit to the gases resulting from combustion. The operating point of platinum contains an intricate coil of platinum wire. The benzoline bottle is hung to the operator's button-hole, and the platinum point held in the still flame of the spirit lamp for half a minute; the pumping is then commenced, and the mixed air and vapour are forced up to the heated platinum point. This causes a chemical union of the gases, with a number of minute explosions, modified by the intricate interior coil. The heat evolved at the chemical union increases that already existing, and so the process is carried on. If fluid benzoline be allowed to run up the tube to the point, its sudden evaporation at once cools it, and leaves the end choked with carbon. In damp weather the apparatus is slower to start, and the benzoline requires more frequent changing. The apparatus should be kept in a warm place, to maintain the rubber parts in order.

In Beach's thermo-cautery (Fig. 280) the hydro-carbon is contained in the handle (H), which is so constructed as to retain the fluid in any position of the instrument. This improvement dispenses with the usual glass bottle which may be upset or broken during operation. In using this cautery the proportion of air passing in at the nozzle (E) may be regulated through a by-pass valve (D), which revolves on a conical seat ground on the head of the screw-cap (G). By adjusting the indicator (F) the charge of vapour can be varied, and deposit of soot in the combustion chamber (A) prevented. The valve also allows cold air to be forced through the instrument to rapidly cool the points, and by the valve the vaporizer may be

closed. These changes can be effected instantaneously. Further, this cautery is provided with arrangements to control the intense heat (1,500° Fahr.) generated in the operating point, to prevent explosion, and to keep the handle cool.

In every respect the thermo-cautery is preferable to the ordinary firing-iron, being more expeditious, cleaner, does not roast the skin adjoining the lines, is less painful, more easily applied to the skin, blemishes very little, is extremely portable, and can be employed anywhere independent of a forge, and is very durable, so far as the platinum is concerned.

In linear firing the cauterizing instrument should be held lightly, the edge or point perpendicular, and it should be drawn towards, not pushed from, the operator.

The first cauteries need not be so hot (a dull-red heat) as the succeeding ones, as they are only required to *trace* the lines by burning the hair, not the skin. After the lines are traced, then they are made deeper by the cautery, which is now heated to a bright-red or cherry colour—never to a white heat—and passed steadily, lightly, and exactly over the tracings, one by one, so that all may receive an equal amount of burning—the rapidity being diminished as the iron cools. There should be little or no pressure exerted on the instrument, its own weight being usually sufficient to produce the necessary effect; if it is too heavy, the hand should support a portion of the weight; it should glide smoothly and regularly over the skin, its effect being closely watched, so as not to burn too deeply.

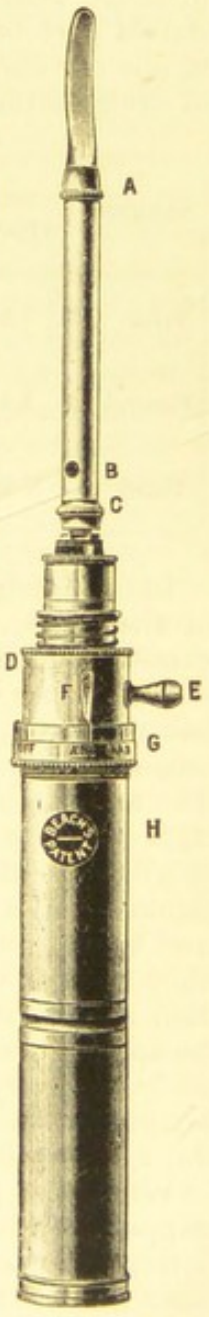

FIG. 280.
BEACH'S THERMO-CAUTERY.

The finer the skin, the steadier and more nimble should be the hand. If the skin is cauterized too deeply, the lines will open, bleed, and suppurate; then will follow granulation and cicatrization, blemishes, and disfigurement. The cauterization should not be hurried; each line should be traversed a certain number of times, a brief interval elapsing between the applications, to prevent disorganization of the cuticle before the proper effect is induced.

There is no fixed rule as to the number of times the cautery should be passed over the same line, as this will vary with circumstances which the operator must consider in each case—such as the effect to be produced, the thickness of the skin, situation, disease, irritability of the animal, etc. The depth of cauterization, tint of the lines, and amount of exudation, are the usual guides.

In light cauterization, the lines are shallow and narrow, the tint a golden yellow, and the cautery glides easily. In medium cauterization, the lines are rather deeper and wider, the colour a bright

yellow, and a very slight reddish moisture exuding (this may be apparent in the first degree). In extreme cauterization, the tint is a very light yellow, lines wide and deep, and the serosity abundant in them, with sometimes phlyctenæ on their course. These effects should only be produced after repeated traversing of the lines—not in one or two strokes. The following table shows the three degrees of cauterization, their mode of production, and appearances :

DEGREES.	NO. OF STROKES.	TINT.	BREADTH AND DEPTH OF LINES.	SEROSITY.
First ...	3 to 5	Golden yellow.	Narrow and superficial.	*Nil*, or very slight.
Second ...	5 to 8	Bright yellow.	Rather wider and deeper.	Perceptible in small beads.
Third ...	8 to 12	Light yellow.	Wide and deep.	Abundant.

In cauterizing the ox, the skin being very much thicker than that of the horse, especially around the joints, the application of the cautery should be more prolonged.

Precautions after the Operation.—Provided the cauterized surface has not been very extensive or the cauterization too severe, the secondary effects of the operation do not demand particular notice. The animal should be so secured within a short time, and for some days after the operation, that it cannot gnaw or rub the part, which it will certainly do otherwise, especially during warm weather. Inflammation is excited in the cauterized part, pain is experienced, and there is more or less swelling ; but provided these are moderate, they are not injurious and gradually disappear. If the imflammation and tumefaction are not sufficiently developed, a blister may be applied over the part ; but this requires care, and is not immediately necessary in every case, nor yet in many cases, as is so often imagined. In many cases the fired animal should rest for some days before the blister is applied.

When the pain and inflammation are excessive, and the lines suppurate, there is much suffering on the part of the animal, and serious blemish is almost certain. Constitutional treatment is then indicated to allay the fever and pain, and local applications will be necessary. The best topical agents, under these circumstances, are carbolized zinc ointment, white lotion, and an antiseptic dry dressing ; these agents, from their sedative and astringent properties, are very beneficial.

2. Objective Cauterization.—This is rarely resorted to. It consists in cauterizing the diseased part by means of a hot iron held at a certain distance from it, so as to produce the desired effect by radiation of the caloric. From the difficulty in applying it safely, and uncertainty in effectiveness in the hands of many practitioners,

it has largely fallen into disuse. The instrument may be any convenient piece of metal heated to a high temperature, the distance it should be held from the skin and the effect to be produced depending upon the judgment of the operator, who has little to guide him.

3. Penetrant Cauterization.—*Inherent* or *penetrant cauterization* consists, practically, of four kinds : (*a*) *Penetrating points*, which sometimes replace superficial points ; (*b*) *Subcutaneous* or *Neapolitan Cauterization ;* (*c*) *Perforating Cauterization ;* (*d*) *Disorganizing Cauterization.*

a. Penetrant Cauterization.—This is sometimes combined with superficial cauterization in points, in order to effect more complete resolution of a morbid product. The instrument employed is a very fine or needle-shaped cautery (Fig. 267*d*), the point being of steel. Whether combined or not, the point of the cautery is heated to a bright-red, passed through the skin and subcutaneous connective tissue, into the deeper-seated tissues. The punctures may be few or many, according to the case. They should pierce the periosteum in bony growths, but care should be exercised in puncturing enlargements in the neighbourhood of the articulations and synovial dilatations, especially of a chronic nature. By some practitioners an instrument named the pyro-puncture iron, consisting of a number of points or pins fixed in a plate attached to a handle, is employed.

b. Subcutaneous Cauterization.—This method has been highly lauded by some authorities, especially in lameness arising from disease or injury to the scapulo-humeral and coxo-femoral articulations. An incision—four to six inches—is made through the skin over the part, in the direction of the hair, and the margins being kept apart, with a pointed cautery, at a bright-red heat, from three to six penetrations are made in a straight line, to a depth of three-fourths of an inch, through the subcutaneous fascia, the point being applied five or six times to each perforation.

c. Perforating or Rapid Cauterization.—This is employed to make artificial openings, perforate the walls of cavities to evacuate their contents, or to dilate openings already existing. The instrument may be the ordinary budding iron, the puncture iron (Fig. 119), or a special elongated iron, according to the case. The hair being removed from the part, the point of the cautery—heated to a bright-red—is applied perpendicularly to the surface, and by gradual pressure, and a slight rotatory movement, is made to penetrate the tissue until resistance disappears, or the necessary depth is reached.

d. Disorganizing Cauterization.—This is employed for the destruction of tissue, as in certain tumours, ulcers, unhealthy wounds, etc. The cautery, special in shape, or the ordinary model, should be heated to a high temperature (white heat), and applied to the part to be acted upon, the neighbouring parts being protected from the heat by wet cloths or other defences, as it is sometimes necessary to use the cautery repeatedly, and over a somewhat wide extent.

SECTION IV.

ELECTRO-PUNCTURE OR GALVANO-PUNCTURE.

This is a combination of acupressure with electricity, and has been employed with more or less success in some cases of hæmorrhagic phlebitis, local paralysis, weakness of particular muscles, aneurisms, blood-tumours, distension of sheaths of tendons, colic, tympanites, acute indigestion, etc. But the operation is rarely resorted to, though it might be very serviceable in many cases. It consists in passing through the skin, to the necessary depth, and in opposite directions, two needles more or less apart, according to circumstances, but their points touching. These needles are insulated by gutta-percha coating, and connected with the wires of a galvanic battery, the action of which is continued for a few minutes, and repeated several times. The operation, as a rule, causes much pain.

SECTION V.

SETONS.

In the treatment of certain diseases or accidents, it is sometimes considered necessary to produce a *fonticulus* or *fontanel* (from *fons*, a well), which is an intentionally-induced wound of the skin, in which suppuration is established and maintained for a certain time. This result is achieved by the insertion of a foreign body passed beneath the skin, sometimes deeper; and this may be what is termed a *seton*, or a *rowel* or *issue*, or an irritating substance (as hellebore root, corrosive sublimate, arsenic, etc.) to which the name of *fonticulus* or *trochiscus* is sometimes given. They are energetic local stimulants, and counter-irritants; and have been frequently employed for various purposes. Setons are well adapted, in addition to their other uses, for establishing drainage from cavities containing pus or other fluids.

Instruments.—The instruments required for the application of a *seton* in ordinary situations are: (1) a *rowelling bistoury* (Fig. 87), (2) a *seton-needle*, armed with (3) a *seton*.

Seton-Needle.—This is of various dimensions, and somewhat varied in shape, according to circumstances. It is usually a thin, narrow blade of steel, from six to sixteen or more inches in length, according to requirement, slightly expanded and sharp, or blunt, or slightly rounded at one extremity—the point, which first enters the skin—and a little thicker, but nearly the same breadth, at the other end. At either or both ends there is a narrow rectangular opening or 'eye' for the reception of the seton, and the needle is generally more or less curved on the flat. For convenience in manipulation, the

needle is often fixed in a handle by means of a thumb-screw (Fig. 281), from which it is withdrawn when inserted to a certain distance beneath the skin. Very long needles are sometimes round in the shank or blade, and divided into two or three pieces, which are screwed together when required for use. In special needles (such

FIG. 281.—SETON-NEEDLE IN HANDLE.

as those for passing setons through the frog) the curvature is great, and made laterally, instead of on the flat (Fig. 282).

Sometimes, in order to have a sharp and blunt-pointed needle in one, this is composed of two pieces—one sharp-pointed, the other blunt—which are made to slide on each other, and so project one beyond the other at the end, at the will of the operator.

For small animals—as the dog—the needles are proportionately

FIG. 282.—SETON-NEEDLE CURVED LATERALLY.

less in size than those for larger creatures, and in some cases a large suture or canvas-needle will serve the purpose.

To pass a seton through a tumour, an abscess, or a fistula, a long, eyed probe is useful.

SETONS.—The seton is usually a piece of tape, varying in length and breadth as the species of animal and the case may require. It should be sufficiently long to tie either by both ends when it is

FIG. 283.—MANNER OF TYING THE END OF A SETON.

inserted, or at each end by a large knot to prevent its being accidentally removed from beneath the skin. The latter is the best, as the loop of the first may cause a damaging laceration, or at least much pain to the animal, should it get caught in any fixed object—an accident to which it is exposed. The knot or button may be made at each end by tying the tape around and across a small piece of wood the thickness of a pencil or goose-quill, or doubling the end of the tape one or more times on itself, and then tying it (Fig. 283). Some practitioners prefer cord to tape. The seton is medicated with

some irritant—as turpentine, cantharides, or tartar emetic ointment —when it is desired that its effect should be more energetic.

To apply a 'fonticulus' or 'rowel,' no other instruments are necessary than a pair of common scissors or the rowelling bistoury. The rowel itself is simply a small piece of thin leather, felt, indiarubber, gutta-percha, or even lead. Whatever the material may be, it should be somewhat rigid, though flexible, and not likely to soften or putrefy. The rowel is generally circular or oval in outline, one to three inches in diameter, with an opening in the middle.

As a trochiscus, and in order to produce a very powerful effect, particularly in parts where vascularity is low, as in the skin of cattle, various irritating substances are employed instead of the rowel—such as black or white hellebore-root, veratrum, arsenious acid, bichromate of potass, bichloride of mercury, etc.

As a rule, setons should only be applied in regions which are vascular, in which the subcutaneous connective tissue is loose and abundant, and where extensive serous effusion may ensue. The exceptions to the rule are: fistulæ, abscesses, drainage of cavities, the frog.

In certain regions, as on the sides of the trunk and over the shoulder, where the *panniculus carnosus* muscle is thick and closely adherent to the skin, the seton has to be passed deeper than elsewhere, as it is difficult to pass the needle through the dense connective tissue uniting these two expansions. The direction of the seton will vary according to situation and special indications, but, as a rule, it should follow a vertical or oblique direction, to allow of the discharge escaping by a depending orifice; if possible, it should be placed in the direction of the hair. If it is desired that the seton should produce a derivative effect, then it should be placed at some distance from the seat of disease; but to stimulate chronic inflammations to remedial action, it should be nearer; while to produce resolution in chronic swellings, it may be placed quite near the diseased part.

Setons may be inserted in nearly every part of the surface of the body, but they are generally confined to certain regions. For instance, in the breast they are often applied, and with ease, as the connective tissue is there loose and abundant, and if only one seton is employed it is generally placed vertically in the middle line; if two are inserted, they are placed in the same direction on each side over the prominences formed by the pectoral muscles, the inferior openings being nearer the middle line than the upper, to prevent pus gravitating towards the limbs. The sides of the chest have been setoned in disease of that cavity or its contents, notwithstanding the small amount of subcutaneous connective tissue existing there, and the tendency to troublesome complications. Setons, one or two in number, may be inserted on each side of the neck, in a direction obliquely downwards and backwards; in the dog the top of the neck is generally selected. In the shoulder they may be placed in any convenient part. In the hip, over the coxo-femoral articulation, two or three setons are easily placed, one being inserted

in front and the other behind the trochanter major, extending above and below the joint, and in a vertical or oblique direction. Setons are sometimes inserted in the loins, thighs, stifles, hocks (for spavin and curb), metacarpal bones (for splint), and in the feet (for navicular disease). On the cheeks they have been inserted one on each side over the masseter muscle, parallel to the zygomatic ridge; but care is necessary to avoid injuring the superficial temporal and facial nerves.

Operation.

The manner of operating varies with the region to be operated upon. With the larger animals the standing position is preferable, but in operating on some regions of the body the recumbent position must be adopted, as in applying a seton to the loins, croup, articulations, and lower parts of the limbs. As the operation is always more or less painful, particularly in some regions, and with long setons, local anæsthesia if the horse is standing, and general anæsthesia if recumbent, should be resorted to whenever possible.

The part to be setoned having been fixed upon, it is sometimes convenient to mark the place of entrance and exit of the seton-needle, by clipping off the hair at these points.

The animal must be restrained, if in the standing position, by placing a twitch on the nose or ear, and, if necessary, holding up one of the fore-limbs; the hobbles ensure restraint, if in the recumbent position.

The incisions through the skin, entrance and exit, for the passage of the needle are quickest and easiest made by the rowelling bistoury (Fig. 87); a small fold of skin, transverse to the direction of the seton, being made by the fingers, and this cut through by the blades of the instrument. Ordinary scissors will suffice, or even a scalpel. In every instance, except in inserting frog-setons, the blunt-pointed needle is preferable to the sharp-pointed one.

One edge of the entering incision being raised, the point of the needle is introduced, and by steady pushing and a slight lateral movement of the point it reaches the exit incision, through which it is drawn if the eyelet and seton are at the opposite or hand extremity; the seton being double—if it is intended that it should be single, one end is held beneath the skin, at the entrance incision, while the other is pulled through the exit by the needle. If the eyelet is at the point of the needle (as in Fig. 281), the seton is passed through it after this part emerges from the exit incision, and the needle being then withdrawn by the entrance opening, carries with it the seton.

In passing the needle it is usually held in the right hand, the first finger and thumb of the left hand raising the skin in front of the point; the pressure should be steady, and not sudden or jerking, care being taken not to wound the skin nor subjacent tissues or organs. If the needle is curved, the convexity should be towards the body, concavity to the skin, though the reverse is sometimes recommended.

The length of the seton will depend upon the extent of surface to be acted upon, and whether the two ends are to be tied together, or (the better procedure) each end is to be made into a large knot, or secured to a small piece of wood. If the latter, one knot should be made before the seton is drawn through the incisions, and a certain length of the seton should be left between these and the knots at the end, so as to allow free movement of the tape in dressing the wounds, and prevent it offering an obstacle to the escape of discharge.

Seton in the Cheek.—Use a somewhat small narrow needle; secure the animal in the standing position by a twitch, and by raising one of the fore-limbs on the side of operation. Incisions, two; direction of needle and seton, beneath and parallel to the zygomatic ridge.

Seton in the Submaxillary Space.—Secure the animal as in the preceding instance; use a curved blunt needle of medium length; two incisions; direction from the middle of the submaxillary space towards the larynx, in the middle line.

Seton in the Neck.—Restraint the same. For lateral seton on each side, use a long needle; incisions, two or three. Direction and situation, backwards and downwards, on the latero-anterior part of the neck, commencing immediately behind the atlas, descending obliquely and terminating at a short distance from the jugular furrow. If a second lateral seton is necessary, it should be three or four inches posterior to the first, have the same length and direction, and commence a little further behind the atlas. The needle is easiest passed from below upwards. For anterior seton (in front of the trachea) three incisions may be necessary, and the needle should have the eyelet at the point, the instrument being directed from below upwards, the seton passed into it when its point has cleared the upper incision, and then withdrawn, carrying with it the seton.

Seton in the Breast.—Restraint the same as in preceding case. If there is to be only one seton, it should be in the middle line in a vertical direction; if two, one on each side, converging somewhat at their lower ends, and situated on the middle of each sterno-humeral muscle, terminating a little in front of the part on which the girths rest, at an equal distance between the middle line and the fore-limbs.

Seton in the Shoulder.—Restraint the same, though in some cases it may be necessary to place the animal in the recumbent position. The setons may be two or three, and their situation and direction will vary with the seat of disease and other circumstances, which need not be indicated here. It may be noted, however, that for setons passing over a convex surface, as round the point of the shoulder, the needle should be curved, and its convex side turned towards the skin, the concave surface being inwards; even then it may be necessary, if the seton is to be a long one, to make a middle incision by which to pass the needle through, and enter it again by this incision to complete the operation. The direction of the seton should be vertical or oblique, when possible; and if the horse is to be cast, it is well to mark on the skin the points where the needle is to enter and leave while the animal is standing.

Seton over the Hip-joint.—Restraint the same, except that, if in the standing position, it may be necessary to place a side-line on the hind-limb of the opposite side. Two setons are usually inserted, one before, the other behind the large trochanter, their direction being somewhat oblique from above downwards and forwards. If the trochanter is very prominent, a middle incision may be necessary over the prominence.

Seton in the Hip.—This is usually placed a little below and to the inner aspect of tuberosity of the ischium, and descends to the origin of the gastrocnemii tendons. Restraint as in the preceding operation, or, as this is more painful, both hind-limbs may be secured. The operator stands a little behind and to one side of the limb to be operated on, and has to exercise considerable pressure on the needle, as the connective tissue is dense, and care is necessary to avoid accidents during the movements of the animal.

Seton in the Loins, Croup, Hock, and Fore-limb.—No particular directions are necessary for placing setons in these parts.

Seton in the Foot.—A seton is occasionally passed through the plantar cushion for the relief of navicular disease. In every case it is advisable to throw the horse down, having previously taken off the shoe from the foot to be operated on, and removed as much horn as possible from the middle commissure of the frog. The seton needle is much curved, either on the face or laterally (Fig. 282), and the skin having been incised by the rowelling bistoury in the hollow of the heel, not too near the tendon, is pushed through the cushion, so that its point may emerge from the middle commissure, close to the body of the frog.

Rowel.—To introduce this, an incision, about one-half the length of the rowel, is made in the skin by means of the rowelling bistoury, the incision being made vertical over the shoulder and hip-joints, and transverse in the breast. A kind of pouch is then made beneath the skin, in detaching this from the tissue beneath by cutting through the connective tissue with scissors or knife, the pouch so formed being a little larger than the rowel. The rowel, being doubled or slightly rolled up, is introduced into the cavity, and unfolded there by the fingers or scissors, the opening in its middle corresponding to the incision, and the end of the latter corresponding to the extremity of the rowel. The whole should be so arranged that pus will not collect in the pouch.

Trochiscus.—This is applied in a pouch in a similar manner to the rowel, the substance employed being secured in it, if need be, by a piece of cord or tape, the end of which is allowed to hang out of the incision. The trochiscus may be composed of any of the substances already mentioned; and it may be attached to a seton, so that when it has set up sufficient irritation it may be withdrawn, leaving in the seton if required, for a longer period.

After Treatment.—Within a certain time after the insertion of a seton, inflammation, swelling, and eventually suppuration ensue along its track—usually towards the third day in the horse, the fourth day in the dog, and sometimes as

late as the eighth day in the ox. Until suppuration is established, nothing is necessary except cleansing the wounds, if there has been bleeding; but when pus has formed attention is required. The seton should be gently moved, and slight pressure made over it to get rid of accumulation of matter; the skin around the wounds should be sponged with tepid boracic lotion, and to prevent depilation by the discharge, the integument may be protected by smearing it, when dry, with vaseline, or zinc oxide ointment.

To prevent the horse tearing out the seton with its teeth, the head may be tied close to the rack, or the cradle (Fig. 11) or side-rod (Fig. 12) may be employed. In some cases—hip, stifle, and hock setons—the tail, if long, should be tied up, or carried to one side, by a cord attached round the horse's neck.

The seton is allowed to remain for a period which varies according to circumstances—such as the effect to be produced, nature of the disease, state of the animal, etc., though if left too long it may induce ulceration or sloughing of the skin over its track.

When the seton is no longer required, it should be withdrawn after cutting off one of its ends, and after removal an antiseptic lotion should be passed through the track, to remove pus and promote healing, and cleanliness should be enjoined. The area affected by the seton is sometimes blistered after the wounds have closed.

Should the seton be accidentally removed, it may be replaced by a fresh piece of tape attached to a probe, if the track is patent; if the wounds have become adherent, the adhesions may be broken up by the handle of a scalpel or any other suitable instrument. If it is required to change the seton, through its becoming foul, or from any other cause, the knotted end should be cut off, and the new piece of tape fastened to it either by sewing, or making a hole in it and so threading it, and pulling it through.

The rowel is left in place for about fifteen days, receiving the same attention as the seton during that time. It is removed by forceps, and if the wound has so diminished in size as to render its extraction difficult, this may be enlarged, or the rowel divided by scissors and removed in pieces.

The trochiscus is allowed to remain for a much shorter space, its effects being more promptly and intensely produced. The black hellebore trochiscus should not remain longer than twenty-four hours beneath the skin of an ox, ten or twelve hours in that of a horse; white hellebore is less active, and its effects slower in developing; but it is reported as having sometimes given rise to general toxic symptoms.

Accidents.—The most likely accidents are *hæmorrhage*, *necrosis*, *abscess*, and *excessive granulation*.

Hæmorrhage to a slight extent is always present on introducing a seton; if it is excessive, it is due to a bloodvessel having been wounded by the seton-needle, or to a natural tendency to bleeding, and the blood will escape by the dependent orifice, or form a swelling beneath the skin. If serious, the seton may require to be removed (unless pressure can be made on the part by a bandage), and the wounds closed by suture; or one of the other measures for the suppression of bleeding already indicated may be necessary.

Should abscesses form along the track, or in the vicinity of the seton, they should be opened and treated with antiseptic dressings.

Too luxuriant granulations should be suppressed by astringents, cautery, compression, or by removing the seton.

SECTION VI.

INJECTIONS.

In this place we will treat of injection as an operation which consists in passing fluids into either natural or accidental cavities, with the object of removing therefrom morbid and injurious products, inducing an alteration in the walls of the cavities, or for the purpose of introducing medicaments into the system.

In this way there are various kinds of injections: hypodermic or subcutaneous ,intra-venous, intra-tracheal, substitutive or modificative, and detersive.

Hypodermic or Subcutaneous Injection.

This operation is employed in serum-therapy, and for the introduction of mallein, tuberculin, protective vaccins, and very active medicines into the subcutaneous connective tissue. It has been already briefly alluded to at p. 94. The region selected should be one where the connective tissue is loose and abundant—as the breast, neck, side of the chest, or abdomen, etc. The instrument is the ordinary Pravaz syringe, or a modification of it (Figs. 284, 285, 286),

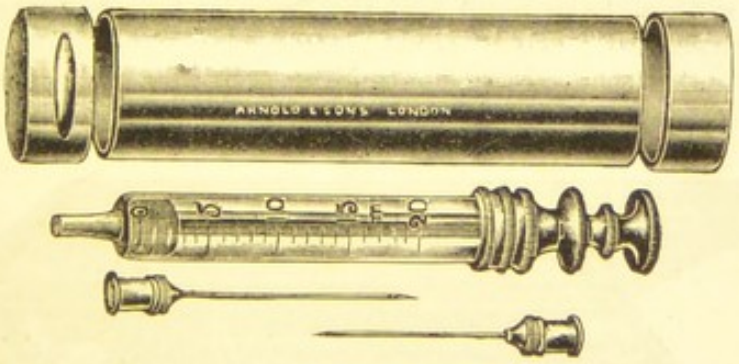

Fig. 284.—Aseptic Hypodermic Syringe.

and the manner of using it is very simple. After disinfection, a fold of the skin is raised by the finger and thumb of the left hand; the needle, detached from the syringe, is passed through the skin, and carried about an inch under the surface. The nozzle of the filled syringe is then attached to the needle, the piston slowly pushed home, and the instrument cautiously withdrawn. It is essential that the syringe be perfectly clean and the needle sharp. The puncture requires no plaster or dressing.

Intra-venous Injection.

Intra-venous injection is sometimes resorted to for the introduction of medicines—barium chloride, silver colloid or toxins, anti-

toxins, salt solution, blood, or other fluid—directly into the circulation.

Any superficial vein may be selected, but that which is perhaps most suitable from its position, direction, and calibre, is the jugular vein. The instrument required in phlebocentesis is an aseptic

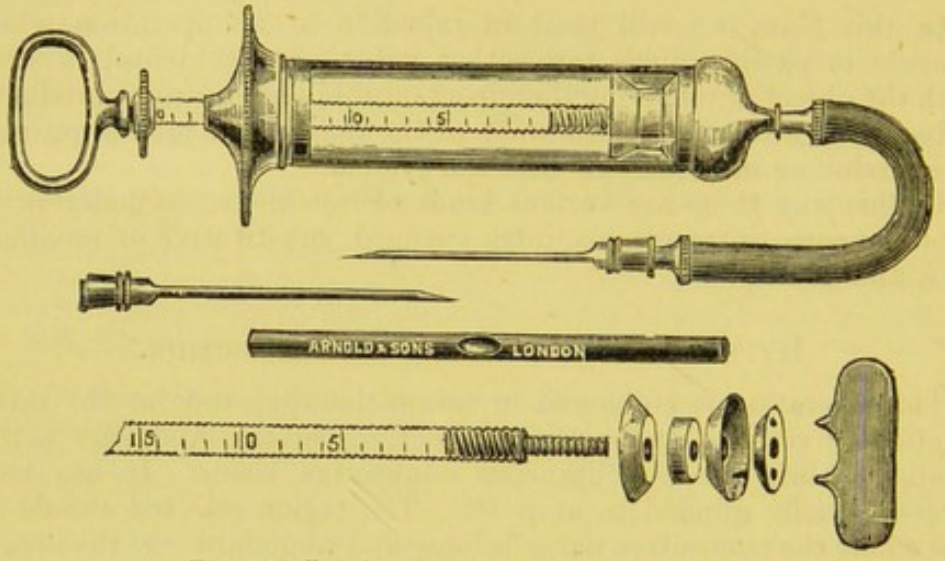

Fig. 285.—Roux's Aseptic Syringe and Needles.

syringe furnished with a fine trocar (Fig. 287). At one time an injection tube with a sharp point and the fleam or lancet were employed for this purpose.

The animal is secured in the standing attitude, with, if necessary, the nose-twitch applied. A small patch of skin having been clipped

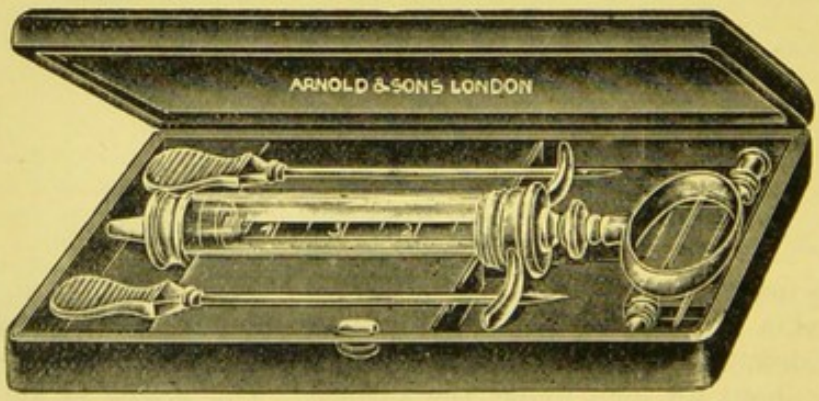

Fig. 286.—Syringe for Black Quarter Vaccin.

and carefully disinfected, the vein is rendered turgid by obstructing the flow of blood through its proximal portion (see 'Operations on Veins'), and then opened by the lancet, fleam, or by thrusting the trocar of the syringe into it. If the syringe is employed, it is easier to make a small incision through the skin immediately over the vein, by the rowelling bistoury; the trocar is then readily passed through the wall of the vein.

When the vein is opened by the lancet or fleam, an injection-tube or small funnel may be passed into it, and through this the fluid may be introduced into the vessel, the tube or funnel being kept in the direction of the blood-stream. Difficulty is often experienced,

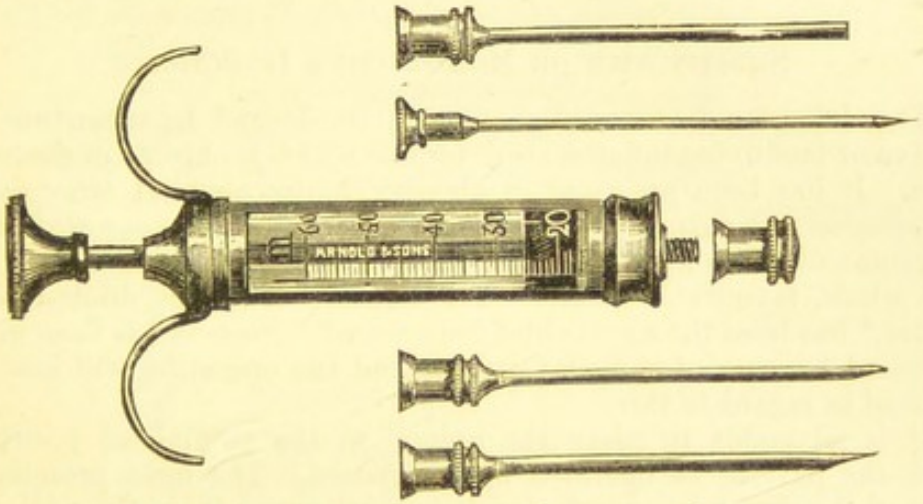

FIG. 287.—SYRINGE AND TROCAR FOR INTRA-VENOUS INJECTION

however, in introducing the tube into the vein-opening, owing to the opening in the skin not corresponding.

The trocar and cannula are preferable, and to avoid wounding the posterior wall of the vein operated upon (a danger always present

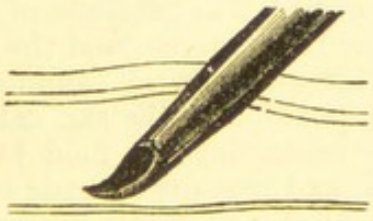

FIG. 288.—TROCAR FOR INTRA-VENOUS INJECTION.

with the ordinary trocar, unless great care is exercised), it is advisable to employ a pen-shaped trocar with the tip turned up (Fig. 288).

The vein having been perforated, the trocar is withdrawn from the cannula, the tube of the syringe is inserted into the latter, and the injection made by steady pressure on the piston, care being taken that air is not allowed to enter the vein. In intra-venous injections the external wound may be closed by suture.

INTRA-TRACHEAL INJECTION.

Intra-tracheal injection is now frequently practised for the introduction of very soluble and active medicaments into the system. Poulton's syringe (Fig. 440), and the injection trocar and cannula adapted to it, are the only instruments necessary. The horse being secured by the twitch, a very small incision may be made through

the skin in front of the trachea, a short distance below the larynx. Then the horse's head being slightly raised, the trocar and cannula are pushed through one of the spaces between the rings, into the canal of the trachea. The trocar is then withdrawn, and the syringe attached to the cannula (see p. 436, vol. ii.).

Substitutive or Modificative Injection.

This injection is resorted to when it is desired to substitute an active or modifying inflammation for one which is chronic or destructive. It has been practised in pleurisy, hydrocele, and other cases of effusion into natural serous cavities, cysts, fistulæ, serous abscesses, hygroma of joints and sheaths of tendons, and with variable but, on the whole, favourable results. The tincture of iodine, diluted with water,* has been the agent chiefly employed. Success has been most frequent in cases of synovial dropsy, and the operation will now be noticed in regard to this.

It is advisable to place the animal in the recumbent position, with the part to be operated upon exposed. The most prominent part of the distension is selected for operation, as there the wall will probably be thinnest, and there is less danger of wounding the opposite side. The hair should be shaved and the skin disinfected at this point, which should be away from vessels, nerves, and ligaments, as well as articular surfaces (if a joint). An aseptic trocar and cannula are then pushed in a slightly oblique direction through the skin (if this has not been previously incised) into the sac, by a slightly rotatory movement. The cessation of resistance is the indication that it has reached the interior, and the removal of the trocar allows the fluid to escape through the cannula. Gentle movement of the latter, and manipulation of the sac, cause evacuation of the synovia. The syringe containing the fluid to be injected is then applied to the cannula, and pressure is made on the piston ; in this way the sac should be filled, and gentle squeezing externally brings the injected fluid into contact with every part. This being done, the cannula is removed, and the fluid is expelled by moderate pressure.

After injection the wound of the skin should be sealed with antiseptic collodion, and the patient placed in slings. Inflammation usually sets in, with considerable swelling ; this gradually subsides. In tapping articular capsules, however, if rigorous antiseptic precautions be neglected, destructive arthritis may ensue.

Fig. 289 represents the *aspirator and injector* recently introduced by Mr. Deans, of Bishop Auckland, for the removal of the synovial distension which is well known as 'bog spavin.' By using this instrument, the whole operation of tapping and injecting the hock can be performed without admission of air.

* Tincture of iodine one part, distilled water two parts, a few drops of concentrated solution of iodide of potassium being added to prevent precipitation of the iodine.

Detersive Injections.

These do not demand notice, as they are readily performed, the cavities to be cleansed being acted upon by means of a syringe or syphon, and water or some other detergent fluid. For injecting fluids into the nasal cavities, a syringe is not so useful with the larger

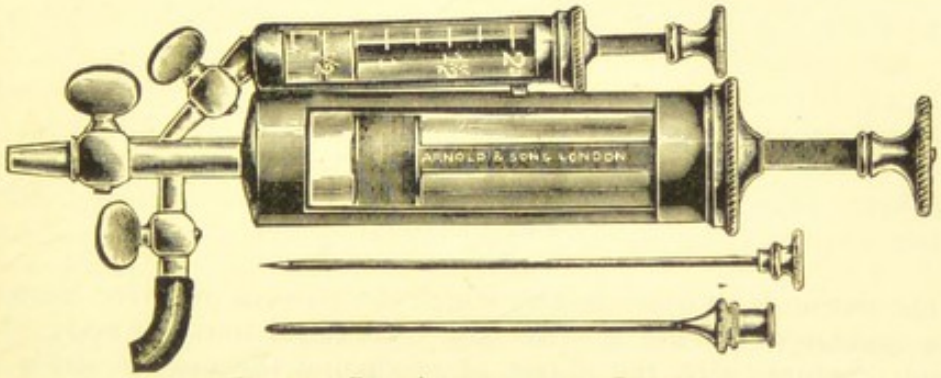

Fig. 289.—Deans' Aspirator and Injector.

animals, such as the horse, as with small animals. For the horse, Rey's tube-syphon is very effective. This is a cylindro-conical tube of leather or gutta-percha, bent at an acute angle, the longer portion being about twelve inches long and four inches in circumference, with its extremity expanded into a cup-shaped cavity two and a

Fig. 290.—Nasal Irrigator.

quarter inches in diameter; while the smaller portion is eight to ten inches in length, and has a circular plate or opercula fixed around its middle by means of a hole in the centre (Fig. 290). To employ it, the horse is held in the standing position (a twitch on the lower lip or ear may be necessary in some instances), the shorter portion is

introduced into the nostril up which the fluid is to pass, as high as the circular plate, which should close the nasal opening; to render occlusion more complete, the nasal portion of the tube may be enveloped in a thick mass of tow. The injection fluid is then slowly poured into the cup of the larger portion, and ascending it fills the cavity, and escapes by the opposite nostril or the mouth.

SECTION VII.

INOCULATION.

Inoculation is an operation by which the virus or infective element of a contagious disease is artificially introduced into the body of a living creature, with the object of producing the disease either in the same or in a modified form.

In some instances the operation is simple and readily performed; in others, it demands care both in performance and in the adoption of certain precautions, in order to render inoculation successful and avert injury. These precautions are related to the condition and surroundings of the animals to be inoculated, the state of the inoculating fluid, the region selected for inoculation, and controlling the subsequent effects of inoculation.

Inoculation may be effected by merely applying the infective material to a membrane which is readily absorbent, introducing it directly into the blood or lymph-stream, or by incision, puncture, or abrasion of the skin or mucous membrane, or subcutaneously by seton, syringe, or other means.

1. *Incision.*—This, which consists in making one or more small incisions through the skin, and placing the virus therein, is not, as a rule, favourable to successful inoculation, the hæmorrhage which ensues being likely to remove the virus, and gangrenous swellings often following.

2. *Puncture.*—This is the operation generally resorted to, and consists in depositing the virus on the sub-epidermic or absorbent surface of the skin. The puncture, or punctures, may be made with any sharp narrow-pointed instrument—scalpel, lancet, bistoury, or cannulated needle (which is the best). The animal being secured in the most advantageous position, the skin of the part after disinfection is made tense by one hand, while the instrument, charged with the virus, and held as if it were a pen, is pushed in an almost horizontal direction into the skin to a very short distance (two to three millimetres), but not through it. Held there for two or three seconds, the instrument is raised almost vertically and withdrawn, the left thumb pressing lightly on the sides of the puncture at the same time, so as to retain the virus therein. It may be necessary to make two or more punctures.

3. *Abrasion or Scratching.*—The epidermis being removed from a small extent of surface, by means of the point of the lancet, so as to expose the derm, the virus is placed upon the denuded part. This procedure is not certain of result with regard to the skin, though it may be resorted to in the case of mucous membranes where the virus is not likely to be rubbed off—as the Schneiderian, conjunctival, or vaginal mucous membrane.

4. *Seton.*—Inoculation may be effected by passing a narrow band of tape, woollen thread, or other material, impregnated with the virus, beneath the skin, like an ordinary seton. A small seton or suture-needle suffices for this purpose, the region to be operated upon depending upon circumstances.

Syringe.—A Pravaz or hypodermic injection-syringe is sometimes employed for introducing virus beneath the skin. The operation is the same as for hypodermic medication.

Experimental inoculations, and indeed all inoculations with animal matters, require much care with regard to cleanliness. But in some experimental inoculations, success depends altogether upon this point. The first object, then, is to ensure absolute cleanliness and freedom from extraneous substances likely to mislead or to do harm. All vessels or utensils used in the inoculation should be sterilized. Instead of syringes, capillary tubes—drawn out from glass-tubing *immediately before the operation*—are preferable. A very small incision is made through the skin by means of a clean knife or scissors, and into this the capillary tube, charged with the inoculating fluid, is introduced as far as the subcutaneous tissues to a depth of one to three inches, the fluid being discharged from the tube by blowing into the free end of the latter. If more than a minute quantity of inoculating material is required, a bulb of the required size to contain it is made in the middle of the capillary tube in the process of blowing. The tube is charged by putting one end in the fluid and exhausting the air in it by gentle suction.

SECTION VIII.

OPERATIONS ON BLOODVESSELS.

The operations practised on bloodvessels have generally for their object the *abstraction of blood* and their *occlusion by ligature.*

The abstraction of blood, or 'blood-letting,' may be effected on *veins*, *arteries*, or *capillaries.* When the operation is practised on veins, it is designated *phlebotomy;* when on arteries, *arteriotomy;* when on arteries and veins, *arterio-phlebotomy;* and when on capillaries, *capillary blood-letting.*

Neither the indications for blood-letting, nor the quantity of blood

to be extracted, need be indicated here. The vessel may be opened by means of the lancet (Fig. 104), scalpel, or bistoury, or fleam (Fig. 109). The length of the opening will depend upon circumstances, but is usually in proportion to the size of the vessel, being equal to the diameter of the latter. When it is too small the blood flows slowly, and ceases before a sufficient quantity has been abstracted; and when too large, it is not so easily closed. It is better, however, that it should be too large than too small, and especially if it is desired to produce a prompt effect. The opening in the vessel should be at least equal in length to that in the skin, and is best made parallel to its long axis, as it is then more easily closed, and there is less liability to accidents.

Phlebotomy.

Blood may be abstracted from any of the superficial or accessible veins, the vessel being first distended by making pressure upon it, at a short distance from the part to be operated on, and nearer the heart, so as to intercept the flow of blood through it. For the horse, the fingers suffice to make pressure. For the ox, when blood is to be abstracted from the jugular, a cord has usually to be drawn tightly round and near the bottom of the neck, because of the thickness of the skin; a cord with large knots at a short distance apart and a loop at one end is very convenient, as the loop can be slipped over any one of the knots, and so the constriction can be readily effected and discontinued without the trouble and inconvenience of tying and untying. For the smaller animals, the fingers or a tape may be employed. The blood abstracted is usually received in a vessel, in order to measure the quantity, and in certain cases to judge of the quality of the fluid.

If the vein which is opened is not of considerable size, the flow of blood from it soon ceases spontaneously; so that, in order to ensure the abstraction of a sufficient quantity, compression usually has to be maintained between the opening in the vessel and the heart. This compression may be effected by the fingers, or by a cord or band, or even by the vessel which receives the blood. The blood should flow in a continuous jet, in order to prevent the escape of blood beneath the skin, and also to hinder the entrance of air. In bleeding from the jugular, the flow is accelerated by causing the animal to move its lower jaw—as in mastication—and to render the side of the neck prominent, by turning the head towards the opposite side. After a sufficient quantity has been obtained the wound in the skin is closed. For small animals, a narrow bandage over a small piece of tow or lint is only required; but for the larger a pin is ordinarily employed, after the manner of the twisted single pin suture (Fig. 158), the pin being passed only through the skin.

Bleeding from the Jugular.—The jugular in the larger animals may be opened by means of the lancet or fleam, the latter being preferable; for the smaller animals, the lancet is the best instrument.

In operating on the HORSE, restraint may not be necessary; at most the nose-twitch may be applied. The head should be rather elevated, and slightly turned away from the operator, who stands on the side to be operated upon, the horse's eye on that side being covered by the hand of the assistant who holds the head. The skin at the point of operation should be clipped and disinfected.

If the animal is unsteady, it may be placed in a corner or against a wall. The left jugular is usually selected, being more convenient. The operator, standing towards the shoulder, with the opened fleam in the left hand (held as in Fig. 110), and the stick with which to strike it in the right, raises the vein by pressing upon it in the jugular furrow with the two last fingers of the left hand, so as to cause the intercepted column of blood to oscillate and distend the vessel. The point of the fleam being placed very close to the skin, but not touching it, immediately over the middle of the vein, a smart blow is given to the back of the instrument by the stick, the strength of the blow being in proportion to the size and dilatation of the vessel. If blood does not flow from the wound, the blow has either not been strong enough, or the blade of the fleam has passed to one side of the vessel; in which case the vein should again be distended, and the operation repeated, not in the same wound, but at a short distance from it. Sometimes blood flows in very small quantity and slowly, due either to the opening in the vein being insufficient, this opening not being opposite the wound in the skin, or to the presence of a second jugular.* The same procedure is to be followed as when no blood appears.

To bleed from the right jugular, the operator should be ambidextrous, the fleam being held in the right hand, and the stick in the left.

When the horse has a fine skin, and the vein is prominent, the vessel may be opened by means of a lancet. The instrument is held between the pollex and index fingers (as in Fig. 107), pressure on the vein being made with the index or medius finger of the left hand, and the lancet is pushed through the skin and vein, in the direction of the axis of the vessel, by slightly extending the pollex and index holding it, the point being then raised so as to give the wound a sufficient length. The lancet may be held in the right hand when the operation is to be performed on the right side; but opening the vein on either side with this instrument is not free from risk, as when the puncture is being made a sudden movement by the horse may cause the lancet to cut a long slit in the vessel, and thus produce serious hæmorrhage, which it may be most difficult to check.

When sufficient blood has been obtained, the wound in the skin is closed by a pin being passed through the evenly adjusted lips (head of the pin upwards), including only a small portion of skin,

* Occasionally in the horse, and in most of the other domesticated animals, there is a second or supplementary jugular alongside the carotid, and this vessel may be large enough to convey a considerable quantity of blood from the main jugular when this is compressed.

which should not be dragged or pulled. Should it bulge after the silk or tow has been twisted round the pin, it may be gently pressed down by the finger. The skin should be cleansed by cotton wool moistened with carbolic lotion.

After the wound has healed, when the vein is distended it presents a varicose or bulging appearance at this point; and when phlebotomy has to be practised, some practitioners prefer re-opening the vessel in this situation, as it is more easily accomplished.

The only precaution necessary after the operation, is prevention of rubbing of the wound by the animal; this is usually done by tying up the head. The horse should not be worked until the wound is quite healed. The pin may be removed on the third day. The danger to be guarded against is phlebitis with formation of thrombus.

In operating on the OX, the procedure and the instruments are the same as for the horse. The animal should, however, as a rule, be well secured to a post or tree. The vein is 'raised' by the neck cord already described, and a large-sized fleam is employed. The stream of blood is considerable, but it ceases as soon as the cord is relaxed, and it is rarely necessary, though advisable, to close the wound by the pin suture.

In the SHEEP the jugular is not very accessible, owing to an adipose layer which separates it from the skin, especially in fat animals, and also because of the wool, which must be removed. The sheep being held between the legs of an assistant, who keeps its head elevated, a cord is applied tightly around the base of the neck, and the vessel is opened by the fleam or lancet.

In the DOG the jugular is very movable, and consequently difficult to puncture; it requires to be distended by a somewhat tight ligature around the root of the neck. The animal ought to be placed on its side, and held firmly on a table, the head being extended by an assistant, who keeps the neck ligature in place. The vessel is opened by a small lancet, and the wound closed by the pin suture.

Bleeding from the Saphena Vein.—To operate on the HORSE, it is necessary to have the opposite hind-limb held up, as in shoeing, and the operator may place himself either to the outside or the inside of the leg to be operated upon—the outside being preferable. Or the opposite hind-leg may be drawn forwards and upwards by the side-line secured round the neck, the operator standing behind. The lancet is the best instrument, as the fleam is liable to be driven into the tibia, from the proximity of the vein to this bone; the vessel being voluminous, and more distended by the additional weight thrown upon it, does not require to be raised. The puncture is made as in the jugular; the blood flows in a free stream at first, but soon diminishes, and will cease unless pressure from below upwards, or friction is applied, or the animal is made to walk. The wound is closed by the pin suture, but its application is difficult, from the great sensitiveness of the skin in this region, and the restrained position of the operator. Thrombus is frequent after the operation, but it usually disappears spontaneously, without any injurious result.

Bleeding from the Subcutaneous Abdominal or Mammary Vein.—This vessel is most frequently opened in the Cow, especially when suffering from Mammitis. It is of considerable size, so that there is no difficulty in puncturing it with the fleam, compression being made to 'raise' the vessel by the free fingers of the hand holding the instrument. The operator stands towards the shoulder, his back to the animal's head, the fleam in the hand next the animal, which should be held firmly by the horns, and if necessary, the hind-leg of the same side secured by passing the tail round it. The wound is closed by twisted suture, or by a compress attached to a surcingle fixed around the body for a day.

Bleeding from the Facial or Angular Vein.—This vein is frequently punctured in the sheep, especially on the Continent of Europe. It is situated in front of the maxillary tuberosity, at an equal distance between the eye and mouth, crossing the face. The operator holds the sheep firmly between his legs, the left knee a little in advance of the right; the left hand seizes the lower jaw in such a way that the ends of the fingers 'raise' the vein at the middle of the cheek. The right hand, armed with the lancet, feels the vein, and punctures it parallel to its direction, a short distance below the maxillary tuberosity.

Bleeding from the Auricular Vein.—This vessel is only opened in the Pig. The animal is held by assistants, its jaws closed, and the head firmly maintained by an assistant. The ear is turned back on the neck, the root being pressed to raise the vein, which is then opened by the lancet. The wound does not require a suture.

Arteriotomy.

The abstraction of blood from arteries is seldom practised, and its result is to produce an immediate and rapid effect on the general circulation, or on that in a certain region, in cases of active congestion, or where a vein is absent or obliterated. Arteriotomy is more difficult than phlebotomy, because of the comparative smallness of arteries, their greater density and mobility, and their being more deeply situated. There is also danger in opening them, from the greater difficulty in suppressing the hæmorrhage. The only arteries which are sometimes punctured are the *temporal* in the HORSE and OX, the *posterior auricular* and *middle coccygeal* in the OX, and the *posterior auricular* in the PIG.

Bleeding from the Temporal Artery.—This vessel, situated immediately beneath the zygomatic ridge, where it can be felt pulsating, is easily punctured by the lancet held in the right hand, parallel to its axis. The bleeding is stopped by pressing upon the artery, with the thumb of one hand, below the maxillary condyle; bringing the lips of the wound together with the other hand, and closing it by the twisted suture. Then a pledget of tow is placed on each side of the wound, and the whole covered by compresses—commencing with small ones—until a prominence has been formed greater than the temporal ridge, the pressure on the artery by the thumb being con-

tinued while they are being placed. One end of a long bandage is passed over these, around the forehead and the lower jaw, the other end being passed in the opposite direction until the whole is rolled round the head, when the ends are secured by strong pins or stitches. The horse's head is to be kept tied up to the rack by two lines for six hours, when the wound will have become closed.

Bleeding from the Posterior Auricular Artery.—This vessel has been operated upon in the Ox and Pig, but the result is of little value. It is opened near the base or middle of the ear, by means of the lancet, either by a longitudinal puncture or a transverse incision, and to maintain the escape of blood the ear is flapped or beaten lightly. The wound closes spontaneously.

Bleeding from the Middle Coccygeal Artery.—This artery is only opened in the Ox, the point being the middle of the under surface of the upper third of the tail. The organ must be elevated, the skin incised immediately over the artery, which is then cut across. The tail may be flapped to accelerate the flow.

The hæmorrhage is suppressed by a pledget of tow inserted in the wound, and a bandage placed over it. The nearer the incision is to the root of the tail, the more profusely the blood flows; but then the sacro-coccygeal muscles must be divided, and the operation is consequently more serious in its consequences.

Capillary Blood-letting.

Capillary blood-letting, which may also be designated arterio-phlebotomy, as the capillaries connect the veins with the arteries, is occasionally resorted to. It is chiefly practised on the palate, at the coronet, and at the toe; and it may be effected by incision, scarification, leeches, or cupping.

Blood-letting at the Palate.—Usually performed on the Horse. The operator stands on the right side of the head, seizes the tongue in the left hand, and with the right hand makes a puncture by means of a strong lancet or bistoury, in the middle of the palate, in the fourth or fifth anterior groove—not nearer the incisor teeth, as the palatine arteries anastomose towards the third groove. If a lancet is employed, the depth of penetration should be guarded, and the instrument with the regulating slide (Fig. 104) is advantageous. If the bleeding persists it can be stopped by placing a large pledget of tow on the wound, and securing it by one or two turns of a bandage around the palate and jaw and under the upper lip.

Blood-letting at the Coronet.—The large superficial plexus of veins and capillaries at each side of the foot, on the lateral cartilages, as well as the large veins before and behind these, are sometimes punctured or scarified. To abstract blood, nothing more is necessary than to push the point of the lancet or bistoury through the skin at this part, multiplying the punctures according to the amount of bleeding considered necessary. As injury may be caused to the cartilage by wounding it, and as the extensor tendon may also be wounded if the punctures are made anterior to the cartilages, it is

generally advisable to open the vessels posterior to the latter, on the bulbs of the plantar cushion. The foot should be immersed in warm water to accelerate the bleeding, or the animal may be moved about gently.

Blood-letting at the Toe.—Blood is abstracted from the capillaries and larger vessels at the margin of the pedal bone, after the shoe has been taken off, by removing the horn of the sole at its anterior part until the vascular tissue is reached, and puncturing or incising this at the lower border of the bone. The horn may be thinned away to some extent at the juncture of the wall with the sole (the white line), and towards the point of the frog, and a small incision made into the vascular tissue; or a narrow groove may be made in the unpared sole across the white line, by means of the drawing-knife or searcher, until this tissue is reached, when the circle of bloodvessels may be cut either with the searcher or a lancet or bistoury, taking care not to wound the sensitive laminæ. If either of the two latter instruments is used, in order to prevent this accident the edge should be towards the point of the frog. I have found the searcher very safe and effective, if it is sharp at the point, and carefully handled. A pledget of carbolized tow wedged firmly in the groove, and another placed between the sole and the shoe when this is replaced, is sufficient to stop the bleeding.

Capillary blood-letting is also practised by means of *punctures*, *scarifications*, *cupping*, and *leeches*.

Punctures.—These are made with the object of relieving swollen parts, as in œdema (subcutaneous or submucous), or local superficial congestions. Care must be taken not to push the instrument too deeply, and to prevent accidents it is well to employ either the lancet with regulating slide, or the blade of the ordinary lancet held between the thumb and index, at a sufficient distance from the point.

Scarifications.—Scarifications are superficial incisions, made at variable depths, according to circumstances, by means of the lancet, scalpel, or straight or curved bistoury, inclined at an angle to the part to be scarified. The scarifications may be parallel incisions or they may intersect each other. Warm fomentations may be required to increase the escape of blood.

Cupping.—This operation is now rarely resorted to in veterinary surgery, though in some cases, when it is required to abstract a quantity of blood rapidly from a particular region, as the loins, abdomen, or sides of the chest, it may be usefully employed.

Leeches.—These annellides are only employed to abstract blood from the smaller domestic animals—as the dog—though with the horse, where the skin is very fine, or previously cleaned and shaved, they might also be applied. To entice them to fix themselves on the skin, this may be smeared with a little milk, sugar, or juice of meat; and before using them it is also advisable to remove them for two or three hours from the water in which they are usually kept, while immediately before applying them it is recommended to plunge

them for a few seconds in bitter beer. To apply them, they are generally placed in a glass or small basin, which is inverted over the region on which they are to operate, so as to throw them on the skin. When they have gorged themselves with blood they roll off the part; but if it be desired to prevent them reaching this stage, a little salt sprinkled on the skin will detach them, as will pinching their tail. If it is necessary to maintain hæmorrhage from the leech-bites, the part may be fomented with warm water, or exposed to the vapour of boiling water.

Accidents Attendant on Blood-letting.—The accidents attendant on or consecutive to blood-letting are numerous, though they may be said to be rare. The chief are: *puncture of arteries, trachea, nerves, bones, introduction of air into the veins, hæmorrhage, syncope, phlebitis,* and *thrombosis.*

Puncture of Arteries.—This may occur in phlebotomy when an artery lies close to the vein to be operated upon, and has been most frequently observed in the carotid artery, either when the blade of the fleam has been too long or struck with too much force, or from altered anatomical relations between it and the jugular vein. The vein generally escapes puncture, and as soon as the artery is opened the crimson blood flows in incessant and regularly intermittent jets, which are diminished by compression *below* the wound—blood escapes into the subcutaneous connective-tissue, forming a large, diffuse, and sometimes deep swelling, and the loss of that fluid may be excessive. Puncture of the carotid or any other artery is a serious accident, though not inevitably fatal; but when practicable the wound should be sutured, or the vessel ligatured above and below the puncture; compression alone is seldom sufficient to check the hæmorrhage. In accidental puncture of the carotid, death has sometimes occurred from the swelling extending up the neck, compressing the larynx, and producing suffocation.

Puncture of the Trachea.—This is a very uncommon accident, and if it occur without the jugular being opened, then little harm results, trifling local subcutaneous emphysema only being observed. If, however, there is bleeding, the blood may enter the trachea and produce asphyxia. The animal coughs in a distressing manner, blood is ejected by the nostrils, and death speedily takes place if the hæmorrhage is not arrested by strong compression of the vein.

Puncture of Nerves.—This accident is also somewhat uncommon. The effect will, of course, vary, according to the nerve injured. With some nerves there will be great pain, and with others there may be loss of function in the organs or parts they supply.

Introduction of Air into the Veins.—Under exceptional conditions, air may be introduced into veins, notably the jugular, during blood-letting, and give rise to more or less serious symptoms; it may even cause death. This introduction is generally accompanied by a sifling or gurgling noise, isochronous with the heart's beats; and if it is very brief, nothing very marked may follow. But if a certain quantity of air is taken in, the animal is soon seized with convulsive movements; the respiration becomes difficult and the circulation disordered, feebleness ensues, the expression is anxious and agitated, and the creature may fall and die in convulsions in a short time; or it may remain in a state of syncope for a long period, then suddenly recover.

This accident may occur while the wound in blood-letting is being closed, and it is therefore recommended to cease compressing the vein very gradually, so as to allow the blood to fill the vessel, and to put the finger on the wound to prevent admission of air while the blood is regaining its ordinary course.

Hæmorrhage.—Secondary hæmorrhage is not unfrequent, and may be due to the operator, the wound being improperly or imperfectly closed, or to the animal opening it by rubbing or biting it. The bleeding is checked by again closing the wound; and in order to ascertain whether this has been done securely the vessel should be slightly distended, when, if there is no leakage, it is safe.

Syncope.—This is a very unusual accident, though it has been witnessed in the horse, more frequently in the sheep and dog, as a result of blood-letting. Con-

striction of the neck by a cord, in order to 'raise' the jugular, appears to favour the production of syncope. To induce recovery, the application of cold water to the head, placing the latter in a dependent position if possible, allowing the inhalation of ammonia, and friction to the limbs, should be resorted to.

Phlebitis.—Inflammation of the vein is a serious result of phlebotomy, as it leads to more or less complete occlusion of the vessel, and consequent obstruction to the flow of blood through it; and if the obstruction is considerable, and the collateral veins cannot carry on the circulation, then the case may be a grave one. When the inflammation is limited in degree, the phlebitis may be only *adhesive;* but only too frequently it runs on to the formation of pus, constituting septic phlebitis. Portions of the clot formed in the vessel may also become detached, and being carried into other and smaller vessels, perhaps in a distant part, plug them, thus giving rise to embolism. Phlebitis supervening on bleeding is sometimes complicated with hæmorrhage, especially when suppuration has set in, if the clot gives way when the pus escapes externally, and a fatal termination has been noted in such cases.

This accident is generally due to a rusty or dirty lancet or fleam, to undue irritation of the vessel when closing the wound, or subsequently, etc.

The treatment must be conducted on surgical principles. In inflammation of the jugular vein, great success has attended the application of a strong vesicant over the inflamed part. When suppuration is established, the abscesses should be promptly opened. Extirpation of the diseased portion of the jugular has been practised frequently, and with the best results, a cure being effected in from fifteen to twenty days. The best method is to place the animal recumbent, administer an anæsthetic, and make three incisions in the inflamed vein—one at the point where blood was obstructed, another at the jugular bifurcation, and the third in the facial branch in the parotideal region, the knife being passed to the lining membrane of the vein. The forefinger is then introduced into each incision, and the cylinder formed by the diseased vein is easily detached from the surrounding tissues. The facial branch is cut across if it is obliterated, and if it contains fluid blood it must be ligatured. The occipital and glosso-facial veins are also divided, and if need be tied. When the diseased portion has been in this way detached, the whole of it is withdrawn from the lower incision, and the part below this opening being dissected out for a short distance, the piece is cut off. This embraces the whole of the diseased portion, and nothing more is required than to dress the wound, and the track of the removed portion, antiseptically, closing the incisions by means of a few sutures, and securing the animal in the stable so that it may not rub the side of the neck operated upon. Hæmorrhage from the upper portion of the vein is to be apprehended, and if it occurs the ligature must be employed.

Ligature of Bloodvessels.

The ligation of bloodvessels generally has already been described at page 103. We have only now to briefly consider the ligation of particular vessels, as the *jugular vein, carotid artery, femoral artery, saphena artery, and intercostal arteries.*

Ligation of the Jugular Vein.—To reach the vessel, incise the skin and panniculus carnosus in the jugular furrow, between the mastoido-humeralis and sterno-maxillaris muscles, to a convenient length, and parallel with the direction of the vein. The latter may then be separated from the connective-tissue and ligatured; if there is already a large opening in it, the finger may be introduced to facilitate the operation. Two ligatures are applied and secured in the manner already described—the upper being hæmostatic, and the lower preventing the introduction of foreign matters into the circulation.

Ligation of the Carotid Artery.—Make an incision through the skin, panniculus carnosus, and subscapulo-hyoideus, between the jugular

vein and anterior border of the mastoido-humeralis muscle, in the upper half or lower third of the neck, holding the knife perpendicularly, and cutting down directly upon the vessel. This being exposed, it is detached from the sympathetic and pneumogastric nerves chiefly by means of the fingers, and two ligatures are placed around it, the inferior being the first tied.

Ligation of the Femoral Artery.—This vessel, which occupies the space between the pectineus, the long adductor of the leg, and the vastus internus muscles, is reached by making an incision above, against the prominence formed by the anterior border of the short adductor of the leg. It is necessary to place the animal on the side corresponding to the vessel to be ligatured, the limb to be operated on being drawn backwards. The skin is first cut through, then the internal crural aponeurosis, when the vessel is exposed and isolated, this being easily and safely done by the fingers, which free it from the surrounding tissues, the deep inguinal glands, and the femoral vein which accompanies it.

Ligation of the Saphena Artery.—This is a comparatively simple operation, the vessel being quite superficial, and exposed by a single incision.

Ligation of the Intercostal Arteries.—These have sometimes to be ligatured, as when the ribs are fractured; they are situated on the posterior border of the ribs, rather at the inner aspect of these, and must be detached slightly from the bone, in order to pass a curved needle, armed with the suture thread, around them.

SECTION IX.

OPERATIONS ON MUSCLES.

The special operations on muscles are very few in the domesticated animals. The chief are *Coccygeal Myotomy* and *Crural Myotomy*, and these only will be described here.

Coccygeal or Caudal Myotomy.

This operation consists in dividing the muscles of the tail of the horse, nearly always the depressors, situated on the under surface of the organ; though in some instances of deformity, when the tail is carried to one side, the curvator of that side may be divided, in order to allow the antagonist muscle to rectify the deviation.

The operation is vulgarly known as 'nicking,' and the fashion of nicking the tail, in order to allow of its being carried higher, and so, as was thought, to improve the appearance of the animal, was for a long time prevalent. If for fashion, the operation is cruel, and therefore should not be performed; but in certain rare circumstances it might be necessary.

Division of the depressor muscles, the longest and strongest pair of the six muscles with which the tail is provided, will only be treated of here.

Operation.—The animal does not require much preparation for the operation. The diet should be light for two or three days previously, and the tail may be bandaged, and tied more or less elevated for a short time to the surcingle, in order to accustom the horse to the restraint which will be subsequently imposed on this organ. In

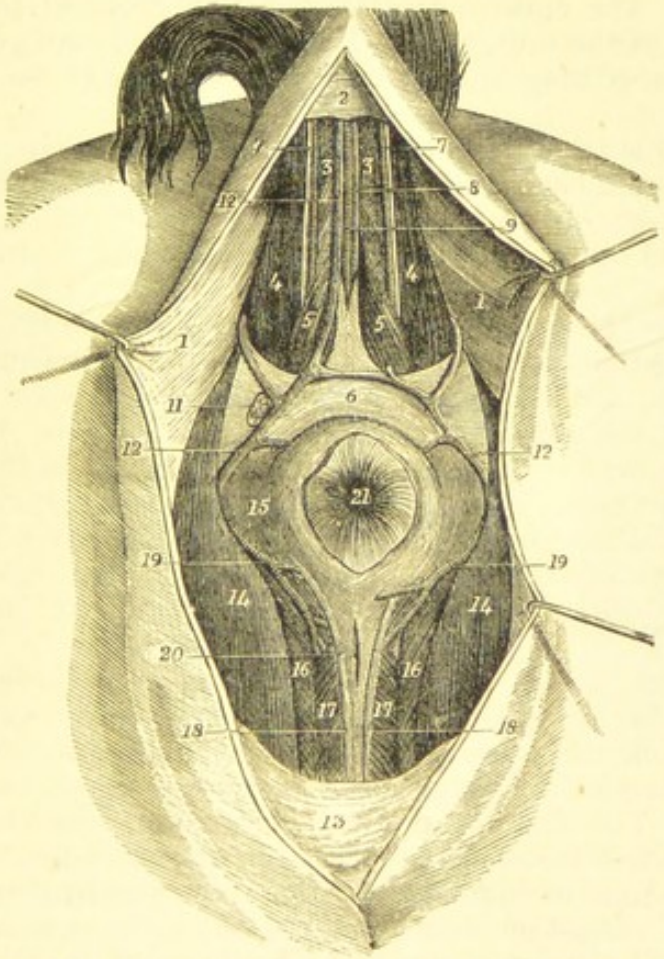

Fig. 291.—Anatomy of the Coccygeal Region: 1, 1, Skin; 2, Portion of the Sheath of the Coccygeal Muscles; 3, 3, Inferior Sacro-Coccygeal Muscles: 4, 4, Lateral ditto; 5, 5, Ischio-Coccygeal Muscles; 6, Suspensory Ligament of the Anus; 7, 7, Lateral Coccygeal Arteries; 8, Deep Coccygeal Vein accompanying the Median Artery; 9, Median Coccygeal Artery; 10, 10, Inferior Coccygeal Nerves; 11, Lymphatic Glands; 12, 12, Superficial Coccygeal or Hæmorrhoidal Veins communicating by Transverse Anastomosis; 12, Superficial Coccygeal Vein.

order to judge as to the manner and degree of the operation, the horse is trotted at a rapid pace to see how the tail is carried naturally; as in some instances one method of procedure may be preferable to another, in others one large incision may suffice, while in others, again, several are needed, and these may be deep or almost subcutaneous, near the root of the tail or more towards its middle.

The anatomy of the region is simple. The chain of coccygeal bones is surrounded by six muscles—two superiorly (elevators), two

inferiorly (depressors), and two laterally (curvators). All these are long tapering muscles, inserted into the bones as they pass to the extremity of the tail, each muscle being composed of a succession of fleshy bundles, contained in a somewhat strong aponeurotic sheath which separates them from the skin. The inferior muscles cover, on each side, the lateral coccygeal artery and its satellite nerve, both of which are nearly always divided in the operation; and between the two muscles, enveloped in a fibrous sheath, is the middle coccygeal artery, which is much less exposed to injury, and should be spared if possible. The muscles are thickest and strongest towards their origin (root of the tail), and if the animal is not strong in its coccygeal muscles, it may be necessary to operate near the base of the organ.

If the tail is to be suspended after the operation, by means of its hair, this should be plaited in such a manner as to afford attachment to a cord; or this preliminary precaution may be omitted if the hair be rolled up in mass, and the cord tied round it after the operation.

If possible, the operation should be performed on the horse in the standing position, the head being held elevated by means of a twitch on the nose, the hind-limbs secured by side-lines or the Cossack hobbles; or the animal may be placed in the travis, if convenient, or against a wall. The area of operation should be freely injected with a 5 per cent. solution of cocaine, well washed with soap and water, and thoroughly disinfected. It is very rarely necessary to cast the horse unless it is excessively irritable or vicious. In the recumbent position the operation is more difficult and less satisfactory.

There are various modes of performing coccygeal myotomy, whether it be by open or subcutaneous muscular section. In the open division, the procedure may be by transverse incision of the skin and muscles, by longitudinal incision of these, or by the two combined. The first, or ordinary procedure, consists in making three transverse incisions on each side; the second is by transverse and longitudinal incisions; the third by longitudinal incisions; the fourth by T-shaped incisions; and the fifth by continuous transverse incisions. The subcutaneous and setoning method will be described after these.

1. *Ordinary Method, by Independent Transverse Incisions.*—This is the usual and the oldest method of operating, and consists in making independent transverse incisions through the depressor muscle on each side of the tail (Fig. 292), with or without excising a portion of each. The cutting instrument is usually a strong short-bladed knife, slightly curved, the cutting edge being on the concave side, the convex back being blunt. A straight or curved bistoury, forceps, and curved scissors should also be at hand as well as pledgets of tow and a bandage.

The horse being properly secured, an assistant seizes the tail and bends it upwards over the croup, so as to completely expose its under or hairless surface, while a second assistant holds the instru-

ments. The operator standing with his face to the tail, which he takes in his left hand, and with the knife held between the index-finger and thumb of the right hand, passes this at a right angle into the inner border of one of the muscles, between it and the bone, which should not be touched, the back of the knife being towards it; then cutting outwards towards the side of the tail, by pressing the hands downwards, so as to make the point of the knife describe the segment of a circle, this comes out at where the hair commences, and the muscle is incised. The incision should be perpendicular to the axis of the muscle.

The first incision is made towards the root of the tail, the others on the same side following towards the apex; the left side of the tail being first done, then the right is operated on, the knife being held in the left hand to make the incisions in the latter. The incisions are usually two or three in number, generally the latter, the first being made three or four inches from the anus; if too near the latter,

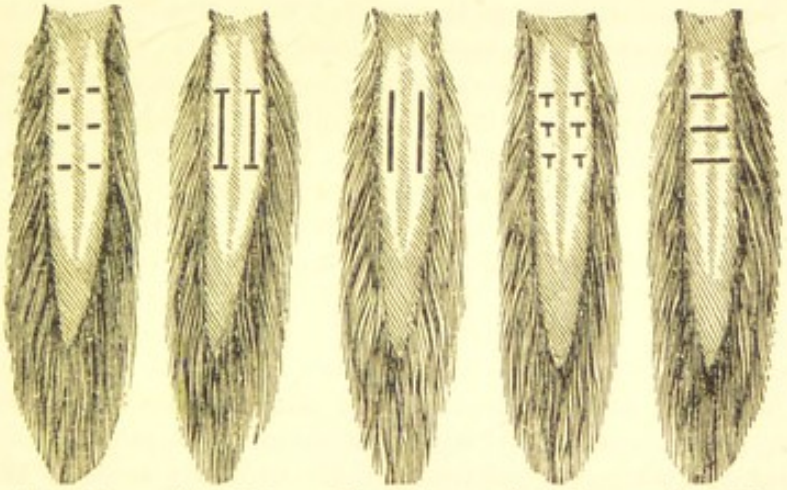

FIG. 292. FIG. 293. FIG. 294. FIG. 295. FIG. 296.

the suspensory ligament may be injured, and a large cavity left, in which a sinus may form. The muscles should be completely divided, care being taken not to injure the bones or the joints.

The first incisions towards the root of the tail are the most important, and they might suffice in some cases, as they are made through the thickest part of the muscles—if there is more than one incision through each, there should be about two inches between them. If the muscles are properly cut through, the divided portion should protrude through the openings of the first and second incisions; if this is not so, the knife must be again introduced, but it is better to completely incise them at a single cut.

The incisions on both sides should be exactly on the same line and symmetrical. A portion of the protruding ends of the muscles should be seized by the forceps and excised by the scissors, as if allowed to remain they will interfere with the process of healing.

2. *Method by Longitudinal and Transverse Incisions.*—This method, proposed by Vatel, consists in making two transverse incisions in

each of the depressor muscles, one three or four inches from the root of the tail, the other three or for inches distant, the two being united by a longitudinal incision (Fig. 293). The muscles thus divided and isolated, are dissected out, commencing with the upper portion, which is seized by a tenaculum, or forceps.

3. *Method by Longitudinal Incisions.*—Delafond brought this method into use again, after it had been given up for some time. With a convex bistoury in the right hand, which is steadied by resting the thumb on the under surface of the tail (thrown over the croup in all these methods), by a single cut the skin is divided on the prominent part of the depressor muscle to the extent of three or four inches, the incision not being prolonged beyond the fold of skin above the anus. The muscle being exposed, the knife is passed under it so as to divide its insertions, commencing at the top and proceeding towards the bottom, where it is cut across obliquely from above to below, so as to prevent its retraction and the formation of a subcutaneous pouch in which pus might accumulate. Being isolated on one side and projecting from the wound by the inferior division, it is seized by the forceps, dissected from the inner side, the knife directed outwards, so as to prevent injury to the coccygeal artery ; then it is removed altogether by cutting it superiorly. The muscle of the opposite side is similarly excised (Fig. 294)

4. *Method by T-shaped Incisions.*—In order to facilitate the excision of the muscles divided in the ordinary method by transverse incisions, a longitudinal cut is made in the lower lip of each wound, so as to make the incision T-shaped (Fig. 295), and allow the end of the divided muscle to be more readily excised.

5. *Method by Continuous Transverse Incisions.*—To afford free exit to pus, and produce a wide and shallow cicatrix, this method has been recommended by some operators. It consists merely in connecting the transverse incisions of the ordinary method (Fig. 296), and is not to be recommended, as it gives rise to much hæmorrhage. Hering and Bernard modify this method, by cutting through the depressor muscles by means of a strong lancet-shaped knife, which, being pushed into the middle of the muscle, the point is moved laterally so as to intersect all the fibres ; a second incision is made in the same manner two inches higher. The protruding muscles are not excised.

6. *Subcutaneous Method.*—This, for several reasons, is the best method, though care and skill are required to render it effective, and ensure complete division of the muscles. With the lancet provided with the regulating slide (Fig. 104), three or four short longitudinal incisions are made on each side of the under surface of the tail, not far from where the hair commences, so as to cut through the skin and the sheath of the depressor muscles. A strong, curved, probe-pointed bistoury or tenotome is passed through the incision, beneath the muscle, and the cutting edge being turned upwards, this is cut through without dividing the skin. The same manœuvre is practised in each incision, and the portions of muscle which protrude are cut off.

Another method is to make an incision through the skin, not more than the third of an inch long, in the same situation, and three or four inches from the root of the tail. The blunt-pointed bistoury or tenotome is passed through this opening between the skin and the muscle nearly at the centre of the tail, when the edge is turned downwards against the muscle, and by slight sawing and pressing this is cut through, the point of the instrument touching the vertebra. This is repeated once or twice on each side; and each time a snapping sound is heard when the muscle and its sheath are cut through, at the same time a cavity appears beneath the skin. There is no excision of muscle required, the hæmorrhage is trifling, if there be any, and suppuration is rare.

Another operation, with the same object, has been proposed, and as it is simpler and requires less time, it is noticed here.

A small, sharp-edged seton-needle, armed with a tape, is passed rather deeply into the under-surface of the tail, two or three inches from the root, and brought out two inches or so lower down, but not so deep towards its exit. The tape is then cut and tied, as with an ordinary seton, or its ends are left free. The tail is secured elevated for a short time occasionally, the seton being allowed to remain for a week or so.

Consecutive Treatment.—The operation being completed, on the tail being released, in all the methods except the subcutaneous there is usually considerable escape of blood from the incisions, due to accidental wounding of the lateral coccygeal arteries. There is seldom any danger attending this bleeding, which may be checked by placing pledgets of tow, moistened with an antiseptic, over the incisions, maintained by a bandage applied sufficiently tight around the tail to produce a moderate degree of compression without checking the circulation; the tail should be held horizontally while the bandage is being applied. If the bleeding has ceased within twenty-four hours, the bandage is removed, but the pledgets of tow may be left on until they fall off spontaneously.

In order that the object of the operation may be attained, it is necessary that the tail be maintained elevated for a certain time, so as to allow the spaces between the divisions in the muscles to be filled up by new tissue, which prevents depression of the tail.

The retention and suspensory apparatus may be, in principle, a cord attached to the tail, passing through a pulley depending from the roof of the stable, immediately above or a little behind the hind-quarters of the horse, a weight being attached to the other end of the cord; or it may be a contrivance fastened to the body of the horse.

Pulley Apparatus.—This should be used in a stall so narrow that the animal cannot move the hind-quarters much to one side or the other, unless a special arrangement be added to the apparatus.

There may be one, two, or four pulleys. If one be employed, it is suspended from the ceiling, a good distance above the croup of the animal; if two are used, the additional one is attached to the wall immediately behind the horse, near the ceiling; and if four are

required, two are hung from the roof, at a distance from each other equal to the width of the animal's hind-quarters, the other two at the wall before or behind the horse, at a corresponding distance from each other. With the latter, two cords are required, one for the two pulleys on each side; if possible this mode of suspension by four pulleys should be adopted, as it admits of the horse moving more freely from side to side. Or recourse may be had to a movable or traversing pulley, running on a line passing across the stall at the height and position already mentioned.

Immediately after the operation (better before), the hair of the tail is tied up into a loop at the end by a piece of cord; or it may be plaited into two tresses of equal length, one on each side, pieces of cord being interlaced in them to form loops. To the loop or loops the pulley-cord or cords are fixed by a slip-knot; they should be strong and pliable, about the thickness of a large quill, and sufficiently long to pass from the tail, through the pulleys, and reach to within a short distance of the ground. The pulleys may be two inches in diameter and three-fourths of an inch in thickness, the channel for the cord being deep. To the free end of the cord is attached a weight (a small bag of sand answers well) of about 4½ to 9 pounds, according to the subject. The cords should run freely and securely in the pulleys, and allow the horse to move without much restraint. The object is to keep the tail elevated and in a direct line with the body until the wounds are healed; any deviation caused by the apparatus will defeat this end.

Apparatus Fixed on the Horse.—In order to avoid distortion of the tail from the unequal healing of the wounds, as well as the restraint of the narrow stall and pulley apparatus, and the enforced confinement for a consecutive number of days, various apparatus, independent of the location, in being attached to the body of the animal, have been devised.

The simplest consists of a surcingle around the body, to which the tail, bent up over the croup, is fastened by two cords plaited into the hair. To prevent the tail being too much curved upwards, which would be likely to retard the circulation, a bundle of straw or hay tied firmly in the middle (so as to make a groove for the reception of the tail), or a bag filled with some soft material, is placed between it and the croup. To obviate the disadvantages of the pulley, an apparatus was introduced by Bartlet, in the last century, which appears to have been on a similar principle to the surcingle and pad apparatus. It consisted of a piece of tough wood, about twelve inches long (*a* to *b*, Fig. 297), nineteen inches wide (*c* to *d*), and seven or eight inches thick. The lower face was hollowed to fit over the croup and quarters, while to receive the tail a groove was cut (*g* to *h*), three inches wide and three deep (*g*), gradually diminishing in depth and width (to *h*); and holes were made at certain intervals in the groove (as at *h*) for the tape, and a notch cut to receive the billet from a strap (*k*). Two buckles were fixed to it (*i i*). On each side the wood was sloped (as from *e* to *c* and *a*) to make the apparatus lighter, and hollowed (at *b*, *g*, and *f*). Fig. 298 represents a horse

with its tail in the apparatus : *a* is a pad to which is fastened a surcingle *b ; c c* are two side-straps, one on each side of the horse, attached to the surcingle to keep the apparatus in place ; *d*, a breast-plate to prevent the pad, etc., slipping back ; *e*, a strap fixed to the pad and buckling to the apparatus ; *g*, to keep the tail extended ; *f*, the tape tied on the hair to confine the tail to the apparatus. When the hair was properly plaited and tied with a knot or two at the end,

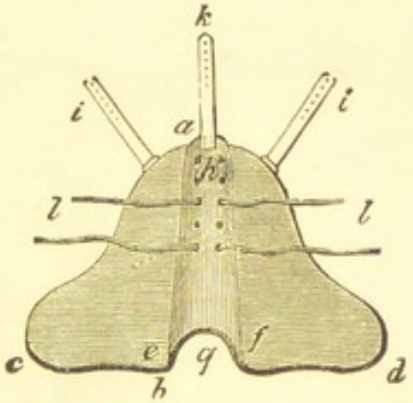

FIG. 297.—BARTLET'S APPARATUS.

the pad, etc., was put on, and the apparatus buckled to them, allowing the part marked *g* to lie over the root of the tail, when an assistant, placed above the horse, gently raised the tail till the knot at the end reached so far beyond the tapes *l l* that it could be tied down. This done, the tail might be let down or raised, as there might be need.

Objections have been made to those appliances which bent the

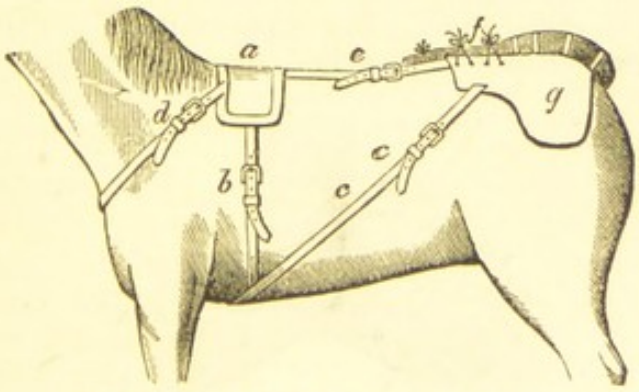

FIG. 298.—BARTLET'S APPARATUS APPLIED.

tail over the croup, because they led to ulceration of the upper part of the organ and prevented favourable cicatrization of the wounds ; therefore others were proposed, to simply keep the tail erect, not flexed, during the healing process. One of these consists of a long piece of wood with its end bifurcated like a stable-fork ; these bifurcations are fixed to the surcingle on each side of the back, the body of the stick resting on a block of wood wrapped up in a bag and placed on the croup, where it is retained by cords passing

round the thighs; to the free extremity of the stick is fastened the end of the tail by means of a tape or cord plaited in the hair.

Another apparatus to prop up the tail has been highly spoken of, and may, in addition, be employed for injury to, or fracture of, the bones of the organ. This consists of a collar (Fig. 298 A), roller or surcingle (B), to which the collar can be fastened at top and bottom

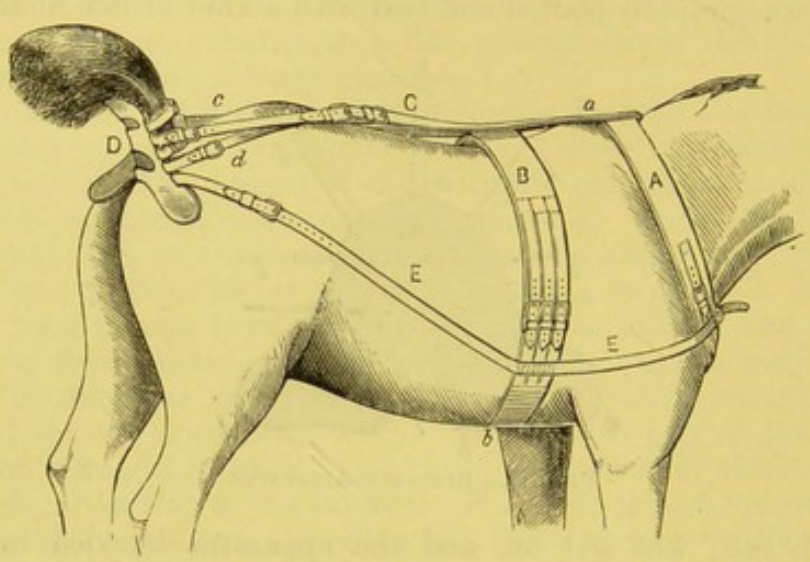

Fig. 299.—Tail Support Applied.

by strap and buckle (*a*, *b*), croup-strap passing from the roller along the back, to which two diverging straps (*c*, *d*) can be buckled, the tail-support (D) to rest on the ischii by its two projections, and fixed on each side by the diverging straps (*c*, *d*), and side-straps (E E) extending from the collar to the roller and tail-support, to prevent this shifting to either side. The support itself is made of a light trifurcate piece of iron channelled for the reception of the tail

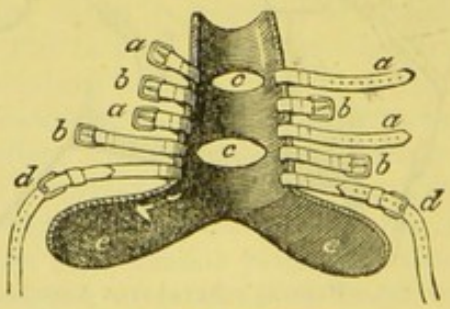

Fig. 300.—Tail Support.

(Fig. 300), the channel being lined with sponge or flannel, and the branches (*e e*) which rest on the ischii covered with leather. Each side of the part for the reception of the tail has five apertures near the border, in which are straps and buckles. Some of these (*a a a a*) are for the purpose of fixing the tail in the support; others (*b b b b*) join the diverging back-straps (Fig. 299, *c*, *d*) to the support, so that the elevation of the tail may be modified to any extent; while others

(*d d*) are joined to the side-straps (Fig. 299, E) to prevent the support becoming displaced laterally. There are two openings (*c c*) in the floor of the support to allow access to the wounds in the tail for the purpose of dressing them. Caps may be made to fit over these openings.

The apparatus having been properly applied, after the wounds have been dressed, if there is any hæmorrhage it soon ceases, owing to the elevation of the tail. In twenty-four hours the bandage may be removed, and the pledgets of tow or lint allowed to fall off spontaneously. No particular care need be given to the wounds, except to keep them clean by frequent dressings. In a fortnight or three weeks the elevating apparatus may be removed, but during this period the horse should have exercise; if the tail has been in the pulley apparatus, it must be liberated while exercise is allowed, but if the apparatus is attached to the body, there is no occasion for this release. The elevation at which it may be desired the tail should be carried may be obtained by carefully watching the effect of the apparatus; as the longer this is employed the higher the tail will be elevated.

Accidents.—Caudal Myotomy is not without danger, and this is sometimes very serious. Hering reports four deaths in 141 horses operated on. Hæmorrhage is the most frequent accident, and this is checked by applying a styptic, bandaging and elevating the tail, or tying it down tightly between the thighs to a surcingle. When the incisions are made too near the anus, or the tension is too great, or a vertebra has been injured, or some other cause has been in operation, considerable tumefaction may ensue, extending to the croup and thighs, and this may run on to abscess, gangrene, or other grave complication, which may result in death. When the coccygeal bones are injured by the knife, the consequence may be of no importance; or necrosis and sinus may result, the latter being most frequent after subcutaneous myotomy.

Tetanus may be a sequel of 'nicking'; while deformity of the tail is not unfrequently observed after the operation, the organ being carried more or less to one side. In some instances the operation is not successful, owing to the depressor muscles not having been completely divided. To remedy the latter condition, the operation must be performed again; and to rectify lateral deviation, if due to mismanagement, the tail may be tied to the surcingle, on the side opposite to that towards which there is deviation, before cicatrization of the wounds is complete.

With regard to coccygeal myotomy for excessively natural elevation of the tail, the elevator muscles may be divided, as the depressors are for depression of the organ; but this is indeed rarely required, and when necessary much care is needed to prevent the tail being carried too low. One incision through each muscle is sufficient. No apparatus is requisite. In natural lateral deviation of the tail, the curvator muscle of the side to which the organ is carried, is divided by one incision—subcutaneous, if possible, without excising a portion of the muscle—the tail being carried round to the opposite side by attaching it to the surcingle for a few days.

Crural Myotomy.

Cattle are liable to a peculiar accident, to which they are predisposed by the special disposition of the long vastus muscle, which

entirely covers the coxo-femoral articulation, and the muscle of the fascia lata, the anterior border of the latter being united to the former by a strong aponeurosis, the two layers of which envelop this border, and closely adhere to it. It frequently happens, and particularly in emaciated animals, and those which have the points of the hocks approximating, with the trochanter of the femur very salient, that the fascia lata is ruptured at the trochanter, and this, instead of gliding on the inner face of the long vastus, slips in front of its anterior border to pass through the accidental fissure, where it is so firmly fixed that an operation is necessary in order to give the limb liberty of movement. The lameness somewhat resembles that due to luxation of the patella. There is great difficulty in flexing the hip-

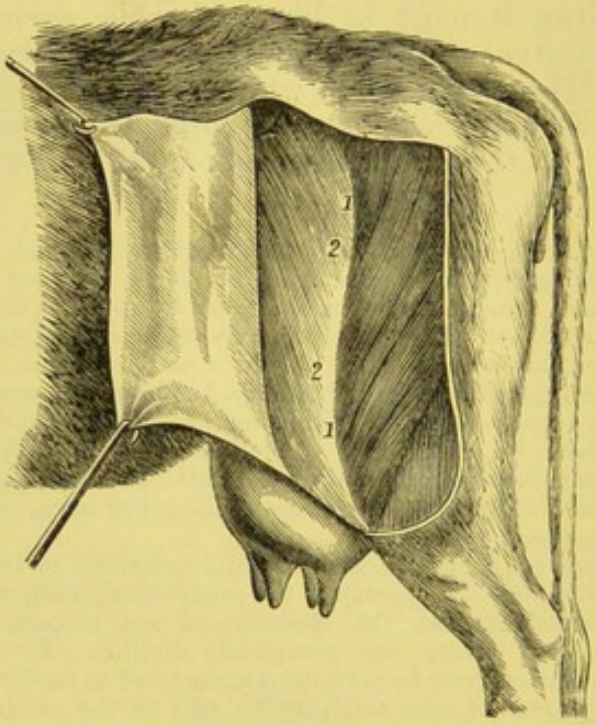

FIG. 301. — ANATOMY OF THE LONG VASTUS AND FASCIA LATA: 1, 1, ANTERIOR BORDER OF THE LONG VASTUS: 2, 2, FASCIA LATA AT ITS UNION WITH THE LONG VASTUS.

joint; the limb cannot be brought forward, the foot is dragged behind, and there is a depression at the part corresponding to the anterior margin of the long vastus, this margin, rendered tense by the suspension of the trochanter, forming to the touch a prominent tense cord passing towards the patella, and increasing in size as it reaches the middle of the muscle. The lameness is greater when the animal is ascending than descending a steep place. The accident may be caused by a fall, false step, slip, etc., and the lameness may be intermittent, if the muscle is replaced now and again.

The accident is usually unilateral, though rupture on both sides is sometimes observed. The bursa, which facilitates the gliding of the muscle over the trochanter, is generally torn.

In some cases the accident is repaired by rest and topical applica-

tions, but when at all severe, operation is necessary. This consists in transverse section of the portion of muscle displaced.

Operation.—The animal may be operated upon in the standing or recumbent position. If standing, it should be tied to a post or wall, or fixed in a travis. If not in the latter, then it is advisable to have the opposite hind-limb raised forward by a rope fastened round the base of the neck.

An incision is made through the skin and fascia lata, two or three inches below the trochanter of the femur, along the salient border formed by the displaced muscle, the incision varying from one to three inches, according to circumstances; the short incision may be made with the fleam, or the scalpel or curved bistoury may be employed to make the short or long incision. The skin is first incised, then the fascia, and lastly the muscle; the latter is incised transversely, or obliquely downwards and forwards (the best) for from two to four inches, by means of the ordinary straight or probe-pointed bistoury. This is passed, flat, beneath the muscle, either directly, or guiding it by the finger or grooved director; then the muscle is made tense by carrying the limb forward, and the knife, being turned edge up, is made to perform a double drawing and lifting movement outwards and upwards.

Consecutive Treatment.—The wound is to be treated in the ordinary manner; exercise allowed for a few minutes every day; and at the end of a week, the animal may be travelled or put to work.

SECTION X.

OPERATIONS ON FASCIÆ AND PERIOSTEUM.

The operations on fasciæ or aponeuroses and periosteum, are very few. On the former there are section of the coraco-radialis aponeurosis, and fascia lata and tibial aponeurosis, while periosteotomy is sometimes performed when nodes or tumours are forming on bones in certain regions, and especially on those of the limbs.

Coraco-Radial or Anti-Brachial Aponeurotomy.

This has been practised in bygone times with the view of straightening the fore-limbs of the horse in cases of 'knuckling over' at the fetlocks and bending forward of the knees, though with doubtful success. It has also been resorted to as a complement to supercarpal tenotomy. Retraction of this aponeurosis, rarely witnessed, gives rise to symptoms resembling those of what is commonly known as 'stringhalt' in the hind-limbs.

Operation.—The animal is placed in the recumbent position, on the side opposite to that to be operated upon. The limb for operation may be left in the hobbles, or fastened back across the hind-limb of the same side: The object of the operation is to divide the

fibrous, cord-like continuation of the coraco-radialis muscle, easily felt as it passes to the anti-brachial aponeurosis by traversing the angle formed by the union of the arm with the fore-arm, and obliquely crossing the cephalic vein.

The incision is made at the most salient part of the cord, and as the cephalic vein obliquely crosses its inner border, to avoid wounding this a fold of the skin is raised, and divided by the rowelling bistoury, immediately over the part to be incised. The tenotome is passed through the cutaneous opening, and around the anterior border and inner side of the cord, which is divided by pressing on the instrument, at the same time drawing it backwards and a little outwards.

The wound is to be treated according to surgical principles.

Fascia Lata Aponeurotomy.

This operation has been practised for the relief or cure of the irregular movement of the hind-limbs designated 'stringhalt.'

Operation.—The animal is placed on the side opposite to that which is to be operated upon. Either of two procedures may be adopted.

First Procedure.—The skin and fascia lata are incised at the point of intersection of two lines—one parallel to the direction of the femur passing by the external tuberosity of that bone; the other perpendicular to the preceding, about five inches above the stifle. The incision should be made in the direction of the hair; it is formed by lifting a small fold of skin, and snipping through it by the rowelling bistoury, to an extent sufficient to admit the probe-pointed bistoury or scalpel. The aponeurosis being exposed, it is incised throughout its width in a direction perpendicular to the greater axis of the femur or, perhaps better, vertically. To facilitate this incision, a hook-shaped knife with a blunt point, sharp on its concavity, is employed. This is passed, flat, beneath the aponeurosis, pushed in the proper direction a little beyond the anterior border of the thigh, in order to divide the thin fibrous layer of the aponeurosis in this part. The knife is then turned edge outwards, the hook catching the fascia, and while one hand supports the skin the other withdraws the instrument, thus dividing the membrane.

Second Procedure.—A second incision is made on the anterior border of the crural region, to afford entrance to the knife, and allow of its making the division in the required direction.

Consecutive Treatment.—The wound is to be treated on ordinary surgical principles, antiseptic dressings being freely employed. If swelling is excessive, cold-water irrigation is useful, and if suppuration results a dependent opening for drainage must be provided.

Peroneal Aponeurotomy and Tenotomy.

This operation has also been practised for 'stringhalt,' subcutaneous section of that portion of the tibial aponeurosis which passes along the extensor of the phalanges, as well as that of the

terminal tendon of the lateral extensor muscle of these, being often followed by good results. It is safer than fascia lata aponeurotomy.

Operation.—The horse is laid on the side opposite to the affected limb. The leg is constricted above the hock, by means of a cord or elastic ligature, in order to check the circulation, and to render the tibial aponeurosis more accessible at the seat of operation. The operator incises the skin below the hock, immediately over the terminal tendon of the lateral extensor of the phalanges. Into the incision he introduces his tenotome, which is well rounded at the point, and placing it on the tibial aponeurosis, he divides this membrane transversely, in pressing the instrument with the left hand. Then taking a sharp-pointed tenotome, he passes this beneath the tendon of the peroneus and cuts it through transversely.

Consecutive Treatment.—When the horse is allowed to rise, it at first flexes and carries the pastern forward, but after taking a few steps the limb rests firmly on the ground. The wound is dressed with tow steeped in antiseptic solution, and is kept there by a bandage around the hock and the upper end of the metatarsus. This dressing should be renewed every day for six or eight days. After the operation, the horse should remain in the stable for two to three weeks. If the horse has stringhalt in both hind-legs, the second limb is operated upon in the third or fourth week after the first.

During four years, Dieckerhoff had operated on nineteen horses, fifteen of which were completely cured, while the others were much relieved. If the stringhalt has been present only for a few months, recovery may always be expected ; but when it has existed for a long time, the operation only affords a little more liberty of movement in the limbs.

Periosteotomy.

Division of the periosteum has been practised to remove the tension on that membrane when a node is forming beneath it.

Operation.—Division of the membrane is best made subcutaneously. The operation may be performed while the horse is standing, a twitch only being applied to the nose ; but the animal is usually cast if a limb is to be operated upon. The operation area having been shaved and disinfected, a slight fold of skin is raised trans-

Fig. 302.—Periosteotomy Knife.

versely over the part ; a little snip is made in this with the rowelling bistoury, and a narrow-bladed knife passed through it, flat ; when pushed across the long or short diameter of the growth, the cutting edge of the knife is turned towards it, and the periosteum cut through as the instrument is withdrawn. A special knife, or 'periosteotome,' has been devised for this operation, the blade being curved, the point blunt, and the convex border sharp (Fig. 302, see p. 188).

Consecutive Treatment.—The wound is to be antiseptically dressed, and afterwards treated in the usual way.

SECTION XI.

OPERATIONS ON TENDONS AND LIGAMENTS

General Remarks.

Tenotomy and desmotomy are not unfrequent operations in veterinary surgery, being resorted to for rectifying deformities, either congenital or acquired, for the relief of disease, or to limit the movement of certain parts.

The horse is the animal most frequently operated upon, and the operation is usually performed in the recumbent position; though it may, in some instances, be conveniently accomplished in the travis. It will be described here as performed in the recumbent position, the horse being secured in the manner already indicated. The instruments required are: rowelling bistoury, or scalpel, to incise the skin; a sharp-pointed tenotome (Fig. 303), as well as a blunt-pointed tenotome, having a curved narrow blade (Fig. 304);

Fig. 303.—Sharp-Pointed Tenotome.

Fig. 304.—Blunt-Pointed Tenotome.

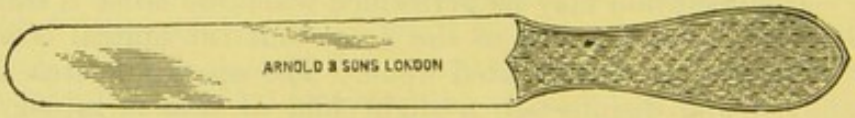

Fig. 305.—Tenotomy Spatula.

and a spatula (Fig. 305), which will be found very useful. The operation should be carried out with strict attention to asepsis in order to insure healing by first intention.

The tendons or ligaments should be divided subcutaneously, the section being transverse and complete. The skin incision may be made with the rowelling or sharp-pointed bistoury; it should be as small as possible, and on the surface or margin of the tendon or ligament to be divided. The spatula (or tenotome) is introduced into the skin incision and pushed steadily towards the farther border of the tendon or ligament. Having made a track for the knife, the spatula is withdrawn, and the tenotome is then passed flatways, its point close to the tendon or ligament, so as to get between this and any vessels, nerves, or other structures in its vicinity, until the opposite side has been reached. The tendon or ligament is then made tense by an

assistant, who manipulates the limb, the cutting edge of the instrument is turned towards the tissue to be cut, and this is divided by a kind of sawing movement. Complete division of the tissue is manifested by cessation of resistance to the instrument; sometimes a snap is heard, the deformed parts are straightened, and a space can be felt between the ends of the incised tendon or ligament. The division should be as complete as possible, all connective tissue or aponeuroses in direct connection with the divided part being cut.

The tenotome should be withdrawn flat, to avoid cutting the skin.

The subsequent treatment will depend upon circumstances. In all cases antiseptic dressings and a bandage are applied to the wound, and the parts are kept as fixed as possible.

Super-Carpal Tenotomy.

Division of the external and oblique flexor tendons of the metacarpus, which are inserted into the super-carpal bone or pisiform, is performed to remedy bending over at the knees, the retraction of these tendons producing that deformity, which is generally the result of excessive exertion, though it may also be due to congenital defect, for which this operation is more particularly indicated. One or other of the two tendons may be divided—the external by preference, which is frequently sufficient to allow the limb to be straightened. If division of one tendon is found in a few days not to suffice, the other may be divided, as the incision need not be at the same point. Or both tendons may be divided at the same time.

Anatomy.—The external flexor muscle of the metacarpus is situated on the outer side of the fore-arm, forming its posterior border, its tendon dividing into two branches, the anterior of which, funicular, is inserted into the head of the external small metacarpal bone, while the posterior, large and short, is inserted into the pisiform, where it is confounded with the tendon of the oblique flexor. Section of this tendon should be made above its point of bifurcation, so as to avoid wounding the artery passing beneath it, as well as the synovial sheath of the carpal arch. The oblique flexor muscle lies behind and at the inner aspect of the fore-arm, and has a single tendon, which is inserted into the pisiform along with the branch tendon of the other muscle, with which it is united. Division should be made before this union is effected; the place for incision being the space or furrow which can be felt between the two tendons, two inches or so above the pisiform.

Operation.—The animal is thrown, chloroformed, and laid on the side opposite to that on which is the defective limb. The skin having been shaved, washed, and disinfected, the tendons are made tense by passing a rope or side-line around the forearm, to draw this backward, and another around the pastern, alongside the hobble, in order to pull the leg forward.

Division of the tendons is made subcutaneously, the operator placing himself in front of the limb.

Section of the *external flexor tendon* is accomplished by making a small incision through the skin, about three inches above the carpal articulation, and immediately in front of the tendon, which can easily be felt beneath the integument. A strongly curved

tenotome is then passed down flat between the skin and tendon, so as to embrace the latter in its sharp concavity when this is turned towards it; this being done, by pressing the handle downwards and backwards, so as to give the blade a forward and upward or 'gouging' movement, while the assistants forcibly extend the limb by pulling on the ropes around it, division is effected—a result known by the absence of resistance, the sudden extension or straightening of the leg, and sometimes a crackling sound.

Or the tenotome may be introduced beneath the tendon, which is cut from within to without; but in operating in this manner there is danger of cutting the skin extensively, should the animal struggle.

Division of the *oblique flexor tendon* is made in a similar manner,

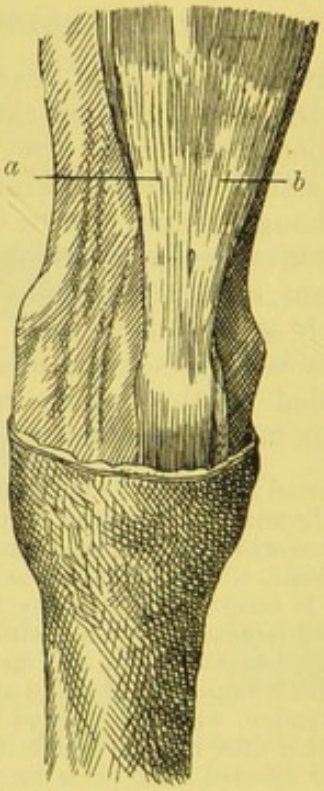

FIG. 306.—INFERIOR PART OF FORE-ARM SHOWING FLEXOR TENDONS.
a, Oblique flexor; *b*, External flexor (after CADIOT).

about two inches above the pisiform, between the two tendons, on the posterior face of the limb, the tenotome being passed down flat until its point can be felt through the skin on the under side of the limb, when its edge is turned towards the tendon, which is divided from without to within.

If both tendons are to be cut at the same time, the incisions should not correspond (*i.e.*, be on the same level), in order to allow better cicatrization and produce less inflammation. The wound is closed by suture, and protected by carbolized wool or tow and a bandage.

Consecutive Treatment.—The wound only requires frequent dressing and cleanliness. A shoe with a long toepiece and low thin heels may be attached to the hoof of the limb, in order to keep this straight until cicatrization is complete. It is generally advisable to place the horse in slings for some days. If there is much swelling, cold-water irrigation may be resorted to.

Plantar Tenotomy.

Plantar tenotomy is most usefully practised in solipeds for the reposition of the phalanges when these have become displaced or deformed, as the result of excessive fatigue or disease, which leads to retraction of the flexor tendons of these bones, or from congenital defect. The animals 'knuckle over' at the fetlock, or walk upon the anterior border of the hoof. Plantar tenotomy includes division of the *Anterior Perforans tendon*, the *Posterior Perforans tendon*, and the *Perforatus tendons* of fore and hind limbs. Division of the perforans tendon alone is practised when the perforatus tendon is not involved. In the majority of cases, at first it is only the deep flexor which has undergone retraction, but this is followed by the superficial also becoming implicated; while the connective tissue uniting and surrounding them becomes indurated, and inseparably fixes them together. In some cases the carpal or tarsal ligaments are also involved, as well as the suspensory ligament. These complications modify the operative procedure, which will, however, be described here as for *each* of these organs.

Anatomy.—The flexor tendons of the phalanges are situated behind the limb, and extend from the knee or hock to below the fetlock. The superficial at the fetlock forms a ring or sheath for the deep tendon, the former being consequently designated *perforatus*, and the latter *perforans*. The perforatus, in the fore-limb, is covered by the fibrous expansions of the carpal and metacarpophalangeal sheaths, in the hind-limb by those of the tarsal and metatarsophalangeal sheaths. Towards the middle of the cannon-bone, the perforans receives a strong fibrous band furnished by the posterior ligament of the carpus or tarsus. In front, immediately behind the large cannon-bone, and between the two splint-bones, is the suspensory ligament of the fetlock—a strong band, thin at its origin and bifid a short distance above the fetlock, where only it is free.

In the *fore-limb*, the carpal sheath through which the tendons glide is lined by a vast synovial membrane, and is continued on them for rather more than one-half the space between the knee and fetlock; while the synovial sheath of the sesamoids ascends on the tendons for a short distance above the fetlock; so that there is only a small space—little more than an inch—where there is no synovial membrane. In the *hind-limb*, the tarsal synovial sheath is prolonged to above the middle third of the metatarsal region, and the sesamoidean sheath being about the same as in the fore-leg, it follows that there is a space of more than three inches free from synovial membrane.

It is in this space that division of the tendons should be made, but frequently, in consequence of disease, section has to be made above or below this space.

Before commencing the operation, it should be carefully ascertained whether one or both flexors, the carpal or tarsal ligament, or the suspensory ligament, should be divided. In many cases, it is only the deep flexor that requires section. In order to discover this, however, the animal should be made to place most of its weight on the deformed limb, by raising the opposite leg, when the tension on tendons and ligaments will enable them to be more readily felt.

Anterior Perforans Tenotomy.

There are two ways of dividing this tendon, both of which have their advocates. The first is that which, perhaps, offers most advantages.

First Procedure.—The horse is laid on the side corresponding to the limb to be operated upon, the opposite fore-leg being secured to the lower end of the tibia of the same side. A rope is tied above the knee, and another on the pastern, so as to forcibly extend the limb for operation, the pastern rope being pulled forward at a certain stage of the operation, while the knee-rope is drawn backwards.

The operator places himself in front of the limb. A small incision is made through the skin, by means of the rowelling bistoury, between the two tendons at the middle of the cannon, where there is no synovial sheath, care being always taken not to wound the large bloodvessels and nerves. Or the skin incision may be made by a scalpel, which, when this has been accomplished, is pushed perpendicularly and gently, flatways, between the two tendons until its point can be felt on the opposite side : the left hand grasping the limb meanwhile, so that the thumb, placed outwards, pushes forward the plantar nerve and vessels on that side, and the other fingers within doing the same for the vessels on the other side, to keep them from injury. The connective tissue between the two tendons, which is frequently dense and indurated, is incised for about a third of an inch, so that the blade of the instrument can be turned in it ; the blunt-pointed tenotome then replaces it, being at first introduced flat, until it reaches the opposite side, when its edge is turned towards the perforans, its back towards the perforatus, while the operator gives its handle the hinge-like, slightly sawing movement already described for tenotomy, the assistants at the same time powerfully extending the limb. This tension of the tendon on the edge of the tenotome, with the movement given to this by the operator, soon leads to division of the tendon, which is manifested by a particular snap, the divided ends of which may be felt at some distance from each other beneath the skin, and is probably followed by straightening of the phalanges.

In this procedure great care is necessary, in order to avoid wounding vessels and nerves.

Second Procedure.—The animal may be placed in the same position, or on the side opposite to the deformed limb. If the latter, the incision is made on the outside of the limb. Whether inside or outside, it is towards the anterior border of the perforans that it must be made. In introducing the tenotome, this is passed flat, slightly obliquely forwards and downwards, so as to get behind the vessels and nerves on the entering side ; the knife is then raised perpendicularly between the suspensory ligament and tendon, and pushed down until it can be felt below ; the cutting edge is now turned to the tendon, and division of this is effected as in the first procedure. The chief difference between the two procedures is that, in the first, the

division is made forwards, exposing the vessels and nerves to injury; while in the second it is backwards, so that the perforatus tendon is liable to be cut.

Posterior Perforans Tenotomy.

This operation is practised with the same object as that just described.

Operation.—It may be performed on the animal in the standing attitude, if secured in the travis; but it is perhaps safer, and certainly more convenient, to have the horse placed on the side, the leg to be operated upon being uppermost, and fixed forward to the lower end of the fore-arm of the same side. A rope round the hoof or pastern suffices for producing extension of the lower articulations; the foot of an assistant, pressing at the same time against the front of the fetlock joint, increases the tension of the tendons.

The operator places himself astride the fore-limbs, and makes the cutaneous incision on the outside, in the centre of the middle third, on the line separating the two flexor tendons. The perforans may be divided from before backwards, or in the opposite direction, in the manner already indicated for the anterior limbs.

Perforatus Tenotomy.

Section of the anterior or posterior perforatus is indicated when alteration in this tendon leads to the production of the deformity for which section of the perforans was described, or when this single tenotomy has not been followed by sufficiently satisfactory results.

Operation.—The animal is laid on the side opposite to the limb to be operated on, the pasterns being left in the hobbles, with one or two cords on the leg to produce extension, and the operator places himself in the same position as for division of the perforans. The spatula is passed flat through the incision of the skin in the middle third of the cannon, at the external border of the tendon, and pushed down so as to make a space for the blunt-pointed tenotome, which, on being inserted, divides the tendon from before backwards.

Double Flexor Tenotomy.

Division of the perforatus and perforans tendons at the same operation is required when both are involved in retraction, are adherent to each other, and when division of one will not remedy the deformity, which in such cases is usually very considerable.

Operation.—The horse is secured as already described, and the cutaneous incision is made as for division of the perforans. The tenotome is then introduced between the suspensory ligament and the perforans, and the two tendons are slowly cut through in the manner just indicated; or the perforans only may be divided, as described for that operation, then the cutting edge of the tenotome being turned backwards, the back resting on the suspensory liga-

ment, the instrument completely incises the other tendon in being made to follow the arc of a circle beneath the skin.

Tarsal Tenotomy.

Two operations are performed on tendons in the tarsal region—one for the relief or cure of the affection marked by sudden, though irregular, extreme flexion and elevation of this part, known as 'stringhalt,' and the other for the removal of the lameness caused by 'bone spavin.' The first is known as *Peroneal tenotomy*, and the second as *Cunean tenotomy*.

Peroneal Tenotomy.

The division of the tendon of the lateral extensor of the phalanges of the hind-limb, first proposed by Boccar, a Belgian veterinarian, for the cure of stringhalt, has often been performed, and generally with successful results.

Operation.—The horse is laid on the side opposite to that on which is the limb to be operated on, which, for better security, should be fixed to the lower third of the fore-arm of the same side. The scalpel or tenotome is pushed, flatways, through the skin and beneath the posterior border of the tendon in the upper third of the metatarsal region, near the junction of the tendon with the anterior extensor of the phalanges. Then the tenotome (blunt-pointed) is introduced, and the tendon is divided from within outwards, division being more readily effected if the fetlock joint is extremely flexed—the flexion being effected either by the hand or by a rope round the hoof (see also Peroneal Aponeurotomy, p. 232).

Cunean Tenotomy.

This operation consists in division of the internal or cunean branch of the tendon of the flexor metatarsi, and was first proposed by the veterinary professor, Lafosse, to abolish the lameness arising from 'bone spavin.'

Anatomy.—The anatomy of the flexor of the metatarsus is interesting, but we need only glance here at that portion which is the seat of operation. The terminal tendon of the muscular division of the organ traverses the annular ligament which the aponeurotic portion forms in front of the hock, where it divides into two parts, one of which becomes inserted into the head of the principal metatarsal bone, along with the analogous branch of the tendinous division, and the other branch being directed obliquely downwards to the inner aspect of the tarsus, is attached to the second cuneiform bone. It is the latter branch which is divided, and, in operating, it will be found posterior to the saphena vein.

Operation.—The animal is laid on the side on which is the spavined limb, the opposite or (upper) hind-leg being fixed to the lower third of the uppermost fore-arm. For division of the tendon there are two procedures—by *open incision*, and by *subcutaneous division*. The first has been specially recommended, because the discovery of the tendon subcutaneously is often difficult, and also

because it is supposed by some authorities that the opening of the inflamed synovial sheath through which the tendon glides is more important than division of the latter. Dieckerhoff has cured the lameness due to spavin by only opening this bursa for a certain length.

First Procedure.—After washing and disinfecting the hock, the hair is shaved from the skin behind the saphena vein. Then an incision is made through the skin, perpendicular to or parallel with the tendon to be divided, behind the vein, and about an inch in length. This incision should be about the middle of the prominence on the inferior and inner face of the hock, immediately over the tendon. If this cannot be felt beneath the skin, its position may be estimated by its relations to the anterior and internal depression

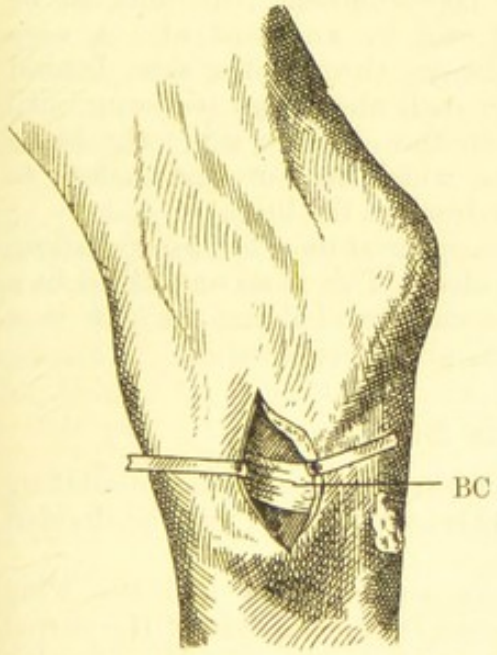

FIG. 307.—INTERNAL SURFACE OF HOCK: BC, CUNEAN TENDON (after CADIOT).

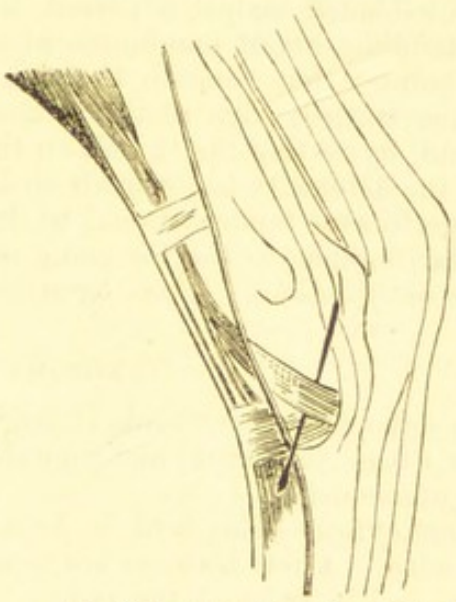

FIG. 308.—HOCK WITH PROBE UNDER CUNEAN TENDON (after SIGNOL).

inside the projection formed by the junction of the tendons of the flexor metatarsi and anterior extensor of the phalanges; the tendon to be divided passing transversely beneath this depression, and descending in a slightly oblique direction on the inner face of the hock. When spavin is present, the tendon generally lies in a groove which is easily felt.

The skin having been incised, this is slightly dissected back (taking care not to wound the vein) so as to expose the tendon, the sheath of which is opened (Fig. 307). A probe, spatula, or a director, is then passed under the tendon, which is divided transversely (Fig. 308).

Second Procedure.—The position of the animal and the seat of operation are the same as in the first procedure. The tenotome or scalpel is passed obliquely through the skin and synovial sheath, and beneath the upper or lower border of the tendon. The probe-

pointed bistoury or tenotome is then passed flatways beneath the scalpel, which is withdrawn, and the tendon is divided from below upwards. The wound should be sutured, and protected with an antiseptic adhesive.

Tenotomy in the Dog.

Attention has been directed to a deformity of one or both fore-paws of young dogs, due to retraction of the flexor tendons, by which the phalanges are drawn backwards to such a degree that the limb rests on the upper surface of the paw, and progression is very difficult. This deformity is removed by dividing the external and oblique flexors of the metacarpus, a very short distance above their insertion into the pisiform.

Operation.—The dog is placed latericumbent, the limb to be operated on being uppermost, and held by an assistant. A very narrow-bladed scalpel is passed, flatways, through the skin, behind the tendons, about one-fourth of an inch above the pisiform, until the point is felt beneath the skin on the opposite side; the blade is then turned, edge to the tendons, which are cut from before to behind, by resting the thumb on the front of the limb.

If the deformity is not made to disappear at once by the operation, the perforatus tendon should be divided. This is accomplished in a similar manner to the foregoing, an assistant holding the paw in a state of extension. This operation is always successful.

Tenotomy in Birds.

In order to prevent birds at large from flying, without amputating their wings, the carpal and digital extensor tendons may be divided subcutaneously.

Operation.—The bird is held by an assistant, and the wing extended. A few feathers are removed from each side of the carpal joint, and in front of the radius, so as to expose the skin, through which the two extensor tendons of the metacarpus can be seen. The skin being incised, these tendons are raised with forceps, and about one-fourth of an inch excised. The same is done, on the opposite face, with the digital extensor tendons, situated on the upper surface of the wing, between the radius and ulna: both operations being performed in the same region, near the carpal joint. There is trifling hæmorrhage which needs no attention, and the birds are well in two or three days.

Cervical Desmotomy.

Division of the cordiform portion of the ligamentum nuchæ in the vicinity of the head may be performed in certain cases of cervical abscess in which this ligament is involved in the disease, or when, by its compression, it increases the tumefaction and pain; and sometimes when it is necessary to remove necrosed bone, etc.

Operation.—The horse is generally placed in the latericumbent position, anæsthetized, and the head well flexed so as to render the

ligament prominent. Section of this is made at the seat of disease, near the prominence formed by the occiput, by making an incision towards the side of the ligament, in passing the scalpel or tenotome behind it, and flexing the head strongly during its division, to make it more tense. As a measure of precaution, it is well to pass a grooved director into the sinus, beneath the ligament, cutting this through from within to without by means of a long straight-bladed bistoury, guided by the director, and taking care to avoid dividing the skin of the mane. If a portion of the ligament is diseased, it should be excised. Hæmorrhage is arrested by ligature or by plugging with fine carbolized tow.

Plantar Desmotomy.

Section of the suspensory ligament of the fetlock is resorted to in cases similar to those requiring division of the perforatus and perforans tendons, and is especially indicated when operation on these has not been completely successful. It may be performed concurrently with division of these tendons.

Operation.—The horse is placed and secured as for tenotomy of the perforans, the seat of operation being the lower third of the cannon, towards the bifurcation or free portion of the ligament. An incision is made through the skin on the external border of the ligament, immediately behind the corresponding small metacarpal or metatarsal bone. A straight bistoury or tenotome is then passed, flat, behind the ligament and in front of the perforans tendon, the vessels and nerves being behind, until its point touches the skin on the opposite side, when the edge is turned towards the ligament, which is divided from behind to before. Some operators, after the straight tenotome has been passed through the skin, as indicated, withdraw it, and introduce the curved probe-pointed bistoury, with which they divide the ligament, by pressing the handle downwards and raising the point of the blade.

Consecutive Treatment.—This is generally that applicable to simple wounds. A pledget of carbolized wool or tow is placed on the wound, which should be sutured, and a bandage applied spirally and moderately tight, if the limbs have been operated upon. If there is much hæmorrhage, and firm compression has to be resorted to in order to check it, this compression should be relaxed within from twelve to twenty-four hours.

Suppuration is comparatively rare, if tenotomy is performed subcutaneously and aseptically.

Some operators recommend that if after the operation of plantar tenotomy in the horse, and particularly when the contraction of the tendons has been chronic, the limb is not adjusted, the animal should be exercised; but in the great majority of cases this adjustment is brought about without exercise, by the horse merely standing in the stable, or by putting a shoe with a long toe on the foot of the limb operated upon, lowering the heels of the hoof as much as possible, or by resorting to the appliance shown in Figs. 240, 241. When the flexion of the fetlock is too great, and it has a tendency to descend towards the ground (as sometimes occurs in double tenotomy), an apparatus like Figs. 242, 243, may be employed.

Accidents.—The accidents attending tenotomy are most frequent in operating on the tendons and ligaments of the limbs, but they may be generally avoided by exercising care and skill. They are chiefly hæmorrhage, injury to the nerves,

incision of the skin, opening of synovial bursæ, and, after operation, suppuration, and intense inflammation with perhaps gangrene.

Hæmorrhage is due to wounding the arteries or veins, and is to be checked by the measures already indicated. Section of nerves can be repaired by the union of the divided ends.

Incision of the skin is a troublesome accident, usually due to the knife slipping during the animal's struggles. It is to be treated in the same manner as a complicated wound.

Opening bursæ should be avoided by exact anatomical knowledge. This accident is known by the escape of synovia, which takes place from the wound; but if tenotomy has been performed subcutaneously, and with observance of antiseptic precautions, it is generally not serious.

Severe inflammation must be combated by the ordinary measures. When there is a sero-purulent discharge from the wound—a prelude to abscess—the wound should be thoroughly cleansed and disinfected. Gangrene is a serious accident, its gravity depending upon its extent. When very limited, on the cause which gives rise to it being removed (as tight bandaging), the dead part soon becomes detached, and the healing process sets in. But when extensive the case is usually hopeless.

In some cases, division of both flexor tendons of the foot leads to excessive flexion of the fetlock, and a very wide gap exists between the ends of the tendons. This is remedied by shortening the toe of the hoof, and putting a high-heeled shoe on it; or if this does not suffice, put the limb in a fixed apparatus, as for fracture of the leg, the animal being placed in slings.

Generally, after plantar tenotomy, the animal should be kept quiet, put in slings if need be, for from twenty to twenty-five days, when gentle exercise may be allowed. In six weeks or two months it may perform light work on a level road, and in three or four months it may be put to ordinary work.

SECTION XII.

OPERATIONS ON NERVES.

The only operation at present practised on nerves in veterinary surgery is resection, which is performed in order to deprive certain parts of sensation and to relieve the animal from pain and consequent lameness. Nerve-stretching might, in some cases and under certain circumstances, be resorted to for the relief of pain, or for the modification of motor or reflex properties of nerves, in animals. Simple division of nerves is sometimes practised to afford temporary relief from pain, or to subdue inordinate muscular contraction in certain parts. Neurectomy and nerve-stretching will only be alluded to here.

Plantar Neurectomy.

Plantar neurectomy may be *high* or *complete*, and *low* or *partial*, according to the place where resection of the nerves is made. The former, which may be designated *metacarpal* neurectomy (the hind-limbs are very rarely operated upon), implies resection of the main divisions of the plantar nerves above the fetlock, before they give off branches to the phalanges; and the latter, which may be termed *digital* neurectomy, is the operation below the fetlock, where one of

these branches can be resected. In order to perform plantar neurectomy with safety and certainty of result, an accurate knowledge of the disposition of the nerves is necessary.

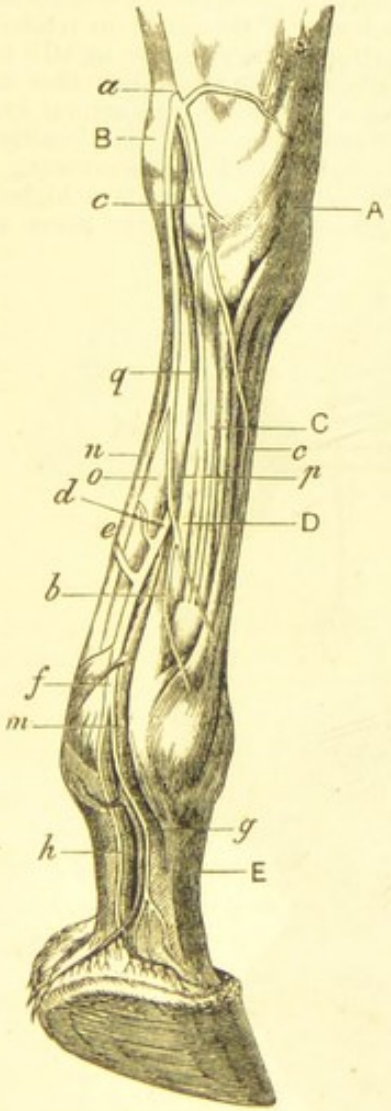

FIG. 309.

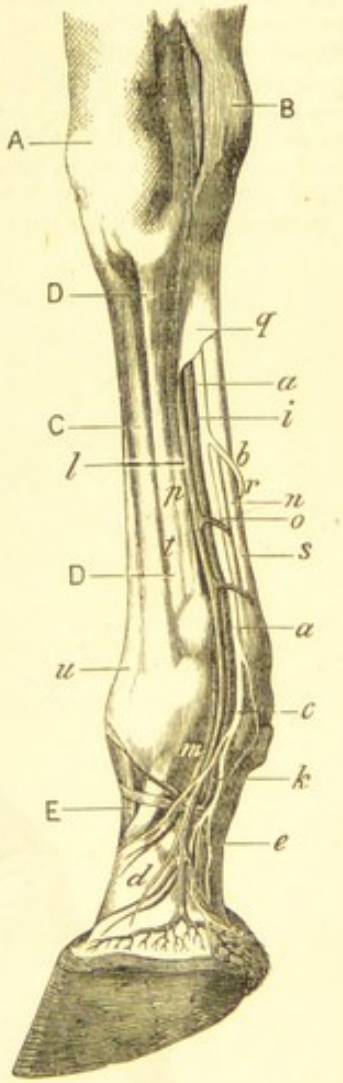

FIG. 310.

VESSELS AND NERVES OF THE HORSE'S FORE-LIMB: A, CARPUS; B, PISIFORM; C, METACARPAL BONE; D, SMALL METACARPAL BONE; E, SUFFRAGINIS, OR LARGE PASTERN BONE.

FIG. 309.—EXTERNAL ASPECT OF LIMB.—*a*, CUTANEOUS NERVE, A BRANCH OF THE ULNAR, SENDING BRANCHES AS LOW AS *b* AND *c*, BETWEEN WHICH IS A SMALL VEIN *q*; *d*, EXTERNAL METACARPAL NERVE, WITH THE COMMUNICATING BRANCH BETWEEN IT AND THE INTERNAL NERVE *e*, ITS CONTINUATION *f*, ANTERIOR BRANCH *g*, POSTERIOR BRANCH *h*, LYING BESIDE THE EXTERNAL DIGITAL ARTERY; *m*, METACARPAL VEIN, WITH THE ARTERY BETWEEN IT AND THE NERVE; *n*, PERFORATUS TENDON; *o*, PERFORANS TENDON; *p*, SUSPENSORY LIGAMENT.

FIG. 310.—INTERNAL ASPECT OF LIMB.—*a*, INTERNAL METACARPAL NERVE, WITH ITS COMMUNICATING BRANCH *b*, ITS CONTINUATION AT THE FETLOCK, AND ANTERIOR (*d*) AND POSTERIOR (*e*) DIGITAL BRANCHES; *i*, METACARPAL ARTERY AND DIGITAL CONTINUATION *k*; *l*, METACARPAL VEIN AND ITS DIGITAL COMMUNICATION *m*; *n*, *o*, *p*, FLEXOR TENDONS; *q*, LOWER END OF THE CARPAL BURSA OF THE FLEXOR TENDONS; *r*, LOWER END OF THE UPPER BURSA OF THE FLEXOR PEDIS PERFORANS; *s*, UPPER END OF THE SESAMOID BURSA; *t*, UPPER END OF THE FETLOCK-JOINT CAPSULE; *u*, BURSA BETWEEN THE EXTENSOR PEDIS AND FETLOCK-JOINT CAPSULE.

Anatomy.—There is a single nerve trunk on each side of each limb, a short distance above the fetlock or sesamoid bones, and lying at the anterior border of the perforans tendon. The external nerve, about two or three inches above the

sesamoid bone, receives a communicating branch from the internal nerve, and descending *on* the tendon, it reaches the sesamoid bursa, over which it passes, with the artery immediately in front, the vein being still more anterior and in close proximity to the suspensory ligament. Close to the joint the nerve divides into two portions: 1. The posterior or principal division, which is a continuation of the preceding, passing along the anterior border of the perforans tendon to the middle of the inner surface of the lateral cartilage, the artery being still in front. 2. A slender anterior branch, which gradually separates from the other division, and on reaching the middle of the first phalanx dividing into several branches, which are distributed to the tendons and other tissues in this locality. The *internal* nerve has a similar arrangement, except that the communicating branch it throws off behind the flexor tendons to the external nerve has a higher origin from it than its junction with the latter. Above the fetlock the nerve also lies

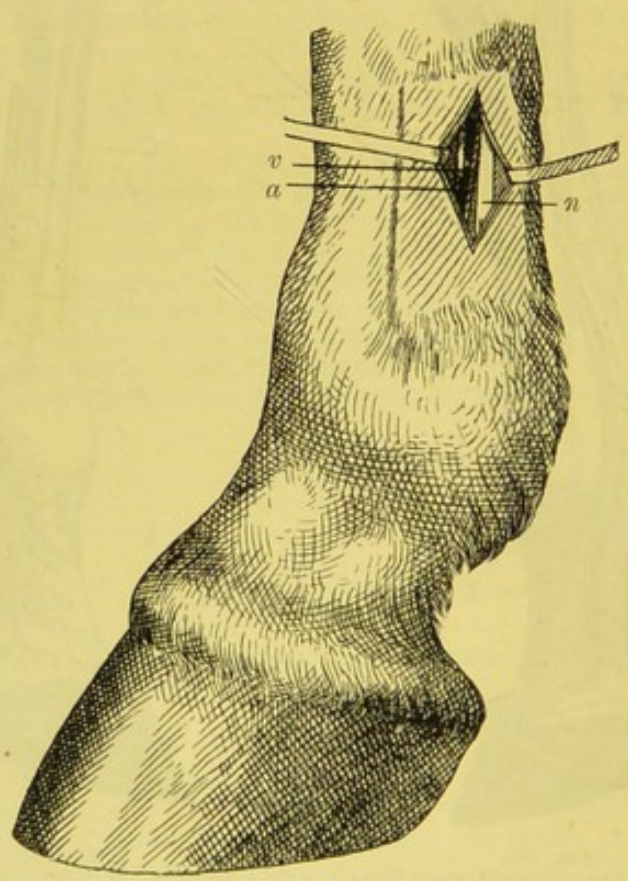

FIG. 311.—PLANTAR NERVE (*n*), ARTERY (*a*), VEIN (*v*).

on the anterior border of the perforans tendon, but the artery is in front all the way, generally slightly deeper, and the vein anterior. On the fetlock the nerve divides, the main branch giving off an anterior twig, which crosses the artery and goes to the front of the pastern, behind the vein; and lodged at the lower end of the sesamoid, close to the perforatus, in a depression, it sends off another branch, the middle, which crosses the artery and descends between this and the vein passing to the lateral cartilage, the main trunk continuing immediately behind the artery and anterior to the perforans. Throughout their course, the relative position of vein, artery, and nerve, from before to behind—may be remembered by the word VAN; though in some rare cases there may be deviations from this arrangement, the nerve being between the two vessels. It will be seen from this description that the operation may be performed on each side of the limb, at three different points: above the fetlock, before the nerve divides, *high operation;* and below the fetlock on the principal branch and the middle branch, *low operation.*

For each of these sections there is a convenient point. The nerve above the fetlock is best reached a very short distance above the upper end of the sesamoid bone, in front, but close to the perforans tendon, where the trunk is very superficial; the external nerve is accompanied by a vein, the internal having the artery and vein related to it in this part. Below the fetlock, the main branch

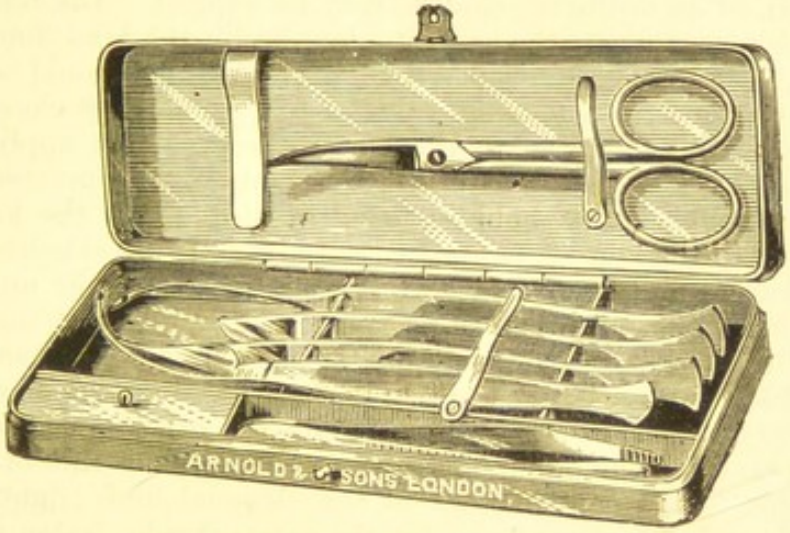

FIG. 312.—ASEPTIC NEURECTOMY INSTRUMENTS.

is most superficial and easiest reached between the upper third of the first phalanx and the perforans tendon. Here the median branch may also be divided. The anterior branch is so rarely resected, that it need not be alluded to. The relation of the nerves to the bursæ above and below the fetlock should not be overlooked.

OPERATION.—The instruments required are: probe-pointed bistoury, neurectomy-knife, dissecting forceps, tenaculum, scissors, suture needle, and aseptic silk or catgut, antiseptic solution, sponge, fine carbolized tow or wool, calico bandages, and a tourniquet.

The animal is placed latericumbent, the side of the limb to be

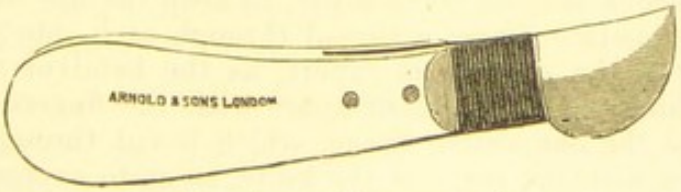

FIG. 313.—ASEPTIC NEURECTOMY KNIFE.

FIG. 314.—ASEPTIC NEURECTOMY TENACULUM (SIMPSON'S).

operated upon being uppermost. If the operation is to be performed on two limbs, the nerve on the inside of the lower leg is to be first divided, then, the animal having been turned over, that on the external side of the same limb.

As the operation is very painful, if the animal is not placed under the influence of an anæsthetic (which is to be recommended), a twitch

must be applied to the nose. To prevent hæmorrhage and render the operation more easy, the limb or limbs should be hosed, or have cold water bandages placed upon them for ten minutes immediately before operating; or a tourniquet, elastic bandage (on Esmarch's principle), or an ordinary bandage may be applied. The tourniquet should be placed above the knee, if a fore-limb; if a hind-limb, below the hock. If a cord is applied, a thick pledget of tow should be placed over the artery; if a bandage, this should commence close to the hoof and be firmly rolled to the knee or hock before applying the tourniquet. It is usual to release the limb to be operated upon, from the hobble (cross hobbles being applied above the knee and hock), and (if the horse is not anæsthetized) to place a side-line on the hoof, which is pulled forward by an assistant. With the uppermost limb, when drawn forward, it is convenient to place it on a sack filled with straw. In operating on the hind-limbs, these should be drawn backwards. When one limb has been operated upon, it should be returned to the hobble before the other one is released. Some operators, when about to operate on the inner side of the leg, fasten this to the cannon bone of the diagonal limb (right fore to left hind, and *vice versâ*); and for the external side, fasten the limb to the lower end of the fore-arm (if the hind-leg is to be operated on), or to the tibia (if the fore-limb), of the same side.

The hair at the point where the nerve is to be exposed is removed from the skin, which must be thoroughly cleansed and disinfected.

The incision is made in the skin immediately over the nerve, by means of the neurectomy-knife, the integument being made tense by the left hand. The incision should not be more than an inch in length, and must be carefully made to avoid wounding the vessels. But this accident is avoided, and the incision quickly and neatly made, by raising a small fold of skin across the track of the nerve, and snipping it through with rowelling scissors.

The cutaneous incision being made, to keep the lips of the wound apart, some operators pass a thread through each side; but this is unnecessary if the surgeon is expert, as the hand of an assistant below the limb can draw them apart with the fingers. With the forceps raise the connective tissue, which is cut through by a few light touches with the point of the knife, so as to expose the nerve, the presence of which is recognised by its white colour, its striation, and its sensitiveness, manifested by compressing it gently. If bleeding obscures the view, the blood should be removed by means of the sponge or pledgets of aseptic cotton-wool. The neurectomy knife is then passed flat under the nerve, the edge is turned towards the latter, which is smartly divided. Many operators prefer the tenaculum armed with a thread, which is passed beneath the nerve; then the probe-pointed bistoury takes the place of the tenaculum, and the nerve is smartly divided by it above the ligature. By means of the forceps, the lower end of the nerve is raised, dissected out for half an inch or so, and cut off by knife or scissors. This resection does not cause any pain.

The precautions to be observed are not to wound the artery, vein,

or bursa. The vein is distinguished by its position, large size, and blue tint; the artery by its position and pulsation; and the bursa by its very thin, smooth appearance. The nerve can be recognised by its position, its firmness, and its sensitiveness; though when the horse is under chloroform there is little or no sensation.

High Operation.—This is performed in the manner just described. The seat of operation is about an inch above the sesamoid bone on each side, at the anterior border of the flexor pedis perforans tendon.

Low Operation.—Performed as already described. The incision is made in the depression between the pastern bone and flexor tendons at a short distance below the fetlock. The vessels and nerve can often be felt through the skin, and the incision can be made forward or backward in the depression, according as the nerves to be divided are anterior or posterior branches.

Consecutive Treatment.—The wound is douched with antiseptic lotion, and closed by a single suture of silk, or catgut; a small pledget of carbolized wool is then applied and covered by a linen bandage. Unless there is much swelling, the bandage need not be removed for a few days. If the wound suppurate it must be treated on ordinary surgical principles. The horse should be kept quiet for three or four days, then gently exercised until the wound has healed. But beyond walking exercise, no considerable exertion should be undergone for a fortnight, or even longer, after operation. Close attention must be paid to the foot afterwards, and great care should be observed in shoeing, so as to avoid injury to the vascular structures.

Accidents.—The chief accidents are wounding the bloodvessels and opening the tendon sheath. Suppuration after plantar neurectomy is uncommon; but when it occurs the wound should be reopened, thoroughly disinfected, sutured, and bandaged as before. The wounding of a vein may be disregarded; when an artery is punctured the breach may be closed by a fine suture, or the vessel can be ligatured, with aseptic silk, above and below the puncture. Strict attention to asepsis inside and outside the operation wound will greatly diminish the danger of accident to bloodvessel, bursa, or tendon sheath. Occasionally, after an interval of weeks or months, the coronet swells, the hoof separates, or the flexor tendons undergo degenerative changes and give way below the seat of operation, but the percentage of successful plantar neurectomies far exceeds that of the failures, immediate or delayed.

Median Neurectomy.

Resection of the median nerve is now frequently practised for the relief of lameness arising from chronic tenositis, knee splint, or bony enlargement of the fetlock; and, in conjunction with external plantar or ulnar neurectomy, it is sometimes performed to relieve lameness caused by navicular disease, ringbone, or sidebone, or other chronic disease below the fetlock-joint.

Anatomy.—From its origin at the posterior part of the brachial plexus the median nerve descends on the inner aspect of the arm in front of the humeral artery, or of its continuation, the posterior radial artery, to the elbow joint, where the nerve lies against the internal lateral ligament, and where it crosses the artery to become posterior. About three inches below the joint the nerve rises over the artery, and then dips between the radius and the internal flexor of the carpus. Under this muscle the nerve proceeds to near the knee, where it divides into two branches, one forming the internal plantar nerve, the other, and smaller, joining a branch of the ulnar to constitute the external plantar nerve.

In its course the median furnishes many muscular branches, and to one of

these (the branch proceeding to the internal flexor of the knee and the deep flexor of the foot) special attention should be given, as it springs from the median at the elbow and immediately above the point usually selected for neurectomy.

Operation.—In addition to the instruments mentioned for plantar neurectomy, a scalpel, grooved director, artery forceps, and a probe-pointed curved bistoury should be at hand. A tourniquet cannot be successfully employed. The horse should be cast on the lame side and anæsthetized. But whether chloroform is used or not, the upper fore-leg should be pulled back and secured to a hind-limb, and the under fore-leg should be held forward with the elbow joint well extended. Shave, wash, and disinfect the internal surface of the upper fourth of the fore-arm, and, at a point two to three inches below the prominence on the internal surface of the head of the radius, and a few lines behind the ridge on the inner border of the

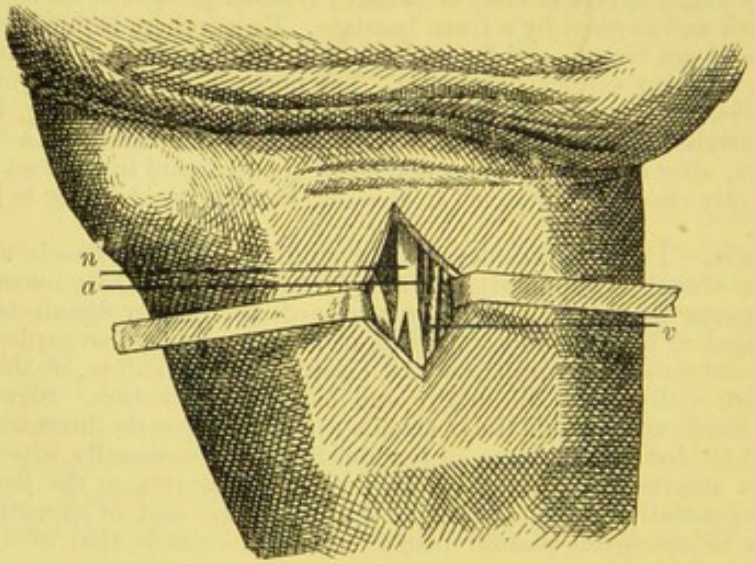

Fig. 315.—Median Neurectomy: *a*, Artery; *n*, Nerve; *v*, Vein. (After Cadiot.)

bone, which can be felt beneath the surface groove of the region, incise the skin for about an inch and a half in a direction parallel with the border of the internal flexor of the carpus. This incision should expose the insertion of the sterno-aponeuroticus muscle and the fascia of the fore-arm. At this stage there may be slight bleeding. When it has stopped, pinch up the fascia, puncture it, and extend the opening upwards by means of scissors or a probe-pointed bistoury, when the nerve will be seen lying on the posterior radial artery with a vein in front, another behind, and, sometimes, a venous branch crossing the nerve. Then carefully incise the fatty connective-tissue surrounding the nerve, under which pass the tenaculum, and make sufficient space for bistoury or scissors, and divide the nerve at the upper limit of the wound. Pull the lower end of the nerve well up, and excise an inch or more. Douche the wound with antiseptic solution, insert two aseptic sutures, and allow the horse to rise.

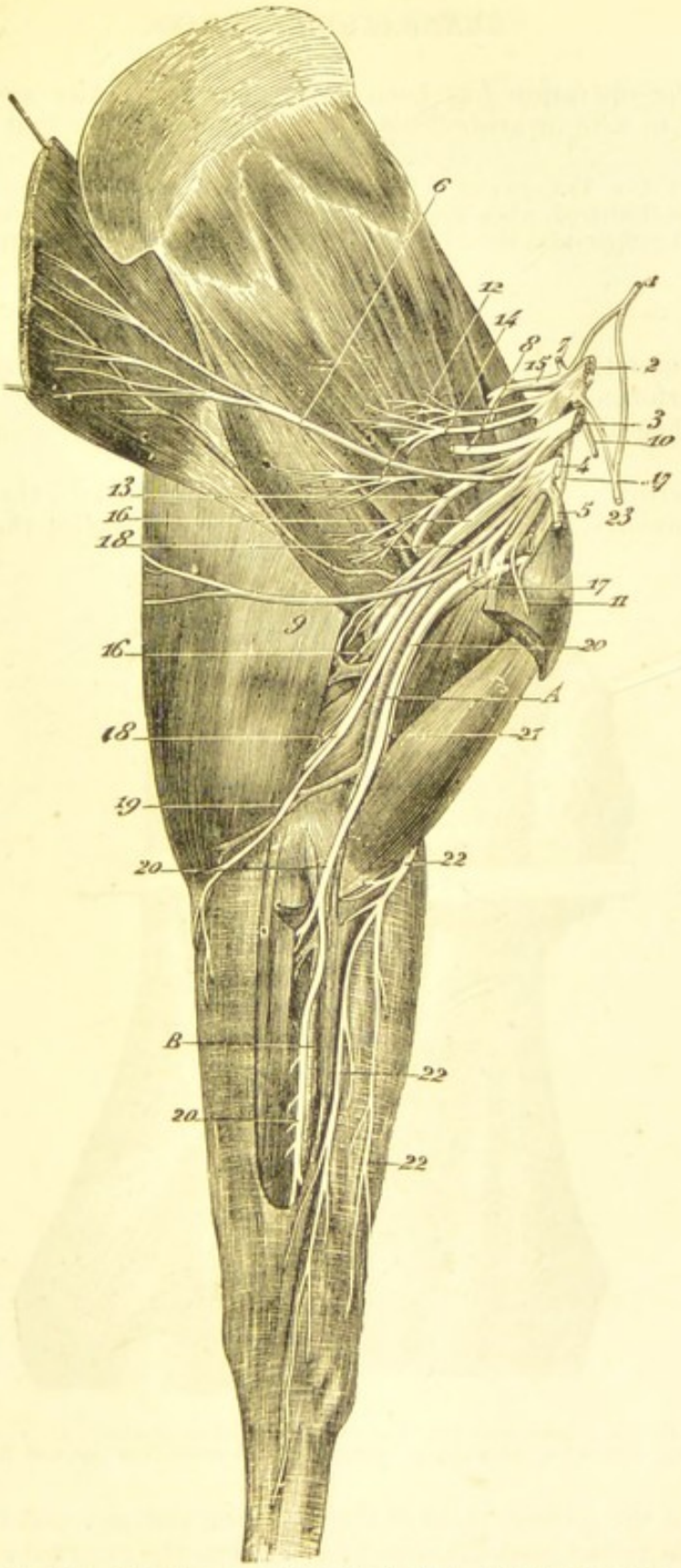

FIG. 316.—NERVES OF THE BRACHIAL PLEXUS. (After CHAUVEAU.)

1, DIAPHRAGMATIC BRANCH OF THE SIXTH CERVICAL PAIR, FURNISHING A BRANCH TO THE BRACHIAL PLEXUS; 2, SEVENTH CERVICAL PAIR; 3, EIGHTH CERVICAL PAIR; 4, FIRST DORSAL PAIR; 5, SECOND DORSAL PAIR; 6, GREAT DORSAL BRANCH; 7, ANGULARIS AND RHOMBOIDEAL BRANCH; 8, SUPERIOR THORACIC BRANCH; 9, SUBCUTANEOUS THORACIC BRANCH, GIVING RISE, NEAR ITS ORIGIN, TO THE THREE INFERIOR THORACIC BRANCHES; 12, NERVE OF THE ADDUCTOR OF THE ARM; 13, AXILLARY NERVE; 14, SUBSCAPULAR NERVES; 15, SUPERSCAPULAR NERVE; 16, RADIAL NERVE; 17, ANTERIOR BRACHIAL NERVE; 18, ULNAR NERVE; 19, ITS INTERNAL CUTANEOUS BRANCH; 20, MEDIAN NERVE; 21, ITS ANTIBRACHIAL MUSCULO-CUTANEOUS BRANCH; 22, 22, 22, SUPERFICIAL RAMUSCULES OF THAT BRANCH.—A, HUMERAL ARTERY; B, POSTERIOR RADIAL ARTERY

When the operation has been performed aseptically and without accident to vein or artery, the wound should heal by first intention.

Consecutive Treatment.—Very little beyond rest is required until the wound has cicatrized, when gradually extending exercise may be prescribed. If the wound suppurate it should be treated on ordinary surgical principles.

Ulnar Neurectomy.

This operation, in conjunction with median neurectomy, is sometimes performed in chronic disease of the pastern or foot, and especially when the condition of the fetlock forbids operation at that point.

Operation.—Cast the horse on the side opposite to the lame leg, and administer chloroform. Shave, wash, and disinfect the posterior

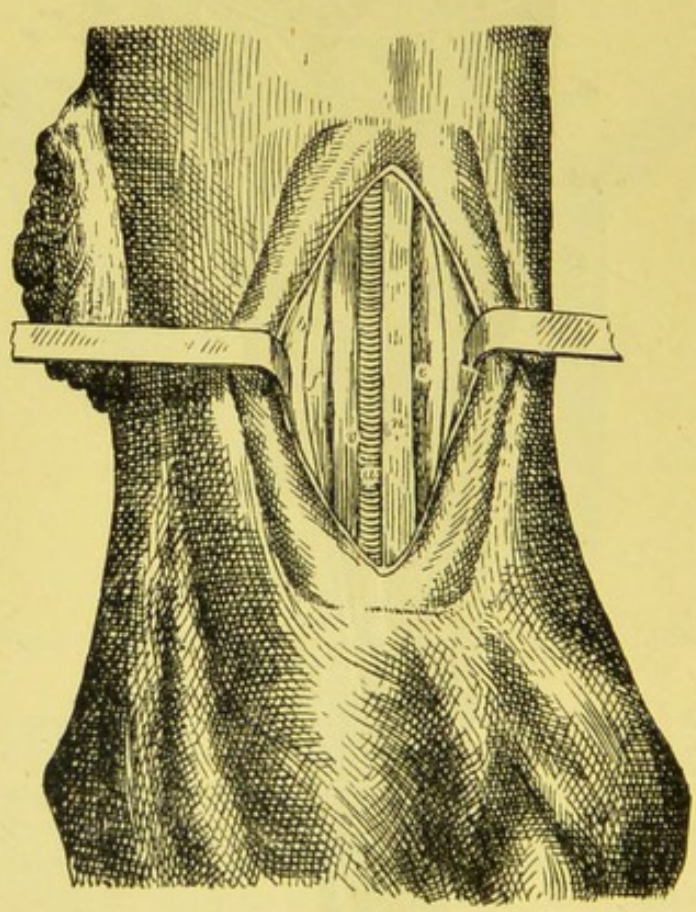

Fig. 317.—Ulnar Neurectomy: *b*, Fascia; *e*, External Flexor; *f*, Oblique Flexor; *n*, Ulnar Nerve; *a*, Artery; *v*, Vein. (Reduced after Pfeiffer and Williams.)

surface of the inferior third of the fore-arm, and, at a point about five inches above the pisiform bone and between the external and oblique flexors of the knee, incise the skin for an inch and a half. This incision will expose the fascia, under which the ulnar nerve may be seen lying close to the external flexor muscle and accompanied by a vein. The artery may not be seen. Then incise the fascia, raise

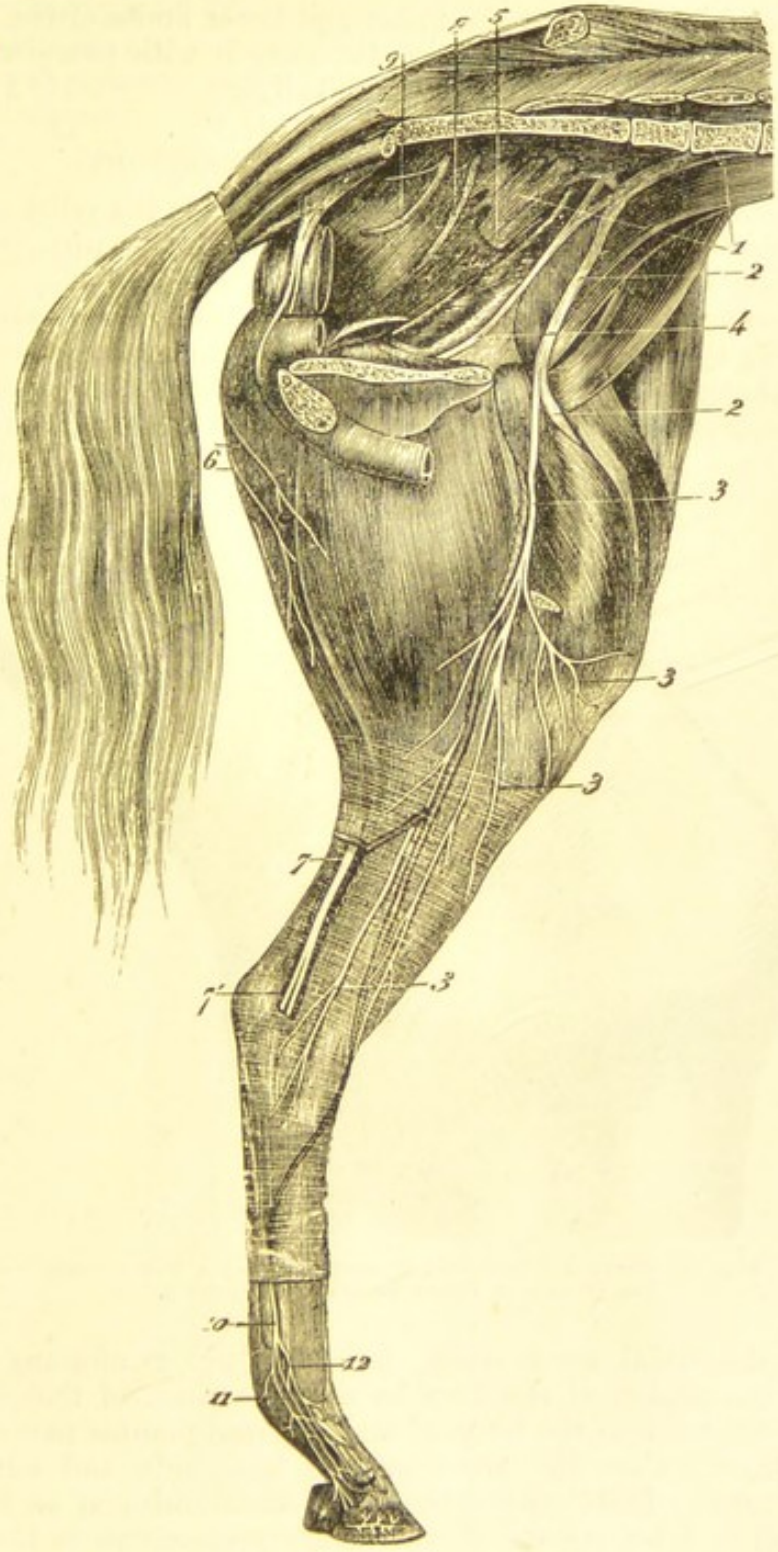

FIG. 318.—INTERNAL NERVES OF THE POSTERIOR LIMB.

1, 1, LUMBO-SACRAL PLEXUS; 2, ANTERIOR FEMORAL NERVE; 3, INTERNAL SAPHENA NERVE; 4, OBTURATOR NERVE; 5, ORIGINATING FASCICULUS OF THE GREAT AND SMALL FEMORO-POPLITEAL NERVES; 6, SUPERFICIAL RAMUSCULES OF THE POSTERIOR GLUTEAL NERVES; 7, POSTERIOR TIBIAL NERVE; 8, INTERNAL PUDIC NERVE; 9, HÆMORRHOIDAL, OR ANAL NERVE; 10, INTERNAL PLANTAR NERVE; 11, 12, ITS DIGITAL RAMIFICATIONS (after CHAUVEAU).

the nerve, and divide it at the upper and lower limits of the wound. Irrigate the wound with an antiseptic, close it with two silk or gut sutures, and protect with antiseptic collodion.

Posterior Tibial (Sciatic) Neurectomy.

The posterior tibial nerve has been resected for the relief of lameness attributed to spavin, posterior splint, flexor tenositis, enlarged fetlock, ringbone, or disease of the hind-foot.

The great sciatic, internal popliteal, or posterior tibial nerve, on reaching the stifle, enters between the heads of the gastrocnemius muscle, passes along the posterior aspect of the perforatus, and descends the channel of the hock, in contact with the perforans muscle,

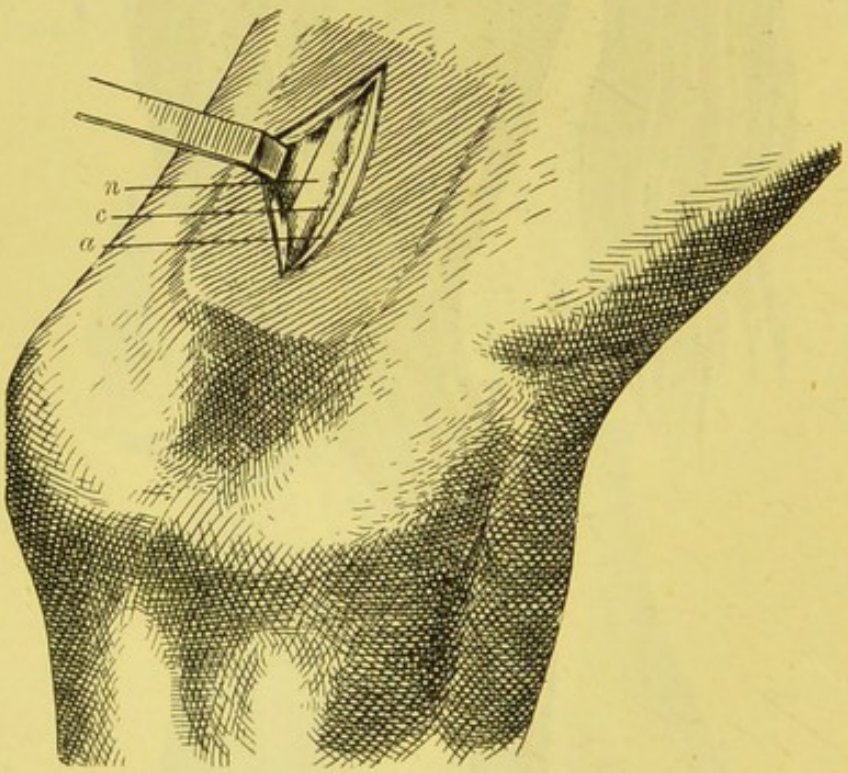

Fig. 319.—Posterior Tibial Neurectomy: *a*, Aponeurosis; *c*, Fatty connective Tissue; *n*, Posterior Tibial Nerve (after Cadiot).

beneath the tibial aponeurosis, following the reinforcing fibrous band of the tendon of the hock to near the point of the os calcis, where it divides into the internal and external plantar nerves.

Operation.—Cast the horse on the lame side and administer an anæsthetic. Pull forward the upper hind-limb and secure it to a fore-limb. After the usual preliminary preparation of the operation area, extend the hock, and, at a point three to four inches above the summit of the os calcis, a few lines in front of the tendon of the hock, and over the postero-internal border of the perforans muscle, incise the skin and aponeurosis for an inch and a half. Carefully dissect the deep fascia and the fatty connective tissue which surrounds the nerve; then, with the tenaculum, raise the nerve, and,

at the upper limit of the incision, divide it with bistoury or scissors. Pull the lower end of the nerve well up and excise an inch or more. Disinfect the wound, close it with sutures, and protect with an antiseptic adhesive.

Anterior Tibial Neurectomy.

This operation has been performed in cases of chronic hock lameness. The external popliteal (a branch of the great sciatic nerve), at the superior extremity of the leg and behind the external lateral

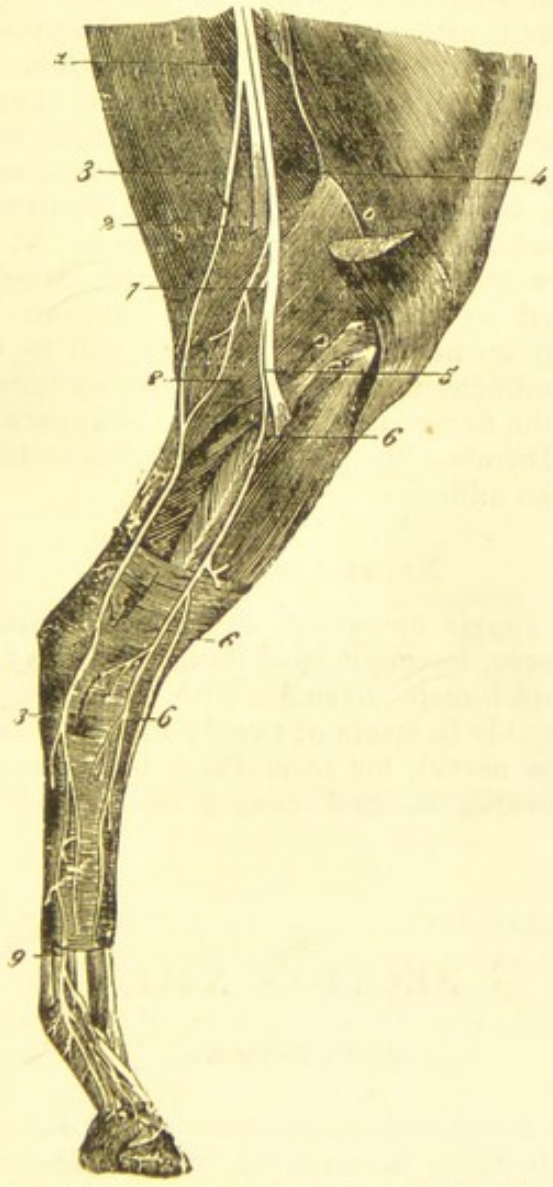

Fig. 320.—External Nerves of the Hind-limb.

1, 2, Sciatic; 3, External Saphena Nerve; 4, External Popliteal Nerve; 5, Anterior Tibial Nerve; 6, Musculo-Cutaneous Nerve (after Chauveau).

ligament of the femoro-tibial joint, divides into the musculo-cutaneous and anterior tibial nerves. The musculo-cutaneous (Fig. 320, 6) passes beneath the tibial aponeurosis and descends between the peroneus and extensor pedis muscles, to about the middle

of the leg, where it becomes subcutaneous, and eventually gains the metatarsus and terminates in filaments to the skin. The anterior tibial (Fig. 320, 5), after passing in front of the preceding nerve and crossing the upper extremity of the peroneus, dips between that muscle and the extensor pedis, under which the nerve descends the leg, in company with the anterior tibial artery, to the front of the hock. It then deviates towards the outer side of the tarsus and proceeds downwards to the fetlock, where it terminates in filaments, which can be traced to the skin of the pastern.

Operation.—In well-bred horses the anterior tibial nerve can easily be felt where it crosses the peroneus at the upper extremity of the leg. At this situation the operation is seldom difficult, as no bloodvessels of consequence are encountered in exposing the nerve (Fig. 320, 5). Cast the horse on the side opposite to the lame leg, and shave, wash, and disinfect the skin over an area extending to about four inches below the external tibial articular margin of the upper hind-leg—which need not be unhobbled. At a point about three inches below the head of the fibula, and immediately behind the groove formed by the peroneus and extensor pedis muscles, incise the skin for an inch, when the nerve will be seen as it dips in front of the peroneus muscle. Pinch up and incise the aponeurosis ; then raise the nerve and divide it at the upper and lower limits of the incision. Disinfect the wound, insert one or two sutures, and cover these with an adhesive.

Nerve-Stretching.

This is a very simple operation, and is accomplished by cutting down upon the nerve, freeing it from its connections for some inches, raising it with blunt forceps, seizing it with the fingers, and stretching it steadily and forcibly (a strain of twenty to forty pounds, according to the size of the nerve), for from three to six minutes, from its origin, then returning it, and closing the wound by suture or bandage.

SECTION XIII.

AMPUTATIONS.

The number of recognised amputations in the domestic animals is, when compared to those in mankind, small. They may be necessary in the interest of the animals themselves ; for the benefit of mankind, in increasing the usefulness or convenience of the animals ; or be resorted to merely for fashion. Those which will be considered in this place are : 1. *Amputation of the limbs ;* 2. *Ears ;* 3. *Tail ;* 4. *Horns.* Other amputations will be considered hereafter.

The operation, comprises the amputation, arrest of bleeding, and treatment of the wound. The accidents which may ensue during

or after operation will depend upon circumstances. They are: undue hæmorrhage—immediate or consecutive; syncope; severe inflammation; suppuration, and sinus; phlebitis; tetanus; necrosis or gangrene, etc.

Amputation of Limbs.

It is very seldom that the veterinary surgeon is called upon to amputate the limbs of animals, and especially those of the horse or other creature kept solely for draught or weight-carrying; and even with animals intended for the butcher, it is only too often more advantageous to sacrifice them at once than to submit them to a mutilation which will reduce them in condition for at least a considerable time, and consequently greatly diminish their value.

Therefore it is that, unless with horses or cattle of much value, which can be successfully utilized in breeding, the amputation of

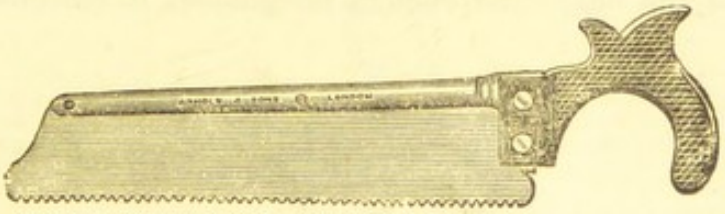

Fig. 321.—Ordinary Amputating Saw.

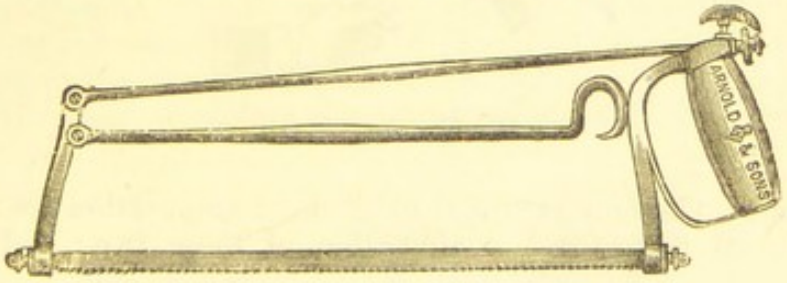

Fig. 322.—Improved Amputating Saw.

limbs is generally confined to small animals—as the pig, dog, and cat, and the smaller ruminants. Cases are recorded in which the lower part of a limb (phalanges) has been successfully removed from brood mares, and solipeds in zoological gardens; portions of limbs—even the upper portions—have been amputated in cows, and they have continued to give milk or to fatten, being in some instances furnished with an artificial leg. With pigs, sheep, and goats, limb-amputation is very successful in its results; with dogs it has generally been most successful, no matter what part of the limb was removed—for the loss of a leg, particularly a hind one, does not prevent this animal from moving about freely. Birds have had a leg removed, and have survived for a long time when provided with an artificial substitute; and resection of their wings is often practised to prevent flight. Supernumerary limbs are generally removed.

Limb-amputation may be considered with regard to removal of a portion of the leg, amputation of a digit in ruminants, and wing amputation in birds.

Amputation of Part of a Limb.

Amputations are generally classed as those of *continuity*, or amputations proper; and those of *contiguity*, or disarticulations.

The object in view in all methods of amputation is the same—namely, after the removal of the part, to secure a suitable and sufficient covering for the end of the bone; to avoid adhesion between the latter and the cicatrix of the integument; to divide the large nerves and bloodvessels transversely, and to leave their cut ends in a part of the stump little exposed to pressure. The remaining end of the limb or 'stump' is either formed of skin and connective-tissue alone, or of these and muscular tissue together. Where the parts admit of it, sufficient muscle is detached to form a cushion around the end of the bone, and enough integument is reflected to cover

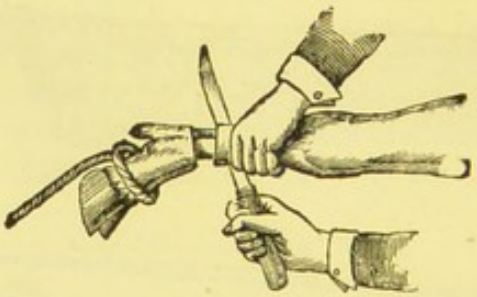

Fig. 323.—Circular Amputation.

the whole. The four principal methods of amputation are: (1) the *circular;* (2) *flap;* (3) a combination of these two; and (4) the *oval.*

(1) The *circular method* (Fig. 323) consists in the formation of a circular incision of the integuments in the entire circumference of a limb; the division of the muscles in the same manner, though higher up the limb, and in the section of the bone at a point still nearer the body. It has its advantages in a comparatively small external wound, and a transverse division of the large bloodvessels of the part; on the other hand, the resulting cicatrix is liable to be opposite and adherent to the extremity of the bone, and the operation requires more care and skill than by the flap method.

(2) The *flap amputation* (Fig. 324) consists in removing a limb by double flaps, of which one is generally anterior, the other posterior, or by forming a single anterior or a single posterior flap. These flaps include all the soft parts of the limb; they may be made by transfixion, where the position of the bones in the limb will admit of it, and in this case they are cut from the centre of the part towards the circumference. When the bones do not occupy a central position in the limb, one of the flaps is generally formed by cutting from the

circumference to the centre. This flap operation is quickly and easily performed, and generally gives satisfactory results.

(3) A combination of the two preceding methods consists in forming double flaps of integument, and subsequently dividing the muscles down to the bone, as in the circular amputation. This plan

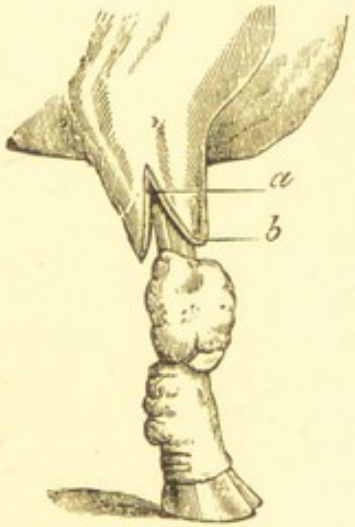

FIG. 324.—FLAP AMPUTATIONS: *a*, POINT WHERE THE BONE IS SAWN THROUGH, *b*, ANTERIOR FLAP.

of dividing the integuments facilitates their reflexion, while the circular division of the muscles ensures a completely transverse section of the vessels—thus the method combines many of the advantages of the circular and flap operations.

(4) The *oval* or *oblique amputation* (Fig. 325 A) is effected by

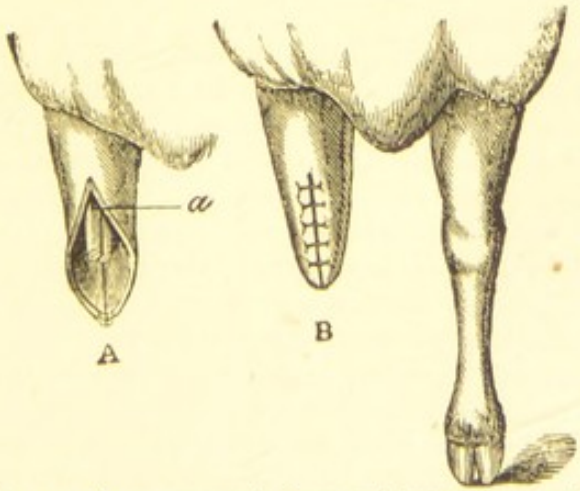

FIG. 325.—OVAL OR OBLIQUE AMPUTATION: A, OBLIQUE SINGLE FLAP; *a*, POINT OF SECTION OF THE BONE; B, THE FLAP SUTURED.

dividing all the soft parts surrounding the bone higher at one side than the other, and in this obliquity it alone differs from the circular method.

A modification consists in amputation by a long and a short rectangular flap. The long flap, which is anterior or antero-external,

is quadrangular in shape, its length and breadth being each equal to half the circumference of the limb. It includes all the soft parts down to the bone on the anterior aspect of the part, and should not contain any important nerve or bloodvessel. The short flap is posterior, or postero-internal; it is one-fourth the length of the anterior, and its breadth is equal to half the circumference of the limb. It includes all the soft parts down to the bone on the posterior aspect of the limb, and should contain the large nerves and bloodvessels of the part. Both flaps are flat at their extremities and of the same thickness throughout, where the arrangement of the soft parts about the bone will permit. This modification allows a freedom from tension in the stump; a soft covering for the ends of the bones free from large vessels and nerves; and a dependent position of the wound, favouring the escape of discharges.

Operation.—Amputation of the limbs of animals is resorted to in cases of comminuted fracture, with contusion or laceration of the skin; laceration of muscles and their separation from bones; extensive gangrene; chronic suppurative arthritis; incurable disease of bones; and supplementary limbs.

The *instruments* required will vary somewhat with the nature of

Fig. 326.—Aseptic Bone-Forceps.

the amputation and the size of the animal; but the convex bistoury for the larger animals, and a scalpel for the smaller, will generally suffice for knives. In addition, dissecting forceps; artery and torsion forceps; an anatomist's saw; bone forceps; ligatures and sutures; a tourniquet and Esmarch's bandage; with sponge, bandage, tow or lint, and antiseptic solution.

The animal should be securely fixed latericumbent, and if possible anæsthetized. The hair should be removed from the part about to be operated on, and, after thorough disinfection, the limb is placed in a convenient position, where it is maintained by one or two assistants. To prevent hæmorrhage in the larger animals, a tourniquet (Esmarch's) or any other form of constrictor may be used; in the smaller animals, compression on the principal artery by means of the fingers may suffice.

Amputation at a joint (*contiguity* or *disarticulation*) only necessitates cutting through the soft parts; between articulations (*continuity*) require division of these and sawing through the bone.

In performing amputation by the *circular method*, the integuments are retracted above the part selected for amputation by an assistant, who encircles the limb with both hands, if the animal be large. The

knife, which should be proportionately large, may be held in the second or eighth position (Figs. 91, 92, 98), and the heel of the instrument being laid on the side of the limb nearest to the operator, the integuments should be divided with one circular sweep of the blade, if possible, so as to free them from their connection with the muscles and deep fascia. While the assistant still forcibly retracts, the operator repeatedly passes the knife around the limb, each time dividing bands of connective tissue between the integuments and muscles, until sufficient of the former has been obtained to cover the stump. The assistant, taking a fresh grasp of the limb, and keeping the integuments well out of the way, the operator then divides all the remaining tissues down to the bone in the same way that the skin was divided, when, if the soft parts be still firmly retracted, the stump presents a somewhat conical shape; the saw should be applied as high as possible to the bone, the operator holding it with his left hand close to the point of section.

In the *flap* operation, the soft parts in front and to the outer side of the bone are grasped and raised by the left hand, the right pushing a sharp-pointed amputating knife through in front and close to the bone, emerging at a corresponding point on the opposite side; the parts in the left hand may now be suffered to drop a little, while an anterior flap is cut to a certain length upwards, and not too thin at the edge. The assistant raises this flap, while the operator passes the knife behind the bone, between it and the remaining undivided parts, and cuts a posterior flap the same in shape as the anterior, but a little longer. The knife is applied around the bone at the divergence of the flaps, to divide the periosteum, and the saw is then applied, the soft tissues being kept out of its track.

In sawing the bone, this must be held firmly on a solid surface, sawing being performed slowly and lightly at the beginning and end. If disarticulation is resorted to, the ligaments are divided, the bones separated, and the articulatory extremity of the remaining bone sawn off, so as to facilitate healing of the wound.

When amputation is completed, hæmorrhage is arrested from the divided bloodvessels by ligature or torsion, the veins and smaller arteries being included, so as to leave only a simple wound to heal. Relaxation of compression reveals the position of the vessels. These being secured, in and around the wound is cleaned, the long ends of ligatures of vessels (if these have been ligated) are excised; the muscles and integument are drawn gently downwards over the stump, and the borders of the skin brought together by interrupted suture, leaving an opening for the escape of discharges.

The limb is finally encircled by a bandage which, commencing at the joint immediately above the wound, is passed evenly, closely, and moderately firmly, to its margin. A thick layer of tow or cotton-wool, which is kept in position by another bandage of tape, is laid over all. Or the dressing may first be laid over the end of the stump and retained there by a bandage wound spirally around the limb from below upwards, and secured to the body by tapes or bands attached to it, and passed round the opposite limb or the trunk.

Consecutive Treatment.—The animal should be kept perfectly quiet, and food sparingly given. If the bandage is too tight the limb will swell, the creature become restless and give evidence of much suffering, and fever will be present. In such a case, the bandage must be loosened. If this accident does not occur, the bandage need not be removed for four or five days, when the dressing should be renewed and the bandage applied as at first ; this being repeated every three or four days. Sponging with a weak solution of carbolic acid will expedite the healing process. Secondary hæmorrhage, suppuration, or gangrene must be treated according to surgical principles.

Special Amputations of Limbs:

Special amputations of portions of limbs must be performed according to circumstances, the mode of operation being based on the anatomy of the region and the condition of the part. Only amputation of the digits, normal and supernumerary, will be noticed here.

Amputation of the Phalanges.—Disarticulation of the fetlock of the horse has been performed by making a circular incision around the pastern (a tourniquet having been placed above the joint), dissecting back the skin as high as the fetlock-joint, dividing the lateral and capsular ligaments of that joint, and removing the phalanges. The edges of the skin having been brought together by sutures and dressing and bandage applied, in about a month the amputation wound was healed. A boot, composed chiefly of cork, and about equal in weight to the portion of limb amputated, was attached to the stump. On this the horse travelled well.

Amputation at the *second phalanx* may be practised by making a deep groove through the wall of the hoof, immediately beneath the coronary cushion (which should not be injured), at the origin of the vascular laminæ, and exposing these. With a strong scalpel, an incision is made through the soft parts to the pedal articulation : dividing, in front, the extensor tendon ; behind, the flexor tendons ; and on each side, the lateral ligaments, leaving a small portion of the lateral cartilage on each. The os pedis and hoof being removed, the remaining portions of the lateral cartilage are carefully dissected away, and the coronary cushion drawn up so as to expose the lower end of the second phalanx, the articular portion of which is sawn off. The soft parts are then pulled down, so as to cover the end of the bone, brought into apposition, and a pledget of fine tow and a bandage applied. During the healing of the wound, the plantar cushion is covered with a layer of horn which, when cicatrization is complete, makes an excellent pad to rest upon the wooden or leather boot which can be adapted to the limb.

Amputation of a digit in ruminants can be successfully performed, one, two, or the three phalanges being removed, as occasion may require. If it is the third phalanx, then the same precaution should be adopted to preserve the coronary cushion as in the same operation for the horse. A tourniquet is fixed towards the knee, to prevent hæmorrhage, and the amputation is by disarticulation, leaving a lateral flap. If the inner digit is removed, the flap is made on the internal side, the knife passing to the bone ; if it is the external digit, the flap is made from the outside integuments. The operation

is commenced in the interdigital space, an assistant keeping the two claws wide apart, and with a strong scalpel the internal ligaments and anterior and posterior tendons are divided, the external ligaments being only cut through when the articulation has been fully exposed, and the blade of the knife can be passed across it; then the flap is made. The soft tissues being moved upward, the articular end of the bone is sawn off, the vessels ligated or twisted, the wound closed by a few sutures, and a pledget of carbolized tow and a bandage applied.

The *amputation of supernumerary digits* is simple, and does not require description, as the procedure will vary with the situation and attachment of the superfluous part.

Amputation of Wings of Birds.

The extremity of the wings is sometimes amputated to prevent the birds flying. With a pair of sharp curved or straight scissors the end of the wing is clipped off about half an inch from the joint between the fore-arm and metacarpal bones. The wound is dressed with nitrate of silver or perchloride of iron.

Or the feathers may be removed from the inner side of the pinion, at the carpal joint, and an incision made through the skin in front of the carpal angle; the skin is detached and drawn back for one-third of an inch, the joint disarticulated, and the bone or bones excised by bone-forceps. The wound is sponged with antiseptic lotion, the skin drawn over, and the wound closed by three points of suture. No further attention is necessary, and the bird is as usual in a few days.

Amputation of the Ears.

Amputation of the ears of animals is rarely practised except for fashion, when they are cropped in a more or less fantastic manner. The severe pain of the operation, the subsequent inconvenience to the animal, and the disfigurement, should lead to the prohibition of ear-cropping as a cruel practice. When the ears are amputated for disease or deformity, then the operation is justifiable. The extent of amputation will depend upon circumstances, and no special directions need be given.

Amputation of the Tail.

Amputation of the tail is performed upon various species of animals—horses, dogs, and sheep—sometimes with a useful object, but, particularly in the case of the horse and dog, generally because it is fashionable to have these creatures with short tails. When not performed for the cure of disease or injury, or removal of deformity, in the horse or dog, the operation may be considered cruel. In certain circumstances, it is necessary to amputate the tail of sheep to prevent disease; and the same may be said of other animals, when this organ is diseased or injured.

Amputation of the Horse's Tail.

This is a very simple operation, though it is not unfrequently followed by evil results, such as necrosis of the bones, inflammation of the muscles of the tail and hind-quarters, tetanus, etc.

Operation.—The horse should be secured by side-line, and it may even be necessary to apply the twitch to the upper lip. The hair above the part to be amputated is turned upwards, and at the place to be incised it is clipped away in a circular manner for about the width of an inch. To prevent hæmorrhage, some operators apply a ligature around the tail a short distance above this part. When about to be amputated, an assistant holds the tail out horizontally, and amputation is usually effected by means of the 'docking machine' (Figs. 327, 328). The tail being placed in the concavity of the

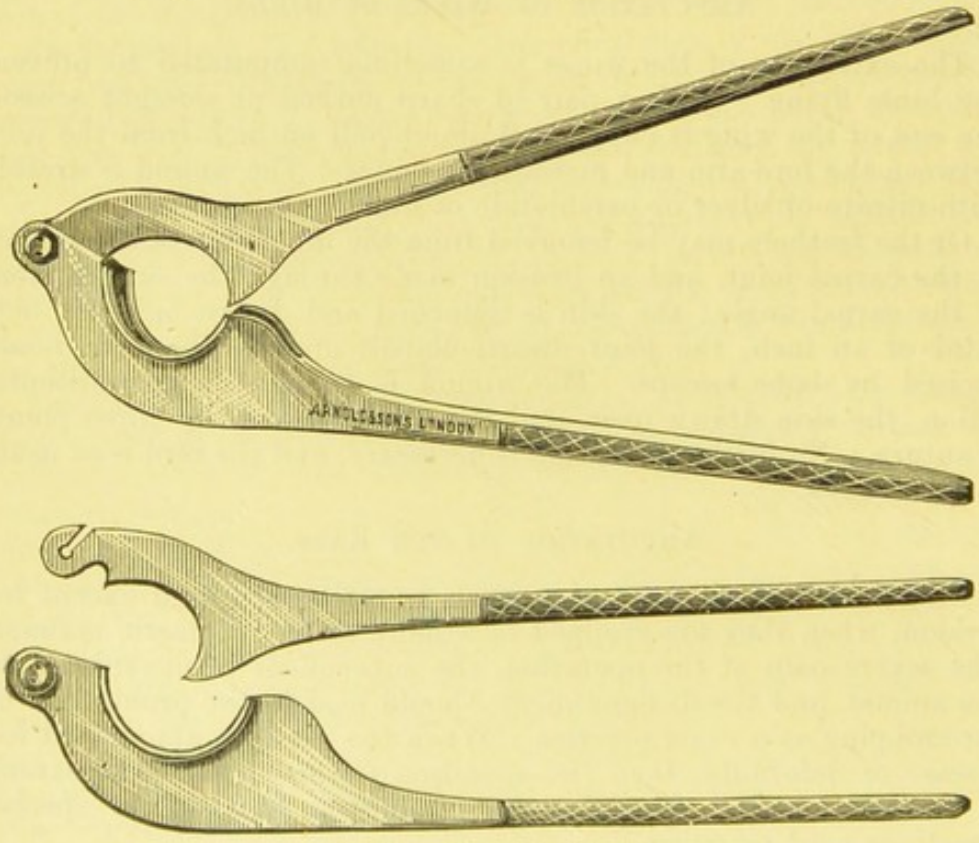

Fig. 327.—Docking Machine.

apparatus, the cutting blade is brought down upon it with sufficient force to cut through the soft parts and bone, the cut being transverse by this machine. If it is desired to make a double-flap amputation, the blade of the instrument may be V-shaped; this will make an angular cut through the tail, removing the bone deeper than the muscles, and leaving two flaps, which are brought together by two or three points of suture on each side. Or the amputation may be made in the ordinary way by the knife—the bone at the incision being sawn through or disarticulated, and the flaps joined by suture. By the flap operation, which is the neatest, the hæmorrhage is soon checked, bringing the flaps into coaptation closing the vessels.

Sometimes the tail is chopped off by laying it on a piece of wood, and striking a knife through it.

When the amputation is immediately transverse, as with the ordinary docking machine, there is much bleeding from the coccygeal arteries. This is usually arrested by means of the actual cautery, applied by a red-hot iron, round in shape, with a hole in the centre, to prevent the coccygeal bone from being burned (Fig. 329). This iron is applied repeatedly, and in a slightly rotatory manner, to the bleeding surface until blood ceases to flow, the soft tissues being

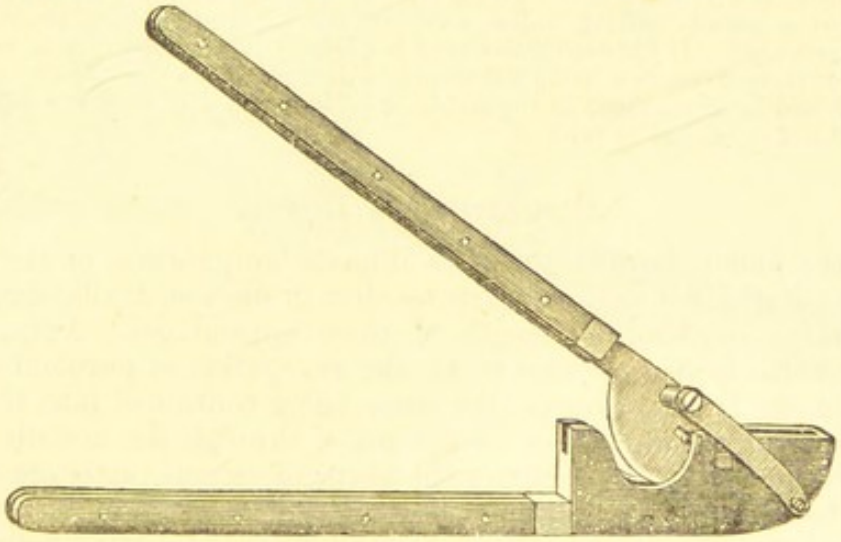

Fig. 328.—Improved Docking Machine.

more or less carbonized and destroyed. To form a thicker eschar and more speedily check the bleeding, a small quantity of powdered resin is sometimes put on the cauterized surface, and melted by another application of the hot iron. But in consequence of the destruction of tissue, and coincident exposure of bone, this roasting process is not to be recommended. The arteries may be twisted by the artery forceps, and the wound dressed antiseptically ; or the hæmorrhage may be suppressed by simply applying a pledget of carbolized tow to the wound, and retaining it there by tying the hairs

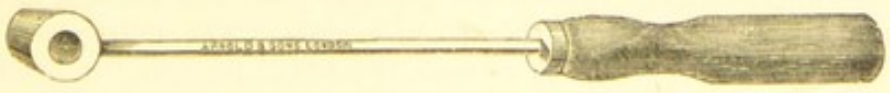

Fig. 329.—Cautery for Tail.

of the tail across it. Even the hairs alone tied across the end of the stump are sufficient to cause the retention of the clot which forms and which acts as a hæmostatic agent.

Amputation of the tail of small animals does not demand any surgical skill, and may be performed with a pair of scissors, the skin being drawn as much as possible towards the base of the organ before the incision is made, in order that it may cover the end of the stump.

Accidents.—The most serious accident is tetanus, which is not very infrequent. Paralysis, due to inflammation of the spinal cord, has also been recorded as a result of 'docking.' Sometimes, either from a ligature having been too tightly applied to check hæmorrhage, the hot iron kept on too long, or the amputation having been effected by laying the tail on a knife and striking it (the tail) with a mallet, the stump becomes much inflamed, and this inflammation may extend to the muscles of the hind-quarters. In other cases, the bones become necrosed, suppuration is set up and continues until the tail drops off, unless amputation of the diseased portion is resorted to; while in other cases, again, excessive granulation may arise in the wound. All these conditions require appropriate treatment.

Consecutive Treatment.—The treatment required by the wound after the operation is usually trifling, unless accidents occur; cleanliness is generally all that is necessary. If the wound has been bandaged, the bandage may be removed in two or three days, care being taken not to disturb the clot or eschar; and the horse should be so managed in the stable, as well as out of it, that the end of the tail will not be rubbed or injured.

Amputation of Horns.

In the hollow-horned domestic animals, amputation of the horns is necessitated not only in fractures, but in disease, faulty direction, deformity, or abnormal length of these appendages. Amputation of the horns is also resorted to for the evacuation of purulent collections in the frontal sinuses (the sinus being continued into the core of the horn), which cannot be got rid of through the nostrils, or to remove the larvæ. Sometimes the horns of vicious cattle are amputated to diminish danger, or render them (if oxen) more serviceable. And it is sometimes the fashion to render horned cattle 'polled,' by removing their horns when young (about two or three months), as it is believed that animals deprived of their horns yield more milk and flesh, the horn of the young creature being mainly secreted from the band which surrounds its base; when this band is destroyed the appendage does not grow again.

Amputation of Horns in the Adult.

Operation.—The animal is either cast with hobbles applied above the fetlocks, or securely fixed to a post or a tree by means of a long cord, one turn of which is passed around the horn to be amputated, and two or three turns around the opposite horn and the tree or post; so that the horn for operation is outermost. The fourth and fifth turns of the cord should be around the lower part of the head and the post, another turn or two being between the head and the post, to secure the cord.

Amputation may be practised at various parts of the horn. If towards its free extremity, the horn-tissue alone is involved, and this may be sawn through, and the sharp edges rounded by means of a file or rasp, without further trouble. Towards the middle and base, however, the core and the vasculo-sensitive membrane are involved, the operation is more serious, and a 'dishorner' (Fig. 330) may be used.

If the horn is fractured or diseased, amputation is effected below the part, by means of a thin, sharp, fine-toothed saw, which should

be previously smeared with lard or oil. The horn-tissue should first be sawn in a circular manner, but not quite through to the sensitive membrane, so as to abridge the suffering. Then the bone is sawn through as rapidly as possible, the head on that side being held a

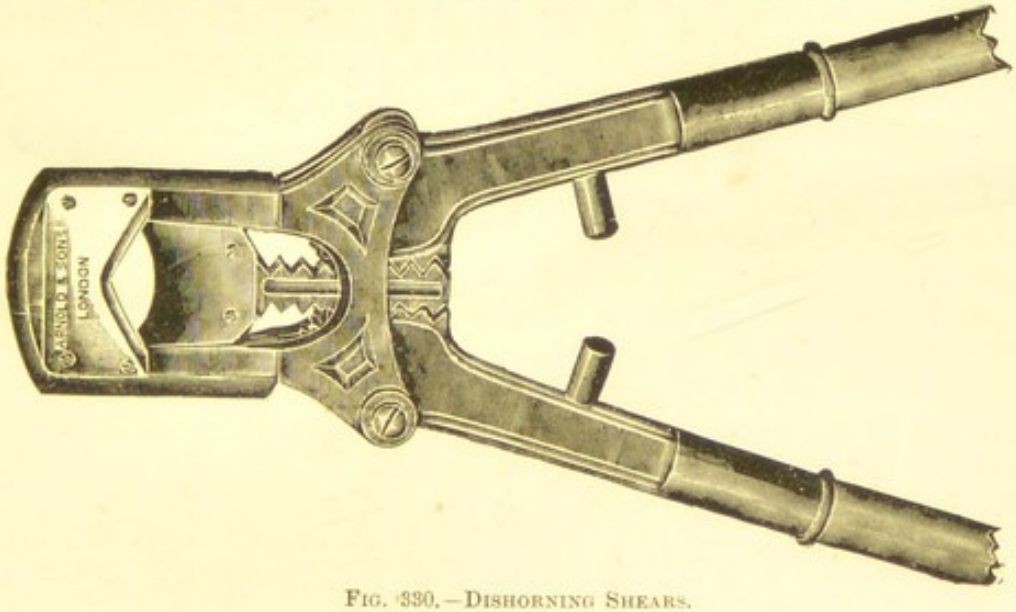

FIG. 230.—DISHORNING SHEARS.

little lower, so as to prevent the blood and bone-sawings falling into the sinus. The saw is held in the right hand, while the left steadies the horn firmly, especially when this is nearly cut through, in order to prevent its breaking. In complicated fractures, it may be necessary to employ the knife and saw.

CONSECUTIVE TREATMENT.—When the horn is removed, the wound should be sponged and cleansed with an antiseptic, allowing some to fall into the cavities of the core to free them from blood and fragments of bone, which the animal itself aids in doing by shaking its head. Then a pad of carbolized tow is placed on the wound and down the sides of the horn, and maintained there by a few turns of a bandage passed around it and the other horn; or the Maltese-Cross compress (Fig. 177) may be placed over the pad, the whole being kept in place by means of a long bandage applied spirally on the stump of the horn, and several figure-of-8 turns between this and the opposite horn. When the entire horn is amputated, large tow pads are placed on the wound, and fixed by a long bandage passed several times around the head and the intact horn.

It has been recommended to cover the wound with a pitch-plaster, which is maintained without a bandage.

The dressing should not be removed for some time—one or two weeks—unless the animal is suffering pain, when it will be necessary to uncover and cleanse the wound. Pus can be removed from the cavity by syringing it with water, a little of which introduced into the ear makes the animal toss its head and so expel the fluid from the horn and sinus.

The carbolized dressings are to be continued until the granulations have closed the wound. The animal must be secured, while being dressed, by a short collar-rope attached to a post, the opposite fore-leg being strapped up.

Amputation of Horns in the Young Animal.

This operation is practised on calves two or three months old, the rudimentary horns being removed, with the view of increasing the milk and flesh producing qualities of the animals.

Operation.—The calves 'dishorner' (Fig. 331) may be used, but a convenient instrument is the old-fashioned gun-wad punch, very sharp, and fastened in a handle; the circular opening of the instrument should be sufficiently large to surround the base of the horn.

The hair is clipped off around the little prominence which marks

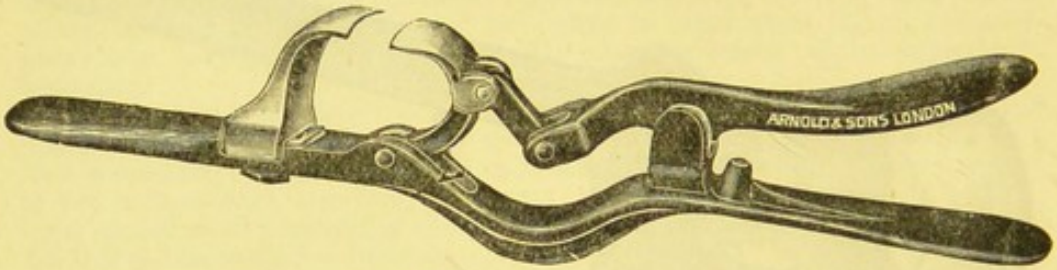

Fig. 331.—Dishorner for Calves.

the site of the young horn; then the calf is placed on its side and held by two assistants. The operator, with his left hand resting on the head, passes the instrument perpendicularly over the horn, and pressing strongly, and in a slightly rotatory manner, cuts through the soft tissue to the frontal bone (Fig. 332), completely isolating

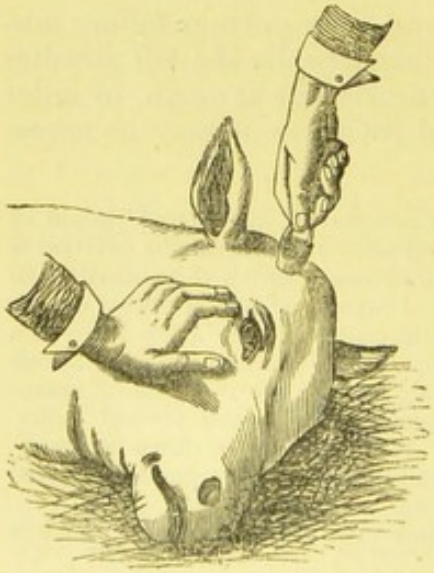

Fig. 332.—Removing the Horns of the Calf—First Stage.

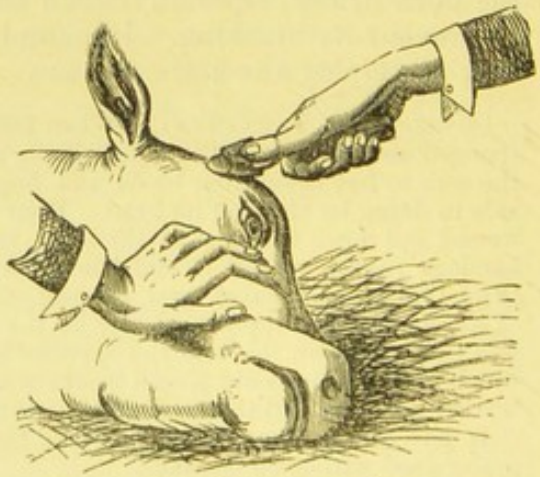

Fig. 333.—*Ibid.*, Second Stage.

the little knob of horn. The hand is then depressed until the instrument is more or less horizontal (Fig. 333), and the portion is gouged out. The wound is cleansed, an ordinary styptic applied, or the hæmorrhage suppressed by actual cautery, and the other horn removed in the same manner. Nothing further requires to be done, as the wounds soon heal.

SECTION XIV.

EXTRACTION OF FOREIGN BODIES FROM WOUNDS.

The extraction of foreign bodies from wounds may be easy or difficult, according to their situation, form, and nature. In many instances they are readily removed when superficially situated; in others their removal is dependent upon skill in manipulation and accurate anatomical knowledge, especially when they are deep-seated and have penetrated by an irregular track.

In the removal of foreign bodies, and especially those lodged by firearms, which will be chiefly dealt with here, not only has their extraction to be considered, but likewise the modification of the wounds they have made, so as to render them more simple and readily cicatrizable, while their subsequent treatment must also be kept in view.

Much will depend upon the situation and the nature of the wounds, as well as the foreign bodies. In wounds caused by firearms, it is generally taught that they should be well opened up immediately after their production, so as to relieve the subsequent tumefaction of the tissues, favour the escape of sloughs, pus, and the foreign bodies themselves. But this dilatation is not always necessary, or even advantageous, and in the neighbourhood of large joints, important bursæ, or large vessels or nerves, it may be dangerous. When a bullet is deeply lodged and has only made one opening, the wound may be incised to such an extent that it represents a cone, the base of which is towards the surface and the apex at the projectile. If the wounded region is provided with strong aponeuroses, it may be advisable to make several incisions around their circumference, to prevent strangulation of the tissues.

When the ball has made two openings and followed a short track, dilatation is needless; but in the opposite condition, the two wounds should be incised to some extent, in order to prevent strangulation and gangrene. When, however, the tissues are much contused and benumbed, incisions should not be attempted, and in all cases they should not be made unless the indications for doing so are precise.

In order to remove the foreign body or splinters of bone, or to ligate bloodvessels, dilatation of the wound is, as a rule, necessary, and this dilatation may require to be carried as far as the vessel, or the substance to be removed.

The manner of making the incision has been described at pages 80 to 89. It is usually made by means of the scalpel, or sharp or blunt-pointed bistoury and director (Fig. 101). The incision is made according to circumstances, but usually upwards and downwards, and parallel to the direction of the large vessels and nerves. To prevent or relieve strangulation of tissues, the extent of the incisions will depend upon the tumefaction and the character of the tissues—muscular being more largely incised than fibrous—the cuts always extending beyond the strangulation. If this is caused by an aponeu-

rosis, a T-shaped, crucial, or stellate incision (Fig. 103, *a*, *c*, *f*) is best.

If there is hæmorrhage, this must be checked in the manner described at page 102.

Before attempting the extraction of a foreign body which is not visible in a wound, it is necessary to be assured of its presence, and to learn as much as possible of its shape, volume, position, course, etc. The position of the animal at the moment when it was wounded, the presumed nature and shape of the foreign body, and its point of entrance, should be ascertained. The harness or equipment the animal wears or has worn should also be examined to discover whether any portion of it has been carried into the wound ; then the latter should be scrutinized, to ascertain whether it is simple or multiple ; in the latter case the openings are compared with each other, and upon their characters, with regard to entrance and exit wounds, will the probability of the presence of the foreign body be founded. For it must be remembered that the existence of two wounds is not always evidence that the foreign body has escaped, as it may have divided into two or more parts, one of which only has made its exit.

Sometimes the foreign substance is discovered by palpation, or a prominence on the surface at some distance from the wound ; and to

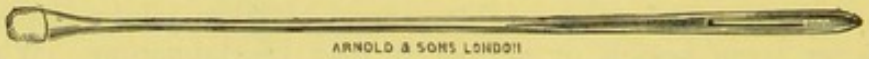

Fig. 334.—Gunshot Probe with Porcelain Bulb.

facilitate its discovery, if in a muscular region, the muscles should be relaxed as much as possible. The interior of the wound should not be explored until a careful superficial examination has been made ; neither should it be explored when inflammation is present in the part.

Exploration of the wound may be made by means of a probe of whalebone, lead, or silver. Nelaton's gun-shot probe (Fig. 334) has a porcelain tip, which becomes leaded when brought into contact with the bullet. The best probe is the finger, as it possesses the sense of touch and does not lacerate the tissues. But it frequently happens that it is not sufficiently long to reach the bottom of the wound, and the ordinary probe must be employed. This should be moderately thick, more or less flexible, and not likely to break. An S-shaped probe has been recommended for the extraction of foreign bodies, as it may serve to displace these.

In using the probe, it will often be found advantageous to vary the position of the part, particularly with the object of placing it as it was at the moment of the accident, so as to discover the track and situation of the penetrating body. In many instances, and especially with projectiles, this exploratory probing demands much patience and judgment, and is not always successful.

Extraction of foreign bodies is not always possible, or it may be inopportune or dangerous at a particular time. It is indicated when

the body is not very deeply buried, readily accessible, and lodged in tissues, the lesions of which are not likely to cause serious disturbance. But when the foreign substance cannot be reached without making large and deep incisions, the danger from which is greater than that from the presence of the substance, it is advisable not to attempt its extraction, as it may become encysted, be expelled spontaneously, or in time appear in a situation favourable for surgical removal.

When, in addition to the foreign body, there are splinters of bone, these should be extracted, except when they are firmly adherent, either to periosteum or the soft tissues, and are likely to live and become united again; if these will not be a cause of danger, it is

FIG. 335.—BULLET FORCEPS, WITH SHIFTING BLADES.

better to leave them in place than to make a large wound to remove them.

When extraction is practicable, it ought to be achieved as soon as possible, and before inflammation sets in; if this has taken place, attempts at removal should be delayed until it has subsided.

When the foreign body has not penetrated too deeply, it may be removed by the aperture of entrance, which may be dilated in the manner described, if found to be too narrow. If there is danger of wounding important organs, or the track of the wound is long and tortuous, and obstructed by the soft parts, it is generally advisable to make a counter-opening, which possesses the advantage, besides facilitating the operation, of affording additional escape for the pus

FIG. 336.—CURETTE BULLET EXTRACTOR.

and sloughs, and thus hastens the healing of the wound. This counter-opening is especially desirable when the foreign body is felt beneath the skin.

When bones intervene in the removal of the foreign body, it may be necessary to have recourse to trepanation or resection of these. The bone is either trepanned above the foreign body, which is removed with the excised piece withdrawn by the instrument, or an opening is made on one side of this, through which the latter may be seized or expelled.

If the wound is extensive, the foreign body not deep and not firmly fixed, the fingers may suffice to extract it; sometimes it falls out by its own weight when it is loosened in the wound; or the

probe (especially if S-shaped and rigid) may bring it so near the surface that ordinary forceps can grasp and withdraw it.

Bullets embedded in or between bones are removed in this way, the probe playing the part of an elevator, by being pushed under one side of the projectile (if need be by a lateral opening).

In other cases, when these means fail, special instruments are employed in the shape of forceps, which vary in design. Those for the extraction of bullets are particularly diversified in shape, but in veterinary practice the simplest are always preferable. In some cases the ordinary dressing forceps (Fig. 166) will suffice; but in others, and especially for the extraction of bullets, a modification of this forceps is necessary.

The simple bullet-forceps with shifting blades (Fig. 335) answers well, as one blade can be introduced at a time, and both blades jointed when they have been placed on each side of the object; a blade, if used alone, can be made to serve as an elevator or *curette*.

Another simple form of bullet-extractor is that of Coxeter, which closely resembles that of Thomassin. This is a long hollow tube,

Fig. 337.—Bullet Forceps.

spoon-shaped at one end, with a handle at the other. Through it moves a rod which, upon the curved expansion at the end being placed on the bullet, is pushed against this, and so retains it while it is being withdrawn (Fig. 336).

In operating for the extraction of foreign bodies from wounds, the manner of operating, and the skill and instruments required, will depend not only upon the situation of these bodies, but on their form, volume, and other circumstances, for which no special directions can be laid down.

Consecutive Treatment.—Wounds caused by foreign bodies do not heal by first intention, whether these be extracted or not, but nearly always suppurate, and their treatment must be chiefly based upon this fact—that which is necessary in all suppurating wounds being required here. Cold-water dressings, or continuous irrigation, to subdue the inflammation, and carbolized lint, detergent and germicide dressings, applied at intervals, with compresses maintained by a moderately tight bandage, should be adopted in ordinary cases. If there is much suppuration, the formation of abscesses should be prevented, as well as the lodgment of pus about bones. Above all things cleanliness is necessary, especially during hot weather, and the wounds should be protected from flies and dust.

SECTION XV.

TREPANATION, OR TREPHINING.

Trepanation or trephining consists in making a perforation in a bone or bones, with the view of reaching a cavity, removing diseased or displaced bone, or fulfilling some other surgical indication. Though most frequently practised on the head, yet any bony surface may be trephined.

It is resorted to in compression of the brain by blood, pus, depressed or fractured bone, or entozoa; when a foreign body, as a bullet, is lodged in the bones of the cranium; when the bones of the face are fractured and depressed, rendering respiration difficult; in removal of molar teeth by punching them out; in catarrh of the membrane lining the frontal and maxillary sinuses, with purulent collections in these cavities, or when polypi or other tumours form in them; in cases of hypertrophy of the superior turbinated bone in the horse, giving rise to impeded and noisy respiration, when the

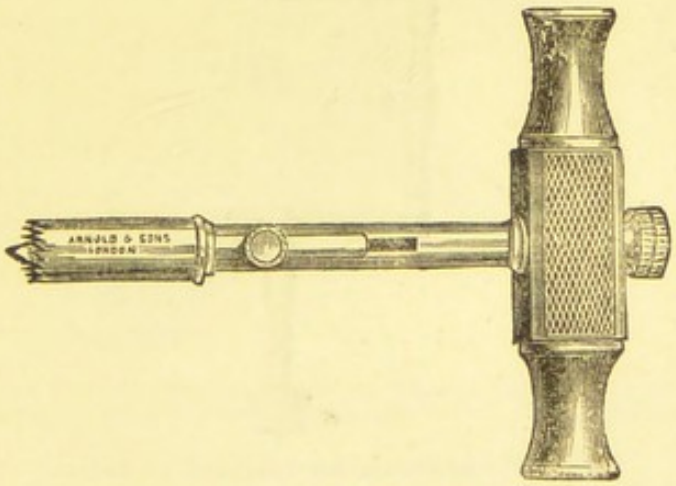

FIG. 338.—ORDINARY TREPHINE.

nasal bone is trephined; also when parasites exist in the nasal cavities in the horse, sheep, or dog; in chronic catarrh of the horns of bovines, with pus in the cavity of the core and frontal sinus, when the base of the horn is trephined. Trepanation has also been practised on the scapula, in cases of dorsal sinus, when pus lodges between that bone and the side of the chest; rarely on the bones of the limbs, for the removal of sequestra; and still more rarely on the hoof, in cases of laminitis, the opening so made serving for the evacuation of blood or pus, or through which to practise blood-letting.

INSTRUMENTS.—The ordinary carpenter's gimlet and brace-and-bit have often been employed as trephining instruments, but each of them has been modified to serve the purpose better. The common surgical trephine (Fig. 338) consists of a stalk, handle, and sharp-toothed cylinder, or circular saw, in the middle of which is a steel

pin that can be more or less projected beyond the cylinder, to fix in the bone, by means of a slide in the stalk. The second form of trephine (trepan) is like the brace-and-bit of the joiner, consisting of a toothed cylinder and a steel point (Fig. 339, *a*), as in the other form, with a spring (*c*) to retain these, in a crank handle (*e*), upon which pressure can be applied either by the hand or breast at the opposite end (*d*).

The first instrument requires only one hand, the second two hands; while the latter, though more powerful and rapid in its action, requires greater care. The first cuts by a semi-rotatory, the other by a rotatory movement.

If only a simple perforation is to be made into a bone, a common gimlet may be employed, or the trepan armed with a joiner's 'bit.'

An 'elevator' is sometimes used to lift up and detach the circular

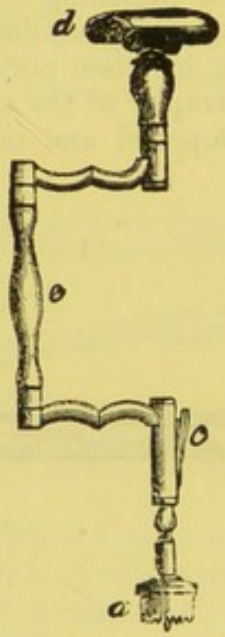

Fig. 339.—Brace-and-Bit Trephine, or Trepan.

piece of bone cut through by the trephine, and to prise up a depressed or fractured bone, after an opening has been made near it. This is a flat, narrow, steel lever, slightly curved at the extremity, introduced beneath the bone.

A brush is also convenient to remove the bone sawdust during the operation; and in addition to these, a bone-gouge and mallet are useful in special cases, and sometimes a bone saw should be at hand; while dissecting forceps, probes, scissors, suture needles and thread, as well as a sponge and antiseptic solution, are always necessary. Fine carbolized tow, ordinary bandages, and tape, should be provided.

Situations for Trepanation.—The necessity for trepanation in certain circumstances has been alluded to. It is desirable that the situations usually selected for the operation, and the peculiarities of these, should be noticed. It may be noted that, if possible, the

angles and thickest parts of bones, and also muscles, veins, and nerves should be avoided.

In the HORSE, trepanation is usually practised on the cranium, forehead, or face; rarely elsewhere. On the *cranium*, it is resorted to in cases of fracture of the cranial bones, with depression of the fractured portions, the object being to raise and, if need be, remove these. Trepanation is therefore performed on the sound bone immediately contiguous to that which is depressed, the exact spot being determined by anatomical and other considerations. The operation may also be required for the evacuation of blood, pus, or other fluid from the cranial cavity of the horse, the parietal bones being those most favourably situated for perforation in such cases. Recently, in cases of tetanus, the cranium has been opened for the injection of antitoxin.

But trephining is most frequently resorted to in disease of the

FIG. 340.—POINTS FOR OPENING THE SINUSES ON THE HORSE'S FACE: A, OPENING INTO THE LEFT FRONTAL SINUS; B, *Ditto* SUPERIOR MAXILLARY SINUS; *Ditto* INFERIOR MAXILLARY SINUS.

frontal and maxillary sinuses, especially when there are collections of pus in these; and the latter sinuses are also sometimes opened for the removal of carious molar teeth. In order to open these sinuses effectively and with safety, their anatomical arrangement should be perfectly understood by the operator.

The total capacity of the sinuses on each side has been estimated at nearly one pint, and they will contain about eighteen ounces of fluid.

The *frontal sinuses* are situated between the orbital arches and the cranial and nasal cavities; the two are completely separated from each other in the middle line by a solid plate of bone; each cavity is intersected by numerous imperfect septa, while the cavity itself communicates with the superior maxillary sinus. The most favourable point for operation is the centre of each sinus. This is found on a horizontal line drawn between the middle of the orbital arch on each side (Fig. 340, A); but the opening may safely be made half

an inch or so above this line, or as low as a horizontal line between the inner angle of each eye, though this involves the upper end of the nasal bone. The opening should be in the space between the frontal suture and the eye.

The *maxillary sinuses* are the largest, and are divided into superior and inferior by a complete septum, while they are separated from the two sinuses of the opposite side by a perfect bony partition. They are situated on each side of the face, below the orbital cavity,

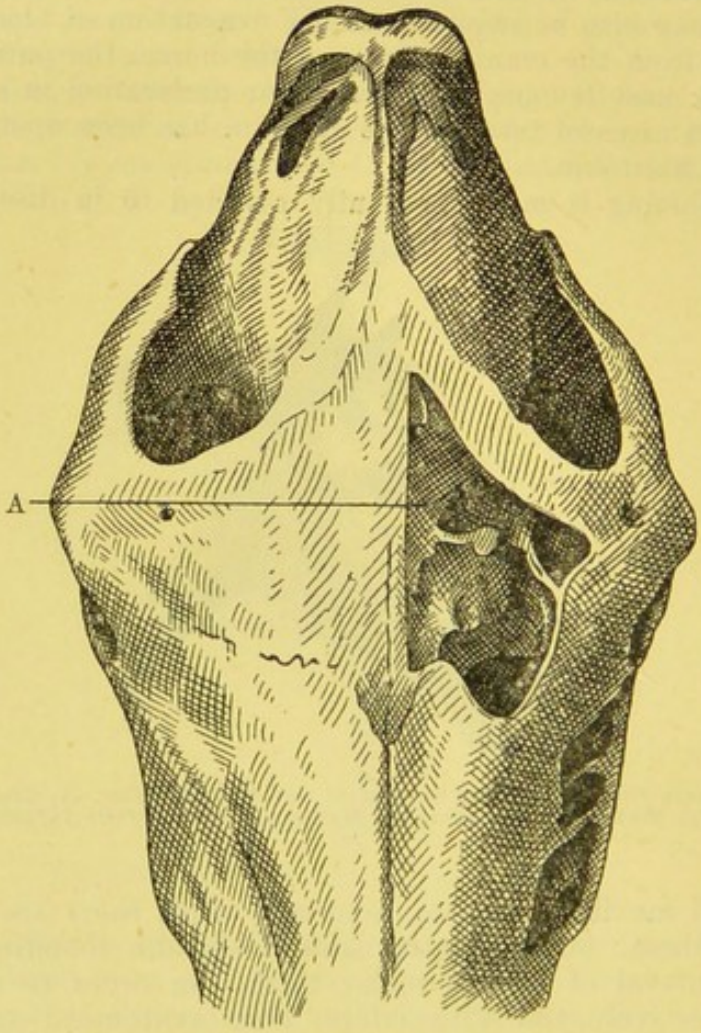

FIG. 341.—FACIAL SINUSES: A, FRONTAL SINUS.

the superior being next that cavity, the inferior lower down the face.

The *superior sinus* communicates with the frontal, ethmoidal, and sphenoidal sinuses, and below with the nasal cavity of the same side; and, provided with numerous imperfect septa, it contains the fangs of the two last molars, which project into the cavity. The point for opening it is at an equal distance between the internal angle of the eye and the zygomatic ridge (Fig. 340, B), behind the nasalis longus muscle.

The *inferior sinus*, excavated in the superior maxilla, is completely

separated from the other, and communicates only with the corresponding nasal cavity by the opening common to all these sinuses. It is divided into two parts, the internal of which passes into the maxillary turbinated bone, while the external contains the fang of the fourth, and sometimes also that of the third, molar.

When the object is to remove purulent collections from the sinuses and medicate their lining membrane, it is advisable to make two openings—one into the frontal and another into the superior maxillary sinus.

The *nasal bones* may be trephined at nearly every part.

In the Ox, in disease of the horn core, the base of the horn is usually the seat of operation, as there the frontal sinus is opened and the large cavity it forms is exposed.

In the Sheep, trepanation is performed for the removal of hydatids, the cysts of which are lodged in the cranial cavity; the

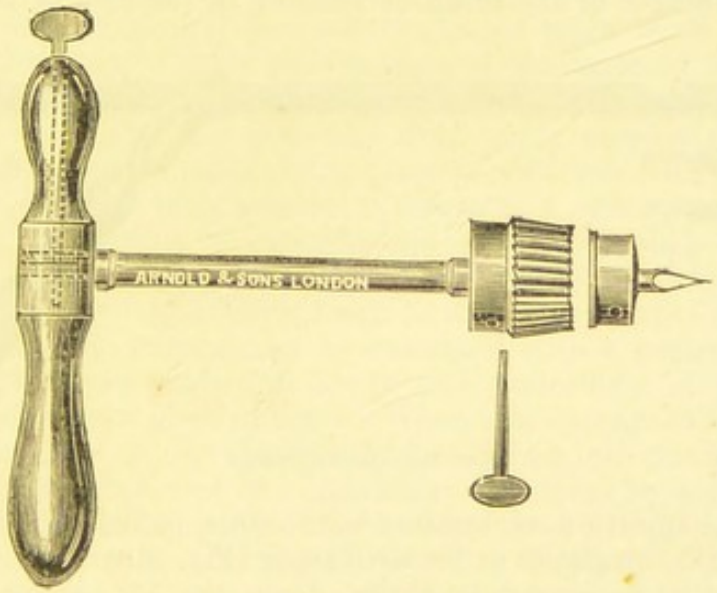

Fig. 342.—Aseptic Trephine.

opening is made where the bone has become thin and elastic from pressure atrophy.

Operation.—With the Horse, if the head is to be operated upon, the animal should be placed latericumbent, on the side opposite that to be trephined. The head and neck should be elevated to a convenient degree by sacks filled with straw; and one or two assistants must hold the head down, if an anæsthetic has not been administered. The hair is removed from the part, and with the scalpel a T- or V-shaped, crucial, or semilunar incision (Fig. 103, *a*, *b*, *c*, *d*) is made through the skin and periosteum on to the bone. The skin and other tissues are dissected back, to leave sufficient surface of the bone exposed for the trephine to act upon. In the centre of this, the steel pin of the trephine makes a perforation sufficient to steady the instrument, owing to its protrusion beyond the level of the cutting teeth, which should all be made to cut equally deep

by the hand of the operator, inclining it where the bone is thickest. The pressure must be steady and firm until perforation is nearly complete, when it should be lighter, to avoid pushing through the detached piece of bone. The trephine is turned in a semicircular manner from right to left, or *vice versâ*, until the groove is sufficiently deep to dispense with the centre point, which may then be withdrawn. At intervals the bone-dust may be brushed away from the instrument and the bone, and if there is bleeding the blood is removed by a sponge. When the piece is almost cut through (which is evidenced by its becoming rather loose), the trephine is dispensed with, and an elevator pushed into the groove raises the piece on one side, while the thumb of the left hand steadies it on the other. When detached it is seized by the forceps and removed. The wound is then cleansed, and any ulterior operation required is performed, but the sinuses should not be washed out until the horse has risen.

In trephining the cranium, great care is necessary to avoid wounding the meninges of the brain or pushing in the disc of bone. For

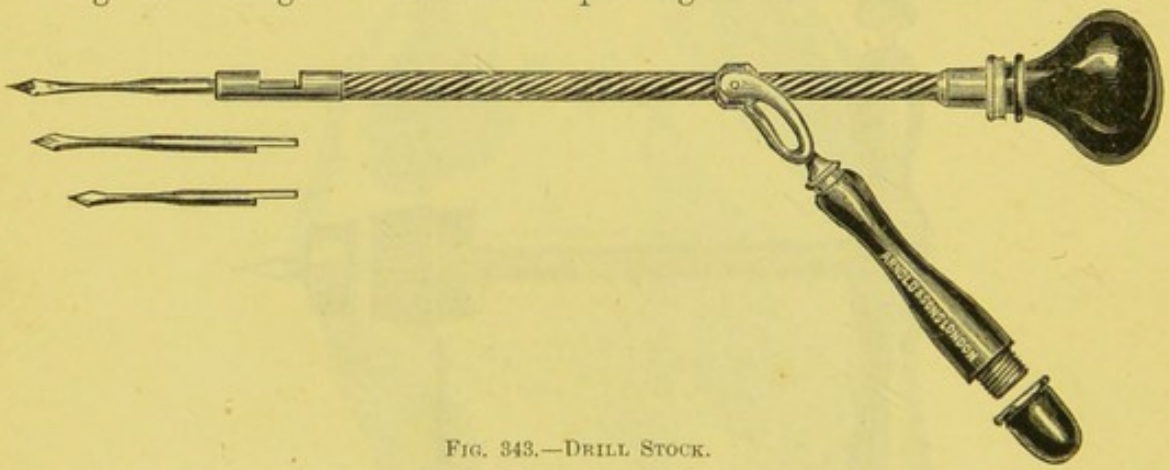

Fig. 343.—Drill Stock.

intracranial injection of tetanus antitoxin a sufficient opening can be made with the gimlet or the drill-stock (Fig. 343).

It is rarely necessary to throw down the Ox, the head being merely pulled up to a post in the manner already described, and held by one or two strong assistants.

The Sheep should be placed upon a table or bench, its feet tied, and the head steadied by assistants. For piercing the cranium of sheep affected with gid, many operators use a special trocar, which is provided with an adjustable stop. The trephine, if used, should be small, and the opening made where the bone is attenuated and elastic, as the hydatid may then be removed *in toto*.

With regard to trephining for fractures of the face or cranium, the mode of operating is similar, the object being to raise or remove depressed portions of bone. For the cranium, in simple or comminuted fracture, unless there are symptoms of cerebral derangement, operative interference is generally unnecessary ; in compound fracture with depression, however, even when unaccompanied by these symptoms, operation should be resorted to without delay. It

must be remembered that certain parts of the cranium should not be trephined, as the occipital bone, and immediately above the venous sinuses of the dura mater. Fracture of the face-bones rarely requires trephining, unless they are depressed and likely to interfere with respiration.

In trephining for fracture, the hair is shaved away from the seat of operation, and the bone to be trephined, if not already exposed by the accident, is laid bare by a crucial or T-shaped incision. The trephine or trepan may be large or small, according to the object in view—*i.e.*, the removal or elevation of bone as a source of compression, or the evacuation of subjacent fluid, such as pus or extravasated blood. The trephine is applied to the solid bone, at such a distance from the fracture that the circular or semicircular piece removed will communicate with the edge of the depressed part, and allow space for its removal or elevation.

A sufficient depth of groove having been made, the steadying centre-pin is withdrawn from the instrument, lest passing too far through, it may wound the membranes or brain itself. Complete section of the outer table and passage of the teeth of the trephine into the diploe, is manifested by the altered character of the bone-dust thrown up by the saw—the dry, mealy powder of the hard bone of the external table giving place to soft, blood-tinted *detritus;* while the hand of the operator experiences a sensation of yielding when the instrument is entering and passing through the diploe. Then the trephine must be worked very lightly and cautiously, and withdrawn every two or three turns as it approaches the dura mater, in order that the groove may be examined with a probe or pointed instrument, to ascertain the depth and uniformity of penetration around the circular piece of bone. When this appears to be loosened, it is removed by an elevator gently introduced into the groove, and the particular object of the operation can then be accomplished. Pus or blood will escape, or may be evacuated; or depressed bone may be raised by insinuating the elevator beneath it through the artificial opening, and bearing on the finger or edge of the firm bone as a fulcrum.

Loose fragments of bone and débris must be carefully removed, the wound sponged, and, if necessary, the flaps of skin are laid down and secured by a few sutures.

In trephining for suppuration in bone—an operation attended with the greatest advantage—a crucial incision is made immediately over the abscess, down to the bone itself. A small trephine, having no projecting rim to oppose its entry, is then applied and worked through the dense bone: penetrating to some depth, and entering the cavity of the abscess. The circle of bone is detached and removed by an elevator or gouge, and the pus evacuated. If only a small quantity or none appears, the bone must be further penetrated by the gouge until the cavity is fully opened, as it sometimes happens that no pus is discovered on raising the piece of bone by the trephine, and it may be necessary to pierce the exposed part in various directions to find traces of it; then the oozing aperture should be freely enlarged.

Consecutive Treatment.—This will vary with circumstances connected with the nature of the disease or accident for which trepanation was necessary. If it is required to have the wound healed as rapidly as possible after the operation, as is generally the case with regard to the removal of hydatids or fractured pieces of bone, or elevation of depressed bones, the borders of the skin are brought together, a piece of carbolized lint is placed over the wound, and over this some pledgets of carbolized tow. These are retained by a long bandage two or three inches in width, which is passed in figure-of-8 fashion around the head, including the lower jaw and each side of the neck, and the ends secured by pins or sewing, the whole being covered, if necessary, by a light hood or head bandage (Figs. 187, 189).

After trepanation the facial sinuses should be washed out daily with a warm antiseptic solution, until fœtor and discharge have disappeared. For irrigation purposes Higginson's syringe, or an enema pump, will be found very convenient. To keep the sinuses open for some time the apertures may be filled with a firm pledget of tow or linen, or (which is best) a rubber-cork may be used. When the openings are to be closed, the plugs or corks should be discontinued.

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Heavy figures indicate illustrations.

END OF VOL I.

Baillière, Tindall, and Cox, 8, Henrietta Street, Covent Garden.

A TEXT-BOOK

OF

OPERATIVE VETERINARY SURGERY

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VETERINARY SURGERY

BY

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VOLUME II

WITH NUMEROUS ILLUSTRATIONS

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1902

PERFACE TO VOLUME II.

THE present work was left unfinished at the death of the author, the late Dr. Fleming, who, however, had prepared nearly all the manuscript with the exception of the last chapter or so. In deference to the wish of Dr. Fleming's widow and his publishers, Messrs. Baillière, Tindall and Cox, I undertook to attend to the completion of the work as being in a sense complementary to that of my late father, and I am responsible for the authorship of the last few pages.

Dr. Fleming's Manual has long held a high position in the not too abundant literature of veterinary science, and it is a matter of regret that he was not spared to put the final touches to the present Text-Book. Those who wish to have details of Dr. Fleming's most industrious life will find them in the *Veterinary Journal* of 1901.

W. OWEN WILLIAMS.

THE NEW VETERINARY COLLEGE,
EDINBURGH,
February, 1902.

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PART II.

SPECIAL OPERATIONS ON ORGANS AND THEIR APPENDAGES.

OPERATIONS ON THE DIGESTIVE APPARATUS AND THE ABDOMEN.

The operations required to be performed on what may be termed the 'digestive apparatus,' and on the abdomen, are somewhat numerous, while several of them are of great importance, and demand much skill and manipulative dexterity for their accomplishment.

They comprise operations in the mouth and its immediate vicinity (on the teeth, tongue, salivary glands, etc.), as well as on the œsophagus, stomach, intestines, and, in connection with these, the abdominal wall. These operations will be described in the following chapters.

CHAPTER I.

OPERATIONS IN THE MOUTH.

Instruments.

Specula—Gags.—In performing operations in the cavity of the mouth, as well as in the pharynx generally, it is nearly always essential for the convenience, and even safety, of the operator that the jaws of the animal to be operated upon should be maintained firmly and securely apart by mechanical means.

For the Horse these means are various, and are in the form of instruments or apparatus to which particular names have been given, such as 'balling-irons,' 'gags,' 'specula,' etc. However

much these may differ in form and structure, in principle they are identical, and are devised to keep the mouth open to the necessary extent, so as to allow the operator ample space for his manipulations, and also protect his hands against injury from closure or lateral movement of the animal's jaws.

The commonest and simplest form of instrument is that known as the 'balling-iron,' of which there are several patterns. The most objectionable pattern is that which has fixed branches, and therefore does not allow of adjustment to different-sized mouths (Figs. 296, 297); those which permit this adjustment are always to be preferred, and of these there are a number of good models.

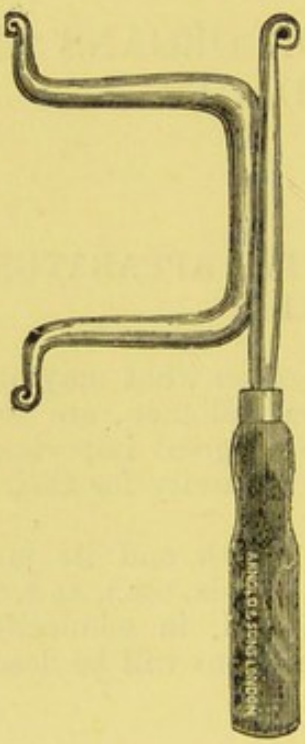


Fig. 296.—Ordinary Unilateral Mouth-Speculum or Gag.

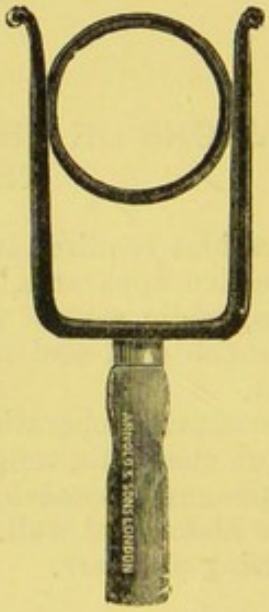


Fig. 297.—Ordinary Circular Mouth-Speculum or Gag.

That of Varnell (Fig. 298) is simple and useful, the branches—which are open at one side—being covered with indiarubber to guard the gums and dental interspaces from abrasion, while the upper branch is moved through the handle to which the lower one is fixed, the distance between the two branches being graduated by means of a screw at the end of the handle.

Fearnley's 'mouth-dilator' (Fig. 299) is somewhat different in shape, the handle being in the middle of two vertical side-bars, which have a fixed transverse bar near the bottom, and a movable one (A) that can be fixed at each side by a screw (A) in the upright branches.

A similar but simpler speculum is in use in France and Germany (Fig. 300); in this the degree of separation between the

fixed and movable sliding bars is regulated by the screw handle. A very simple form of speculum, also employed in Germany, has been devised by Dominick. It is merely a half-round piece of

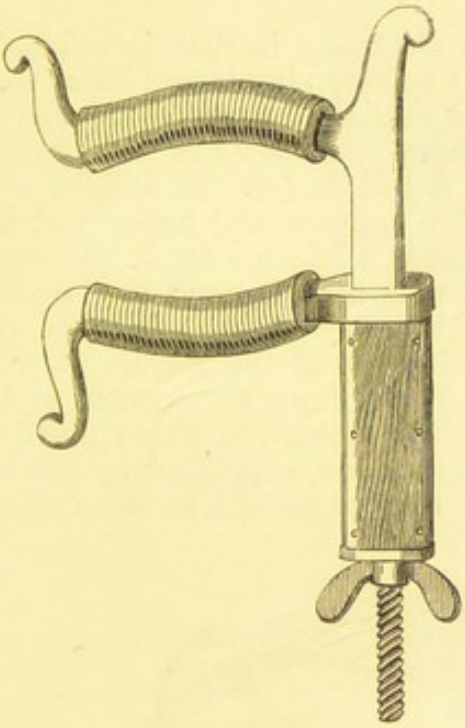


FIG. 298.—VARNELL'S UNILATERAL MOUTH-SPECULUM.

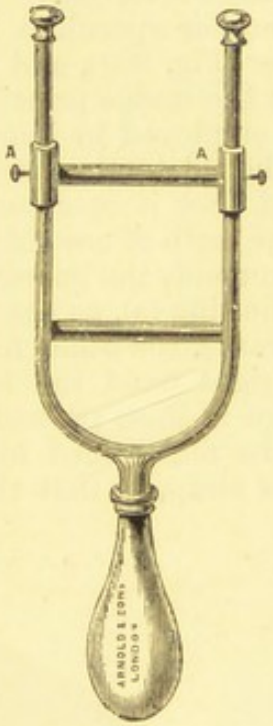


FIG. 299.—FEARNLEY'S BILATERAL MOUTH-SPECULUM.

iron bent to form rather more than three-fourths of a circle, or, rather, oval ring, the convex side of the iron being inwards; this has two straps attached to the upper branch, which is somewhat

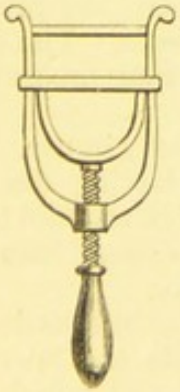


FIG. 300.—RIGOT'S BILATERAL MOUTH-SPECULUM.

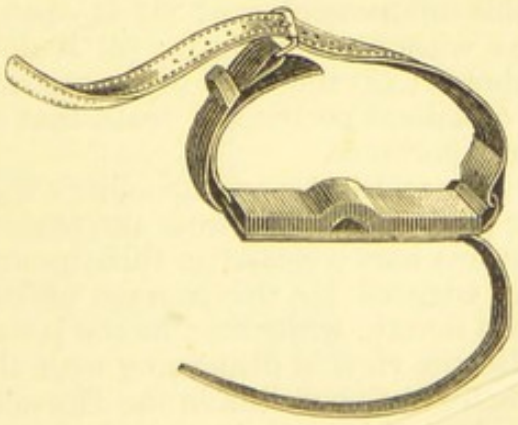


FIG. 301.—DOMINICK'S MOUTH-SPECULUM. (Improved by Pflug.)

straighter than the other. The upper branch is applied to the roof of the mouth, behind the canine teeth, and the straps are buckled across the nose in order to retain the instrument in the mouth,

the more convex branch being lodged behind the inferior canine teeth. This has been improved by Pflug, as seen in Fig. 301, the strap being passed through a pad of india-rubber, which is applied to the roof of the mouth, and the iron itself is also covered with the same material.

Another speculum in use in Germany is that introduced by Bayer (Fig. 302), and is said to be very simple and effective. It is on the wedge principle, and is similar in shape to the *speculum oris* employed in human surgery. It consists of a body (*a*), a roughened tooth-plate (*b*), and a handle (*d*). It will be understood that it operates as a wedge between the upper and lower molar teeth of one side, which act as a fulcrum for it. To use this instrument, the operator grasps with his left hand the handle (*d*) by the ring (*e*), so that the thumb passes through it from within outwards, the other fingers passing round the handle at *c*. By the right hand the tongue is drawn from the mouth, and the wedge is then pushed between the molars, in which position it can be maintained by the thumb alone, supported by the head-collar strap, so that the tongue may be passed to the fingers of

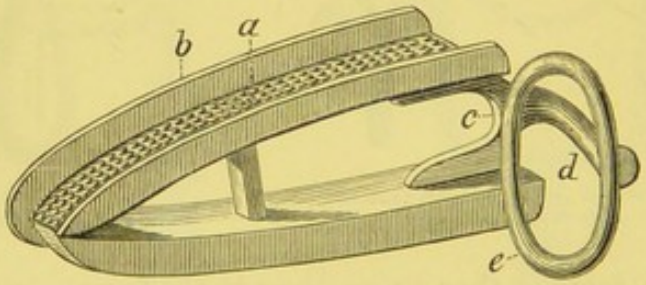


Fig. 302.—Bayer's Wedge Mouth-Speculum.

the left hand, leaving the right one free. The advantages claimed for this instrument are: (1) It opens the mouth to the fullest extent without injuring it; (2) it does not damage the mucous membrane; (3) the hand of the operator is quite safe. The chipping of salient portions of teeth that may occur from pressure is of no importance.

In France, Rigot's and Lecellier's specula are chiefly in use. The latter (Fig. 303) differs from the other models in having the two transverse bars concave on their inner aspect, which renders them better adapted for the passage of the operator's hand into the Horse's mouth, while they fit the jaws more closely.

With the view of dispensing with the services of the assistant who holds the speculum in the Horse's mouth while the operator is manipulating, various specula have been produced which are retained by leather straps on the head. Of these, five only need be alluded to—those of Brogniez, Mackel, Rogers, Boswell, and Haussmann—though Dominick's also belongs to this category.

Brogniez's speculum (Fig. 304) consists of an iron curved handle-piece with a screw at each end, to each of which is

attached a leather strap. One of these straps passes over the upper, the other over the lower, jaw, and the whole apparatus is fastened on the head by means of three straps that join a single

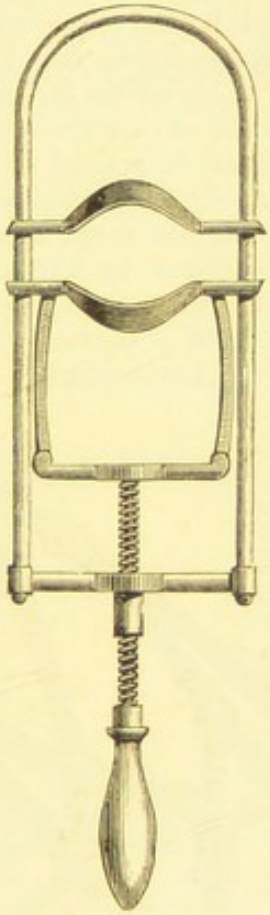


FIG. 303.—LECELLIER'S MOUTH-SPECULUM.

strap that passes behind the ears. The mouth can be widened to the necessary extent by means of the screws, and the speculum can be held or moved by passing the fingers through an opening

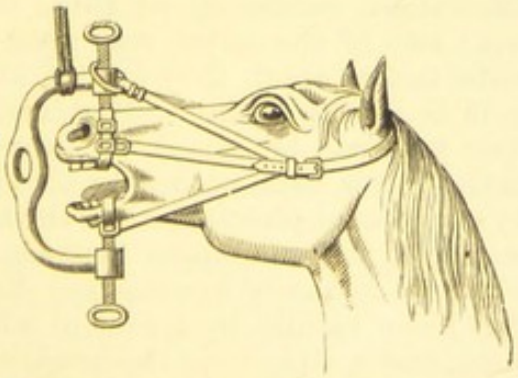


FIG. 304.—BROGNIEZ'S SELF-RETAINING MOUTH-SPECULUM.

in its middle. A cord fastened to the upper part and passed over a beam above will suffice to raise the Horse's head to a convenient height.

Mackel's speculum (Fig. 305) is recommended because of its simplicity, lightness, and general handiness. Like the last, it can be fixed in the manner of a bridle, and the mouth may be dilated to a considerable extent, while both hands of the operator are left free, no assistant being required. It is formed by two vertical and two transverse bars, the former having a screw-thread (*a a*) along nearly their whole length, while a screw nut (*b*) on each side of them raises or lowers the upper transverse bar. The arrangement is attached to a kind of headstall. In using it, the lips are liable to be pinched by the screw nuts unless care is taken; the upper transverse bar must also be kept parallel with the lower one, and the headstall be properly fitted to the Horse's head, so that the apparatus may stand square in the mouth.

Rogers' speculum (Fig. 306) is perhaps more advantageous than the other two self-retaining instruments. It is composed of two

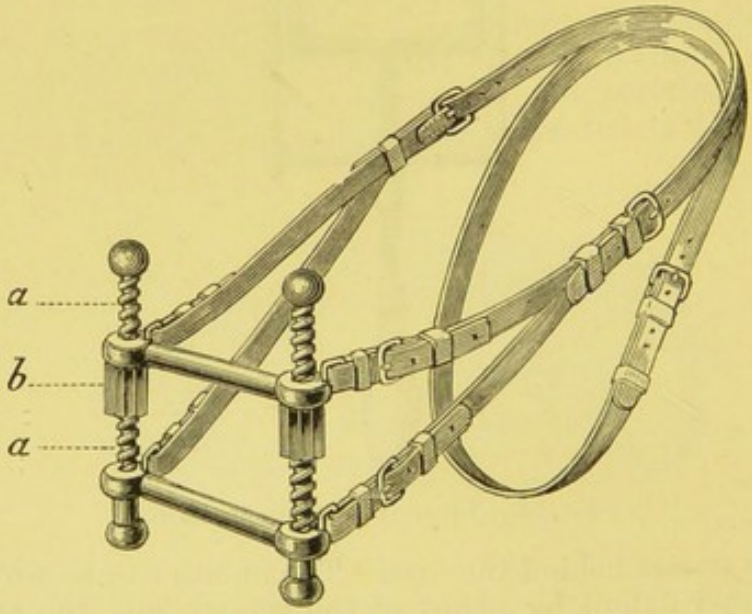


Fig. 305.—Mackel's Self-retaining Mouth-Speculum.

vertical metal side-frames, connected by three transverse india-rubber-covered bars; two of the latter rest upon the lower jaw, and as they are some inches apart, they form a firm base for the instrument when it is in the mouth. The third bar, which is applied to the upper jaw, can be raised or lowered and kept at any distance from the lower bars, according to the requirements of the operator, by a rack-and-pinion motion, the handle for which is placed conveniently, so that the space between the upper and lower bars can be almost instantly increased or diminished. One of the side-branches has a handle, by means of which the Horse's head can be steadied, and a strap over the head holds the instrument firmly in the mouth. The ironwork is nickel-plated to prevent oxidation. The reputed advantages of this speculum are: (1) When properly fixed in position, it is rigid on its base; (2) it permits any part of the mouth to be fully explored or operated

upon; (3) it is perfectly safe in use, and can be applied to any sized mouth.

A ratchet gag, Boswell's, similar in construction, but possessing perhaps greater advantages (Fig. 307), has also been made in England. These ratchet gags are very convenient, as they allow the mouth to be widened to a greater or lesser degree with ease and rapidity, and permit the muscles of the jaws to be relieved

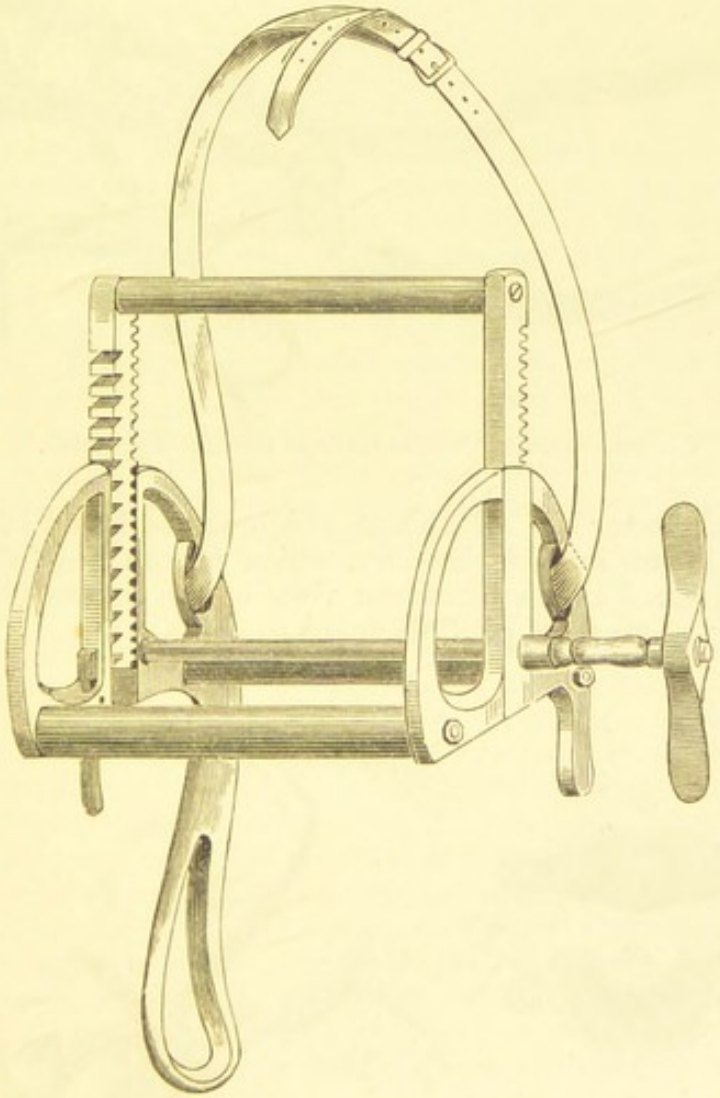


FIG. 306.—ROGERS' SELF-RETAINING MOUTH-GAG.

without removing the instrument from the mouth, while they remain on the head by means of straps.

Haussmann's mouth-speculum is stated to be the most perfect ever produced (Fig. 308). It consists of four curved side-bars, two on each side, hinged at the rear ends; to the opposite ends are attached two cupped plates, or two cross-bars, as preferred. The speculum is introduced into the mouth in the same manner as a bit, and, when spread, is kept open by means of two ratchet

bars (capable of sustaining immense pressure), connected with and at right angles to the curved side-bars, as shown in Fig. 308. Thus held open, there is no possibility of the instrument closing, and operations on, and examinations of, the teeth can be made with the greatest facility.

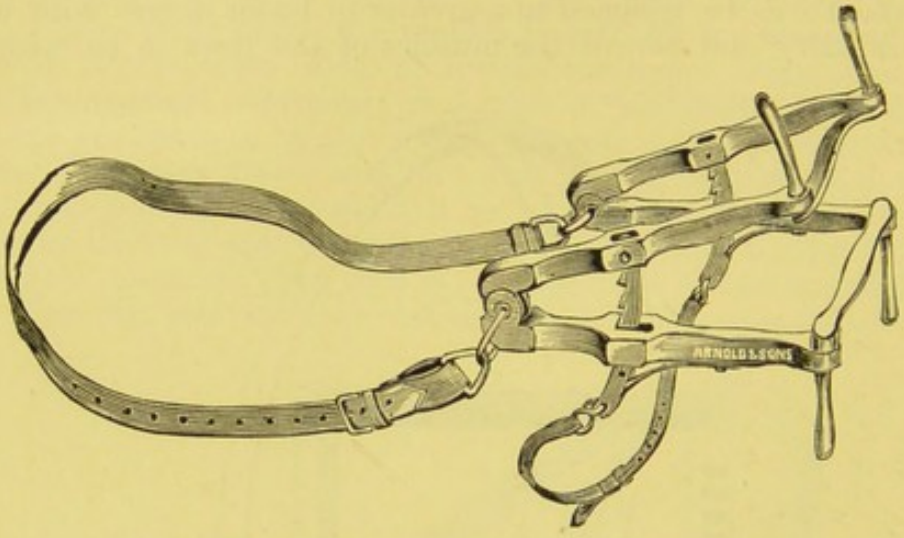


Fig. 307.—Boswell's Self-retaining Ratchet Mouth-Gag.

A special feature of advantage which can be found in no other speculum is the *curved side-bars*, which expose the front molar teeth, and afford an unobstructed view of the mouth from either side, with the greatest possible space to operate in.

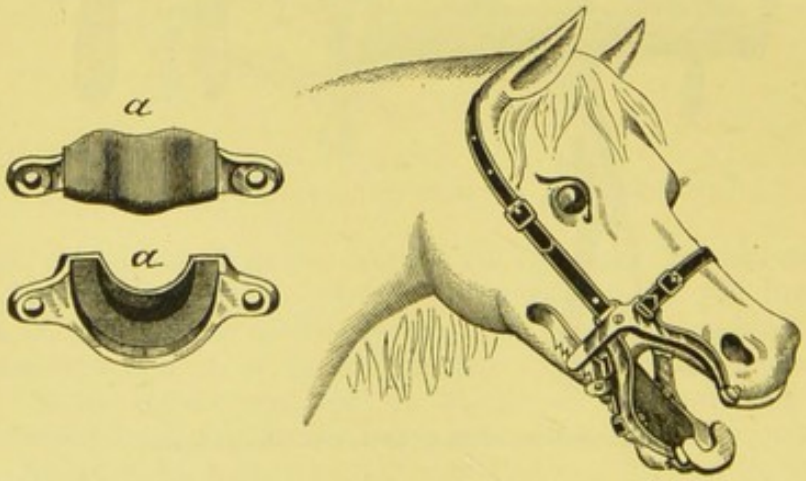


Fig. 308.—Haussmann's Self-retaining Mouth-Gag.

For making examinations and operating upon the molar teeth, the semilunar cupped plates (*a a*), which are so made that they will fit any mouth, should be used, so that the *pressure of the jaws will be brought upon the front-teeth instead of the soft tissues of the gums*, thereby causing no laceration or pain. The animal,

receiving no injury from the instrument, will not fight it or make any resistance whatever.

For operating upon the incisor teeth, the cup-plates should be removed and the cross-bars substituted. These cross-bars adapt themselves to the contour of the upper and lower jaw, and, being so shaped, receive the pressure uniformly, thus preventing bruising or hurting the gums.

To explore or operate in a Horse's mouth with the ordinary specula, such as have just been described, if the Horse is in the standing position, the operator places himself in front of the animal, holding the speculum in the right hand. He then passes the left hand into the space between the incisor and molar teeth on the right side of the mouth, seizes the tongue and gently withdraws it, pressing it at the same time against the angle of the mouth to be out of the way, but to prevent injury to the organ through the Horse's struggles or tossing of the head, the fourth and fifth fingers should have a hold on the jaw at the lower dental interspace. The right hand now places the superior transverse bar in the mouth, behind the upper incisors, and pushing it upwards so as to cause the mouth to be opened, the lower transverse bar is carried beyond the inferior incisors and the speculum raised across the mouth. If one of the transverse bars is movable, the mouth can be opened to the required extent; but great care is necessary in all cases and with all specula, in order to avoid separating the jaws too much, as this causes the animal pain, injures the muscles of the jaws, or may even produce dislocation or fracture of the lower jaw. The speculum is then given to the assistant to hold (if it be not self-retaining), so as to leave the right hand free; but if the operator requires both hands, then the assistant must hold both speculum and tongue, while another assistant should steady the Horse's head. It ought to be remembered, when employing all mouth-specula, that the instrument should be removed at intervals—all the briefer the more widely the mouth is opened—so as to relieve the tension on the jaws; and special regard should be had to handling the tongue gently, so as not to pull it excessively or otherwise damage it.

For the Ox, a speculum similar to one of those in use for the horse may be employed.

For the Dog, a speculum like Bayer's (Fig. 302), but of course proportionately smaller, is very useful when employed in the same manner. The mouth of the Dog can be opened and maintained wide, however, by passing a piece of strong tape behind the fangs of each jaw and pulling them apart; or by the use of a gag, consisting of a round piece of wood with a cord or strap at each end to fasten behind the head after the wood has been placed across the mouth. With quiet animals, and if little pain is to be inflicted, the jaws may be held apart by the hands. For powerful or savage Dogs, however, it is advisable to have a

speculum or gag that will keep the mouth open without danger to the operator, and for this purpose Wolf's mouth-dilator (Fig. 309) is most convenient, as the jaws can be separated to any extent, while the instrument is securely attached to the head. Recently it has been much improved (Fig. 310).

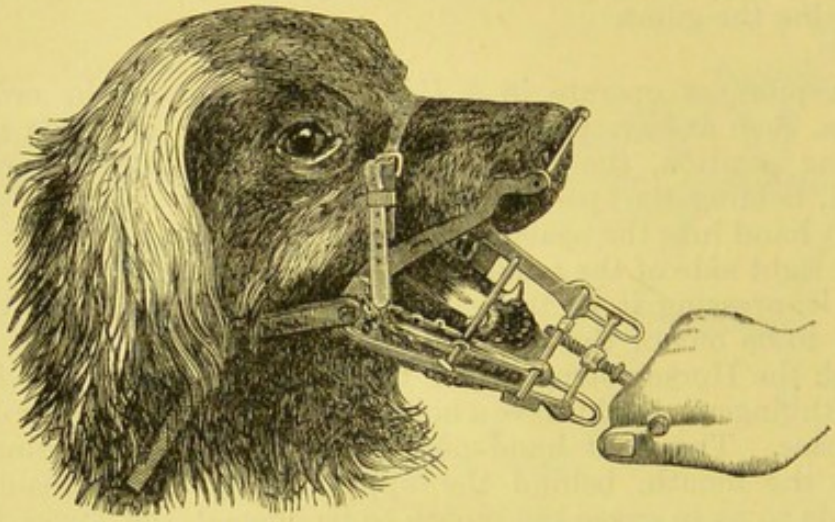


FIG. 309.—WOLF'S MOUTH-DILATOR FOR DOGS.

With the Cat, pieces of tape to pull the jaws apart, or a wooden gag as for the Dog, will suffice to keep the mouth open; but this animal should be securely wrapped in a strong cloth or enclosed in a bag, the head only projecting, before attempts are made to interfere with its mouth.

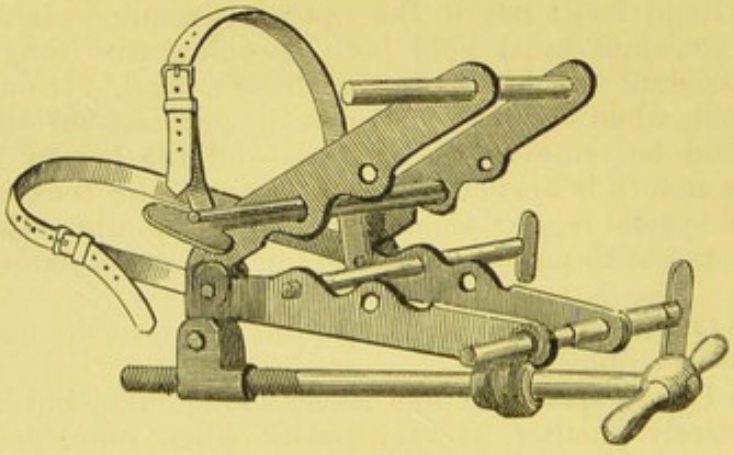


FIG. 310.—WOLF'S MOUTH-DILATOR. (Improved.)

The mouth of the Pig may be examined or operated in by using a small speculum of Bayer's pattern, or a wooden gag similar to that for the Dog. A walking-stick may even be employed by introducing it across the mouth and pressing the lower jaw downwards.

Tongue-Depressors.—In order to obtain as much space as possible in the oral cavity, either for inspection or operation, and also to prevent injury to the tongue, it is frequently necessary to depress that organ in the floor of the mouth. This can be done by using a strong wooden or metal spatula, or, better still, by the depressor introduced by Reynal (Fig. 311). This is a trowel-like instrument, the blade of which for the Horse may be from eight to ten inches in length, and two to two and a half inches broad at its widest part, which is the middle of the blade. The blade is concave superiorly, and convex inferiorly, for contact with the tongue. To assist in illuminating the cavity, this blade may be nickel- or electro-plated. The neck of the instrument is long, and forms two bends before terminating in the handle, so as to admit of its use without interfering with the manipulations in the mouth. This tongue-depressor may also be utilized in pulling or pressing the cheek outwards, and serves to illuminate the posterior teeth, the inner surface of the cheeks, and the roof of the mouth.

An ordinary metal spoon will suffice to depress the tongue of the Dog, Cat, and other small animals.

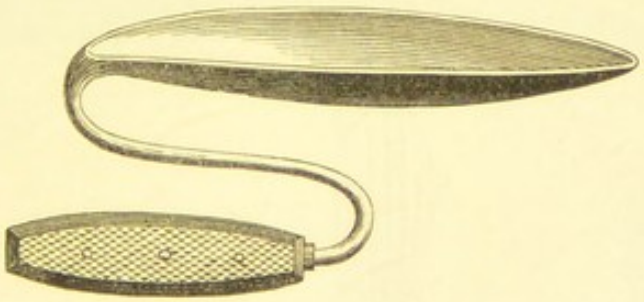


Fig. 311.—Reynal's Tongue-Depressor and Oral Illuminator.

Illuminating Apparatus.—In exploring and operating in such cavities as the mouth, nasal cavities, larynx, trachea, vagina, etc., it is frequently found that ordinary daylight, or even sunlight, does not illuminate them sufficiently, and then—and also always at night—it is necessary to have recourse to artificial illumination. An ordinary unprotected light may suffice in some circumstances, but when employed in the region of the nostrils it is usually quickly extinguished; consequently, reflected light has to be made available, unless a special apparatus be brought into use. If a candle or lamp be employed, it is held at a distance from the nose, and the light from it is reflected into the cavity by a mirror. Any kind of mirror may be employed for this purpose, but perhaps the best is a medium-sized concave one. Such a mirror is often resorted to when sunlight is available; but a candle, paraffin-lamp, or gaslight will answer when this cannot be had.

Mention has been made of Reynal's tongue-depressor, when nickel- or electro-plated, serving as an oral illuminator. But for the mouth and other cavities, various kinds of illuminating apparatus have been introduced at different times. Brogniez's

stomatoscope consists of a concave mirror attached to an oil of turpentine lamp, the flame of which is easily extinguished. But a mirror constructed like that of an ophthalmoscope, though with a larger area, is easier to use, and may be employed both as a stomatoscope and a rhinoscope, but a strong and steady light is required. A simple and easily-improvised reflector may be made by tying a silver or plated spoon to a candle, or the reflector of a carriage-lamp may be employed as a mirror in cases of emergency.

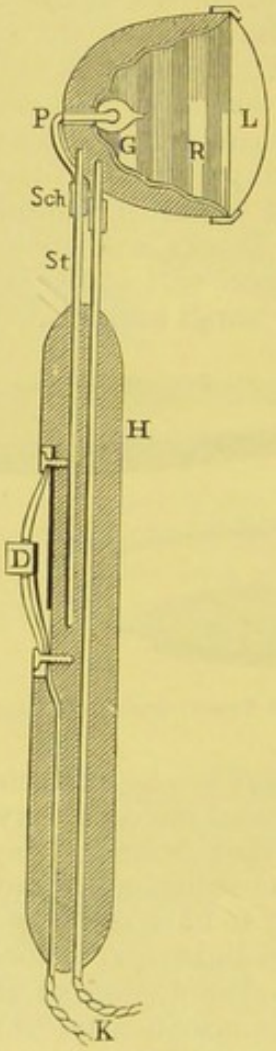


FIG. 312.—BAYER'S ELECTRIC LAMP FOR THE ILLUMINATION OF THE MOUTH AND NASAL CAVITIES. (*Full Size.*)

It having been found that an uncovered light dazzles the eyes during the examination of cavities, and therefore renders the view uncertain, platinum glow-lamps in connection with an electric battery have been tried, the radiation of heat from them being checked by surrounding the connecting wire with water or other non-conducting substances. Subsequently charcoal points were adopted, and these gave a very intense, steady, and pure light; then reflectors and lenses were fitted to the lamps. Bayer,

of the Vienna Veterinary School, invented an electric lamp which has been most successfully employed in veterinary surgery to illuminate such cavities as the mouth and nostrils (Fig. 312). In the centre of a parabolic silver-plated reflector (R) are two platinum wires (P), which are fixed by means of two slides (Sch) into slits in two metal rods (St). One of these rods penetrates the handle (H), and is connected with the wire (K) by pressing the spring (D). Both wires are in connection with an accumulator, which can be worn around the neck of the operator or carried in his pocket. This accumulator can be charged anywhere from an electric battery. On pressing the spring (D) the poles are connected, light is at once emitted, and continues as long as the circuit is maintained. The intensity of the light can be considerably increased by the addition of a lens (L). By means of this little instrument the oral and nasal or any other open cavities can be better and more conveniently illuminated than by sunlight, while the tint of the surfaces is unaltered and

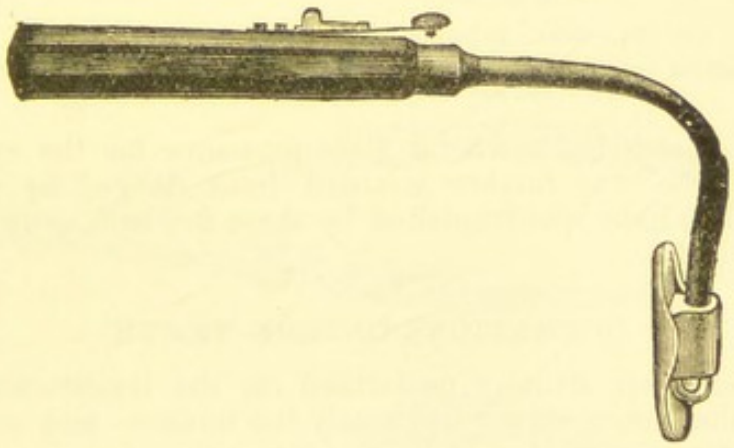


FIG. 313.—RAYMOND'S ELECTRIC ILLUMINATOR.

the eyes of the operator are not dazzled or fatigued. The light, however, can only be depended upon to last for an hour at the utmost, and it is therefore advisable, if required for a longer period, to have another accumulator ready. It has been found that the accumulator is very sensitive, so that the battery must be regularly supplied with acid before it is used.

The chief drawback to the general employment of this most useful illumination apparatus has been its expense, and it has also been found that it is capable of improvement.

Raymond's electric lamp (Fig. 313) is most useful and effective. It is bent at an angle within about two inches of the handle, though for most purposes it might be straight, and at the end, on one side of the globe containing the platinum wire, is a shield to protect the tissues from heat; the posterior surface of the shield, which is of metal, may be covered with india-rubber, vulcanite, ivory, or bone, and the front (facing the lamp) is plated, and so constitutes a mirror.

In 1893, a small and cheap electric lamp for veterinary purposes was exhibited at a meeting of the Central Veterinary Society. This consisted of a combination of two tubes provided

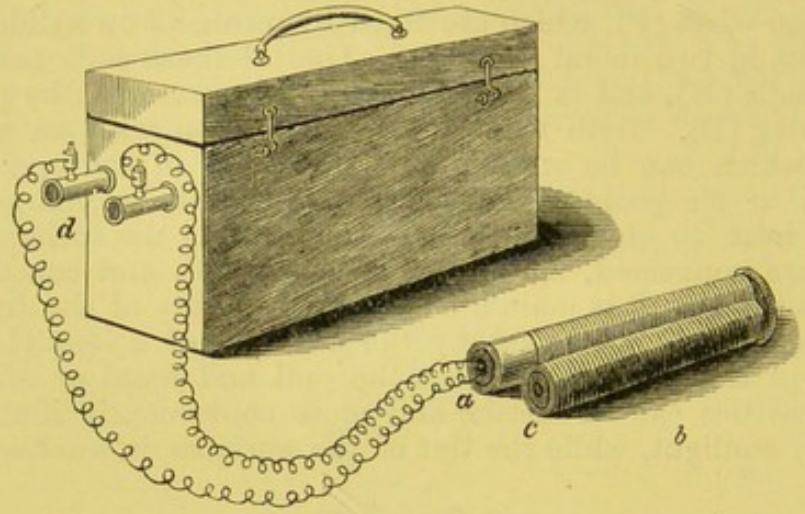


FIG. 314.—SMALL ELECTRIC LAMP FOR VETERINARY PURPOSES.

a, Tube containing lamp; *b*, tube to introduce into mouth or other cavity, with eyepiece at *c*; *d*, box containing three dry cells in cement.

with the electric light, with a glass protector for the eye of the observer, who was further guarded from danger by a leather shield. The light was furnished by three dry cells cemented in a box (Fig. 314).

OPERATIONS ON THE TEETH.

Operations are usually performed on the incisor and molar teeth of the Horse—most frequently the molars—and are chiefly *levelling*, *resection*, and *avulsion* or *extraction*.

Horse.

INCISORS.

The incisors of the Horse can be easily examined by the eye and hand, and irregularities in shape or wear are remedied by suitable instruments, as the rasp, file, or chisel; while extraction can be generally effected by strong forceps. The rasp may be an ordinary horse-shoeing one, or the usual tooth-rasp for the molar teeth, and a file may be employed to smooth the edges of the teeth; the chisel need not be large (Fig. 315); but the forceps must be strong and easily manipulated (Figs. 316, 317). For broken or splintered teeth, a convenient form of forceps has a spring between the handles, and the jaws are better adapted for securing a firm hold (Fig. 318).

(1) *Levelling the Incisor Teeth.*

This is effected by the rasp, which should be frequently dipped in a bucket of water during the operation, in order to get rid of the teeth *detritus*.

(2) *Resection of the Incisor Teeth.*

This is necessary when one or more of the teeth become overgrown and injure the lips or hinder prehension of food. If it would require too much time to remove the projection by means of the rasp, then recourse must be had to the chisel. In using this instrument, care must be taken not to break off too much of the tooth or to loosen it. The head must be well steadied, a gag having been placed in the mouth, and the chisel, held firmly against the portion of tooth to be removed, is to be struck a short sharp

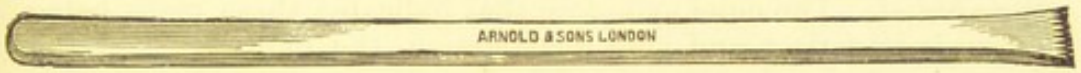


FIG. 315.—TOOTH CHISEL.

FIG. 316.—INCISOR-TOOTH FORCEPS.

FIG. 317.—INCISOR-TOOTH FORCEPS.

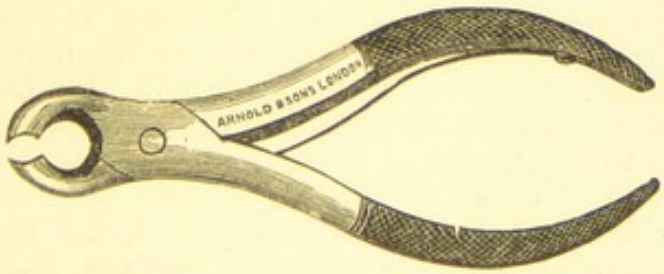


FIG. 318.—FORCEPS FOR SPLINTERED OR BROKEN TEETH.

blow with a hammer. When possible, the chisel should be placed at the side of the tooth, not the front, as then there is less risk of loosening it. The screw chisel, to be described immediately, may be used with advantage, as it is less likely to splinter or loosen the tooth. After resection, the part should be rendered smooth by the file.

Extraction.—Extraction of the incisors is often rendered necessary when the adult teeth are split or broken, when there are supplementary teeth, or when the temporary teeth are not shed in due course, but are retained against the permanent teeth. No special directions are required for extraction. The Horse has to

be secured firmly, a gag applied, and the tooth or its fragments removed with a firm, steady, and slightly rotatory pull. The wound is to be dressed with water and kept clean.

Molars.

The molar teeth most frequently demand surgical interference, from their being more exposed to accidents, disease, and irregularity of growth, while the essential part they assume in mastication renders defects in them of more or less serious importance to the animal. The chief symptom that indicates these teeth being amiss is imperfect and slow mastication, the movements of the lower jaw being less free, and in some cases more to one side than usual. When mastication is much interfered with, there is generally abundant salivation, the saliva flowing copiously; but the hay, being insufficiently crushed, can only be swallowed in small quantities or not at all, so that the bolus drops from the mouth or is retained in that cavity until several are accumulated and form a large mass; it is the same with the oats which the animal attempts to crush, but which, profusely insalivated, are partly swallowed more or less whole and partly fall from the mouth. With rapidity, varying according to the nature and extent of the defect, the animal loses condition and vigour, and there may also be signs of indigestion, which may be misleading unless the state of the mouth is ascertained. An inspection of this cavity, made by means of the gag or speculum, the tongue being slightly and carefully withdrawn, and illuminated, if possible, by natural or artificial light, will reveal excoriations or wounds of the cheeks or tongue, according as the upper or lower molars are involved on one or both sides, due to irregularity in the wear or growth of the teeth, or other condition visible to the eye. Manual examination of the teeth will also furnish more important information in the majority of cases than the eye, as the hand can be introduced as far as the last molar, and irregular growth or wear, fracture or caries, etc., can be more certainly detected in this way. It is to be remembered that the tables of the upper molars are directed obliquely inwards, therefore their outer margin is most frequently irregular; while the tables of the lower molars slope outwards, so that their inner border is generally at fault.

In addition to the profuse salivation, as has been stated, masses of semi-masticated food may be found lodged between the teeth and the cheeks, while the mucous membrane is hot and injected. When caries of the teeth is present, there is the peculiar fetid odour attending that condition; and if the animal is suffering pain, it gives evidence of this by its expression and the manner in which the head is carried to one side—that on which the diseased tooth is situated. Irregularity in wear of the upper molars, as well as anomaly in their direction, can often be detected externally in the region of the cheek by the hand, rubbing or pressure causing the

animal pain; or even by the eye when the direction of the tooth or teeth is very abnormal, or abscess or fistula is present. Surgical intervention, then, is required when the molar teeth are irregular on their borders or tables, when they are anomalous in their direction, position, or number, or when there is disease or fracture. This intervention takes the form of (1) *levelling*, (2) *excision*, or (3) *extraction*.

1. *Levelling the Molar Teeth.*

The gag is generally required, the animal being in the standing position, the hind-quarters placed in a corner, and one or two assistants holding the gag and the tongue, and observing the precautions already insisted upon with regard to these. It should be here remarked, with regard to the position of the animal when operating upon the teeth, that the standing attitude is the best when it can be adopted, both for the convenience of the operator and the safety of the patient; and even the mouth-gag should not be employed when it can be dispensed with, as it fatigues the muscles of the jaws, and more or less injures the mouth. The following directions are observed by those who dispense with the gag: The mouth should be kept open and instruments manipulated by the hand and arm; if operating on the lower molars, pass three fingers alongside the tongue, and press it over between the molars of the opposite side, the other finger and thumb being employed to make pressure on the rasp or in guiding the shears or forceps: the arm at the same time is in the interdental space. When operating on the upper molars, press the thumb against the first molar, the fingers passing up along the inside of the cheek, allowing the rasp to run between thumb and fingers, with the arm in the interdental space. In operating on the upper or lower incisors, the arm is also placed in the interdental space, and the thumb and first finger are passed round the incisor teeth to raise the upper lip or hold away the lower one. If the animal is very unsteady, a twitch on the nose will be necessary; but it is seldom that further restraint is required.

Instruments.—These are a tooth rasp or tooth chisel, or both; a bucket of water to dip the rasp in, in order to free it from tooth raspings; a hard brush dipped in the water may be also usefully employed in their removal.

Operation.—This is simple. If the outer border of the upper, or inner margin of the lower, molars is sharp and only slightly irregular, then the rasp carefully passed along it with firm pressure will soon make it even and smooth. The rasp should be so managed that in its backward and forward movements it will not injure the cheeks, gums, or tongue. The shape of a well-made rasp tends to prevent accidents (Fig. 319), and especially if its borders are guarded by india-rubber or other soft material. When the asperities are larger, and would require more time and labour to remove them, recourse may be had to the tooth chisel, of which

there are various forms. The simplest is a long steel chisel, with a sharp serrated end to prevent it slipping off the tooth (Fig. 320). This has to be held firmly against the part to be removed, while the opposite end is struck a somewhat light sharp tap by a hammer

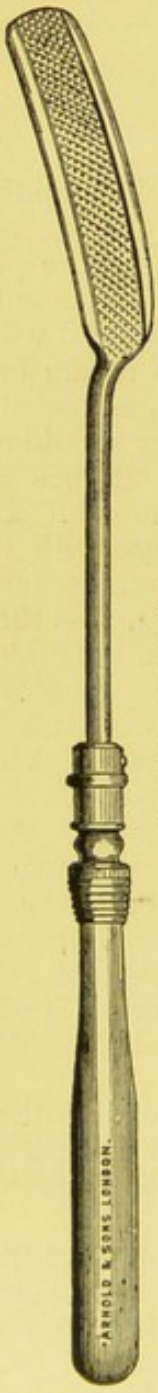


Fig. 319.—Tooth Rasp.

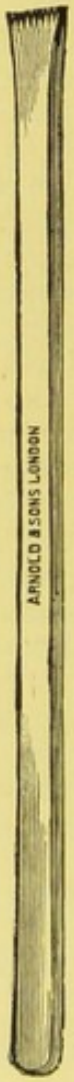


Fig. 320.—Chisel for the Molar Teeth.

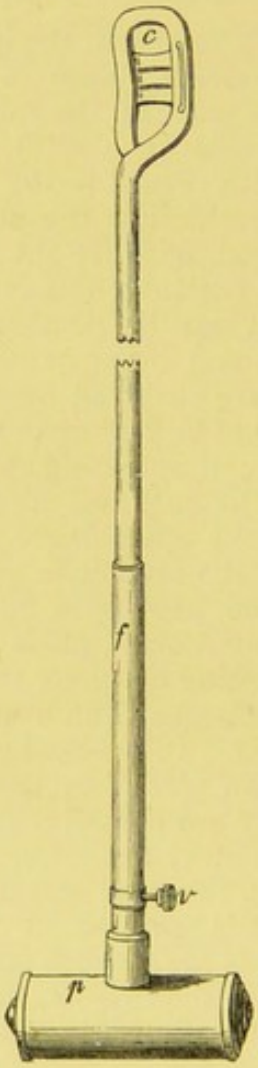


Fig. 321.—The Odontritor of Brognez.

c, Oval cavity mortised for the cutter; *f*, hollow handle in which the rod of the chisel glides; *p*, heavy transverse portion of handle which acts as a mallet; *v*, screw to fix the rod if necessary.

Fig. 322.—Gowing's Guarded Tooth Chisel.

or mallet. But it is evident that the use of such an instrument must be attended with risk of damage, either splitting or loosening of the teeth or injury to the soft parts, and to avoid this a guarded chisel is generally employed, the guard fitting over the tooth to be operated on, and the chisel, working through the

handle into this, is pushed smartly against the projection. The earliest of these contrivances is that of Brogniez (Fig. 321); but in this country Gowing's—similar in principle (Fig. 322)—is generally employed. On account of the steadiness with which it can be used, and generally its greater efficiency, a screw is preferred to a striking chisel (Fig. 323). No particular directions are required for the performance of this operation. It is advisable to use the rasp after the irregularities have been removed, in order to level and smooth the part. If more than one tooth is to be operated upon, the anterior should be done first, and so on to the most posterior.

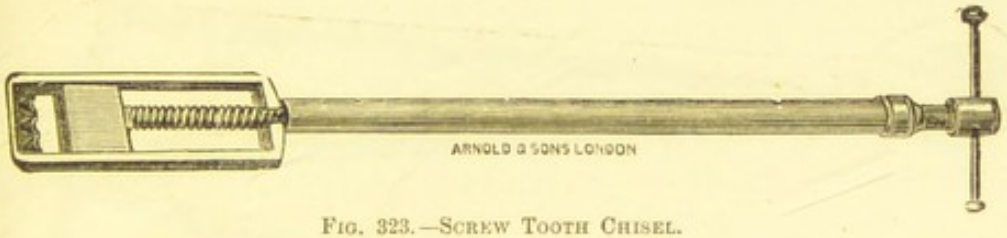


Fig. 323.—Screw Tooth Chisel.

Fig. 324.—Tooth Saw.

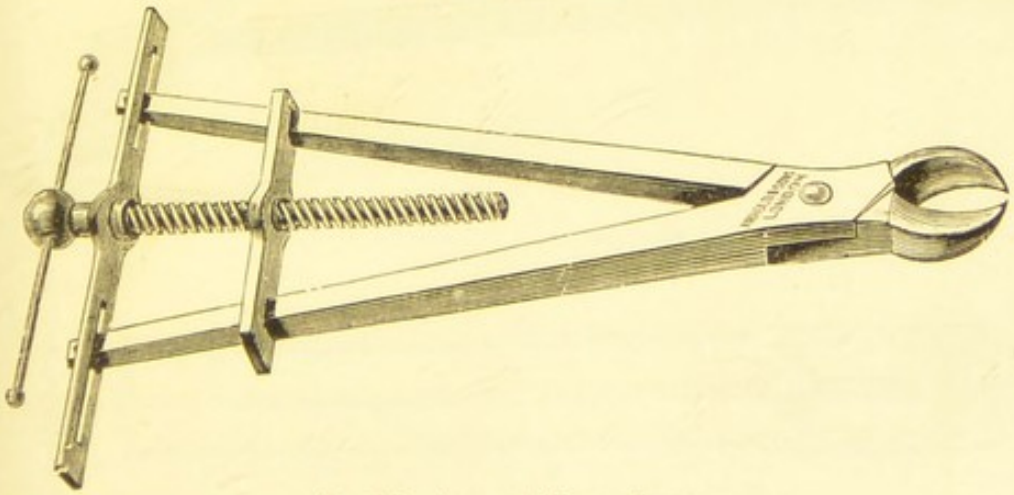


Fig. 325.—Arnold's Tooth Shears.

2. *Excision of the Molar Teeth.*

When the irregularities or projections are so large that none of the instruments mentioned are suitable, then recourse must be had to their excision. To accomplish this, if the molar is easily accessible, a tooth saw (Fig. 324) will sometimes suffice; but the operator must be cautious in using it. Shears are generally preferred, and of these there are many patterns; but the general principle upon which they are constructed is the same, the blades being acted upon by a powerful screw (Figs. 325, 326, 327). Unless great care is observed, however, there is danger of cutting the

cheeks or gums, especially if operating upon the posterior molars. This is obviated if a modified tooth chisel be used, moved by a screw against a sharp edge in the guard (Fig. 328). As sometimes the entire body of a tooth projects above its fellows, and has to be excised to their level, it is evident that these instruments must be very strong and rigid, and of sufficient dimensions to embrace the largest of the upper molars.

Another form of this shears, acted upon by two handles instead of a screw handle (Fig. 329), is most useful, in that there is no

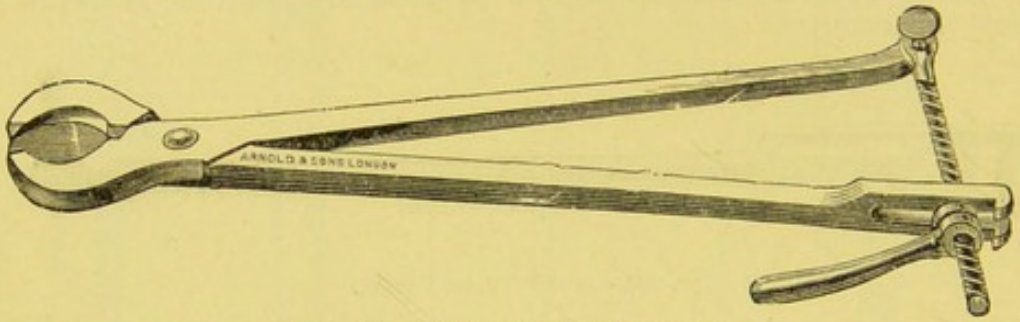


FIG. 326.—ROBERTSON'S TOOTH SHEARS.

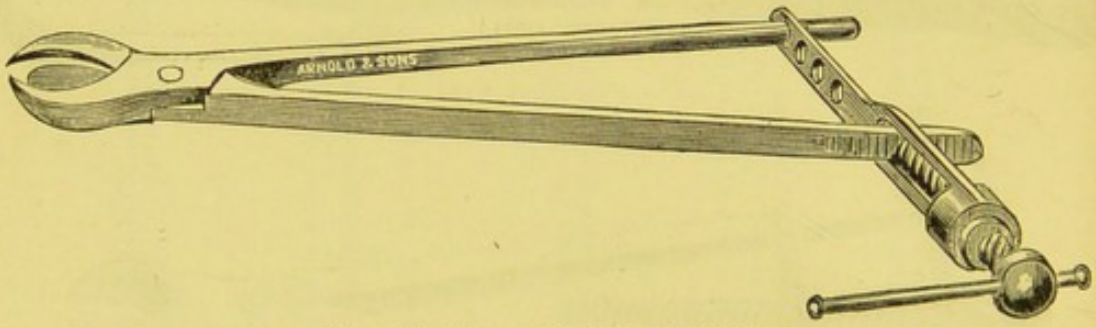


FIG. 327.—THOMPSON'S TOOTH SHEARS.

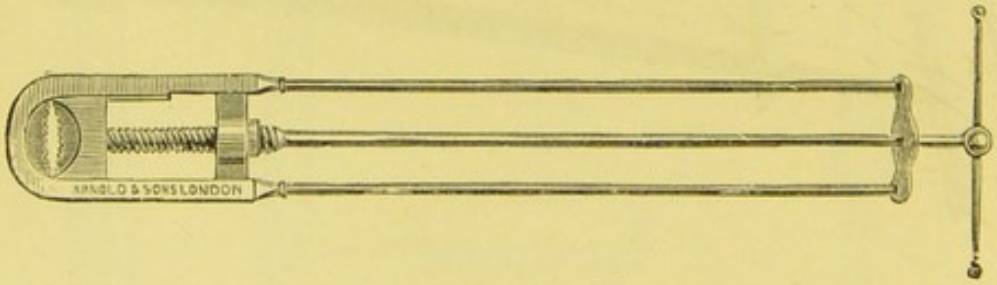


FIG. 328.—EDGAR'S TOOHT EXCISOR.

tendency to fracturing the jaw or loosening the fang of the tooth, because of the equal pressure brought to bear on the posterior as well as the anterior part of the crown in the act of cutting it. There is no suffering inflicted on the animal, and no after-treatment is required, because it is usually a clean level cut.

OPERATION.—This does not require much description, whether saw or shears be used. The former can only be safely or conveniently employed on the anterior molars, and shears, from their rapidity of action, are preferable in the great majority of cases.

Position.—When only one or two of the front-molars are to be operated upon, the Horse will stand; but if the posterior ones are to be excised, or if the animal is restless, then it is generally advisable to place it in the latericumbent position, head as well as body, in order to prevent fragments of tooth falling into the larynx. The animal should lie so that the molars to be operated on will be on the upper side, and the head may be raised to a convenient height by a sack filled with hay placed beneath it.

Technic.—Insert a mouth-gag with sufficient space to allow the shears to be easily manipulated in the mouth—a dilatable gag is best; an assistant partially withdraws the tongue from the mouth and away from the molars to be cut; the cutting parts of the shears are placed on the portion of tooth to be removed, and the handle of the screw is smartly turned by the operator or an assistant, another holding the instrument; after a sufficient number of turns the piece of tooth comes away with a cracking sound; the piece is to be removed from the mouth before the tongue is

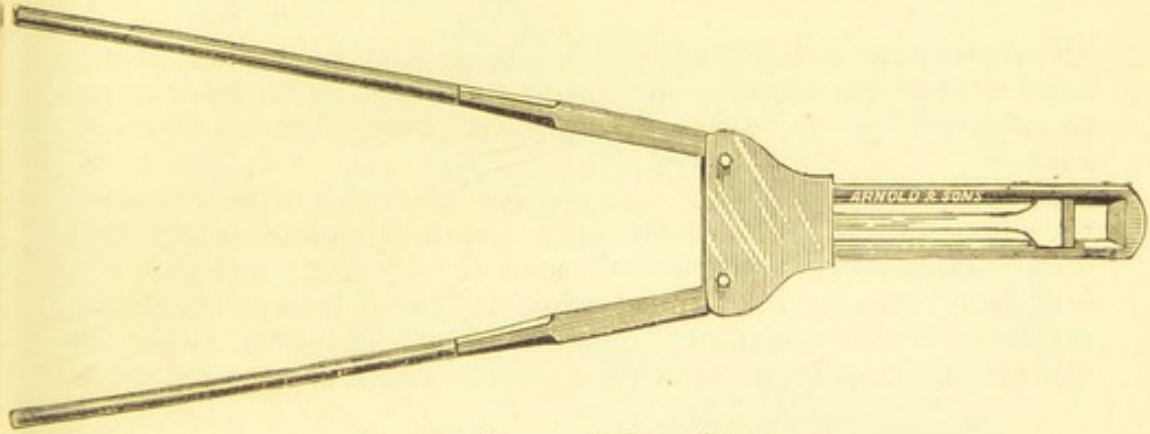


Fig. 329.—Crawford's Tooth Shears.

released. When more teeth are to be levelled, it is well to remove the gag after each tooth is operated on, in order to rest the muscles of the jaws and the tongue. The operation may be completed by the tooth-rasp.

After-Treatment.—Little has to be done, if the operation has been carefully performed, beyond washing out the mouth with water, which may be slightly acidulated.

3. *Extraction of the Molar Teeth.*

Extraction of the molar teeth is indicated when mastication is interfered with, because of their being supernumerary (usually from retention of the deciduous teeth), or when they are fractured, carious, or involved in alveolar periostitis with its consequences. The removal of deciduous teeth is comparatively easy, and can be effected by a conical-pointed gouge, which is inserted between it and the table of the permanent tooth on which it rests, the mouth being kept open by a gag; or long-handled forceps

(Fig. 330), or Lecellier's forceps (Fig. 331) may be employed. This removal should not be attempted until the crown of the permanent tooth projects some distance from the alveolus, and the animal is really inconvenienced in eating. Then the point of the chisel can be inserted between the two teeth, and the temporary one prised off.

Removal of the permanent molar teeth is generally a difficult operation, and one requiring the employment of great mechanical force, owing to the manner in which they are implanted in their

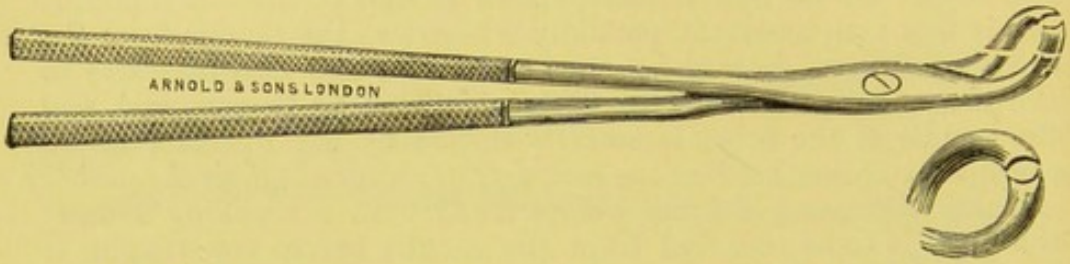


Fig. 330.—Tooth Forceps for removing Deciduous Molars or Old Stumps.

alveoli, the considerable length of their fangs, and the comparatively small size of the crowns—upon which the extraction instruments can only act—as well as the closeness with which these teeth are in contact.

But the difficulties to be encountered vary with circumstances. In young animals the molar teeth are much more firmly and deeply implanted in the alveoli than in old ones; and they are less firmly fixed in the upper than in the lower jaw, owing to the presence of the maxillary sinuses. It is generally easier to operate on the anterior than the posterior teeth, as they are more

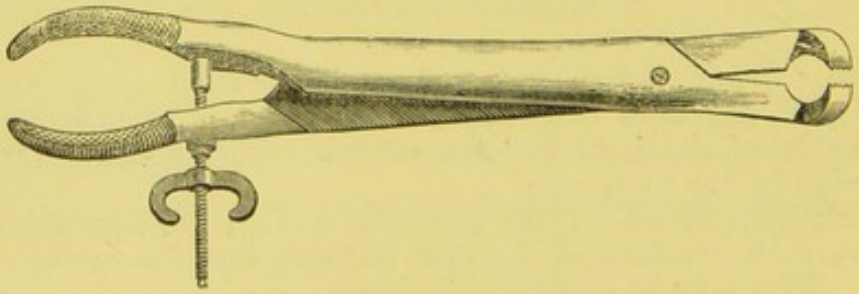


Fig. 331.—Lecellier's Forceps for removing Temporary Molars.

accessible to instruments; whereas, because of the length of the Horse's jaws, the more posterior the teeth are, the difficulty is increased, until the removal of the last molars in either jaw becomes an almost impossible task, not only because of their situation, but also from the shape of the crown, which protrudes less than in the others. The condition of the teeth and the alveoli has also a considerable influence in this respect. Teeth affected with caries or periostitis are usually less firm than those in health, and especially if suppuration has taken place; then

sometimes a small degree of force will remove them, particularly if caries has proceeded so far as to permit them to be extracted in longitudinal fragments. But when the crown has been more or less destroyed by caries, and the fang is at the same time affected with exostosis, then indeed extraction becomes a very serious matter for the operator, as not only is it most difficult to seize the tooth, let alone remove it, but the adjoining teeth, although healthy, are looser than usual, and are therefore more easily displaced or broken during the efforts made to carry out the operation. In some rare cases, from defective composition of the teeth or other cause, they are so much worn and so loosely implanted in the jaws that they may be extracted by the fingers.[1]

The removal of the molars may be effected in two ways: (1) By opening the maxillary sinuses and driving the tooth from its alveolus by means of a punch applied to its root through this opening; (2) by pulling the tooth, in seizing its crown by a suit-

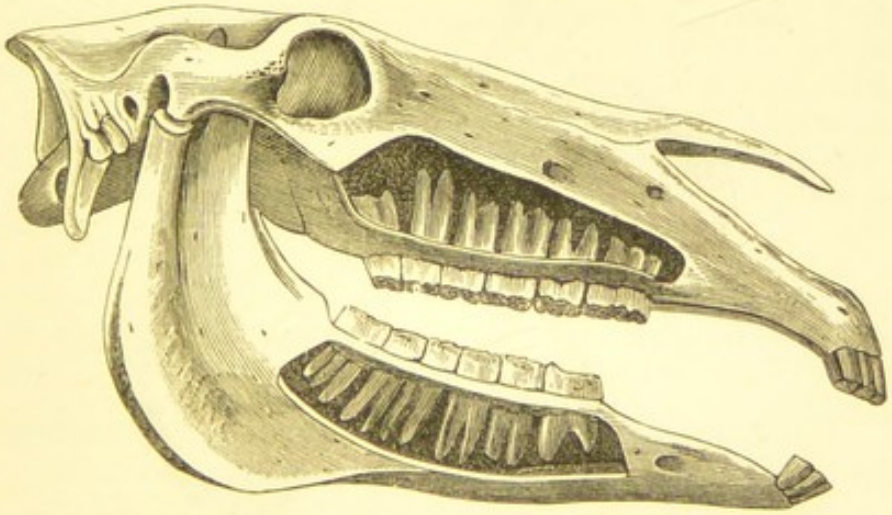


Fig. 332.—Position of the Molar Teeth in the Jaws.

able instrument introduced into the mouth, and extracting it from the jaw.

Whichever method is resorted to, the inclination and position of the roots of the teeth must be remembered, in order that pressure or traction may be made in the proper direction and on the right tooth, the three anterior or premolar fangs (above and below) being inclined somewhat forward, and the three posterior directed slightly backwards (Fig. 332). The molars at each end of the row (above and below) have three roots, but the intermediate ones in the upper jaw have four, while in the lower jaw they have only two.

Operation—1. Method by Retropulsion.—This is perhaps the oldest method for the removal of molar teeth, and is some-

[1] A case of this kind I observed in a middle-aged artillery Horse at the Woolwich Infirmary stables some years ago, in which all the molar teeth were so loose that some of them were removed by the fingers.

times the only one that can be adopted for the most posterior molars, or in cases in which any of the teeth cannot be seized by instruments, or when suitable instruments are not at hand; and although a more formidable and tedious operation than extraction, yet, in addition to its other advantages, it allows the sinuses to be cleansed and dressed, when these are diseased, before or after the teeth are removed.

Instruments.—Scalpel and forceps; trephine; bone forceps; round, slightly-tapering punch, the end of which is flat and about an inch in diameter; sponges, water, and a large syringe.

Position.—Latericumbent, on the side opposite to that of the tooth to be removed.

Technic.—The Horse is completely anæsthetised, and the situation of the fang of the tooth to be removed accurately

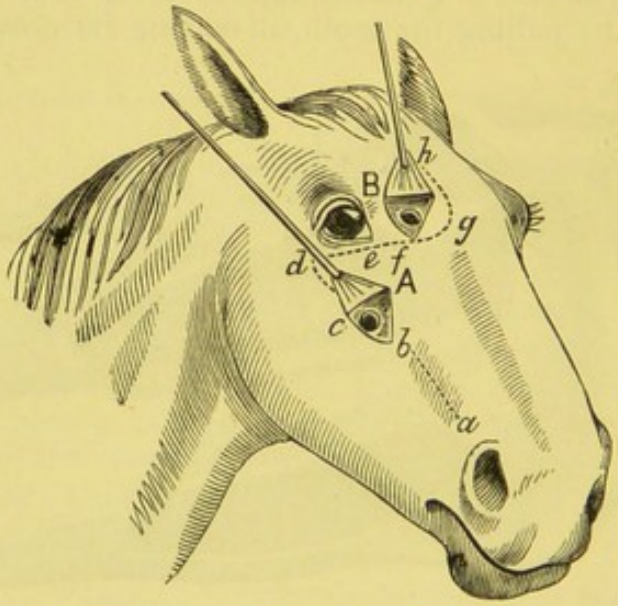


Fig. 333.—Trephining the Sinuses. (After Cadiot.)

B, A, Opening into the inferior maxillary sinus; *e, d, c*, line of incision for a large opening into the maxillary sinuses; *a, b*, line of incision for retropulsion of the first molars.

determined upon. If it is an upper molar, make a large V-shaped or crucial incision through the skin over the maxillary sinus at a point corresponding to the fang of the tooth, care being taken not to injure the labial or nasal muscles; dissect back the flaps of skin; scrape the exposed bone to a sufficient extent; with the trephine make two openings through the external table of the bone, parallel to the row of teeth, and a third opening above and between these; with the bone forceps remove the intervening piece of bone, which leaves a triangular space (Fig. 333). If there is any pus or foreign matter in the cavity, clear it out, and the fang of the tooth being ascertained, the end of the punch is placed on it, the mouth-gag is applied, and the operator's hand holds the crown of the tooth while an assistant strikes the punch smart measured blows, the effects of which are noted by the hand in the mouth, and the force

of the blows regulated accordingly, the punch being held in the direction of the tooth. Sometimes the tooth is easily displaced; in other cases it requires repeated and strong blows to drive it out, and it may break into two or more pieces.

The technic is the same in removing the *lower molars*, though, as there are no sinuses, the alveolus of the tooth to be removed must be opened directly by the trephine. If the last molars are to be operated upon, it is necessary, after incising and dissecting back the skin, to cut through the masseter muscle before applying the trephine. When the third or fourth tooth is to be removed, great care must be taken not to injure the parotid duct or the glosso-facial artery and vein; and to avoid damaging the important nerves which pass through it, the trephine must be applied above the maxillo-dental canal. As the lower jaw is easily fractured, the blows on the punch should be lighter than those required for the upper molars.

After-Treatment.—If the sinuses are healthy, then they only need washing out, and the divided skin over the opening brought together by suture; if they are diseased, then at least a portion of the trephined space should be left open for the injection of detergent or other necessary medicaments. If the face-wound is a long time in closing, and the animal must be worked before this has taken place, a plaster may be fixed over it, or a leather plate be attached to the cheek of the bridle, so as to cover the opening while the Horse is out of doors. The cavity left by the removal of the tooth gradually disappears, though never completely, by the oblique direction the adjacent teeth assume in converging towards each other. Sometimes a fistula will remain for some time, and this can be treated according to surgical principles.

2. Method by Extraction.—This is preferable to the last method in all cases in which it is applicable, as there is not so much damage done to the hard and soft tissues surrounding the tooth to be removed; though it is not without its disadvantages, as it sometimes happens that the appropriate instruments are not at hand, and the last molars are generally extremely difficult to deal with by this method.

Instruments.—Many and varied in shape and complexity are the instruments which have been devised for the extraction of the Horse's molar teeth, whether these were to be removed by luxation or by direct avulsion. A long blunt gouge was at one time employed to loosen and detach the tooth when it was not very firmly implanted; then this was replaced by a long iron lever, about twenty inches in length, bifurcated at one end, the bifurcations being bevelled to a thin edge on their inner border. In using this instrument, the tooth was fixed between the prongs by striking it at the opposite extremity with a hammer; then the incisors being made to act as a fulcrum, the tooth was raised out of its socket; if unsuccessful at the first attempt, the operation was continued by repeated blows until the tooth was completely loosened. This instrument could only be employed on the first

molar, or on those projecting above or laterally beyond their fellows, and even then it often failed.

A lever of the second kind was for some time employed, this being merely a greatly enlarged human tooth-key (Fig. 334), by which the tooth was loosened and torn out of the alveolus by a powerful wrench or twist. But this instrument was difficult to manipulate, and often failed to effect extraction, while it exposed

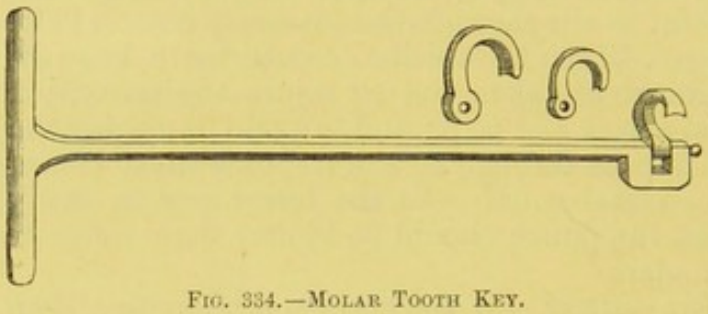


FIG. 334.—MOLAR TOOTH KEY.

the jaw to fracture, and the tooth was liable to fall into the pharynx and be swallowed.

A great number of powerful forceps of various patterns have been introduced, certain advantages being claimed for each; some are simple, and others very complicated, and probably every operator has his own particular instrument among them, which he prefers because of its efficiency. It is one or other of these that is now

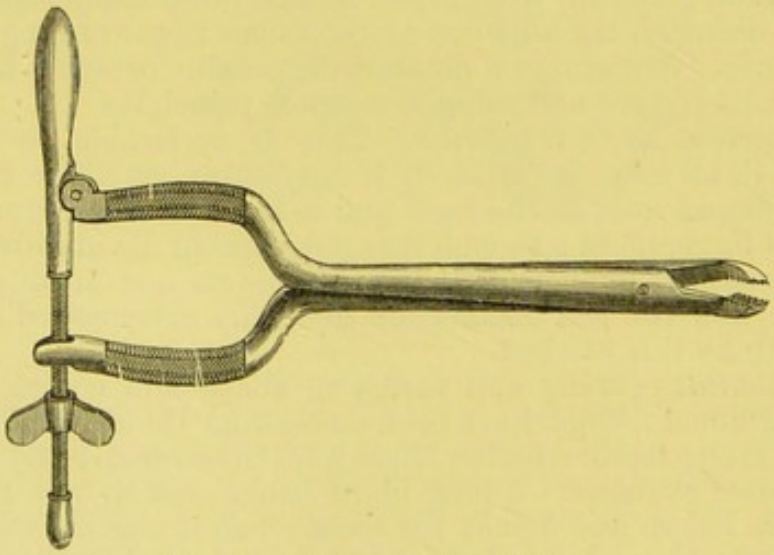


FIG. 335.—BOULEY'S MOLAR FORCEPS.

generally employed when the crown of the tooth can be effectively seized, though it may be necessary to have more than one kind of forceps to suit different mouths or teeth; indeed, some authorities, as the Günthers of Hanover, have devised a particular forceps for each tooth. But as a rule this is unnecessary, and the majority of practitioners limit themselves to one or two. It would, therefore, serve no very useful purpose to describe all the

forceps which have been from time to time introduced, so that only a small number will be noticed.

In France, one of the best keys or forceps employed is that of Bouley (Fig. 335), which is very powerful; as the operator, after placing the jaws on the tooth and screwing them tight on it by means of the screw, can wrench the organ laterally by acting on the transverse lever with his hands.

In Germany, the most recent introduction is the forceps of Frick and Hauptner (Fig. 336), in which the tooth is also grasped

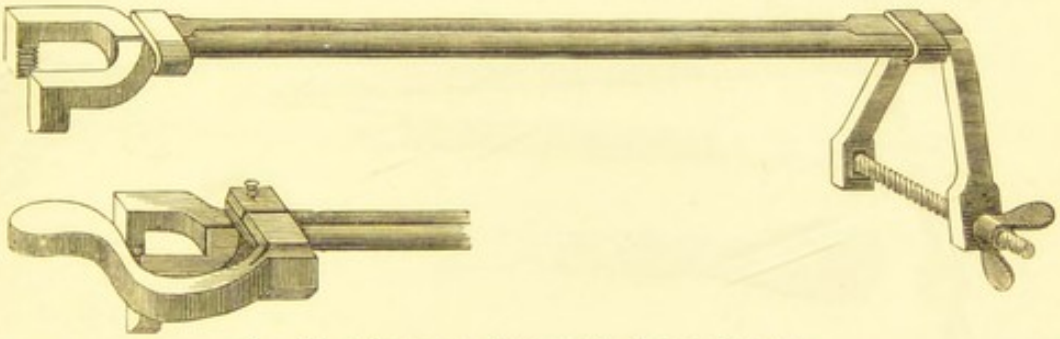


Fig. 336.—Frick and Hauptner's Molar Forceps.

firmly through the medium of a screw, and which can be employed as a lever of the first or second class. The jaws are clumsy, however, and there may be difficulty in getting them well on some teeth, especially the last upper molars.

Gowing's forceps (Fig. 337) have long been popular in England; they resemble Bouley's—in fact, the latter is only a modification of Gowing's, which is used in the same way. Robertson's forceps (Fig. 338) have also been found very serviceable, the fulcrum being screwed on the instrument near the joint, and the grasp of

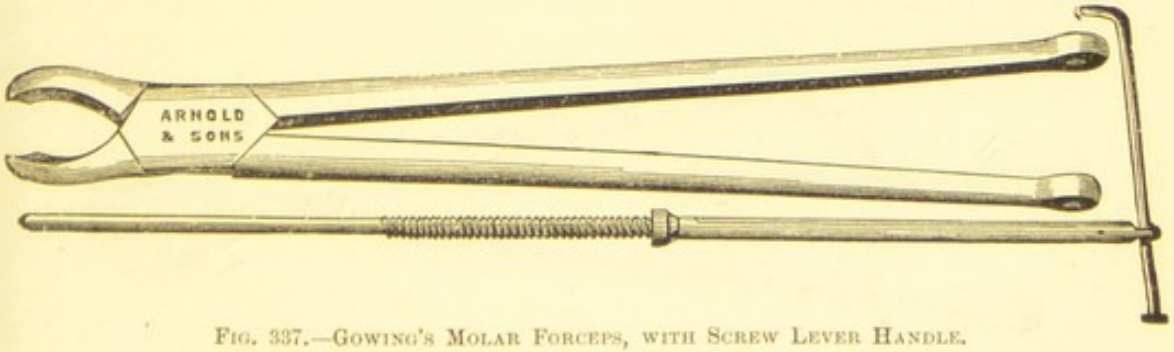


Fig. 337.—Gowing's Molar Forceps, with Screw Lever Handle.

the tooth, as well as the lever needed to start it from its cavity, is secured by a long screwed handle.

But perhaps the simplest and most efficient of the British models is that of Santy (Fig. 339), which has been largely used in this country. This affords an excellent grip of the tooth, a grip which is secured by a sliding bar on the handles, while the necessary leverage is ensured by the insertion of a fulcrum beneath the joint of the instrument, and which rests on the tooth in front, without injuring it. The fulcrum should be a long iron rod, bent

at a slight angle at each end; to these ends a small block of hard wood is attached, one thicker than the other; these act as fulcra, according to requirement. The longest molars have been extracted by these forceps, and even the fifth and sixth, without breaking a fang.

In addition to forceps, a dilatable speculum, water, and sponges, with fine tow and a hæmostatic agent, are needed for the operation.

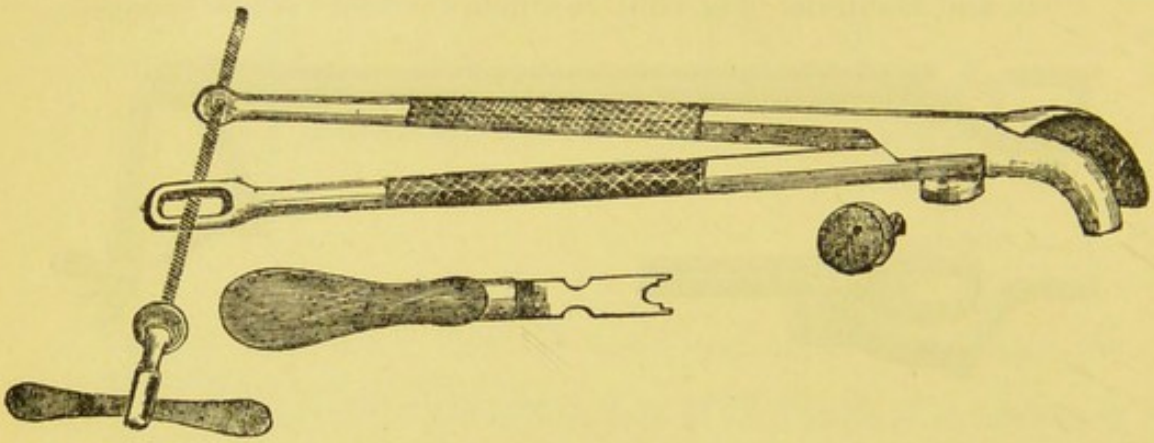


Fig. 338.—Robertson's Molar Forceps.

Position.—Sometimes molar teeth are extracted while the animal is standing, but usually it is placed latericumbent on the opposite side to that on which the tooth is, and if the operation is likely to be tedious or very painful, an anæsthetic ought to be administered.

Technic.—1. A gag in the mouth maintains the jaws a convenient distance apart; this is held by an assistant, who also

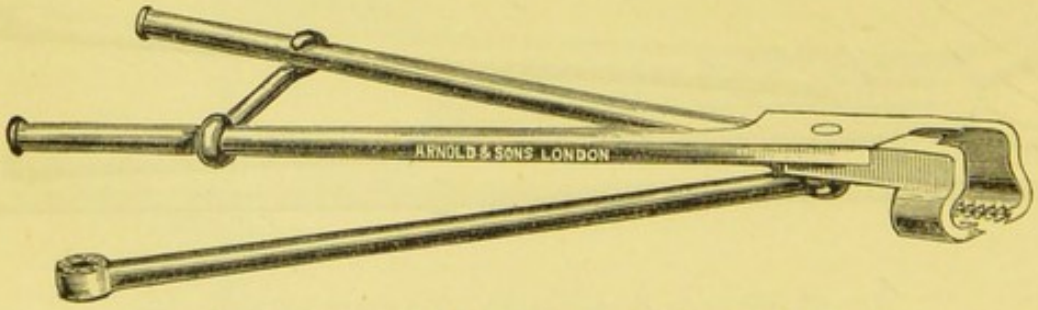


Fig. 339.—Santy's Molar Forceps, with Fulcrum.

holds the tongue to one side, with all due precautions if the animal is not insensible. 2. An examination is made to ascertain exactly the position and condition of the tooth which is to be extracted, and to remove any semi-masticated food that might interfere with its seizure by the forceps. 3. Should the tooth be so overgrown that the forceps cannot be properly placed, then it may be shortened by means of the shears; or if an intervening tooth present a similar obstacle to the placing of the forceps, it

must be cut by that instrument. 4. The forceps is placed with certainty on the tooth, the cheek being pushed aside with a smooth rod; if there is any difficulty in getting a good firm hold of the tooth because of its misdirection outwardly, it may be useful to remove or reduce the width of the gag and move the lower jaw to one side in order to allow more room. If possible, the hand should guide the forceps on to the tooth. 5. The operator gives the forceps a slight lateral or rotatory movement to loosen the tooth, though care must be taken not to break it or the jaw; then the fulcrum is placed under the forceps, resting on the table of the tooth immediately in front of the one in the forceps, which is now raised out of the socket by forcibly pressing the handles steadily downwards in the direction of the long axis of the tooth; when the latter is partially extracted, a sucking sound is heard, produced by the air passing into the socket; the forceps is then made to take a deeper hold, or a thicker fulcrum is put under it, and, inclining the pressure somewhat towards the inner side, the tooth is completely removed from the alveolus and the mouth.

If more than one tooth is to be extracted, it is generally advisable to remove the most posterior first if this be convenient. If upper and lower teeth must be removed, the lower should be the first.

After-Treatment.—As a rule, little treatment is necessary after the operation beyond removing the blood from the mouth and plugging up the cavity with tow saturated in dilute iron perchloride (1 to 2) if there is much hæmorrhage, or in an antiseptic solution if this is slight. Should there be dental fistula, this will require special treatment. The cavity should be replugged every third or fourth day with tow and diluted iron perchloride (1 to 4) if necessary. The diet should be soft nutritious food until all pain has disappeared and hard food can be masticated. If the cavity is in the upper jaw, and there is a probability of food finding its way into the sinus, then it may be necessary to fill the alveolus with guttapercha pressed into it while soft (from being steeped in warm water); this plug will be retained for a considerable time if two copper wires be passed through it before it is inserted, which are to be secured around the tooth at each side of the alveolus.

It will be necessary from time to time to examine the mouth and regulate the length of the tooth opposite, as this will become prominent and interfere with mastication, as well as damage the jaw it comes in contact with; the other teeth may also become irregular or displaced, and need rectification.

Ox.

The teeth of the Ox rarely require attention, and then it is usually extraction in consequence of disease either of the teeth themselves or, as is most frequently the case, of the bones in which they are implanted. As their removal is easily accom-

plished in the standing posture, no special directions are deemed necessary.

Dog.

The operations on the teeth of the Dog are limited to *blunting* the points of the incisors and canines by means of cutting forceps or a file, to prevent the animal inflicting wounds; *extraction* when the teeth are loose or diseased; and *scaling* or cleaning them when they are crusted with tartar.

Blunting.—No detailed description is needed for this operation. The animal is conveniently placed, held by one or two assistants, a mouth-gag applied, and the teeth mentioned resected by bone forceps and smoothed by means of a file, or blunted by filing only. The file should not be very rough, and the head must be held steadily by the assistant.

Extraction.—This is effected by means of strong dissecting forceps if the teeth are very loose, or by forceps of a smaller size than Fig. 317 if they are firm in the jaw (Fig. 340). When this is the case, it may be advisable—and, indeed, it should be the rule—to place the Dog under the influence of an anæsthetic. If many teeth have to be removed, it is often the safest procedure to extract only one, two, or three at a time, lest hæmorrhage be too

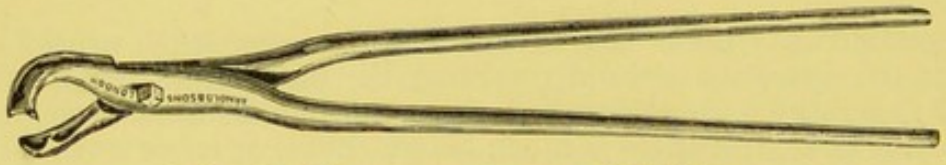


Fig. 340.—Forceps for extracting Dog's Teeth.

copious. No particular after-treatment is necessary beyond cleanliness and giving the animal soft food.

Scaling.—When tartar has accumulated around the teeth, this is removed by scraping. This can be done by means of a small short-bladed knife, or by the special instruments used in human dentistry for this purpose. The mouth-gag is usually necessary, and care should be taken not to injure the gums or loosen the teeth. These should be afterwards brushed with dilute hydrochloric acid.

OPERATIONS ON THE TONGUE.

Operations on the tongue of the domestic animals are much less frequent than in mankind, and consist chiefly in (1) scarifying the organ, in order to reduce tumefaction due to inflammation or other morbid conditions; (2) in removing foreign bodies; (3) in repairing wounds so frequently occurring from various causes; (4) in amputation when the organ is seriously injured or diseased; and (5) in operations on the frænum.

The symptoms of these conditions are usually very marked; they may be protrusion of the tongue from the mouth, hæmorrhage, salivation, difficulty in mastication and deglutition, mani-

festations of pain, etc. An inspection of the oral cavity, which these symptoms lead to, reveals the nature of the affection, and affords an indication of the kind of operation necessary.

1. Scarification.

Owing to the rigidity and thickness of the lingual mucous membrane, when inflammation from any cause is severe the resulting tumefaction is likely to run on rapidly to gangrene, unless relief is afforded by scarification. The length and depth of the incisions will, of course, depend upon the extent of the swelling; but as a rule they should be made longitudinally, nearly or quite the whole length of this, and their depth must be in proportion to the tumefaction; though they ought never to be so deep as to incur the risk of wounding the lingual artery.

After-Treatment.—This will depend upon the cause of the swelling; but usually all that is necessary is to bathe the tongue with some weak antiseptic (as solution of boracic acid) or astringent (as solution of alum or tannic acid) fluid.

2. Removing Foreign Bodies.

Foreign bodies often become fixed in or about the tongue, and when these are small or thin it is frequently difficult to detect them, especially if they are towards the root or sides of the organ, notwithstanding close examination. The chief symptoms are impeded mastication and trouble in swallowing, salivation, the mouth maintained more or less open, and perhaps protrusion of the tongue, which may be discoloured, swollen, and hot.

The mode of removal of these bodies, when detected, will depend on their character and the manner in which they are fixed in or on the tongue. A mouth-gag may be required, but it is rarely necessary to lay the animal down; forceps or the hand will remove sharp bodies which have penetrated the organ, and it has been remarked that these are generally inclined obliquely from behind to before, so that in extracting them the tongue should be pulled well forward and the penetrating body pushed or pulled backwards and upwards.

3. Operations for Wounds.

Wounds of the Horse's tongue are of frequent occurrence; they are usually transverse and generally lacerated, varying considerably in extent, from a small incision or tear to almost complete detachment of a portion of the organ: not infrequently a part is entirely separated, and the resulting wound must then be treated on general principles, cleanliness and soft food being the chief points requiring attention.

In order to suture wounds of the tongue, the Horse may be cast, but unless very intractable, or the injury is severe and not easily accessible, this operation may be performed in the standing position. In any case a mouth-gag is necessary. If large bloodvessels are

divided, they must be secured and tied. The wound is to be well cleansed, and the cut surfaces brought into apposition by interrupted suture. The suture material may be of soft lead, wire or strong silk, and the sutures placed close together and deep, so as to ensure a firm and durable hold if the wound is extensive. The object being to obtain union by the first intention, if the semi-detached portion has sufficient vitality, the tongue must be kept as immovable as possible until this has taken place. This immobility may be achieved to a considerable degree in closing the mouth by means of a muzzle, or by placing the tongue as far as the frænum in a fine net or muslin suspensory bag (Fig. 341), which is kept on the organ by a tape at each side, that can be tied to the head-collar. The muzzle may be used as an adjunct to this suspensory apparatus.

Should a point of suture give way, it may be replaced by a fresh one if considered necessary.

When union has taken place, the sutures are to be removed,

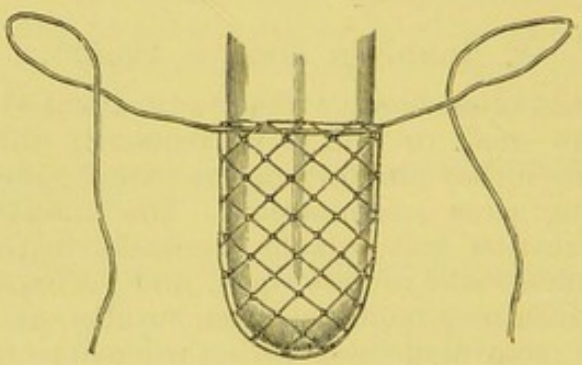


Fig. 341.—Tongue-Suspender.

but until then the suspensory bag should be taken off at least once a day and washed in boric solution. The mouth is to be washed out two or three times daily, and the diet must be fluid or pultaceous food; all hard, dry food must be withheld until the wound is healed.

4. Amputation of the Tongue.

Glossotomy is resorted to when disease has invaded the anterior portion of the tongue; when it is paralysed or prolapsed from accident, disease, or habit; or when it has been so injured that repair is not possible. This operation can be practised more advantageously on the Horse and Dog than on the Ox, which, owing to its tongue being largely prehensile in function, cannot seize its food so well after losing a considerable portion of it. A Horse may lose about four inches without suffering marked inconvenience, but more than this delays mastication and hinders drinking. Dogs are particularly inconvenienced in lapping fluids

when the tongue is shortened. Horses have been able to eat when the organ has only extended to the frænum.

Operation.—In some cases the tongue is so deeply incised accidentally, that removal of the partially-detached portion is a very simple matter, and may be effected with scissors, the animal being in the standing position and the mouth kept open by a gag. The hæmorrhage is usually trifling if the part removed be near the point of the tongue, and soon ceases; but if considerable and persistent, it may yield to a hæmostatic agent, such as iron perchloride, and keeping the mouth closed for some time. When a larger portion has to be amputated, then the animal may be handled while standing or latericumbent, and the organ operated upon in either of three ways: 1. It may be tightly encircled by an elastic ligature close above the portion it is desired to remove, the ligature to be left on, and, if necessary, made tighter, until separation has taken place. But this is a slow and most painful process, and not to be recommended. 2. The tongue is seized by the hand, held fixed by broad-mouthed forceps, or by a stout piece of silk or twine passed through it, and amputated at the part designed by a scalpel or bistoury. The artery may be secured by ligature, or the hæmorrhage suppressed by the actual cautery, though this is not to be recommended, as, unless applied with great care and for the briefest time possible, and frequently until bleeding is stopped, it is likely to scorch the mouth. 3. Amputation by means of the chain ecraseur, which is preferable to the other two methods, as it is more rapid, and there is less risk of hæmorrhage; the chain is placed around the tongue immediately beyond the part to be taken away, and the handle of the instrument turned slowly and steadily. A muzzle should be worn for a short time after the operation.

After-Treatment.—The mouth may be washed out with an astringent or antiseptic solution, and the wound kept clean. The diet should consist of soft mashes and gruel for the Horse and Ox, of broths and soups for the Dog, until the wound has healed.

5. Operations on the Frænum of the Tongue.

Tongue-tie.—This congenital defect is occasionally witnessed in young animals, and may prove detrimental to their sucking, drinking, or eating. The tongue is attached too forward in the floor of the mouth by the frænum being either too short or too near the point. This can be remedied by the simple operation of cutting through the frænum to a sufficient depth by sharp-pointed scissors. No subsequent treatment is necessary beyond keeping the wound clean.

Ranula.—Sometimes a non-inflammatory soft tumour, whitish in colour, and from the size of a hazel-nut to that of a fowl's egg, becomes developed on the frænum, and is probably due to closure of a mucous duct, as it contains a thick yellow fluid. It interferes with eating and drinking when large, and has to be removed.

This is permanently effected by incising it, and extirpating the sac-wall by means of scalpel or sharp-pointed scissors and forceps. Soft food and cleanliness are all that is necessary until the wound is healed.

OPERATIONS ON THE PALATE.

The operations on the palate are very few, and are limited to abstracting blood from it, repairing wounds, and, it may be, remedying the congenital defect known as 'cleft palate.'

Abstracting Blood from the Palate.

This operation is seldom resorted to nowadays, though at one time it was very fashionable for the relief or cure of the somewhat hypothetical disorder known as 'lampas.' But in certain morbid conditions, blood might be withdrawn from this region with advantage by puncturing the submucous venous network.

A mouth-gag is applied, and the animal's head raised to a horizontal position. The operator holds the tongue in the left hand against the right interdental space, and with the right hand armed with a lancet or bistoury, point directed upwards and edge forwards, a deep puncture is made in the middle line at the fifth or sixth palatine furrow, the cut being extended to about one-third of an inch by bringing the point of the instrument slightly downwards to that extent. If the operation has been properly performed, the hæmorrhage in nearly all cases ceases spontaneously in due course; but exceptionally it continues too long, and then it can be suppressed by placing a pledget of tow saturated with iron perchloride, or a short piece of wood wrapped in a piece of cotton, across the wound, fastening it firmly there by a wide piece of tape brought across the palate, and tied in front of the face and to the head-collar.

Operation for Injuries.

The palate is not infrequently injured accidentally, and the operative procedure to be adopted must depend upon the nature of the lesions. Hæmorrhage, if not arterial, may be checked by the application of a hæmostatic agent or pressure in the manner just indicated. Covering the dorsum of the tongue thickly with flour, and fastening the jaws together for six to eight hours, has been recommended.

When arterial bleeding is due to opening of the palatine artery, that vessel must be ligatured. In order to accomplish this, the Horse should be cast, the mouth maintained open by a gag, and the vessel exposed and tied.

Operation for Cleft Palate (Staphyloraphy).

This abnormal condition has been observed in the Equine, Bovine, and Canine species; but the cases recorded are few in number, and operation does not appear to have been attempted, in

consequence of the difficulty in reaching the soft palate, due to the length of the jaws. But before condemning an animal to be destroyed because of this congenital defect, especially if it be of sufficient value to warrant the experiment, an attempt might be made to remedy it by pursuing the course adopted for cleft palate in mankind.

Instruments.—A long curved needle set in a handle, with an eye close to the point, armed with a waxed thread of ordinary suture-silk; a long pair of forceps to seize the thread; long hooked forceps to catch the soft palate; a long narrow-bladed knife to pare the margins of the cleft; small and large scissors; sponges and water.

Position.—The animal should be placed on its side and anæsthetised; then the neck should be raised on a stuffed sack and the head turned upwards, the mouth towards the light as much as possible; the jaws are kept wide apart by the gag—a unilateral one is most convenient. The tongue is withdrawn from the mouth and held steadily by an assistant, who, with one on the other side, maintains the head in position. If there is any apprehension of much hæmorrhage and the blood finding its way into the trachea, a tampon cannula may be inserted into the trachea.

Technic.—1. The edges of the cleft are slightly pared to make them raw, the cleft portion being made tense at the bottom by the hooked forceps; the knife is entered close to the forceps, with its back towards the tongue, and carried upwards to the apex of the cleft, and repeating the procedure on the opposite side, a continuous strip of tissue may in this way be removed. 2. The margins are brought together by passing the point of the curved needle with the waxed thread from below upwards, about a quarter of an inch from the edge of the fissure; the thread is caught by the flat forceps close to the eye of the needle, and drawn as a double thread out of the mouth, with the single ends also hanging out; the needle is then withdrawn, leaving the double thread through that edge of the cleft. A similar double thread is passed from below upwards through the other margin, at the same distance from the cut surface, and exactly opposite the first thread. There is now a double thread through each side of the fissure. The left hand loop is passed through the right one, and on pulling the ends of the right thread the left is drawn through the right side. By holding one end and pulling on the left loop, the thread becomes single, and the ends may remain hanging out, one at each side of the mouth, ready, when the other stitches are passed, to be drawn tight and made fast. As many more threads as may be necessary are introduced in a similar manner along the margins, and then each is tied securely, first with a slip-knot, and then with a double reef-knot, to keep the edges in apposition. The threads must not be drawn very tight, as the circulation in the edge of the cleft might be interfered with when the inevitable swelling occurs. If the cleft extends into the hard palate, the

mucous and periosteal tissues have to be separated down to the bone close to the alveolar ridge on each side, so as to allow these tissues to be drawn to the median line by suture. Care must be taken not to wound the artery in making these incisions.

In operating on mankind, it is sometimes required to divide the levator palati and the palato-glossus or palato-pharyngeus when these muscles exercise any action on the soft palate during the operation.[1]

The mouth is to be kept as free from blood as possible.

After-Treatment.—The jaws should be held together by a muzzle-strap, and the diet must be altogether fluid and very nutritious, so that a smaller quantity will suffice for several days until union between the edges of the cleft has taken place. It is advisable to have the head tied up to the wall, so as to limit movement. At the end of four to six days the stitches may be removed; but to do this the animal must be again laid down, with the head in the same position, though an anæsthetic may not be necessary.

OPERATIONS ON THE SALIVARY GLANDS.

The operations performed on the salivary glands are few in number and seldom required. They are generally related to the ducts of the parotid and submaxillary glands, though disease of the glands themselves may necessitate operative procedure upon them. Operation is demanded in the case of (1) *salivary calculi*, (2) *salivary fistulæ*, (3) *glandular abscess*, (4) *glandular tumours*.

1. Salivary Calculi.

Salivary calculi or concretions are formed most frequently in the duct of the parotid gland (Stenon's duct) and in that of the submaxillary gland (Wharton's duct). In Stenon's duct the calculi are generally observed in Horses and Cattle, in which there may be one, two, or more in one canal; but there is usually only one, which may acquire the dimensions of a small apple, and weigh as much as twelve or thirteen ounces. When they attain a certain size they can be seen on the cheek; they feel as a hard and somewhat elongated movable tumour situated on the course of the duct, near its opening into the mouth, though in some cases they may be lower down, and as far back as the posterior border of the inferior maxilla. The duct itself is distended behind the calculus, the distension being all the greater if this entirely occludes the canal, and the parotid gland itself may be tumefied. The concretions—for they are nearly always due to the entrance of a foreign body into the duct from the mouth, lime-salts being gradually deposited around it—are generally limited to one side.

Operation.—When the concretions are small and high up in the cheek, manipulation may successfully push them onwards and

[1] Gant, 'Science and Practice of Surgery.'

into the mouth. With this object, the Horse is placed latericumbent, the head and neck raised on a stuffed sack, and the mouth well opened by a gag. The operator makes steady pressure upwards on the calculus, so as to force it into the mouth of the duct, where he can seize it with the other hand. If he cannot remove it, a slight enlargement of the mouth of the duct inside the cheek may be made by a sharp- or probe-pointed curved bistoury. When the calculus is large, however, the duct must be opened in order to extract it. The animal should be well fed for a day or two previous to the operation, and a good feed given immediately before it.

Position.—The operation can usually be accomplished while the animal is standing, though, if it be a Horse, a twitch on the nose will be necessary.

Instruments, Apparatus, etc.—Scalpel and forceps, suture-needle and waxed silk thread, collodion, shreds of lint, sponge, and antiseptic solution.

Technic.—1. Remove as much of the hair as possible from the skin on and around the tumour, and have the surface sponged with the antiseptic solution. 2. A transverse or longitudinal incision—the former to be preferred, if convenient—is made through the skin and subjacent tissues down to the concretion, and of sufficient extent to allow of this being removed. 3. Removal being effected, the wound is carefully and at once closed by the interrupted or Lembert's suture; over the wound is painted a layer of collodion, on which are laid in various directions the small shreds of lint and more layers of collodion. The jaws are kept together by a close-fitting muzzle or mouth-strap.

If the concretion has been of such great size as to convert the portion of duct in which it had formed into a capacious cyst, the external pressure of the suture and dressing, as well as the process of cicatrization, may reduce this somewhat. But if the canal in the upper part of the duct is obliterated, then it is evident that another procedure must be adopted; this will be described immediately, when treating of making an artificial duct.

After-Treatment.—The diet should consist only of thin gruel of flour or oatmeal, first given twelve hours after the operation, and then sucked through between the closed jaws; though water may be allowed to be taken in the same way soon after the operation. The animal should be kept tied up for four or five days, and in six days the muzzle may be removed and hard food allowed. If no saliva escapes from the wound, it may be inferred that it is closed; but there need be no hurry to remove the collodion and the stitches. It is a favourable indication of cure if, before these are removed, the posterior part of the duct is not unduly distended, or has nearly regained its normal size.

Calculi in Wharton's duct are usually removed by manipulation with forceps, and do not require a cutting operation.

2. Salivary Fistulæ.

(*a*) *Fistula of the Parotid Duct.*

Salivary fistulæ may occur in connection with the glands, but then they generally heal readily, as in the parotid gland, where they either disappear spontaneously or are cured by simple treatment, such as a blister applied to the surface, and the animal fed sparingly on soft food. They are more serious when situated in the gland duct, and by far the most frequent situation is the parotid duct of the Horse, where they are generally due to an accidental injury. The saliva escapes abundantly when the animal is eating, and particularly if the food be dry; and though this loss does not appear to affect the Horse's health to any marked degree, yet the discharge is unsightly and disagreeable, and leads to blemish of the part over which the saliva flows. The usual seat of fistula of the parotid duct is on the cheek at the margin of the masseter muscle, and towards the inferior border of the lower jaw.

When recent, and especially if the duct is not completely divided, the injury can be remedied by closing the wound in the skin by suture, and following the treatment laid down for healing the incision made for the extraction of salivary calculi. When the wound is contused, or of such a character that the ordinary continuous or interrupted suture cannot be employed, the twisted suture around pins inserted at intervals on each side of the injury may effect the closure of the wound; or the drawing or purse-string suture—made by passing a stout silk thread in a curved needle out and in around the opening, and pulling and tying the ends, so as to bring the edges close to the centre—may be more suitable. The actual cautery or caustics should not be employed to close the wound, as they generally aggravate the case and render it more refractory to subsequent treatment. If the upper portion of the duct is patent and the saliva can enter it, then the suture, collodion or styptic-colloid and shreds of lint laid on thickly and widely, muzzling, and keeping the animal on nutrient gruel for some days, will effect a cure.

When the upper part of the duct is occluded through inflammatory processes, however, and cannot be opened to allow the saliva to pass into it, then one of four courses can be adopted: (1) Making an artificial canal or opening from the wound into the mouth; (2) ligation of the parotid duct below the wound; (3) dividing the duct transversely; (4) destroying the function of the gland.

(1) *Making an Artificial Duct.*

The Horse must be prepared by good feeding, as he will have to undergo semi-starvation for some days after the fistula has been operated upon.

Operation.—This is in two parts, the first being the formation of the artificial passage, and the second closing the external wound.

Instruments.—Scalpel and forceps; a long narrow seton-needle or sharp-pointed probe, with an eyehole at the point; a long, thick silk thread, doubled or trebled to form a seton, or a long piece of soft lead wire slightly thinner than a goose-quill.

Position.—The Horse may be operated upon in the standing position, with a twitch on the nose; or it may be laid latericumbent, the fistula side being uppermost.

Technic.—1. The seton-needle or probe is passed from the wound upwards, between the skin and facial panniculus, as nearly alongside the occluded portion of the duct as possible, care being taken not to injure the vessels that run in the same direction. When it has reached the point at which the duct opens into the mouth, it must be moved a little laterally, so as to leave room for the passage of the seton or wire, then pushed through into the mouth and withdrawn. 2. The needle or probe, armed with the silk thread or lead wire (though the latter may be passed alone), is pushed up the space thus made, and the point carried into the opening in the mouth, so that the hand, introduced into that cavity through the mouth-gag, can seize the end of the seton or wire and bring it down to the lips, where it can be fastened to a flat button, and then pulled up to the mouth-wound inside the cheek; the other (external) end, the needle or probe having been withdrawn from it, is cut off close to the fistula and secured in a similar manner.

The Horse may be worked and fed as usual if required, but it will be better to keep him quiet for two or three weeks until the seton or wire shall have formed a semi-indurated passage. Then the operation must be completed by withdrawal of the seton or wire, removal of any indurated non-vascular tissue or cyst-wall from the fistulous wound, and closure of this in the manner already described, followed by the treatment also indicated for open parotid duct.[1]

(2) *Ligation of the Parotid Duct.*

When the above treatment is unsuccessful or inapplicable, then recourse may be had to ligation of the parotid duct either on the cheek or behind the lower jaw, according to circumstances.

Operation.—This is simple, but it requires an accurate knowledge of the anatomy of the region and the course of the duct behind the jaw and over the cheek (see Fig. 342).

Position.—Latericumbent, on the side opposite to that to be operated on; head raised and extended, and head-collar removed.

Instruments.—Scalpel and forceps; curved blunt needle in handle, with an eye at the point armed with a waxed silk thread.

[1] I believe I was the first to perform this operation for the cure of fistulous parotid duct in the Horse so long ago as 1857; the case was completely successful (see the *Veterinarian*, vol. xxx., p. 388). I was not then aware that a similar operation for this condition had been performed by Hübner on a Cow in 1834. Since the report of my operation was published, it was successfully performed in 1860 by Lafosse, in 1861-62 by Prambolini, in 1861 by Mottet, in 1880 by Morot, in 1882 by Labat, and in 1885 by Nocard.

Technic—(*a*) *Cheek Operation.*—Carefully make a straight vertical incision through the skin about one to two inches from the border of the inferior maxilla and slightly behind the glosso-facial artery; cut through the thin layer of panniculus and the connective tissue and expose the duct, which appears as a narrow, white, flat cord. Pass the needle under it, avoiding the vein, seize one end of the ligature, withdraw the needle which carries the other end, and tie sufficiently firm to cause gradual obliteration of the vessel.

(*b*) *Jaw Operation.*—At the antero-inferior part of the parotid gland, about an inch behind the ascending portion of the lower

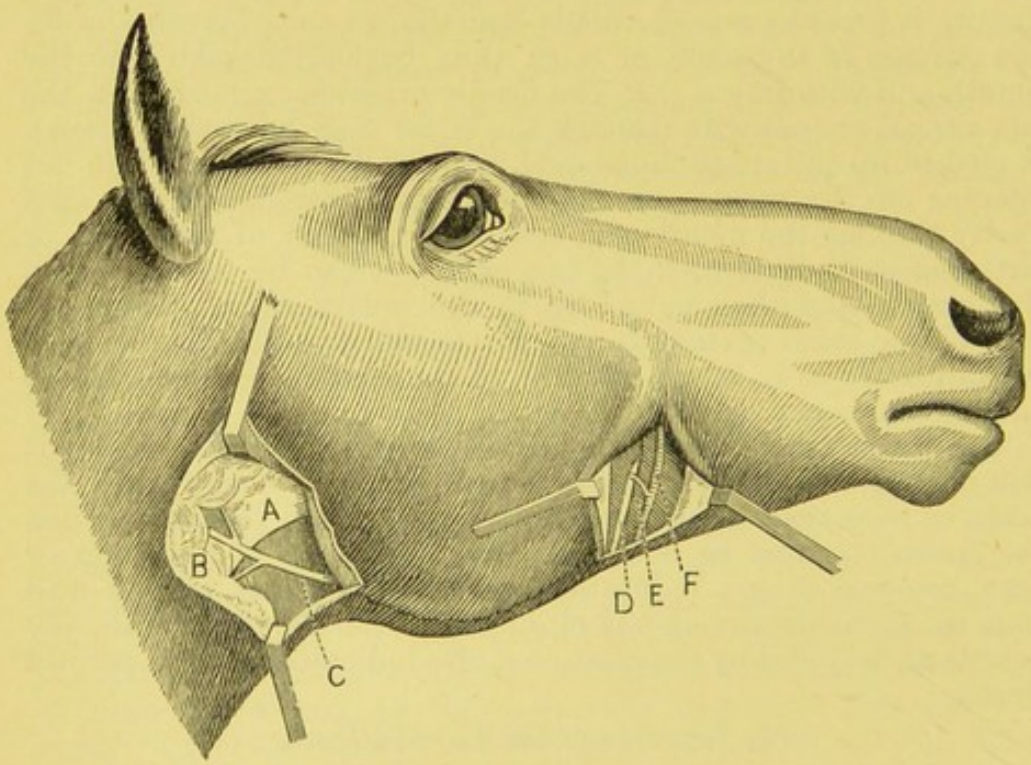


Fig. 342.—Situation and Relations of the Parotid Duct on the Cheek and behind the Lower Jaw. (After Cadiot.)

A, Tendon of the sterno-maxillaris muscle; B, parotid gland; C, post-maxillary portion of duct; D, cheek portion of duct; E, facial vein; F, facial artery.

jaw and above the tendon of the sterno-maxillaris muscle, make an incision slightly oblique downwards and forwards, and about one and a half inch long, through the skin and panniculus; carefully dissect through the connective tissue in which the duct is enveloped, expose that vessel, and tie it in the same manner as on the cheek.

After-Treatment.—No food should be allowed for one or two days except thin gruel, which should be sucked into the mouth, the jaws being held together by the muzzle. Soft food must be given for some time. The parotid gland becomes tumefied soon after the operation, but this subsides gradually, and atrophy commences.

(3) *Division of the Duct.*

Transverse division of the parotid duct below the fistula has been recommended and practised, the inflammation supervening on the incision leading to closure of its canal and ultimate atrophy of the gland. But this operation has no advantage over ligation of the duct, which is certainly to be preferred, as it entails less risk and is more certain of achieving the desired object. The operation is the same except that, instead of passing a ligature round the vessel, this is simply cut through.

(4) *Destroying the Function of the Gland.*

So unsuccessful was the treatment adopted for the cure of fistula of the parotid duct, that for a very long time, in the great majority of cases, suppressing the function of the gland was considered the most advisable course in order to get rid of the annoying escape of saliva. But it is to be hoped that this step is seldom taken now, as the skilled operator can generally effect a cure of salivary fistula without destroying a gland so important to mastication and digestion. But cases may, nevertheless, be met with in which its function must be abolished. This is attained by injecting into the duct, by means of a syringe, any irritant preparation that will destroy its power of secretion without setting up severe inflammation. Of the many which have been so employed, the following have been successful: Tincture of iodine 30 parts, potassium iodide 1 part, water, 69 parts; tincture of iodine and water, equal quantities; a 30 per cent. dilution of alcohol in water; a 20 per cent. solution of lactic acid. The injection may be made into the duct at the fistula, or at either of the points indicated as those suitable for its ligation, and it may be repeated as often as is desirable, though one or two injections are generally effective.

(*b*) *Fistula of the Whartonian Duct.*

Fistula of the duct of the submaxillary gland is of rare occurrence, but instances are on record, and they have proved so intractable to surgical treatment that extirpation has been necessitated. This is a comparatively simple operation when the operator is sufficiently acquainted with the situation and relation of the gland. This is an elongated, flat, narrow body, lying to the inside of the parotid gland at the side of the larynx, slightly curved upwards and forwards, and extending from the wing of the atlas to the commencement of the intermaxillary space.

Operation.—No preparation of the animal is necessary beyond that required previous to casting.

Instruments.—Only a scalpel and forceps are necessary, with water and sponge, and a suture needle and thread.

Position.—Latericumbent, head and neck slightly raised.

Technic.—The head-collar being removed, an incision about three inches long is made through the skin and panniculus, along the inferior border of the gland, in the direction of the glosso-

facial vein. Cutting through the connective tissue, the gland is exposed; this is isolated by the fingers tearing it away from its surrounding connective tissue, and lifted outwards, when the fingers of the other hand free it at each end, which is cut through, and the organ removed. The wound may be closed by suture.

After-Treatment.—Little is necessary beyond keeping the wound clean and allowing soft food for a few days.

3. Abscess of the Salivary Glands.

Inflammation of the parotid and other salivary glands, leading to abscess formation, is not infrequent, though the parotid is most liable from several causes, some of which are specific. This suppurative inflammation is witnessed in Horses more particularly; occasionally it is so acute, and the tumefaction is so great in the parotideal region, as to endanger life. The swelling is generally confined to the parotid gland, and the presence of pus may be detected, when it reaches near the surface, by palpation. Then it is advisable to evacuate it by incision, especially if the respiration is seriously interfered with, when it may also be necessary to resort to tracheotomy.

Operation.—This must be performed while the animal is standing, and a twitch on the nose may be necessary.

Instruments.—A bistoury, lancet, or scalpel; sponge and tepid water.

Technic.—The skin over the swelling being washed with an antiseptic fluid, a vertical incision from one to two inches in length is made through it at the most prominent part, and the subcutaneous fascia divided with great care, so as not to wound any bloodvessels. The fore-finger is now introduced into the opening, and perforates the gland tissue in order to reach the pus cavity, the other hand assisting by pressing the swelling upwards. The pus usually escapes in a strong jet, owing to the tension, and the operator should stand to one side to escape this. The cavity should be emptied as completely as possible by syringing tepid water into it, and afterwards a solution of Condy's fluid, carbolic acid, or corrosive sublimate. Or an attempt may be made to remove the pus by aspiration, a small incision being made through the skin, and the needle of the aspirator carefully introduced into the pus cavity.

The same procedure is required when suppuration occurs in the lymphatic glands beneath the parotid.

After-Treatment.—Cleanliness and fomentations with warm water, or poultices, expedite the subsidence of the swelling; the wound is to be syringed out occasionally with tepid water, and injected with a weak antiseptic.

4. Tumours of the Salivary Glands.

Tumours are most frequently met with in the salivary glands of the Horse and Ox, and they are often of new formation; in the

former animal they are usually melano-sarcomatous, and in the latter actinomycotic. They cannot be mistaken for inflammatory tumefaction, because of the absence of abnormal heat and pain, their slow growth, and their outline. When they cause so much inconvenience as to render valuable animals useless or threaten existence, then it may be desirable to attempt their removal by operation. If the tumour is small and has not invaded surrounding tissues, it may be removed without much trouble; but when extensive and its margins are undefined, its eradication demands

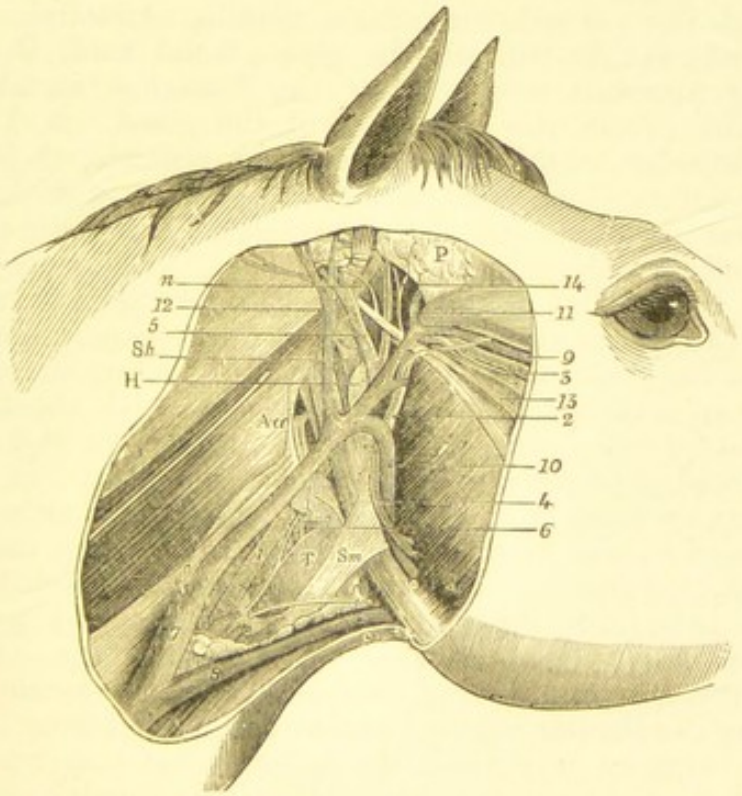


FIG. 343.—ANATOMY OF THE PAROTIDEAL REGION. THE SKIN, PAROTIDO-AURICULARIS MUSCLE, AND PAROTID GLAND HAVE BEEN REMOVED.

P, Upper part of parotid gland; D, digastricus muscle; *Sh*, stylo-hyoid muscle; *Sm*, stylo-maxillaris muscle; T, thyroid body; H, posterior border of the hyoid cornu; 1, common carotid artery; 2, external carotid artery; 3, transverse artery of the face; 4, maxillo-muscular artery; 5, posterior auricular artery; 6, thyro-laryngeal artery; 7, jugular vein; 8, glosso-facial vein; 9, transverse vein of the face; 10, maxillo-muscular vein; 11, anterior auricular vein; 12, posterior auricular vein; 13, facial nerve; 14, anterior auricular nerve.

a more serious operation—possibly excision of the entire gland. The measure is not without risk, and demands considerable operative skill; but it has been repeatedly performed with successful results. We will deal with total removal of the parotid gland, which has also been effected when that organ was affected with gangrenous sloughing and fistula.

OPERATION.—A knowledge of the complex anatomy of the parotideal region is, of course, essential, as well as manipulative skill.

Instruments and Appliances.—Curved and straight bistouries; scalpel and dissecting forceps; blunt flat hooks; scissors; suture-

needles and strong silk thread, well waxed; small round wooden pins; torsion and bull-dog forceps; fine antiseptic tow or lint.

Position.—Latericumbent, on the side opposite to the diseased gland. An anæsthetic should be administered, and the head-collar removed after the head has been somewhat elevated by a stuffed sack placed beneath it, which should also make the gland more prominent.

Technic.—According to Degive, the skin over the gland is cleansed and dressed with an antiseptic solution. 1. An incision is made through the skin in the direction of the middle of the gland and the parotido-auricularis muscle, extending from the base of the ear to beneath the glosso-facial vein, the muscle remaining attached to the skin; the dissection should extend beyond the extremities and sides of the gland. 2. The gland must now be separated as completely as possible, though there are some points where great care must be taken in doing this, as at the base of the ear and at the masseter, where there are blood-vessels and the subzygomatic nerves; but to avoid injury to these a few of the lobules may be left, as they are soon destroyed by subsequent inflammation. In order also to escape damaging the numerous important vessels and nerves in this region, as much of the dissection as possible should be made with the fingers or blunt instruments, such as a director, probe, or the points of closed dressing forceps or blunt-pointed scissors. The posterior auricular vein must be ligatured and divided at an early period in this dissection, and its satellite nerve isolated; then the anterior border of the gland is dissected from above to below, and to separate this from the subzygomatic vessels and nerves, the superficial connective tissue is divided with the bistoury or scalpel, the separation being completed by the director. In the same way the jugular vein is isolated throughout from the gland; and this being accomplished, the latter is cut into two parts in the middle, one above, the other below, the jugular canal. The dissection of these two portions is completed by cutting through the tissue still attaching them internally and at their posterior border. The inferior portion is detached from above to below, but the superior half is removed from below upwards, avoiding (1) the four branches of the carotid—external carotid, temporal and internal maxillary, and posterior auricular; (2) the two nerves, superficial temporal and facial, with its three divisions; (3) the guttural pouch contiguous to the upper end of the gland.

The small vessels which may be divided during the dissection are ligatured or twisted, according to their size; and by frequent sponging during the operation, or applying pads of fine tow or lint to bleeding surfaces, the hæmorrhage that might embarrass the operator is checked.

The wound is dressed with an antiseptic solution and powdered with boric acid or iodoform, then filled with fine tow or lint, and the margins brought together by temporary or quilled suture.

After-Treatment.—In one to two days after the operation the dressings will probably require renewal, when the sutures may be relaxed or removed and the former dressing repeated; though, if the wound appears to be healthy, the lint or tow need not be applied, dry dressing being carried out by the use of boric powder or iodoform, or a mixture of both. If, however, there is much discharge, this may be absorbed by keeping pledgets of carbolised tow or lint in the wound, the lower end of which must be left open; a drainage-tube may be advantageously employed if the discharge is very profuse. As it becomes diminished and the wound drier, the lint may be discontinued and the surface dusted with a mixture of iodoform and powdered starch (1 to 2). This will form a crust that should be allowed to remain until the wound is healed, which, under favourable circumstances, may be in about a month.

The diet for the first week or two should be soft and require little mastication.

OPERATIONS IN THE PHARYNX.

Operations in the pharynx are usually necessitated by the presence of foreign substances, abscess, or tumours in that cavity. The foreign bodies are most frequently noted in the pharynx of Dogs and Cats, and generally find their way into that cavity with the food; in Cattle they are not uncommon, and may be pieces of unmasticated food, as well as various objects of a non-assimilable kind; while in Horses they are rare, and may be masses of solid food or other matters which cannot be passed into the œsophagus.

Abscesses may form in any part of the pharyngeal cavity, but they are usually most serious when located at the back of that space, constituting what is known as post-pharyngeal abscess. Collections of pus also form in the guttural pouches, and when they are large they unite and project as one mass into the pharynx, interfering with deglutition, and possibly respiration.

The tumours may be benignant or malignant; they are usually located towards or upon the posterior wall of the pharynx.

The diagnosis will rest upon the history of the case presented: the gradual or sudden development of symptoms, the character of these, and the evidence furnished by a manual examination and possible ocular inspection. The symptoms will depend upon the situation, nature, and volume of the body, and are related to mastication, deglutition (or suspension of that act), and respiration.

Operation.—This will depend upon the evidence afforded by an examination of the pharynx. Masses of food or foreign bodies may be removed directly by hand or with the aid of instruments, the mouth being maintained open by the double-sided or unilateral gag in the larger animals, the operation being carried out in the standing or recumbent position, according to circumstances.

Abscesses in the pharynx may be opened in the usual way

when accessible, and if their spontaneous evacuation cannot be waited for. This may be effected in the standing position or latericumbent, the mouth being kept open with the gag, and the incision made with the bistoury cachée, or a long straight-pointed bistoury, the whole of the blade of which is wrapped in tow except about half an inch of the end.

Post-pharyngeal abscess, due to an accumulation of pus in the guttural pouches, may be evacuated by an external operation to be hereafter described when dealing with operations on the respiratory apparatus, or through the mouth.

The Horse is secured, the mouth-gag applied, and the operator having satisfied himself that the swelling is due to pus, the point of the bistoury is pushed into its centre, in the middle line of the posterior wall of the pharynx, so as to avoid the carotid arteries on each side. Little has to be done after the pus escapes, and the wound soon heals.

In cases of tumours in the pharynx, the operative treatment must depend upon their nature, form, and seat. In the larger animals, and especially the Horse, their removal is difficult because of the length of the mouth. If pre-epiglottidean and having a narrow pedicle, their excision is less embarrassing than when they are lateral or post-pharyngeal and grow from a wide base. In these animals operation must generally be considered serious because of these circumstances. The position should be latericumbent, and anæsthesia greatly facilitates the procedure. The head and neck are suitably raised, and the hand introduced into the pharyngeal cavity, where the tumour may be seized by the fingers and possibly torn or twisted off, or surrounded by the chain or wire of the ecraseur, or incised by a bistoury cachet or obstetrist's finger-ring knife. Should there be danger of suffocation during the operation, which is more especially to be apprehended when the tumour is post-pharyngeal, tracheotomy ought to be previously practised.

In some cases of post-pharyngeal tumour, when it is inferior, it may be removed by the ecraseur through the larynx, the interior of which may be reached through an opening in the crico-thyroid ligament, or, better still, by incising two or more of the upper rings of the trachea, respiration having been ensured by the insertion of a tampon-cannula in that tube, as in the operation of arytenoidectomy (which see).

The subsequent treatment must depend upon the extent and seat of the operation, and the diet ought to be soft or fluid food until the soreness has disappeared and swallowing is easy.

OPERATIONS ON THE ŒSOPHAGUS.

Operations on the œsophagus are much more frequently required, especially with Cattle and Horses, than those in the pharynx, owing to the narrowness and great length of this tube and its special function. The fact that a large portion of the tube

is inaccessible externally, from its lodgment in the thorax, also militates against operative procedure in that region, though in the cervical region it is easily reached.

Operations are necessitated when (1) food or foreign bodies have become impacted in it, (2) in œsophagotomy, (3) for fistula, (4) for constriction or stenosis, (5) for sacculation, (6) for rupture, (7) for disease, (8) in catheterism.

1. Operation for Impactment.

Impactment may occur at any part of the œsophagus, but it generally takes place at its upper part near the pharynx, before its entrance into the thorax, and at or near the diaphragm. The obstruction or impaction may be due to food, or to foreign bodies of different kinds, which, from their roughness, hardness, angularity, or sharpness, become very firmly lodged, and wound the walls of the tube, while they necessitate more varied and careful procedure for their removal. This is the case most frequently in the Cow.

The symptoms of impaction, or 'choking' as it is popularly termed, are usually well marked. Mastication ceases, and the animal makes gulping or choking movements with the head and neck, which are extended, while there is frequently an urgent cough, and the countenance betrays anxiety and distress. There may also be repeated attempts at vomition, and if the obstacle is large in volume respiration is seriously interfered with. Salivation may be profuse, and as it is usually impossible to swallow, any fluid taken by the mouth is either ejected again or returned by the nose along with saliva and mucus. The symptoms are most urgent when the obstruction is near the larynx, and when in the cervical portion of the tube the obstruction can usually be seen; when the thoracic section is blocked, diagnosis is not so easy; but when fluids are swallowed, they accumulate in the tube until it is distended for some distance up the neck, and this leads to a suspicion of occlusion. There may be abdominal tympanites in the Horse, but this is the rule in the Bovine species, in which the rumen soon becomes greatly inflated with gas, while there is champing of the jaws, violent cough, and salivation. Tympanites in the Ox, if not soon relieved, quickly leads to grave consequences by interfering with respiration; though death by suffocation, through pressure on the trachea, is usually the termination of choking when relief is not obtained.

Of course, operation will not be undertaken until ample time has been allowed for the obstacle to be overcome by natural effort, by external manipulation on each side of the œsophagus after administering water, oil, or mucilaginous fluids, pressing the substance gently upwards or downwards, or kneading it if it can be softened. It must be remembered that, if successful in raising the obstacle into the pharynx, especially in the Horse, the soft palate prevents its passage to the mouth, so that the hand must

be introduced into that cavity to remove it. When a sufficient time has elapsed and these measures fail, a dose of pilocarpine may assist in effecting removal; but if there is danger, as is more especially the case when the substance is lodged in the thoracic section of the tube, then it may be necessary to attempt mechanical removal by means of the œsophageal catheter, sound, probang, or forceps. Indeed, if the symptoms are urgent, it may be necessary to have recourse to these at once, and especially if the obstructing substances are hard, of large volume, and cannot be promptly removed otherwise.

In operating on the œsophagus, it is necessary to remember that it is longer and narrower in the Horse, comparatively, than in any other of the domesticated animals, being from fifty to sixty inches in length, according to the size of the creature; its walls are also thicker, and near the stomach become very strong. In its course down the neck, about the middle, it deviates to the left side, but regains the middle of the trachea after it enters the chest; in very rare instances this deviation is to the right side. The foramen in the diaphragm through which it passes to the stomach, and the great thickness of its walls at this part, offer the strongest resistance to the passage of hard bodies of any unusual size; in addition, it would seem that the muscular coat not only at this point, but throughout its whole length in the Horse, becomes spasmodically contracted behind the obstructing substance. Besides all this, the mucous membrane at the junction of the œsophagus with the stomach is thrown into a number of large longitudinal folds, which increase the resistance to the entrance of any body unusually large.[1]

In Bovines the œsophagus is slightly constricted a little above its middle, and below this it becomes wider and thinner; in Ovines there is no constriction in the middle, the walls are comparatively thin, and gradually become more so as the tube descends; in the Caprine species there is a constriction in the middle of its length; in Swine there is also a constriction in the same part; in Dogs there are three constrictions; in Cats two, top and bottom.

[1] Nevertheless it is sometimes astonishing to find Horses swallowing comparatively large objects without sustaining any apparent damage at the time. A memorable instance of this occurred in my own experience, while serving with the 2nd Life Guards. When being groomed, a troop Horse swallowed the cast-iron weight (log) that is fastened to the end of the head-collar chain to keep it down, and which happened to be lying in the manger, detached from the chain. This article is circular in outline, flattened on both faces, and round at the circumference; it weighs 1¼ lb., measures 2½ inches in diameter and 1¾ inch in thickness, and has a perforation in the middle for the T of the chain to pass through. The first indications the animal gave that it had ingested this large and heavy object were the extraordinary movements of its head and neck, which were described to me as 'serpentine,' and the frightened look. The trooper ran for the Farrier-Major, and when the latter arrived the Horse did not seem amiss, but there was a quantity of saliva in the manger. It was when about to secure the Horse by his head-collar that the log was missed, and of course it could not be found. The animal remained in good health while I was in the regiment, and though laxative medicine and food were given for some days after the accident, the log was retained.

Horse.

Instruments and Appliances.—One or all of the instruments above-named, as well as a wire snare, mouth-gag, one or two twitches, some oil or grease to lubricate the instruments, and thin gruel to administer before or during the operation.

The ordinary Horse probang (Fig. 344) is about six feet in length, with a handle at one end and a conical concave expansion at the other, the stalk being of cane or whalebone for flexibility; but in cases of emergency a useful probang may be extemporised by employing a piece of stout rope six or seven feet long, or a whip-handle. Other forms of probangs are in use, and will be referred to when treating of impaction in Bovines.

When the obstruction is at the upper end of the œsophagus, and cannot be reached by the hand or pushed upwards by external taxis, a snare or loop of one-eighth inch wire, fastened to the end of a cane or probang, may be passed over it, so as to pull it forwards into the mouth.

Position.—The probang can sometimes be passed into the œsophagus of the Horse in the standing position, with a twitch applied to the nose or ear and a gag in the mouth; but it is generally necessary to place the animal latericumbent.

Fig. 344.—Horse Probang.

Technic.—Whether the animal is standing or lying, the head and neck must be extended as much as possible, so as to bring them into a straight line. The mouth-gag is applied, and the probang, well oiled, is carried back in the mouth, guided carefully over the epiglottis and into the œsophagus, down which it is steadily but gently pushed until it reaches the obstacle; upon this moderate and intermittent pressure downwards is to be made. If the obstruction is in the cervical portion of the tube, an assistant may usefully aid the probang by employing taxis with both hands on the substance at each side of the neck. Should the body remain immovable, the probang may be removed, a small quantity of oil or gruel administered, and the attempt to push it downwards again resumed.

It has been recommended to employ the probang fitted with spring forceps (Figs. 349, 350) or with the corkscrew (Fig. 348) when the substance cannot be displaced by the ordinary probang, and is hard or sufficiently dense to be penetrated and held by the screw; and in certain cases this recommendation may be accepted, as the assistant can render much service in enabling these instruments to seize the substance by holding and steadying it until they get hold of it; if they cannot withdraw it, they may serve the very important purpose of crushing or breaking it, and so allowing

the fragments to be passed either up or down. When the obstacle is in the thoracic section of the œsophagus, it is obvious that the operator must be at a great disadvantage, and such cases are very serious if the obstacle cannot be easily moved through the diaphragmatic foramen into the stomach.

Ox.

In this animal choking is of comparatively frequent occurrence, not only from the fact that the œsophageal canal gradually becomes smaller from its commencement to the bottom part of the neck, but also from the kind of food given, more especially roots, such as turnips. The symptoms presented are similar to those shown by the Horse, with the addition of abdominal tympanites, which is rapidly developed, and is due to retention of the gases normally generated in large amount in the rumen, and which always escape through the œsophagus, but now distend the viscus and the intestines to such a degree as to produce suffocation if not liberated. This is achieved by the operation of rumenotomy (which see).

Operation.—If the foreign body is fixed towards the entrance to the œsophagus, it may be pushed into the pharynx by external taxis on each side of the neck, immediately behind the substance, the operator standing on the left side of the animal with his right arm over the neck, the head being left free. In this way the obstruction may be loosened and pressed forward. Or the mouth-gag is applied, and the hand, introduced into the mouth and pharynx, may seize the object and remove it, care being taken not to obstruct the larynx for more than a few seconds.

When the substance is lower down the neck, taxis should still be attempted, with the view of pressing it up into the pharynx, and making the animal swallow a small quantity of oil or other lubricant may assist in effecting this manœuvre. But it must be remarked that in practising taxis at any part of the cervical portion of the œsophagus, the greatest circumspection must be observed if the object to be removed is angular or sharp, otherwise serious injury may be inflicted. It should also be remarked that certain substances can be kneaded externally, and so worked with oil or gruel into a soft or yielding mass that it can be moved upwards. When the object is hard and in the upper part of the œsophagus, the wire snare already described may be tried.

If these measures fail, owing to the obstruction being too low down the tube or too firmly fixed, then the œsophageal sound or probang must be used if the substance is not likely to lacerate the walls when pushed downwards.

As with the Horse so with the Ox, an oiled whip-handle or a piece of rather stiff rope well greased, and passed through the mouth into the œsophagus, may be employed in cases of emergency when no better appliances are at hand. The tongue should be wrapped in a cloth and held to one side by an assistant, who

also keeps the mouth open while the rope or whip-handle is introduced.

But the usual appliances are a mouth-gag and probang, and, if need be, the œsophageal forceps.

The mouth-gag used for the Horse may be employed, but that for the Ox is usually a piece of wood with a hole in the centre

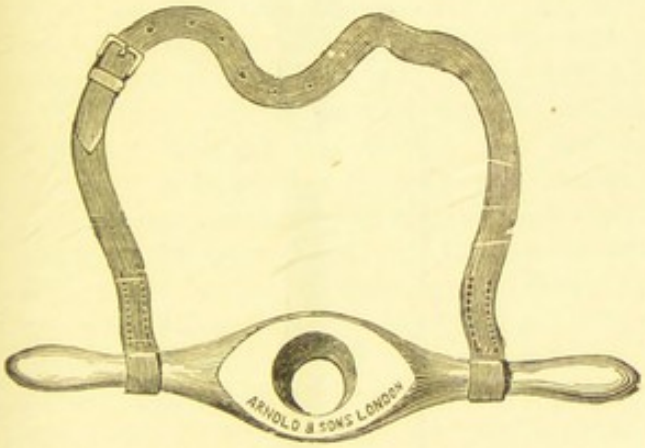


FIG. 345.—MOUTH-GAG FOR OX. (Ordinary Pattern.)

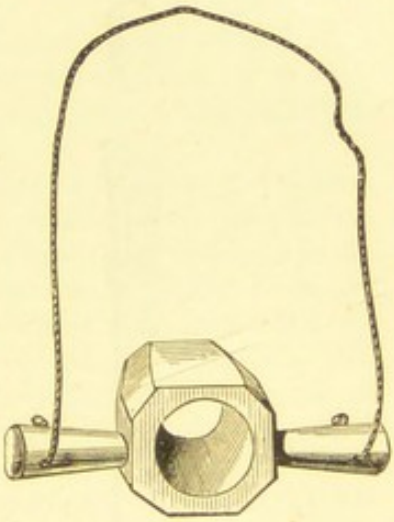


FIG. 346.—MOUTH-GAG FOR OX. (Armatage's Pattern.)

and a handle at each side, to which a cord or strap is attached, and which is passed over the head (Figs. 345, 346).

The ordinary probang is larger than that used for the Horse, and is similar in construction, being formed of spiral wire (Monro's pattern) covered with leather, and furnished with a cane stilette (Fig. 347). This probang may be fitted with a portable screw, or a special probang with that instrument fixed in it is used for

FIG. 347.—MONRO'S CATTLE PROBANG.

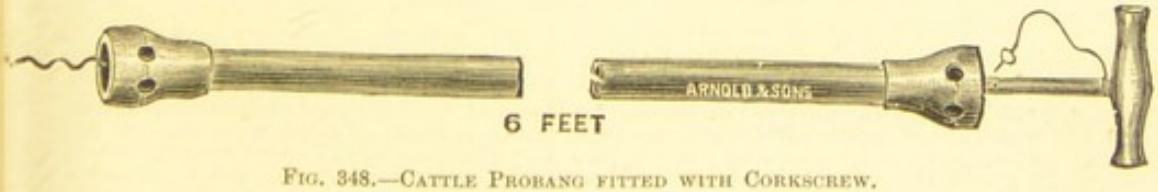


FIG. 348.—CATTLE PROBANG FITTED WITH CORKSCREW.

screwing into the obstruction (Fig. 348), and withdrawing it in the same way as a cork is extracted from a bottle. The forceps probang is safer and more useful, the forceps being concealed in the expansion at the end; when the obstruction is reached, the forceps is pushed out by the handle, and the jaws spring open around it; these being toothed or hooked, take a firm hold, which can be increased by slightly drawing back the handle.

A French model, Baujin's (Fig. 349), serves the double purpose of the ordinary probang and forceps probang by merely reversing the ends. This, like the preceding instrument, is a long tube formed by spiral iron or steel wire to constitute a flexible rod, which is covered with leather, having at one extremity the pro-

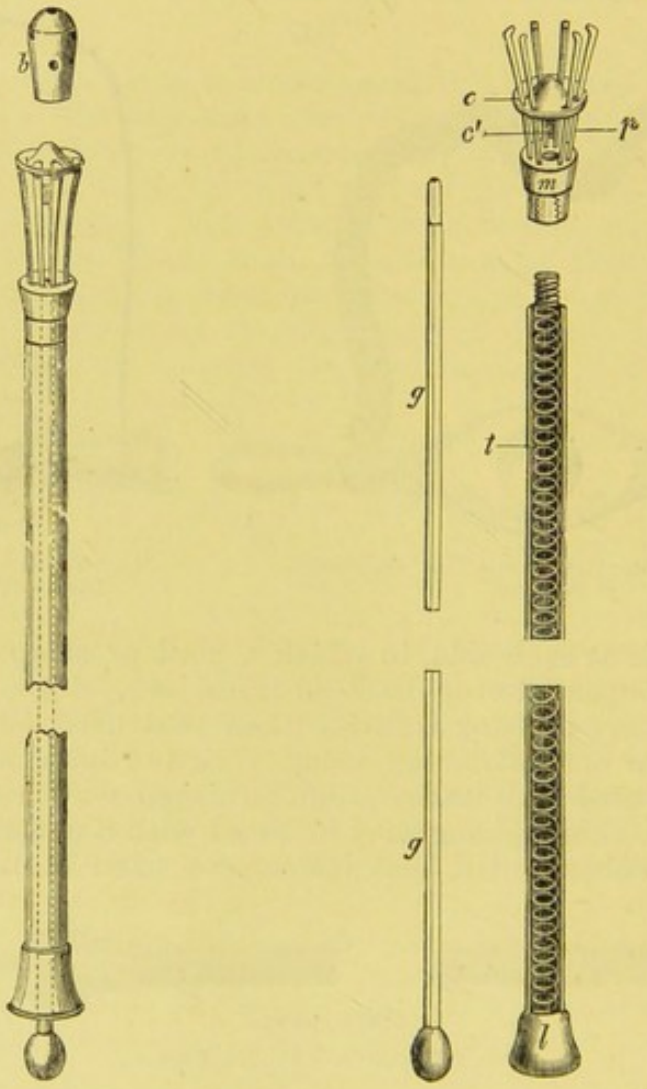


FIG. 349.—BANJIN'S CATTLE PROBANG.

A, Exterior of the instrument, with the end, *b*, unscrewed. B, Interior, showing a running ring which closes or relaxes the spring hooks around it, *p*, inside of which is the part for the sound, *b*, to be screwed on *c'*; *m*, the part into which the spring hooks are implanted; *g*, *g*, a flexible rod, one end of which screws on *c'*, the other having a ball, and which serves as a stilette lodged in the tube; *l*, a funnel-shaped expansion for pushing obstructing bodies onward; *t*, the spiral wire.

pelling end (an expanded hollow piece of metal), and at the other a metal screw fixed on the leather, on which may be screwed either a sound or a piece consisting of six hooks, which can be brought close together or widely separated by means of a ring that is acted upon by a long stilette screwed into this apparatus and moving freely inside the tube.

An English forceps probang (Fig. 350) is similar in principle, though only one end is utilised; instead of having six spring hooks, however, it has two serrated or toothed blades, that are acted upon by a rod moved inside the probang by a handle at the opposite end.

In Germany there is a forceps probang in use not unlike this—the model of Delves and Hertwig.

Position.—Standing, with the head extended in a line with the neck by two assistants, or, better, the head elevated to a convenient height by a rope round the horns and passed over a beam above the animal, the nose being extended.

Technic.—The mouth-gag is placed between the jaws and fastened behind the horns, the probang, well oiled, is passed through it over the tongue and carefully into the pharynx and œsophagus, avoiding the laryngeal opening immediately beneath that of the œsophagus, and entrance into which will immediately induce violent coughing and efforts to breathe. Entering the œsophageal canal, the instrument is pushed steadily on until it comes in contact with the obstruction, when it shcuild be more firmly, but intermittingly, pressed or tapped onwards; great force must not be employed. In the cervical region the hands of an

Fig. 350.—English Œsophageal Forceps.

assistant manipulating externally may assist in displacing the body; or the probang may be withdrawn after a brief attempt, the animal allowed to rest a few minutes, then some oil or gruel administered, and another trial made if there is any expectation of success. The movement of the obstruction is made evident by the progress the probang makes, owing to the diminution of resistance, and the final cessation of this when the end of the instrument enters the stomach. If there are indications, however, that the substance cannot be pushed onwards, or that it is dangerous to attempt this, then the corkscrew or the forceps probang must be tried.

The first is passed down to the obstruction like the ordinary probang, and when it is firmly placed against it, the handle is turned in the direction to project the screw into the substance, so as to obtain a good hold of it; the instrument is then steadily withdrawn, the hands of an assistant placed on each side of the œsophageal furrow aiding in carrying the mass up the neck.

The forceps probang is more likely to be effective in the removal of bodies, whether sharp or angular, solid or semi-solid, than the corkscrew, and, indeed, should be the first tried. It is passed down the œsophagus until the wide end touches the obstacle, the

handle being drawn back; on contact with the substance to be removed, the handle is pushed down by one hand, the other holding the probang, and attempts are then made to make the jaws now extended obtain a good hold; when this is effected, the hold may be tightened by pulling the handle out to a certain extent, and then the instrument can be withdrawn in the manner suggested when using the corkscrew probang.

It is taken for granted that there is time for these attempts to be made, and that the tympanites, which always begins early, has either not proceeded to a dangerous stage or has been relieved. If there is great inflation of the stomach and intestines, so that respiration is impeded, then rumenotomy should be performed before any attempt at catheterism is made. And even in cases in which abdominal distension is not serious when these attempts begin, and the obstruction cannot be readily removed, it is necessary to allow the gases in the rumen to escape by puncture of that viscus; then administer a quantity of gruel or oil, and wait for some time, as it has frequently happened that the obstructing substance has passed spontaneously into the rumen after a variable period.

If all these measures fail, and the obstacle is fixed in the cervical portion of the œsophagus, then recourse must be had to œsopha-

Fig. 351.—Calf Probang.

gotomy, an operation which will be described presently. But if the obstruction is in the thoracic portion, this operation cannot be resorted to, and little can be done except carefully administering oil or thick linseed gruel in small quantities at a time, and waiting for these to soften and disintegrate the substance, keeping the wound in the rumen open to allow the gases to escape as they are generated. A solution of veratrine subcutaneously administered might be tried, as it acts upon the muscular coat of the œsophagus, inducing spasms of its fibres.

Impaction of the œsophagus sometimes occurs in Calves, and must be treated in a similar manner; but the probang used is, of course, much smaller and shorter (Fig. 351), and the handling must needs be gentler.

Carnivora.

Foreign substances are more frequently lodged in the pharynx than the œsophagus of these animals, and the symptoms are usually well marked. Before operative procedure is adopted, if the obstruction cannot be removed through the mouth by means of forceps, a solution of apomorphine subcutaneously administered may lead to its dislodgment. If the substance can be felt in the neck, and it be not sharp or angular, taxis may move it upwards, or a wire snare may be passed down the œsophagus

from the mouth ; but a long probe or small catheter should not be employed to push the obstacle downwards unless it is smooth on the surface. As a last recourse œsophagotomy should be performed.

Pigs.

Pigs rarely suffer from choking where they are carefully fed ; but according to Möller, who quotes from Lothes, when they are roaming in great droves, and are fed on potatoes and roots, pieces of these frequently lodge in the pharynx or œsophagus. When fixed in the pharynx, they produce the usual symptoms, a very marked one being a screaming or shrieking noise instead of the natural grunt ; when in the œsophagus, vomiting is induced, and the offending substance may be dislodged during this act, but if retained tympanites ensues, which may lead to asphyxia. If the animals are lean, the substance may be felt in the region of the pharynx or neck, and assistance must be afforded timeously, though little can be done if the animal is fat. External taxis may move it into the mouth, or if in the pharynx or slightly below it, the wire snare or a blunt hook may succeed in drawing it forward ; if lower down, a small probang or flexible rod may push it into the stomach, mucilaginous fluids being given in small quantity at the same time. Under certain conditions, œsophagotomy can be successfully performed on the Pig.

Fowls.

Sometimes the crop of fowls, from various causes, becomes impacted with food, or with feathers or other foreign substances that remain there, and produce serious symptoms which may terminate in death, if this diverticulum of the œsophagus is not emptied. The crop is greatly distended, and may feel hard and nodulated. Pressing it gently and kneading its contents with the fingers, at the same time giving small doses of hydrochloric acid, as suggested by Zürn, may succeed in getting rid of some substances, but will be of no avail with others.

I have on several occasions successfully opened the sack by means of a sharp knife, and removed the contents (usually feathers) with forceps. The incision need not be large, and can be closed by several fine sutures.

2. Œsophagotomy.

This operation is resorted to when foreign bodies are so firmly fixed in the cervical portion of the œsophagus that they cannot be otherwise removed, or when, from their form, it would be dangerous to push them upwards or downwards, because of their lacerating the walls of the tube ; it is also performed on other occasions. Incision of the œsophagus has been successfully and repeatedly practised on the Horse, Ox, Dog, and Pig ; and the operation itself is not at all difficult, especially if the impacted body forms a prominence on the side of the neck. Otherwise, it

is well to remember the anatomy and relations of the cervical portion of the tube, which, for convenience of description, is divided into three sections—upper, middle, and lower.

It has already been stated that in the Horse, at its commencement, the œsophagus is immediately above or behind the trachea, where it is comprised between the guttural pouches and the posterior crico-arytenoid muscles; in the cervical region (Fig. 352) it is enveloped in an abundance of loose connective tissue, which lightly attaches it to adjacent organs, its relations to which vary

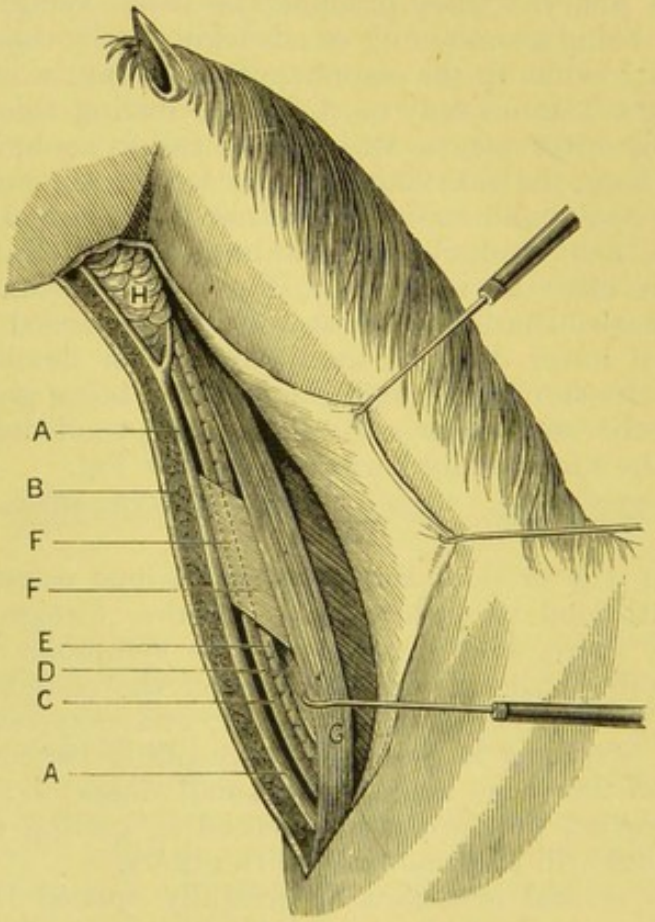


FIG. 352.—THE CERVICAL PORTION OF THE ŒSOPHAGUS, AND SOME OF ITS RELATIONS IN THE NECK. (After Peuch and Toussaint.)

A, A, Jugular vein; B, sterno-maxillaris muscle; C, Carotid artery; D, œsophagus; E, trachea; F, F, subscapulo-hyoideus muscle; G, mastoido-humeralis muscle; H, parotid gland.

on its course. Superiorly, to about the middle of the neck, it lies on the trachea, with the longus colli muscle above it, and on each side the common carotid artery and satellite nerves (pneumogastric, inferior laryngeal, and sympathetic), also the jugular vein; at the middle third it begins to deviate to the left, and this deviation becomes most marked in the inferior third, continuing in this position after its entrance into the thorax; at its lower third it has the trachea on its right or inner side, and occupies a sort of triangular space (apex forwards), formed above by the lower border of the subscapulo-hyoideus and laterally by the

sterno-maxillaris and inferior scalenus muscles, with the above-mentioned vessels and nerves, all of which are covered by the cervical panniculus muscle and skin.

In operating for impaction, the place selected must depend upon the seat of obstruction, and when this forms a prominence the incision may conveniently be made over it. Otherwise, if

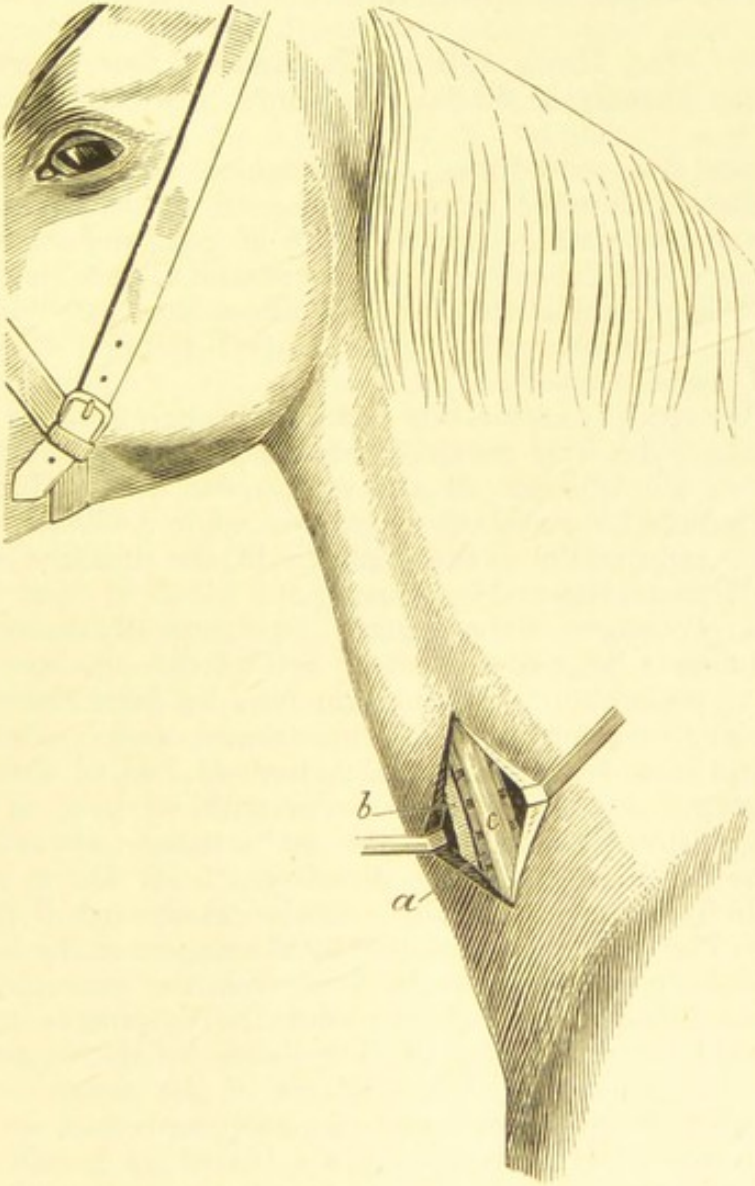


FIG. 353.—THE USUAL SITUATION FOR ŒSOPHAGOTOMY. (After Cadiot.)
a, Trachea; *b*, carotid artery; *c*, œsophagus.

there is any choice of situation, the incision is made on the left side, in the jugular furrow, about the junction of the middle and lower third of the tube, and slightly above and behind the jugular vein.

Instruments and Appliances.—A straight and a curved bistoury, grooved director, dissecting and longer forceps, handled tenaculum or aneurism-needle, suture-needle, and fine carbolised catgut.

Position.—The larger animal, can be operated on in the standing position ; the Horse, if necessary, with a twitch on the nose, and the opposite fore-foot may be held up, or one or both fore-feet can be secured by a line or hobbles, if the animal is inclined to be troublesome. The Ox can be secured by holding the head firmly and applying the 'bull-holder' to its nose; and the smaller animals may be placed latericumbent, and raised on a bench or table.

Technic.—The Horse will be the animal more particularly referred to, though a similar procedure will be suitable for the Ox.

There are two procedures, one of which aims at making a small incision directly through the wall of the œsophagus, dividing the obstructing body if it can be cut, and pushing the pieces up or down the tube; in the other, the tube is also incised, the wound being sufficiently large to allow the obstructing substance to be withdrawn through it. In both the first stage of the operation is the same.

First Procedure.—An incision is made through the skin—which may have had the hair removed from it for some distance previously—on the left side of the neck, near the border of the mastoido-humeralis muscle if possible, and immediately in front of or below and parallel to the jugular vein, the situation of which can readily be ascertained by causing the blood in it to flow up and down by pressure of the fingers. It is generally recommended that the incision be made above or behind the jugular vein, but below it is preferable. The incision may be from three to five inches in length, according to circumstances, and is most safely and promptly made by raising a transverse fold of skin of the requisite depth and snipping it across with scissors, or passing the curved bistoury through its base and cutting outwards. The panniculus is divided in the direction of its fibres, and the subscapulo-hyoideus muscle also must be cut through if it crosses the part. The wound is kept open by the fingers of the left hand, which also keep away the jugular vein while the connective tissue is cut through and that which surrounds the œsophagus is incised; there should be no tearing of this tissue by the fingers, as is generally recommended. The position of the carotid artery is ascertained by its pulsations, and the œsophagus can scarcely be mistaken, even when it is only slightly dilated by the obstruction, though it has not the same appearance in the dead animal that it has in the living one, in which it is flaccid, soft, and readily movable, though always pale. Being exposed either behind or at the side of the trachea, the fore-finger is passed round it and detaches it from that tube for a little distance, but no more than is absolutely necessary, and it is drawn outwards. Curved scissors may now be passed below it to keep it out, and a straight scalpel or tenotomy knife is passed into it lengthways, and into the obstructing substance—if this be potato, apple, turnip, or other similar body—nearly to the opposite side, though care must be

taken not to wound this. A curved or probe-pointed bistoury is introduced alongside the tenotome, which now serves as a director, until it reaches the opposite wall, when the tenotome is withdrawn, and the substance is divided by moving the edge of the bistoury against it in the easiest and most convenient manner.

The fragments of the substance can then be passed downwards by the hand or probang, or they may glide down spontaneously. The incision in the œsophagus is scarcely longer than the breadth of the knife, and it often heals rapidly.

Second Procedure.—This is carried out in the same manner, so far as the exposure of the œsophagus and its incision are concerned. The tube has in some cases to be carefully opened if the incision is not made immediately over the foreign body, or the shape of this is not favourable for a direct single cut through its wall. The curved scissors being placed behind and across the portion of œsophagus to be opened, this is held firmly against them by the thumb and first finger of the left hand while the knife in the right carefully makes a small longitudinal incision through the muscular and mucous coats; into this a grooved director is passed, the groove outwards, and along it the bistoury is run so as to enlarge the incision in the same direction to the necessary length. The foreign body is now removed and the wound sutured, the material being fine catgut. Some authorities are of opinion that the wound in the mucous membrane should alone be closed by suture; others advise that, after this is done, the muscular coat should also be dealt with in the same way; while others recommend that the skin wound also should be closed by strong silk or wire sutures. Much will depend upon circumstances, but it will generally be found that closure of the opening in the mucous membrane to prevent leakage is sufficient, as the wound in the muscular coat has a tendency to close spontaneously and at once. Suturing the skin is not very advantageous, as primary union of it is scarcely possible.

The operation should be performed as quickly, and with as little laceration and bruising as possible. Should there be a pouch at the bottom of the skin wound likely to lodge discharge, the wound must be enlarged downwards, so as to efface it. A bandage may be placed round the neck to keep the wound clean.

After-Treatment.—No food or water should be allowed for twenty-four hours after the operation, after which water and damp chopped hay may be given for some days; and if the wound is healing favourably, and there is no leakage of water or saliva between the sutures—which need not be removed—then pultaceous food in small quantities at a time can be ingested until recovery is complete, so far as the œsophagus is concerned.

The wound is to be treated antiseptically as far as possible, and should pus form, this must be got rid of by a counter-opening.

3. Operation for Fistula of the Œsophagus.

In consequence of foreign bodies in the œsophagus causing injury to its walls, as a result of disease or injury, or of the above-described operation, one or more fistulous openings may appear at any point of its cervical portion, and not infrequently after the formation of an abscess. The existence of œsophageal fistula is rendered evident by the escape of saliva, mucus, water, and sometimes fine particles of food mixed with these.

Operation.—Œsophageal fistula is often very difficult to cure, the difficulty being increased by its situation, as when in connection with the pharynx.

The animal should be well fed for some days, to enable it to dispense with food during a certain period after operation; the fistula should then be opened out by the knife, its track scarified, and, if necessary, the wound closed by catgut suture. If the situation renders the use of the knife hazardous, the fistulous track may be cauterised or treated with a strong solution of corrosive sublimate. A large layer of collodion should also be painted over the opening afterwards.

After-Treatment.—The animal must be compelled to fast for two or three days, its jaws being kept together by the strap muzzle, so as to check the secretion of saliva and hinder deglutition.

4. Operation for Constriction (Stenosis) of the Œsophagus.

Cases of constriction of the œsophagus in Horses are on record; it may be due to several causes, and it gives rise to difficulty in swallowing, impaction of the tube with food, and usually results in emaciation, debility, and death.

Operative treatment must largely depend upon the cause of the stenosis and its seat, and also whether it is due to internal contraction or external pressure. Passing the sound will fix its location with tolerable certainty; and if this is in the cervical portion, manipulation will ascertain whether an external cause, such as a tumour, enlarged gland, etc., is producing the stoppage in the tube. It may be possible to dilate the œsophagus at the narrow portion, if the constriction is owing to contraction of the tube itself, by passing a sound sufficiently small through it frequently and carefully, gradually enlarging the instrument as the lumen widens. An accessible tumour may be removed, and it may even be advisable to perform œsophagotomy if there is reason to believe that a growth, parasites, or any other cause, is fixed in the interior.

5. Operation for Sacculated Œsophagus.

The œsophagus sometimes becomes pouched or sacculated (*ectasia*) when the muscular coat has been ruptured, the lining membrane passing through the rupture and constituting an œsophagocele, into which fluids and solid food may pass. It

may be the result of stricture, of impaction, of laceration by the probang, or of external injury; it may also be very extensive, so as to form a large diverticulum that will contain some pints of fluid, and in other cases it is small and well defined, though it has always a tendency to enlarge. It occurs most frequently in the thoracic portion of the tube, and when it is observed in the cervical part it is usually towards the lower end of the neck. It is only in the region of the neck that it can be made amenable to surgical treatment, and here its presence is manifest, so that there need be no difficulty with regard to diagnosis; as after feeding it increases much in size, and gradually diminishes afterwards.

The animal usually feeds slowly, as deglutition is retarded, and there may be symptoms of choking from pressure on the trachea, while attempts at vomiting are sometimes witnessed, especially if the sac be manipulated when full; this may also evoke symptoms of dyspnœa.

Operation.—As mentioned, it is only when the œsophagocele is situated in the neck that operation can be attempted.

Position.—Standing or latericumbent, the latter being preferable, as the operation may be troublesome and occupy some time.

Instruments.—The same as for œsophagotomy.

Technic.—The procedure is the same as for œsophagotomy, so far as exposure of the sac is concerned. If the diverticulum is small comparatively, then the extruded mucous membrane should be carefully passed intact through the muscular rupture into the œsophageal canal. The edges of the muscle-wound are then to be brought together either by continuous fine catgut suture, or by a number of points of suture placed near each other. If the œsophagocele has been in existence for some time, it will be necessary to make the edges of the wound a little raw before applying the suture.

If the sac is very large and the loose mucous membrane difficult to return into the tube, or, when returned, if it is likely to hinder the passage of food, then the superfluous portion of the membrane should be excised and sutured with the fine catgut, and the opening in the muscular coat also closed by suture.

After-Treatment.—This will be the same as for œsophagotomy. Food must be withheld for two days and only water allowed, the strap muzzle being worn. A bandage should be applied to the wound in the shape of a glue or pitch plaster to support the sutures during swallowing; a thick layer of collodion will answer the same purpose, but whether this or the plaster be employed, it should afford support on both sides of the œsophagus at this point.

6. Operation for Rupture of the Œsophagus.

Complete rupture of the œsophagus may occur as the result of accident or disease, and can only be dealt with if it is in the cervical portion. Food and water become extravasated sub-

cutaneously, and may give rise to extensive inflammation, suppuration, and gangrene.

Operation.—This is similar to œsophagotomy, the procedure being modified according to circumstances—*i.e.*, whether the accident was due to an internal or external cause, the character of the wound, etc. After cleansing the wound—incising the skin if it is not an open wound—and getting rid of all foreign matters, the lesion is to be treated on the lines just indicated, and the after-treatment is to be the same.

7. Operation for Disease of the Œsophagus.

Disease of the œsophagus is rare in animals. Parasites sometimes locate themselves in its walls and give rise to tumours, which may impede swallowing; polypi, papillomata, melanotic, and other growths may arise from the surface of the mucous membrane, and extremely rarely the tube may be invaded by carcinoma. No rule can be laid down for surgical treatment in these cases, as so much must depend upon circumstances. Should it be necessary to open the œsophagus, this can be done according to the directions already given, and the same indications for after-treatment will hold good.

8. Œsophageal Catheterism.

This term is here applied more particularly to the introduction of a tube through the mouth and œsophagus to the stomach, to permit the escape of gases which have accumulated there, or for the passage of food, medicine, or other fluids. The Bovine species most frequently requires œsophageal catheterism.

Operation.—This is almost identical with that resorted to in cases of œsophageal impaction, in which a probang is passed into that tube; and the position, instruments, and appliances are the same, the probang being hollow and suitable for the species of animal.

Technic.—The head is raised and extended in the manner already described, and firmly held; the mouth-gag is inserted, and the operator stands before the animal with the sound—previously well oiled—in both hands; the tongue is partially withdrawn from the mouth by an assistant, and the sound is then passed into that cavity, carried up against its roof, and pressed through the pharynx into the œsophagus, down which it is made to glide steadily until it reaches the stomach. In Horses, and particularly if they are old, there is some resistance at the last portion of the tube, and this must be overcome without too much force. When the gastric cavity is penetrated, which is known by the cessation of resistance and the length of sound introduced, the stilette is withdrawn from the latter, and the gases escape. But the sound is often blocked by food carried into it by the gases, and the stilette must be passed through it whenever this occurs; even this, however, is not always sufficient, and then it is necessary to practise rumenotomy.

CHAPTER II.

OPERATIONS ON THE STOMACH AND INTESTINES.

Operations on the abdominal viscera are comparatively few in animals, when compared with the large number practised on mankind. There are several reasons for this. Disease of the viscera, especially that of a malignant nature, is much less frequent in them; the after-treatment of some operations, even if these are undertaken, cannot be satisfactory, because of the difficulty, if not impossibility, of carrying out aseptic or antiseptic measures so thoroughly as in human surgery; position cannot be fixed or controlled as in man, with whom the dorsal attitude is so valuable after abdominal operations, whereas the dorsicumbent position in all the domestic animals, though most desirable because of the great bulk and weight of the viscera in the Horse and Ox especially, is most unnatural, and cannot be maintained without violent struggles and straining efforts, for more than a few minutes; animal life is not so valuable as human life, and the expense of operations and their subsequent treatment only too frequently militates against their adoption; while a perfect, or even a useful, cure cannot always be guaranteed, and without this operations are not usually sanctioned. Human life is too sacred to be sacrificed, and suffering is not allowed to continue, if by operation the one may be preserved or the other alleviated, even if the patient remain crippled or useless to himself and the community for the remainder of his days; while many appliances, conveniences, and means for restoring him to usefulness or an endurable existence are at the disposal of the surgeon, but are not available for the veterinary surgeon.

Notwithstanding all these disadvantages, operations on the abdominal organs of animals are more frequently attempted now, and often with more successful results, than was the case a few years ago, and especially since the introduction of asepticism; for many veterinary surgeons have adopted this system, so far as it can be employed in their practice, and with great advantage; as it has enabled them to undertake operations which they previously would not have ventured upon—at least, with any hope of success; while it has given them confidence, which may lead them to attempt others that will rescue animals from suffering and inefficiency, or even death.

Laparo-Rumenotomy.

This operation is performed on Ruminant animals, chiefly the Ox tribe, for impaction of the rumen with food, or its dangerous distention with the gases given off by fermentation while its function is partially or wholly in abeyance, and these gases cannot escape by the ordinary channel, the œsophagus.

Gastrotomy might be the term employed to designate the operation; but the above is perhaps preferable, as only one division or compartment of the viscus is most seriously involved, the rumen. In the Ox tribe this is an immense receptacle, occupying nearly three-fourths of the abdominal cavity, and situated chiefly on the left side, where, when it is distended, it forms externally a great prominence between the angle of the haunch and the last rib, where it may be punctured or incised.

When the disengagement of gases is rapid, the symptoms are quickly developed. They are: uneasiness, breathing and pulse quickened, the superficial veins become enlarged, there is great abdominal distention of a tympanitic character at the upper part of the left side, though as it becomes more acute it extends to the right side. The breathing is quicker, shallower, and dyspnœa is more and more marked as inflation progresses, until the animal falls and dies of suffocation, if not relieved. Death often occurs in a very brief space.

The condition may be treated at the very commencement with internal remedies, or by œsophageal catheterism; but in acute cases these are not often successful, and as time is of great importance, it is generally advisable to resort at once to (1) puncture, or (2) incision of the rumen.

Fig. 354.—Trocar and Cannula for Tympanites in Cattle.

When the presence of injurious foreign bodies is suspected in the rumen, that viscus may be incised, and search made for them in its cavity, and even into the second compartment of the stomach.

Operation—1. Puncture.—The operation is very simple, and can be readily performed.

Instruments.—A large trocar and cannula (Fig. 354), or even a pocket-knife in an emergency.

Position.—Standing. The animal, if restless, may be held (right side) against the wall by an assistant, and, if likely to kick, the tail should be passed round the left leg and held firmly; the nose-clamp can also be applied.

Technic.—If there is time, the hair may be removed from the seat of operation, and the skin cleansed. The part for puncture may be anywhere between the angle of the ilium or haunch and the last rib, a few inches from the transverse processes of the tumbar vertebræ, on the left side. The operator stands facing that side, and either makes an incision through the skin at the part indicated—which is preferable, because of the thickness of the skin—or drives the trocar and cannula, previously oiled or wetted, directly through the skin into the rumen with a slight rotary twist; a smart blow on the handle with the open hand

may be necessary to effect penetration. The instrument should be passed to a considerable depth—as far as the shield if need be—and the trocar withdrawn, when the gas will escape with force, though the cannula may be frequently blocked by food passing

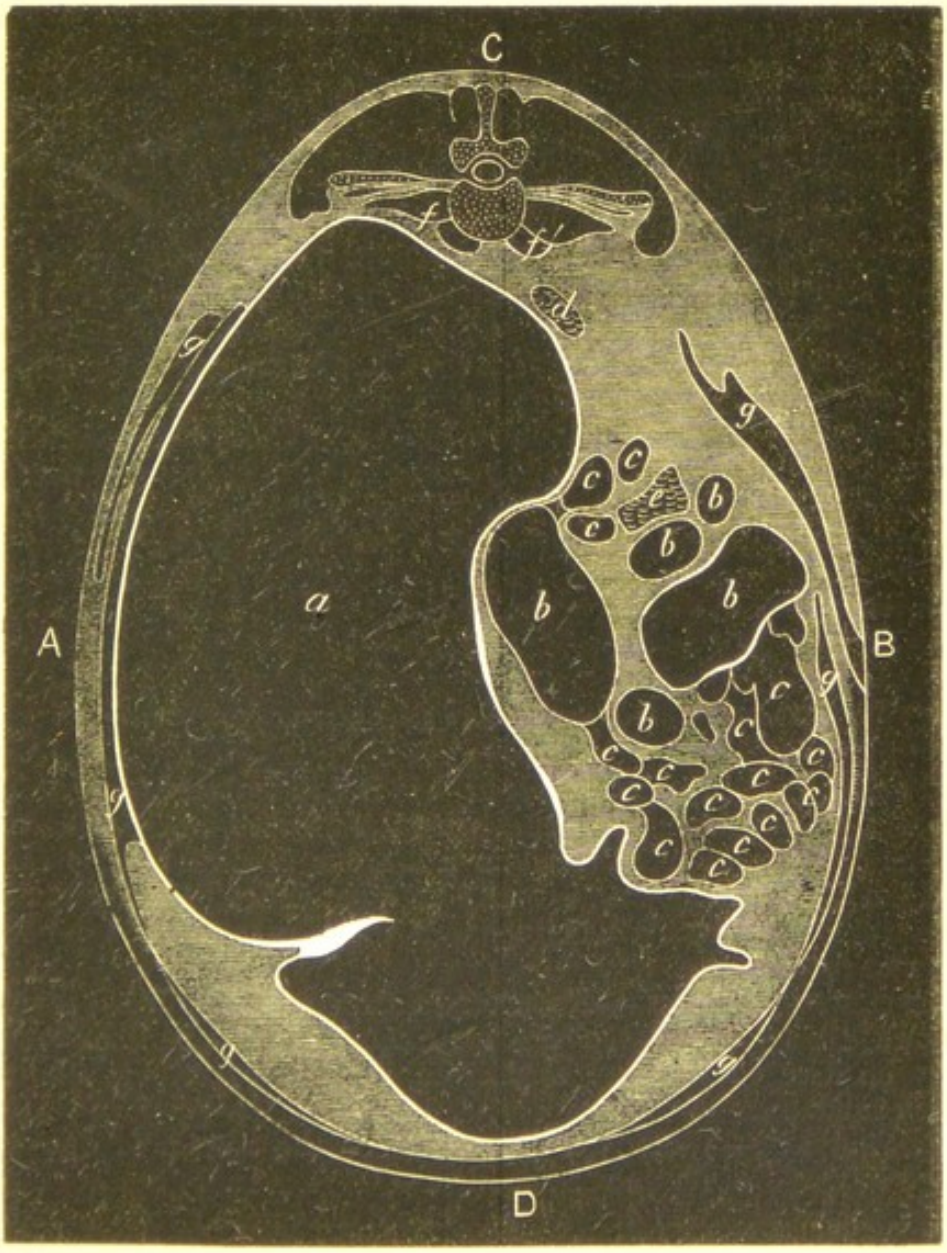


FIG. 355.—TRANSVERSE SECTION OF OX'S BODY BETWEEN THE LAST RIB AND ANTERIOR SPINOUS PROCESS OF THE ILIUM. (After Ellenberger and Baum.)

A, Left side; B, right side; C, dorsal region; D, ventral region. *a*, Rumen; *b*, colon; *c*, small intestine; *d*, gland; *e*, pancreas; *f*, psoas magnus muscle; *g*, abdominal muscles.

into it; this must be pushed back by the trocar, a long probe, or piece of stick.

The cannula remains in the rumen until the gas has escaped and the animal is relieved. Some cannulæ have a hole in each side of the shield, in which a tape is tied; the two tapes are

fastened round the body, and in this way the tube can be retained in the cavity for a long time; as the tapes become tense or unduly relaxed, however, according as the rumen becomes flaccid or the cannula becomes choked from particles of food, some practitioners pass a tape through the skin and over the shield at each side in the manner of a loop, which effectually retains the instrument in the wound.

Medicaments may be passed through the cannula into the rumen to fulfil certain indications—for example, when fluid, food, and gas are ejected through it like soap-bubbles, this condition can be largely remedied by pouring a quantity of ether into the instrument, so as to reach the cavity.

Sometimes subcutaneous emphysema is a sequel when the trocar has been introduced without first incising the skin; but this usually disappears in a few days. Abscess and peritonitis have also been reported as sequelæ; but these must be exceedingly rare, and due to some mismanagement.

When the only instrument to hand is a knife, this is held like a dagger, the back towards the vertebræ, and a stab made through the skin directly into the rumen. The wound should be sufficiently large to admit two fingers, which keep the lips apart,

Fig. 356.—Trocar and Cannula for Rumenotomy in Sheep.

and so permit the gas to escape; but it will be evident that this procedure is not so safe as that with the trocar and cannula.

The operation is performed in a similar manner in the Sheep and Goat, the trocar and cannula being much smaller (Fig. 356). The wool or hair must be clipped off the part where the puncture is to be made.

After-Treatment. — No after-treatment is required, as the wound soon heals when the cannula is removed. The wound may be dressed with an antiseptic, however, and especially if flies are about.

2. Incision.—When the distention of the rumen is due to a large quantity of fermenting food, and the cannula does not afford sufficient relief, then the organ should be incised to a sufficient extent to allow of much of the food being removed through the wound by means of the hand or duck-billed forceps.

Instruments and Appliances.—Bistoury or scalpel; suture needles and strong silk thread; duck-billed forceps or Bräuer's trocar and cannula, or both; a towel or piece of waterproof material; large suture or small seton needle, and tape.

Various trocars or gastrotomes have been devised to facilitate the removal of the food from the rumen, such as those of Brogniez, Sajoux, and Bräuer; but only the latter appears to have been much employed, because it is the simplest and easiest

managed (Fig. 357). It is a magnified trocar and cannula, the latter being so large that the food can be removed through it by means of duck-billed forceps; the cannula is made of thin galvanised iron, though it might be of steel, is oval in shape, being nearly five inches long, and about two inches wide at the top, and a little smaller at the bottom; while the stilette (similar in form) and its handle are of wood, the point being formed by two sharp steel blades fixed on it. If this trocar is not used, then it is well to have a towel, a large syringe, and water and sponges.

Position.—The animal is secured in the same position as for puncture of the rumen.

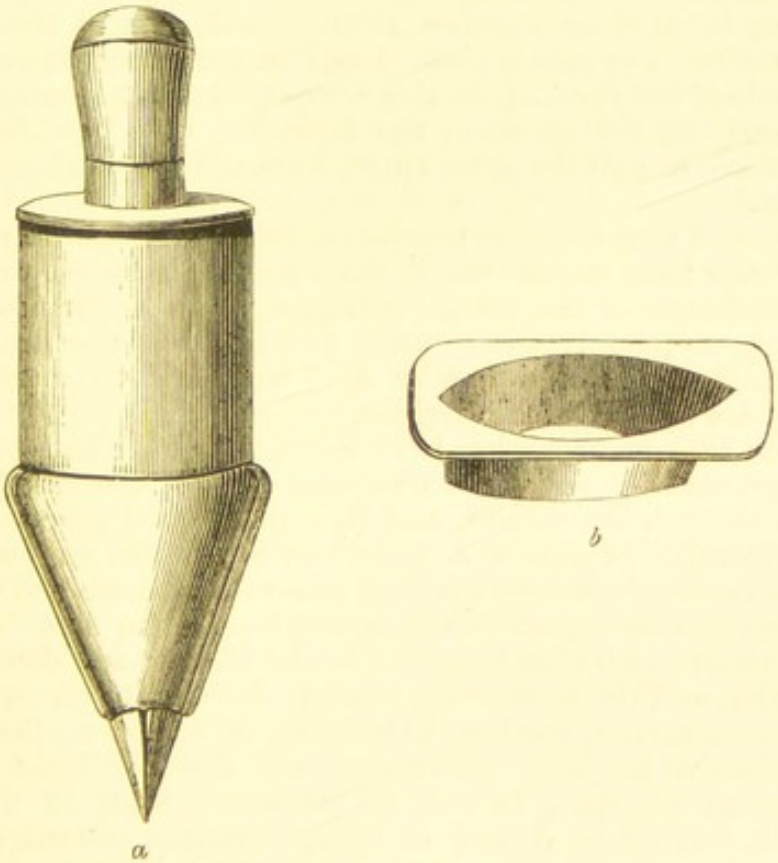


FIG. 357.—BRÄUER'S GASTROTOME.

a, Its trocar and cannula; *b*, sheath or collar.

TECHNIC.—If possible, the hair should be removed and the skin cleansed at the part to be incised, which is about the same place as, or a trifle higher than, that recommended for puncture of the rumen. The incision is to be made in the same way, with the back of the bistoury towards the spine, the knife being thrust deeply through the skin and muscles into the rumen, and drawn downwards so as to make a convenient-sized wound—say four to eight inches long—according to the size of the operator's hand, taking care to have the skin and muscle incision as long as, or even a little longer than, that in the rumen. When the operator is not very expert, or when the case is not very urgent, the skin may be first

incised, then the muscles and peritoneum, and finally the rumen, which then presses up through the opening and can be most readily penetrated. Gas and particles of food are usually forcibly ejected for a brief period, and as the former is inflammable, it is advisable not to have a light in too close proximity.

Before commencing to remove the ingesta, it is well to take precautions against portions of it escaping into the peritoneal cavity. One way to avert this troublesome accident is to pass a towel, or, better, a piece of thin waterproof material, partly into the rumen at the lower part of the wound, the other portion being left hanging out; another is to pass a narrow tape, by means of a large suture needle, through the skin, muscles, and rumen, so as to bring them close together at the lower part of the incision; and another is to pass a piece of tape in the same manner through each side of the opening, as this not only keeps the rumen close to the overlying tissues when the tapes are tied, but the ends of these serve to pull the sides apart, so that there is more room for the hand.

The hand now removes the food carefully and leisurely, as some authorities have stated that if the rumen is emptied too quickly there is danger of the animal collapsing. It is not necessary to empty it completely, for if about two-thirds of the contents are taken away the case generally does well, and the operator and patient are spared further fatigue.

When sufficient food has been taken out, if the patient requires it, a stimulant or any other medicine can be introduced into the rumen through the wound, and it is often good practice to pass in a quantity of salt and water—two or three gallons—which arrests further fermentation, and acts as a laxative and tonic.

When Bräuer's gastrotome is employed, the skin incision is made about five inches long, and in the manner and direction just described, and the instrument forcibly driven into the rumen by a hammer or mallet, the long axis being of course vertical. Then the stilette or trocar is withdrawn, and the food lifted out with duck-billed forceps. It will be perceived that, in using this cannula, there is no danger of foreign matters entering the peritoneal cavity.

The rumen having been emptied to the necessary extent, the wound, after being cleaned, is then to be dealt with when the temporary sutures have been taken away.

In cases in which foreign bodies are suspected to be giving rise to mischief in and from the rumen, the procedure is the same in opening it. Then the hand and arm are passed downwards and forwards into its cavity, and search made there, and also in the reticulum, which is situated towards the right side. When the body or bodies have been found and removed, or if the search has been fruitless, the after-procedure is the same. The wound in the rumen itself is to be closed by interrupted suture of fine catgut or silk thread, the sides of the wound to be turned inwards, so that the peritoneal surfaces may be in apposition;

this ensures prompt adhesion between them. Then the muscles may be sutured in the usual manner, and the wound in the skin left open, or muscles and skin may be brought together by strong waxed thread. It is sometimes advisable to apply a glue or Burgundy pitch plaster over all, to expedite healing and keep away flies.

After-Treatment.—Beyond care in feeding, little, if anything, requires to be done to the animal after the operation.

Sheep.

In Sheep a similar procedure has to be adopted, the wool being clipped off the part of the skin which is to be incised, and the incision made in the same place and direction as in the Ox; but the wound, of course, must not be so large, as it is better to dispense with passing the hand into the rumen, and to employ, instead, long duck-billed forceps or tongs, if the food is sufficiently solid to be lifted out by them, or a small ladle, or even a long-handled spoon bent at an angle near the wide end, the concavity of this being upwards, if the contents of the rumen are pultaceous.

Laparo-Gastrotomy.

Allusion will be made hereafter to operations on the abdominal wall; at present we will deal with those on the stomach and intestines, through the parietes of that cavity.

Hitherto operations on the stomach, with the exception of those on the first compartment of that organ in ruminants, and which have just been described, have generally been performed on small animals. The reticulum of the Ox has been explored by the hand being passed downwards and forwards to the right side of the rumen, after incision of the flank on the right side as for rumenotomy. Gastrotomy, however, has seldom, if ever, been practised on the larger domestic animals, and has only been most successful in the Dog, having been resorted to for the extraction of foreign bodies from the stomach.

Instruments and Appliances.—Those required for laparotomy, to be presently described, are sufficient. Appliances for carrying out antiseptic precautions as thoroughly as possible.

Position.—Latericumbent or dorsicumbent, according to the situation of the laparotomy—flank or lower aspect of abdomen. The latter is usually preferred.

Operation.—The animal is completely narcotised, and the abdominal cavity is opened after the skin has been shaved and cleansed. One or more fingers are to be introduced through the wound; in the larger animals the entire hand must be passed into the cavity. The stomach is sought for and carefully brought up to the wound, where it can be operated upon; but every endeavour must be made to prevent any of its contents passing into the peritoneal cavity. This is best effected by bringing the part which is to be incised outside the abdominal wall; to pre-

vent the bowels following, they should be held back by sponge or cloth damp with antiseptic mixture, as carbolic acid, 1 to 100. After removal of the foreign body, the wound in the stomach should be closed by continuous or other of the sutures to be immediately described, the viscus washed with antiseptic solution —as boracic lotion—and returned to the abdominal cavity, and the external wound sutured as in laparotomy. Over and around this external wound boracic acid powder or iodoform should be sprinkled, a single or double layer of cyanide gauze applied, a pad of lint, absorbent wool, or fine tow being laid upon this, and a wide bandage placed over the whole and rather firmly secured around the body. If it is considered necessary to establish drainage, this should be effected by cyanide gauze tampon, in preference to an india-rubber or glass tube.

After-Treatment.—No solid or fluid should be allowed to reach the stomach for some time, but a very small quantity of milk or beef-tea, to which a little brandy may be added, may be placed in the mouth by means of a sponge slightly saturated with it, reliance being placed upon sustenance administered per rectum by enema. After four or five days, small quantities of easily-digested fluid or semi-solid food may be given by the mouth, and a frequent but very limited allowance of tepid water to drink. If the animal be a Dog, it is advisable to have it muzzled immediately after the operation is completed, to prevent its tearing off the bandage and disturbing the wound. The muzzle should be worn until the wound is healed. The wound itself, if it has been properly sutured and dressed, need not be disturbed for two or three days, when it may be again treated antiseptically and the bandage reapplied; it should be kept as dry as possible.

Gastrostomy.

This operation, which consists in attaching the stomach to the abdominal wall—the parietal peritoneum only by preference—with the view of making a more or less permanent opening into the organ, so that nourishment may be passed into its cavity when food cannot reach it through the œsophagus, has not yet, so far as I am aware, been resorted to for this purpose in animals; it has, however, been practised on them with experimental objects, and it might happen that it would be necessary to perform it in order to preserve life. It will therefore be briefly described in outline, the principles being applicable in the case of large as well as small animals.

Instruments.—The same as for abdominal section.

Position.—This will be latericumbent or dorsicumbent, the former if laparotomy is to be practised at the flank, and the latter if on the lower part of the abdomen.

Operation.—The skin and abdominal muscles are incised to the extent of two to four inches, according to the size of the animal, all possible antiseptic precautions having been adopted.

The parietal peritoneum is cut through to a slightly less extent, and the stomach is sought for by one or more fingers; when found, it is wholly or partially drawn out and held by an assistant, while the operator attaches it to the peritoneum, all round the opening in that membrane, by means of sutures. These may be Halsted's sutures, each of which is in the form of a blanket stitch, passing in a radial direction through the peritoneum, then through a quarter to half an inch of the stomach wall, and back again through stomach and peritoneum; it is then tied and the ends cut short. Each stitch is placed from half an inch to an inch apart, the number required depending upon the size of the organ or the opening in the peritoneum. A guiding suture may be placed in the middle of the exposed portion of the stomach, and the skin wound may be lessened by one or two sutures. The organ is then put back into the abdomen without straining the sutures, the wound being packed with antiseptic gauze. The stomach retracts considerably, dragging with it the peritoneum; in three or four days, however, when the gauze is removed, it is readily accessible, and an opening is made into it at the part indicated by the guiding suture, by means of a scalpel or tenotomy knife, the opening being made the required width with the assistance of a director. The width will, of course, depend upon circumstances, but it need not be large if only a catheter is to be fixed in it for the passage of fluid food or medicaments. The catheter is securely fixed in the stomach by tying it to the guiding suture.

Attaching the stomach to the parietal peritoneum only is preferable to suturing it through the entire thickness of the abdominal wall, as it forms a firmer adhesion, returns to its normal position, dragging with it a funnel-shaped portion of parietal peritoneum, which has a great tendency to contract, and so prevent the escape of stomach contents; the stitches also, not passing through the skin and muscles, are not liable to become septic, and may therefore be left in permanently, to serve as a support to the adhesions between the stomach and peritoneum. Deferring incising the stomach for three or four days after suturing it to the peritoneum also obviates risks of wound infection.[1]

If a catheter is not inserted in the stomach, the fluids that escape, gastric or other, will tend to irritate the wound and cause trouble. This may be considerably, if not entirely, obviated by adopting a plan which has been successfully carried out in cases of gastrostomy in the human subject,[2] in which the opening was seldom larger than a sixpenny piece. A circular disc of sheet india-rubber, the thickness of a shilling, and nearly twice the diameter of the orifice to be closed, has a strong silk thread passed through it by a needle a little to one side of the centre, and back again a short distance from the first puncture, so that the two ends are parallel, these being six inches long. The disc is rolled up, held lengthways in a fine pair of dressing forceps, and introduced into the interior of the stomach, where, being

[1] *British Medical Journal*, October 24, 1896. [2] *Ibid.*, June 6, 1896.

released (the ends of the thread are held outside), it assumes its original shape. By drawing the strings the disc is lifted up against the mucous membrane, and prevents anything passing through ; it can be so kept by tying the threads across a roll of lint, or piece of wooden pencil, or a goose-quill placed over the external orifice, with sufficient firmness to keep the roll close on the skin. When fluids are to be introduced into the stomach, the threads are untied and held, the roll removed, and the disc pressed back into the stomach by means of a probe or director.

Should it be desired to close the wound after gastrostomy, a similar procedure will suffice, the plate being allowed to remain without disturbance. It would be advisable, however, to have this made of some substance, as gelatine, which would in time dissolve in the stomach. There might be several threads or plated wires passing loopways through the disc, and this being placed and drawn up in the stomach in the manner just described, the margins of the fistula could be made raw by paring them, which will necessitate pulling out the organ to some extent ; on this being put back, with a handled curved needle each wire is threaded separately, and carried through the coats of the stomach and abdominal wall from within outwards close to the edge of the opening. In this way one row of sutures passes through one side of the opening, and the other row through the other side, so that the edges can be brought together and the sutures tied externally. In this way the opening is completely closed by what is practically a button suture, the button being in the stomach. When sufficient time has elapsed the suture can be cut and withdrawn whole, the plate being dissolved, or, if insoluble, got rid of by vomition or through the intestinal canal.[1]

Enterocentesis.

The simplest operation on the intestines is that of puncturing them through the abdominal wall for relief in cases of tympanites in Solipeds, though it is attended with more risk of accident, and even of danger, than puncture of the rumen in the Ox. The risk is also greater if the intestine be punctured through the rectum, as is sometimes done, or even through the vagina. In cases of strangulated intestinal hernia, inguinal or ventral, when gases have formed in the strangulated portion to such a degree as to prevent reduction, puncture is resorted to for their escape. But the operation is most frequently practised in cases of intestinal inflation due to indigestion or obstruction, the portion of intestine punctured being either the cæcum or colon, and the seat of puncture is generally the right flank, though the left may also be selected under certain circumstances. As mentioned, the distended viscus may also be pierced through the rectum or vagina, but there are serious drawbacks to the selection of these situations. We will therefore chiefly treat of the operation as performed from the external surface of the abdomen.

[1] *British Medical Journal*, July 4, 1896.

The operation is only resorted to in urgent cases, when the distention of the large intestines is so great as to lead to impending suffocation, by pressure on the diaphragm and fixation of the asternal ribs, marked by hurried, shallow respiration, distress, and unsteady gait; the abdomen is greatly distended, particularly in the region of the flanks, and the animal rarely lies down because of the difficulty in breathing, though the restlessness may be as extraordinary as in spasmodic colic. To prevent a fatal termination, evacuation of the gas must be early and quickly effected, and as remedies are slow in removing what may be the cause of fermentation, this measure relieves the urgent symptoms, and permits of time for medicines to operate.

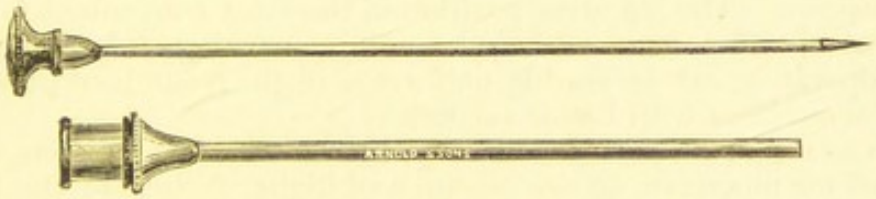


FIG. 358.—STRAIGHT TROCAR AND CANNULA FOR PUNCTURE OF THE INTESTINE.

FIG. 359.—CURVED TROCAR AND CANNULA FOR PUNCTURE OF THE INTESTINE.

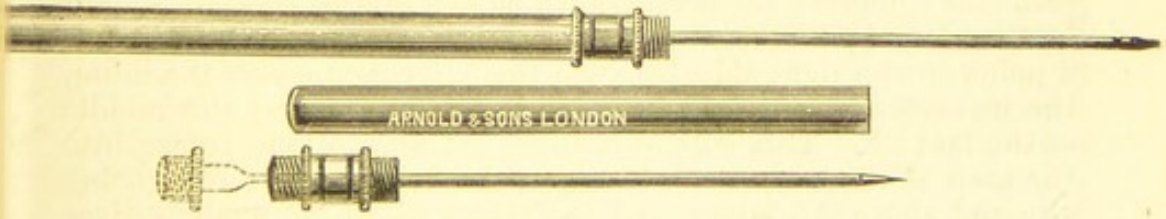


FIG. 360.—IMPROVED TROCAR AND CANNULA FOR ENTEROCENTESIS.

Instruments and Appliances.—As the operation has usually to be hurriedly performed, without the opportunity for making special preparations, the instruments are limited nearly always to a trocar and cannula, and perhaps a bistoury in addition. But, if possible, scissors or a razor, a disinfecting sponge, a little ether or alcohol, iodoform, and collodion or pitch plaster, should be available, as well as soap and water. A twitch may be required.

With regard to the trocar and cannula, these should be combined in an instrument measuring, excluding the handle, about six or eight to ten inches in length, and about one-third of an inch in diameter if round; some operators prefer it a little flattened in shape, and instead of being straight (Fig. 358), others like it slightly curved (Fig. 359). An improved instrument (Fig. 360)

has the point of the trocar spear-pointed, so that the perforation in the intestine is only a fine slit, much smaller, and likely to heal more rapidly, than that made with the ordinary trocar. It is also longer than the ordinary trocars, so as to ensure its passing for some distance into the bowel. The cannula has likewise a very fine bore, sufficient to allow the escape of gas, but less liable to become choked than a larger bore would be. The instrument has a cap or cover to protect the point from injury when not in use.

The instrument should be kept scrupulously clean, in order to avoid unfavourable *sequelæ*, and to ensure this it should be boiled for a few minutes before being used, when it may be made warm; after use it ought to be again cleansed, and washed in carbolic or boracic solution.

Position.—The standing position is the most convenient for the operator, and is that which the animal usually maintains; but the operation can be readily performed in the recumbent position, and sometimes with better success.

Operation.—The right side is, for anatomical reasons, preferred for puncture, as the cæcum and higher flexure of the large colon are in that situation, and to these the gas ascends; whereas on the left side the low-lying flexure of the colon is likely to contain more fæculent matter. The operation has been performed in various places in the region of the flank when gas does not escape after one puncture, and generally with impunity, owing to the extremely distended condition of the large intestines; but the normal situation of these viscera indicates where enterocentesis is most likely to be successful (Fig. 361). High up on the right flank the distention is generally most marked, and tympanitic resonance loudest on percussion; where this is greatest should be the seat of puncture. As a rule, the instrument is inserted at a point on the right side, between the external angle of the ilium, the transverse processes of the lumbar vertebræ, and the middle of the last rib. This will ensure the entrance of the trocar into the arch of the cæcum or, if lower, the colon; the former being situated above the latter, and the viscus whose evacuation gives the best results. If the left side is selected, the puncture should be made much lower—almost in front of the stifle, in fact. It may be necessary to apply a twitch to the nose to steady the animal, and it may also be advisable to have the fore-foot on the same side held up, to prevent injury to the operator.

If there is time and opportunity, the skin at the seat of operation should be prepared by clipping or shaving off the hair, washing well with soap and water, and rubbing with ether, then with carbolic solution.

Technic.—It is advisable to make a small opening through the skin by means of the bistoury or rowelling scissors, as this facilitates the passage of the trocar. This incision may be made immediately over the part to be punctured, or the skin may be drawn to one side of it and the incision practised, so that the abdominal wound will be covered by intact skin when the cannula is withdrawn.

The trocar is inserted into the incision and held perpendicularly in the left hand; with the palm of the right hand a smart

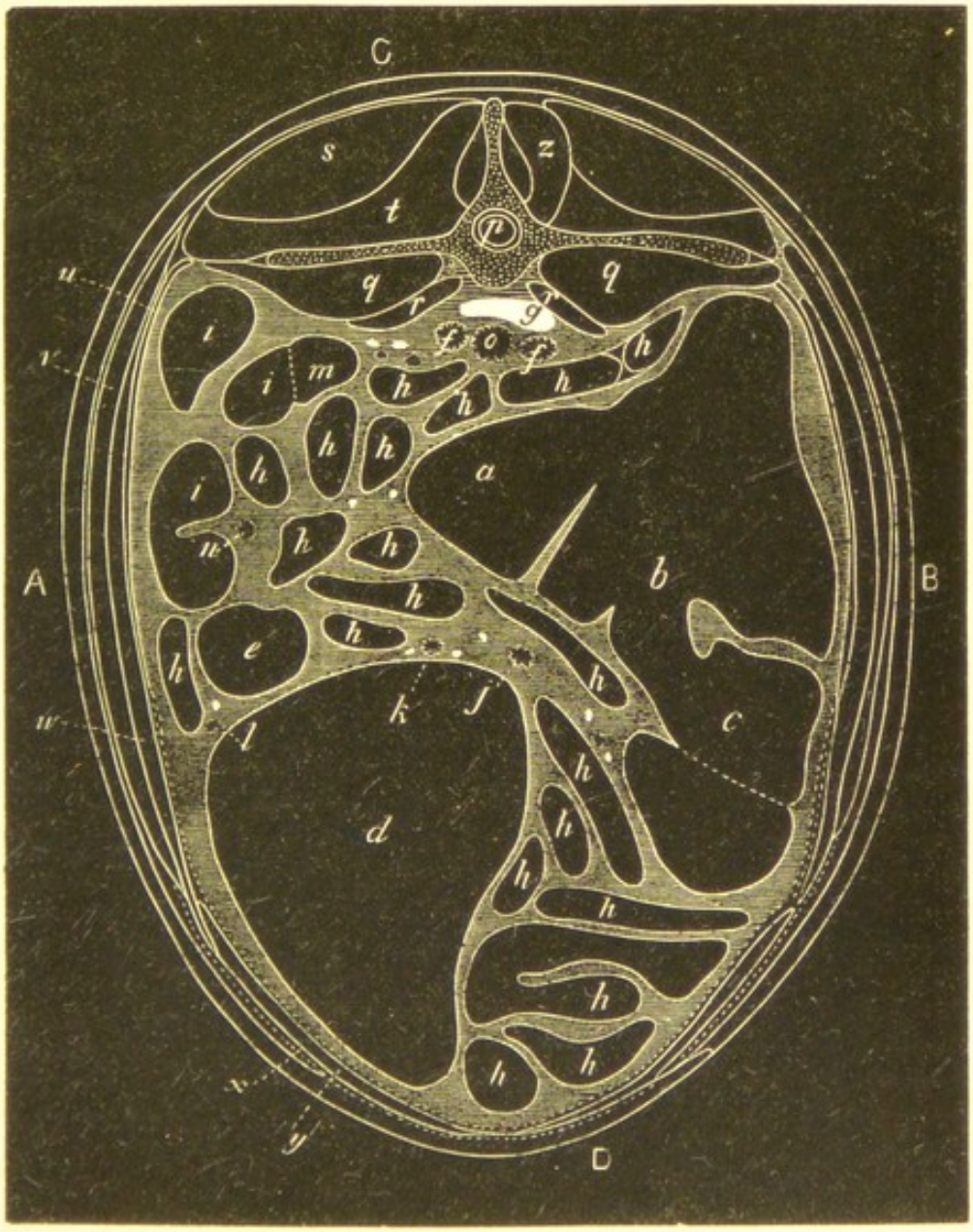


FIG. 361.—TRANSVERSE SECTION OF HORSE BETWEEN THE LAST RIB AND ANTERIOR SPINOUS PROCESS OF ILIUM. (After Ellenberger and Baum.)

A, Left side; B, right side; C, dorsal region; D, ventral region. *a*, cæcum; *b*, *c*, right flexures of colon; *d*, left flexure of colon; *e*, transverse colon; *f*, femoral artery; *g*, posterior vena cava; *h*, small intestine convolutions; *i*, rectum; *j*, colic artery; *k*, inferior colic artery; *l*, superior colic artery; *m*, rectal artery; *n*, small mesenteric artery; *o*, aorta; *p*, lumbar vertebra; *q*, psoas magnus muscle; *r*, psoas parvus muscle; *s*, gluteus medius; *t*, longissimus dorsi; *u*, transversalis abdominis; *v*, obliquus externus abdominis; *w*, obliquus internus abdominis; *x*, panniculus carnosus; *y*, rectus abdominis; *z*, semispinalis.

blow is given on the top of the handle, so as to drive the instrument some inches—three to five—into the cavity of the intestine; the trocar is then withdrawn steadily by the right hand, and the

gas escapes through the cannula with a hissing sound; the tube is kept in the viscus until the tympanites has been dispelled.

If no gas escapes at the first puncture, a second may be made a short distance lower or higher, though care must be taken not to go too near the kidney; or if the exit of gas is checked by fæces getting into the cannula before the distention is sufficiently reduced, the trocar may be pushed into the tube again, or a probe, quill, or twig inserted in order to clear it. When the gas has been evacuated, the cannula is removed slowly by a slightly rotatory movement, great care being taken that no foreign matters escape into the peritoneal cavity or into the tissues beneath the skin.

In cases of torsion of the large intestine, when tympanites may be very great, hæmorrhage often takes place into the viscus, and instead of gas escaping, blood flows from the cannula. Such cases may be regarded as hopeless.

As has been remarked, enterocentesis may be performed through the wall of the rectum, but this is neither so easy nor so safe an operation as the one just described. To do it, the rectum is emptied of fæces for a considerable distance, then the oiled hand, armed with the trocar and cannula, the point of which is guarded by the fingers or by a small piece of cork, which can be readily rubbed off when required, is passed well into the rectum and clear of the pelvic cavity; when it has reached the desired spot, the point of the instrument is uncovered, and pushed downwards and rather outwards to the right. When it has penetrated some inches, the trocar must be withdrawn by the fingers, the cannula being still pushed downwards, so as to leave more room for the trocar to leave it. The trocar is removed from the rectum, its point still covered by the fingers, and the hand being again introduced, it holds the cannula, and moves about the distant end if needed, until a sufficiency of the gas has escaped, when the tube is taken away.

After-Treatment.—In the majority of cases no after-treatment is required, though to ensure a rapid recovery it may be well to dress the wound in the skin, cleansing it and powdering it with iodoform. It may be covered with a piece of adhesive plaster.

Complications do, however, occur, especially if asepsis has been neglected, or the operation has been improperly performed. The bowel has been torn; hæmorrhage has resulted from the trocar wounding a bloodvessel; abscess has formed at the seat of puncture or below it; peritonitis or septicæmia has occurred; and subcutaneous emphysema has even been observed. But these are very infrequent accidents, and may be attributed chiefly to carelessness in operating, or the neglect of antiseptic precautions, and must be treated, when recovery is possible, according to their indications.

Enterotomy.

Incision of the intestines has been frequently practised in the Ox and Dog for the removal of obstructions, and the operation has been followed by recovery. In the Horse, however, it has been generally unsuccessful, probably because it was resorted to when too late, and perhaps also because antiseptic measures were neglected or imperfectly carried out. When performed early and under favourable circumstances, success might be anticipated in a fair proportion of cases, even in the Horse; though it offers better prospect of a favourable result in the smaller animals.

The cases that demand operative interference must depend upon circumstances which the veterinary surgeon will have to carefully consider before arriving at a decision, and in some instances this decision will have to be made without delay after a satisfactory diagnosis has been made. In the words of Macqueen, 'Abdominal diseases amenable to surgical treatment, with few exceptions, may be diagnosed in Dogs by manipulation, in Cattle by rectal exploration or by rumenotomy, but in Horses diagnosis is extremely difficult. The size, disposition, and relations of the viscera, and the common symptoms they provoke when diseased, give little hope of greater accuracy in diagnosis so long as only current methods are pursued. In the future, exploratory incision may be reasonably expected to give some assistance. When it has been shown that the peritoneum can be opened without risk to the patient, or without adding to the gravity of the disease that may call for relief, present difficulties will diminish, and in time perhaps disappear. This view, in face of past and present practice, may be too sanguine; but with anæsthetics to suspend movement, and antiseptics to prevent contamination of surgical wounds, expectant treatment and dangerous delay may yet give place to more active measures.

'Assuming that cases of volvulus, invagination, internal herniæ, and obstruction by bands, pedunculated tumours, or by concretions, can be treated by surgical interference, the question arises: How may these conditions be distinguished from other abdominal affections? At once I confess my inability to give a satisfactory answer. The history of the patient; the character of the pain, whether intense and continuous, or subacute and intermittent; distention, local or general; constipation, persistent or interrupted; the action of eserine; the posture of the patient; backing; straining; the quantity of urine passed; the rejection of clysters; expulsion of flatus; and the symptoms sometimes afforded by palpation, percussion, and auscultation, merely suggest a possible cause—all are fallacious and unreliable in the diagnosis of the diseases just mentioned. If examination *per rectum* gives more assistance, it does not always yield satisfaction. The height of the operator and the length of his arm should be considered, as well as the state of the horse's bowels. In a healthy horse, fifteen hands high and of medium coupling, the

hand may reach the cœliac axis and the last rib. In a long-loined sixteen-hands carriage-horse, lying on his right side, I have felt without difficulty the border of the spleen, the last rib, and the left kidney; but in the standing horse I have never reached the spleen. Experiment warrants the assertion that an imaginary vertical plane falling from the first lumbar vertebra to midway between the xiphoid and umbilicus represents the forward limit of rectal exploration. Employing the left hand for the right half and the right hand for the left half of the abdomen, all the viscera behind this boundary may be examined more or less satisfactorily in the healthy horse. In abdominal disease, especially in obstruction, the intestines are often crowded towards the pelvis, and frequently the hand cannot pass onwards in consequence of straining and pressure from distended bowels. But when the hand has reached the flank it may, and sometimes does, discover displacements, volvulus, or invagination; recognise and remove concretions; ascertain the condition of the contents of the colon, cæcum, floating colon, and small intestine; and in herniæ distinguish and liberate omentum and bowel. Cases that give no sign to exploration are uncommon, and without this precious aid diagnosis, whether positive or negative, is doubtful. In this, as in other diagnostic efforts, the spirit of the practitioner dominates procedure. With faith in possibilities, rectal exploration may be tried again and again, and information may be gained at every investigation.'

With accidental wounds of the intestines, there cannot be much difficulty in deciding what ought to be done in the way of operation, as this will depend to a considerable degree on the nature and extent of the lesions. The same remark applies to the extraction of foreign bodies, and to the presence of disease, displacement, etc. If an incision has to be made, this should always be, whenever possible, in the direction of the long axis of the intestine, and not transversely.

Instruments and Appliances.—These will be the same as for laparotomy (which see), with the addition of spring and dressing forceps, straight and curved suture needles, a number of milliner's needles—straws No 5—to stitch intestine, Chinese silk twist (No. 1). For intestinal suture silk thread is to be preferred, because of its being easily rendered aseptic, and also because of its softness, flexibility, and toughness. It should be well stretched by winding it on a small ruler, boiling it in water for some minutes, stretching it again in the same manner, and then placing it in a 5 per cent. solution of carbolic acid. Black thread may be considered more advantageous than white, as it is more easily seen. All the instruments employed should likewise be rendered aseptic. These may vary, according as the animal is large or small, and special instruments will be needed for certain purposes, such as a small trocar and cannula to puncture the intestine.

Aseptic indications must be carefully observed throughout.

Position.—This will depend upon the animal operated on, but it must be dorsicumbent or latericumbent. If the latter, the side to be uppermost must depend upon circumstances connected with the anatomy of the part, and the cause for operation. The abdomen is opened at the flank, or near the linea alba, and parallel to it.

Operation.—The animal is rendered partially or totally unconscious; the latter is the more desirable. The skin, after being shaved and cleansed, is incised to the necessary extent, together with the subcutaneous tissues and peritoneum. The portion of bowel to be operated upon having been exposed, is opened. The part at which the incision is made will, of course, depend upon circumstances. Macqueen, in operating upon the Horse, gives the following directions: Pass a large sponge, wrung out of a 2½ per cent. warm carbolic solution, into the abdomen, and get tarlatan ready. Pass the hand into the abdomen, bring out the bowel, and hold it gently until the assistant has placed pieces of tarlatan, moistened with warm carbolic solution (2½ per cent.),

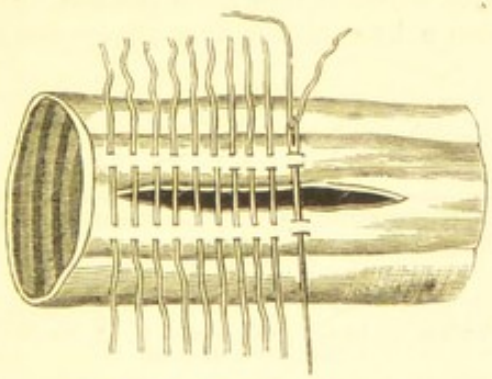


Fig. 362.—Lembert's Suture.

around the wound. This done, let him (the assistant) take the bowel between his fingers, applied like clamps, the hands resting, one in front, the other behind the wound. Incline the bowel towards the Horse's thigh, and slit the free border with scissors; remove contents, and wash its mucous lining.'

The precedure may require to be varied somewhat, but the above is an outline of the course that ought to be adopted. The incision should be made in the direction of the long axis of the intestine, and its extent will depend upon the cause for it; if it be a calculus, concretion, or other foreign body, the opening should be sufficiently wide to allow it to be extracted without lacerating the borders of the wound.

When the intestinal wound is to be closed, the operator has a choice of bowel sutures, either of which he may employ as he thinks fit. We will briefly describe them, but before doing so it may be repeated that the Chinese silk twist No. 1, prepared as already described, is best adapted for closing intestinal wounds.

Lembert's Suture (Fig. 362) is perhaps the one most ferquently employed. In this the suture is passed through the

serous and muscular coats, as well as the submucosa, for a reason to be given hereafter, though this tissue is not included by Lembert, Joubert, and others; the mucosa is exempted. The needle is entered vertically about one-fourth of an inch from the margin of the wound, by gentle pressure on its blunt end with the pulp of one of the fingers, then pushed through the above-mentioned textures, carried along about an eighth of an inch beneath them, and brought out at the same distance from the wound, which it is carried across, and reinserted at an eighth of an inch from the border, carried beneath the same textures for the same distance, and made to leave at one-fourth of an inch from the wound. The thread is then cut, and the same procedure adopted for the other sutures, which should be placed one-eighth of an inch apart. When all the sutures are applied, they are tied separately, the ends being cut off near the knots. It may be observed that instead of the sutures being tied separately, the wound may be closed by one continuous suture applied in the same manner, forming what is called the 'square' or 'quilt' stitch; the thread, instead of being cut from the needle when it has been passed through both sides, being made to form a like stitch at a short distance, then passed

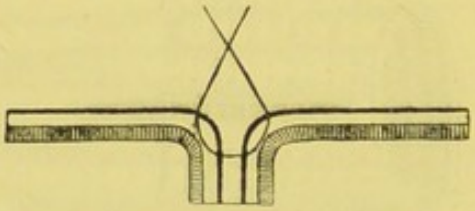


FIG. 363.—APPOSITION OF PERITONEAL SURFACES OF MARGIN OF WOUND BY LEMBERT'S SUTURE.

to the side from which it started, and so on until the end of the wound is reached. Or when it has been passed across twice it may be cut, and the two ends tied on the same side; this certainly constitutes it a multiple suture, but then the ties are only half as numerous as in Lembert's method. In drawing the edges of the wound together, these should be inverted, so as to bring the serous membrane on each side into immediate apposition (Fig. 363), and so as to effect rapid union.

JOUBERT'S SUTURE is sometimes employed, though it is not so good as Lembert's, because it passes through the mucous membrane of the intestine. Yet there are occasions when it may be useful. The needle is passed obliquely through the wall of the intestine from without inwards, so that it enters about one-third of an inch from the margin of the wound, and emerges about one-eighth of an inch; it passes through the opposite side at one-eighth of an inch from the wound, and comes out on the surface a little beyond this. The sutures are placed about one-fourth of an inch apart, and successively tied, the ends being cut off close to the knots; but in drawing the borders of the wound together care must be taken, as in Lembert's suture, to invert the edges

of the peritoneum, so that the two surfaces may come in contact (Fig. 364).

GELY'S SUTURE has its advantages in certain cases, and may even be preferred by some operators to Lembert's in all cases of wounds in the stomach, intestine, or uterus. Each end of a long thread is passed through a fine suture needle; one of these is pushed through the intestinal wall beyond one extremity of the wound, and brought out about one-fourth of an inch on the same

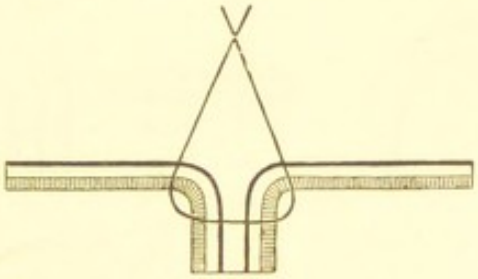


FIG. 364.—JOUBERT'S SUTURE.

side, parallel to the wound, and about one-eighth of an inch from it. The same manœuvre is executed on the opposite side with the other needle; then the first needle is carried across the wound and passed into the hole made by the exit of the second needle, and made to come out again parallel to the wound, about one-fourth of an inch from its last entrance. This is repeated with the second needle, and so on, the intercrossing being carried out as in lacing a boot (Fig. 365), until the other end of the wound is reached, when the two threads are brought to the surface a little beyond the wound, and sufficiently tightened

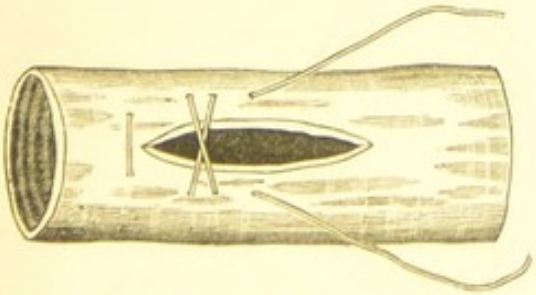


FIG. 365.—COMMENCEMENT OF GELY'S SUTURE.

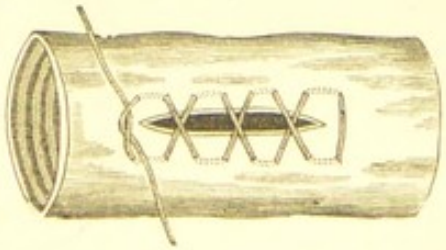


FIG. 366.—GELY'S SUTURE COMPLETED.

throughout, by means of two pairs of dissecting forceps, so as to close the opening and bring the inverted margins of the peritoneum against each other without a wrinkle. The ends are tied securely and cut off near the knot (Fig. 366).

WÖLFLER'S SUTURE somewhat resembles Lembert's in avoiding the mucous membrane, but it passes twice through the serous and muscular coats on each side of the wound, as shown in the annexed figure (Fig. 367).

Czerny's Suture is also similar to Lembert's, the only difference being a double passage through the serous and muscular tunics, as in Wölfler's suture, at one point, and only through the serous membrane at another. The thread is passed through the two tunics, as in Lembert's suture, then another thread is passed through the serous membrane alone at a point one-third of an

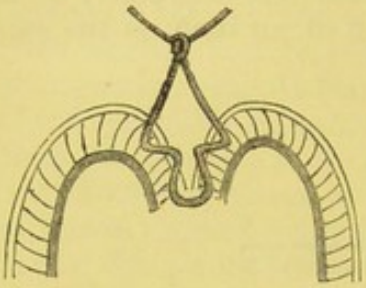


Fig. 367.—Wölfler's Suture.

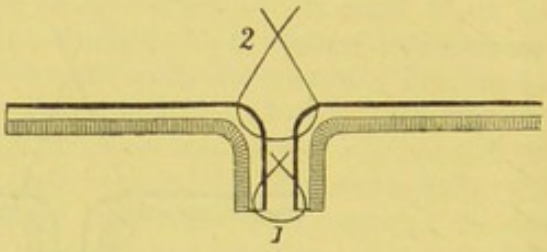


Fig. 368.—Czerny's Suture.

1, Suture through the sero-muscular tunic; 2, suture through the serous tunic only.

inch farther from the wound than the first. By this means the lips of the wound are kept in contact on the serous surface for a depth of nearly half an inch, while the sutures do not penetrate the mucous membrane (Fig. 368).

Sometimes, as a result of disease or accident, so much of the intestinal wall may be destroyed or has to be removed, that if the borders of the wound were brought together, the lumen of the tube

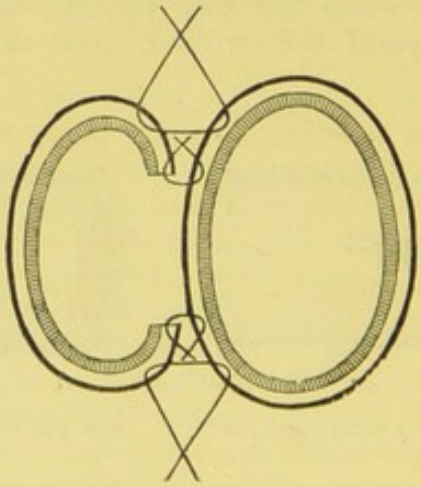


Fig. 369.—Mode of making an Intestinal Graft. (After Cadiot.)

would be diminished to such a serious extent as to be almost equivalent to obliteration. In such a case intestinal grafting might be attempted in animals, as it has given good results when practised in the human subject. This grafting is carried out as follows: A loop is made of this portion of the intestine, and the opening, or wounded side, is brought into contact with the oppo-

site wall of the loop; the two portions of intestine are then attached to each other by means of Czerny's suture passed through them around the wound, as in the accompanying figure (Fig. 369).

It should be again remarked that, in bowel suturing, it is most essential that union between the divided surfaces should take place as rapidly as possible, therefore co-aptation of the serous surfaces ought to be complete; and also that infection of the wound from the intestine should be averted, by passing the sutures through the serous and muscular tunics only, avoiding perforation of the mucous membrane. In insisting upon the observance of this precaution in enterorrhaphy, it must be observed that in speaking of the exclusion of the mucous membrane from the suture, and the inclusion of the serous and muscular coats, it should not be inferred that the thread is only to be passed through the latter. They will be found too fragile to withstand the strain and cutting action of the thread, and in order that the suture be effective for a certain length of time, it should include the submucosa, which has far more tenacity and resistance than these two tissues combined. Therefore the needle should pass through the serosa, musculature, and submucosa, and it is probably through neglect of including the latter that cases of enterotomy and enterectomy are not so successful as they might otherwise be, as stitches readily give way when the tough submucosa is not secured in the suture. At the same time, the stitch should not enter the lumen of the intestine, lest leakage take place. As Dr. Halsted points out,[1] it is not difficult to familiarise one's self with the resistance furnished by the submucosa, and it is quite as easy to include a bit of this coat in each stitch as to suture the serosa and the muscularis alone.

The wound in the bowel having been sutured, the peritoneal cavity is to be cleansed, if it has been soiled by the contents of the intestine, blood, or extraneous matters, and the abdominal incision closed in the manner hereafter to be described.

After-Treatment.—The animal must be kept as quiet as possible for some days, and only a sufficiency of very nutritious food in the least bulky form and in a soft condition allowed, with a limited amount of tepid water to drink.

Enterectomy.

Excision of a portion of intestine has been successfully practised in Cattle and Dogs for irreducible strangulation and invagination of that viscus; but it has been hitherto unsuccessful in the Horse, though there is no reason why it should not be sometimes followed by recovery in that animal, especially if the small intestine is operated upon, and the operation is done skilfully, sufficiently early, and with the usual antiseptic precautions.

[1] Bulletin of the Johns Hopkins Hospital, January, 1891.

Instruments and Appliances.—These are the same as for laparo-enterotomy.

Position.—This may either be standing in the case of Cattle, when the animal is placed with its left side against a wall and the flank opened on the left side; or latericumbent or dorsicumbent in the case of the Horse, Dog, or Pig, though the last-named position is usually preferred when the small intestine is to be operated upon, the abdomen being opened at or near, and parallel to, the *linea alba.* If the cavity is to be opened at the flank, then the position must be latericumbent, the right or left side being uppermost, as circumstances may require. This situation is to be preferred whenever possible in the larger animals, as it is the most favourable for the healing of the abdominal wound, though it may not be the most advantageous for reaching and manipulating some of the viscera. Opening the abdomen at its lower part, towards the linea alba, offers the greatest advantages in small animals, as it affords more room for the operator, and gives direct access to all the abdominal organs, while the healing of the wound can be better controlled than in the Horse or Ox, in which the great weight of the viscera imposes a severe strain on sutures and bandages.

If abdominal section must be performed towards the linea alba in such animals, then in closing the wound everything must be done to ensure its security by employing quilled or similar sutures, long strips of adhesive plaster, and wide body-bandages.

Operation. — Laparotomy is performed, and the portion of intestine to be operated upon is sought for, withdrawn from the abdominal cavity, and ligatured with tape, or clamped on healthy bowel at a short distance from the part to be resected, and on each side if possible; if not possible, then on the side next the stomach. The bowel should be quite empty at the part that is to be cut through, to prevent contamination of the peritoneal cavity. If it be the small intestine, the mesenteric vessels will probably have to be tied with antiseptic silk thread at the part which is about to be removed. Portions of omentum which are damaged or in the way should be cut off; a ligature may be required to prevent bleeding.

Resection is best effected by means of scissors, care being taken that when the portion is gangrenous it be removed completely, so that the remaining ends are quite sound and healthy.

As much of the bowel as may be necessary having been cut out, the divided ends, cleansed with antiseptic solution, are held by one or two assistants, while the operator proceeds to apply appropriate sutures to the mesentery and the wound. With regard to the separated mesentery, Macqueen insists that no gap should be left between it and the bowel, and that it ought to be carefully folded to the right or left, and secured by fine sutures placed at the borders of the fold, or a piece of mesentery can be excised and the edges united by continuous suture.

Approximation of the divided ends of the intestine is effected

by suture, either continued or interrupted, and Lembert's, Czerny's, or Wölfler's will be found best adapted for the purpose, though Chaput's has been highly commended in enterectomy. Whenever circumstances admit, the continuous suture is to be preferred, as it is more effectual in hindering the escape of infecting matters from the interior of the bowel; and if the mucous membrane is not perforated by the stitches, this danger is still further averted. The following is the procedure in applying Chaput's suture: Throughout the whole extent of each margin of the ends of the bowel, separate the muscular from the mucous coat for about one-third of an inch, then place a row of non-perforating sutures through the edge of that coat, after excision or invagination inside the intestine of the detached portion; this done, place a second row of perforating sutures in the sero-muscular coats (Fig. 370, A and B). On the posterior semi-circumference of the intestine the sutures in the mucous membrane are tied inside, and on the anterior semi-circumference they are tied outside. Above the sero-muscular sutures may be placed

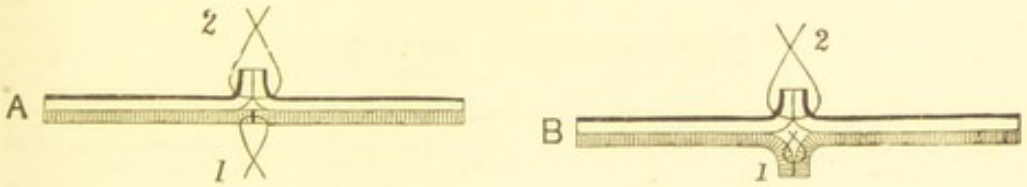


FIG. 370.—CHAPUT'S INTESTINAL SUTURES. (After Cadiot.)

A, Suture by abrasion, first procedure: 1, mucous membrane suture; 2, suture by abrasion. B, Second procedure: 1, mucous membrane suture by inflexion; 2, suture by abrasion.

another row, passed through the serous membrane alone, to make the union more secure.

A simple and rapid method of performing enterectomy in the Dog has recently been published.[1] The abdomen having been opened and a loop of small intestine drawn out, this was clamped in two places by means of a thin flat piece of wood pointed at one end, and having a slit in each end through which a piece of tape could be passed. The tape, knotted at one extremity, having been passed through the slit in the blunt end, the sharp end of the piece of wood was pushed through the mesentery close to the bowel, and the tape, passed over the bowel and through the other slit, was pulled sufficiently tight to compress the bowel between the piece of wood and the tape to the desired degree and then fixed with a pair of artery forceps. This simple and easily improvised piece of apparatus worked very efficiently. On cutting through the bowel, its lumen was found to be full of tape-worms. After several feet of these had been removed, the operation was proceeded with. There was some difficulty in detaching the peritoneum from the upper end of the intestine, but when de-

[1] Rogers, *British Medical Journal*, April 11, 1896.

nuded the muscular coat was easily approximated to the peritoneal coat of the lower end by a continuous suture, which was laced up so as to bring the surfaces into intimate contact without being so tight as to be likely to cut through the included coats of the intestine. A second continuous suture was now employed to unite the triangular gap in the mesentery, beginning at the apex. When the bowel was reached, the suture was continued around the gut to draw the piece of reflected peritoneum down over the first row of sutures, and to attach its deep fibrous surface to the serous surface of the peritoneum of the lower portion of the gut (Figs. 371, 372). This was successfully accomplished, except over a small portion, where the reflected peritoneum had

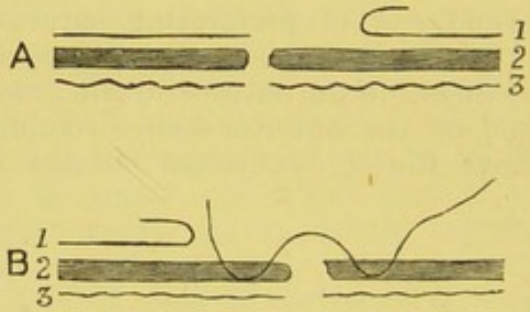


FIG. 371.—ROGERS' SUTURE.

A shows the peritoneal coat of the intestine turned back from one end of the section; B, method of passing the inner suture: 1, serous coat; 2, muscular coat; 3, mucous coat.

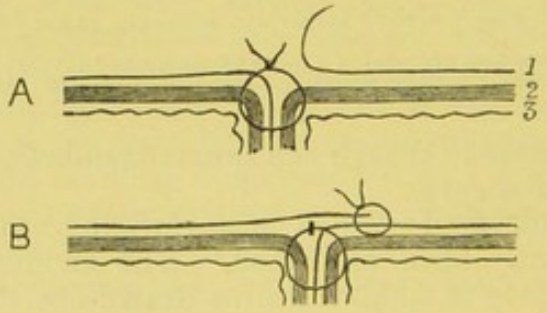


FIG. 372.—THE SAME.

A, Ends of section brought in apposition on tightening the inner suture; B, second suture shown in position, completing the junction.

curled up and could not be brought down quite so far as was desired. The clamps having been removed and the hole in the mesentery sutured, the intestine was returned, the abdominal wound sutured, and dressings strapped on it. The animal made an excellent and an uninterrupted recovery; it was sick on the day following the operation, passed a dark motion on the fourth day, and well-formed motions subsequently; on the seventh day the abdominal wound was united, when the stitches were removed and ordinary food allowed. On the fifteenth day the Dog was killed, when it was found that the abdominal wound was soundly healed; the great omentum was adherent to the outer side of the junction in the intestine, which was thickened at this

point. The gut was very firmly united, and no stitches could be seen ; a current of water flowed freely through it, and on passing the little finger into the bowel above the junction the first joint could go beyond the union, though in the normal intestine it fitted closely, showing that there was no material constriction at the seat of the resection. The advantages of this mode of operating are stated to be : (1) It can be done with the aid of the instruments in a pocket-case, ordinary round sewing needles being used (although curved intestinal needles are to be preferred), and with very little assistance ; (2) it can be completed in about half an hour, or only a little longer than the time required with the aid of such special appliances as plates, buttons, and bobbins ; (3) the junction is a double sero-fibrous one, and will combine the maximum of rapidity and firmness ; (4) the mesenteric side can be made very firm, by the apposition of the muscular coat of one end to the peritoneum of the other, and the subsequent covering up of this suture by the reflected peritoneum. This method certainly commends itself to veterinary operators, both for small and large animals.

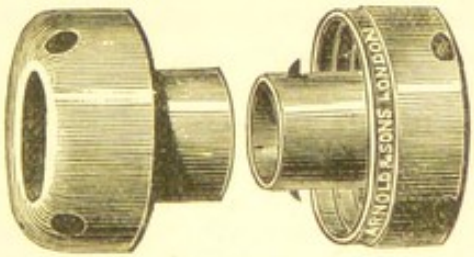


Fig. 373.—Murphy's Enterotomy Button.

In order to facilitate apposition of the ends of the divided tube, bone plates and slices of turnip have been employed.

The ends of the intestine are inverted and closed ; each is then slit open at the side for about two inches from the end, and the bone plate (Senn's) or slip of turnip to which sutures have been attached, is inserted through the opening. The sutures are then passed through the wall of the intestine, and tied together to maintain the serous surfaces in apposition. A similar device in the form of a metal button has been employed for attaining the same object, and with success, in enterotomy in man (Fig. 373). This device, known as 'Murphy's button,' consists of two portions, one fitting into the other, which has a thin rim or flange to receive and hold it when it is covered by the end of the intestine. When the latter is cleared of fæces, compression clamps placed on each of the parts to be excised, and the mesentery ligatured, excision takes place, and a running stitch is made around the margin ; this stitch begins at the side opposite to the mesentery and runs up to it, where one return overstitch is made, named the 'puckering string,' and which, when tied round the stem of the inserted button, draws the cut end inside the clasp.

Particular attention has to be paid to the return overstitch at the mesentery, so that both layers of the peritoneum overlap. The other half of the button is inserted in the same way, and the two portions are then pressed together. Though employed successfully in man, yet I am not aware that this button has proved satisfactory in the trials made with it in animals, nor, I fear, is it likely to do so, for anatomical reasons.

But these appliances are really not absolutely necessary for enterotomy in animals; indeed, it is very questionable whether they would not prove detrimental to recovery in the majority of cases, and sutures alone should be sufficient, as experience has shown. If any foreign body is employed to facilitate junction of the ends of the intestine, it should be of such a nature as to dissolve there in the course of a few days. Probably nothing better will be found more readily than a rather broad section of unpeeled turnip, in diameter sufficient to dilate the intestine, and the centre of which has been removed, so as to leave a hole in the middle. The rind, well cleansed, together with the remaining portion of the interior, will be sufficiently resisting to support the sutures passed through it and the intestine, and at the same time will keep the ends of the gut in approximation by their serous surfaces until union has been accomplished. The turnip will gradually soften and dissolve, without causing irritation, especially if it be steeped in a solution of boracic acid before being introduced into the lumen of the intestine. Segments of decalcified round bones might also be safely employed, as they would afford sufficient support, allow of matters passing their canal, and, being readily soluble, they will gradually disappear without unduly irritating the intestinal wound or the mucous membrane, while they could be had in various sizes. Tubes of cocoa-butter or of gelatine, and which could be made of any diameter, the thickness of their wall corresponding to their dimensions, and their ends made slightly smaller than the middle portion to facilitate introduction into the section of intestine, might also answer the purpose.

The intestine having been sutured and the external surface of the bowel cleansed, the wound in the abdominal wall is closed as in laparotomy.

After-Treatment.—The animal must be kept quiet, and only very small quantities of nutritious soft food given at frequent intervals, after fasting for twelve hours. Should the animal suffer pain, anodynes, chiefly opium, must be administered. At the end of four or five days more food may be allowed, and after ten days the usual food in gradually increasing quantity can be safely given. The external wound requires attention, but this will be alluded to presently.

OPERATION FOR INTRA-ABDOMINAL INTUSSUSCEPTION AND STRANGULATION OF THE INTESTINE.

Surgical operation for torsion and invagination of the intestine has only been successfully practised on the Ox, but it might be attempted with some prospect of success in the Horse if had recourse to before gangrene had begun to invade the imprisoned or tied-up bowel, and the animal is not too exhausted. Of course it is necessary that an accurate diagnosis of the case be made, and this is dependent upon the symptoms the animal exhibits, and also upon what may be ascertained by manual exploration *per rectum*. But it must be confessed that, in the Horse at least, there is very much against the success of the operation, which must be looked upon as a last resource, and a feeble one then.

Instruments and Appliances. — These are the same as for laparotomy and enterotomy.

Position.—The Ox has been operated on in the standing position, with the left side against a wall, and the hind-limbs secured by a rope, laparotomy being performed on the right side, as for rumenotomy; but with the Horse it would be necessary to place the animal on the right side, the left side being the best to reach the small intestine, which is usually involved. Or the Horse might be placed in the dorsicumbent position, if it is more likely to ensure ready access to the implicated portion of bowel.

Operation. — If the subject of operation is a Horse, an anæsthetic or powerful narcotic should be administered. If an Ox in the standing position, of course this is not necessary, though, if there is time, partial narcosis might be induced.

Laparotomy is performed, and the hand being introduced into the abdominal cavity, the involved portion of bowel is sought for; when found, it is brought as near the wound as possible, so that it may be more easily and effectively manipulated. If the bowel is strangulated by the pedicle of a tumour, by having passed through an opening in the mesentery, or through its having become twisted upon itself, or in any other way, or should one portion have become invaginated in another, attempts must be made by gentle traction and other manœuvres of the fingers to undo the constriction and unravel the entanglement.

If the constriction is due to the pedicle of a tumour, or anything else of that description, it may be necessary to divide this by means of a bistoury.

If the case has been of some hours' duration, inflammation may have begun in the part, and the serous surfaces in contact with each other will probably adhere more or less closely; but an effort should be made to break down these adhesions by means of the finger-nail (the hand having been well washed with antiseptic fluid before being passed into the abdomen), care being taken to injure the peritoneum as little as possible.

If the intestine is set free, and there are no indications of gangrene, then it should be gently sponged with a warm solution of

boracic acid, replaced in the abdomen, and the external wound closed as in laparotomy. But if the bowel cannot be freed, if it be gangrenous, or if it has suffered such injury as is likely to lead to death of the portion involved, then the only chance of saving the animal is to resect the part as far as it is healthy on each side of the strangulation or invagination. This measure has just been described.

After-Treatment. — The administration of an anodyne is necessary immediately after the operation is concluded, and if symptoms of enteritis or peritonitis become manifest, treatment must be adopted as for these affections.

Atresia of the Rectum and Anus.

This congenital defect is only met with in animals immediately after birth, and is more frequent in the Dog and Pig than in the Horse or Ruminants. It is due to imperfect development of the rectum or anus, and can only be remedied by operation.

The symptoms are retention of fæces, which, when they accumulate to a certain extent, cause uneasiness and signs of colic, and may give rise to dangerous consequences. When the obstruction exists at the anus, the condition is readily discovered, as the skin over the part bulges, and often the fæces can be felt through it. When the rectum itself is imperforate, the closure being generally not far from the anus, the same symptoms are exhibited, but the cutaneous projection is not seen, and a digital exploration is necessary is order to discover the nature of the obstruction.

Instruments and Appliances.—For *atresia ani* only scissors and scalpel, and suture needles and silk thread are necessary ; but for *atresia recti*, in addition to the foregoing, should the animal be a male, a catheter may be required.

Position.—If the animal is small, it may be secured in the standing position, or placed dorsicumbent, latericumbent, or ventricumbent, as circumstances may demand. For the larger creatures the latericumbent position will be found most convenient.

Operation.—In anal atresia, when the anal opening is only closed by skin, this is raised by forceps in a fold over the place where it is desired to make the entrance to the rectum, and cut across with scissors to the requisite depth. Then the finger is inserted to make the opening perfectly patent, and if the fæces are not immediately expelled, they can be removed either digitally or by enema. Sometimes the skin at the opening is slightly notched on each side to ensure the maintenance of the aperture. If there is any danger of the wound closing, it may be advisable to unite the skin to the mucous membrane by sutures ; but this should rarely be required.

In atresia of the rectum, the procedure is not so simple, and the difficulty is all the greater the more extensive and deep the

obstacle. If there is also atresia of the anus, a perforation is first made there in the manner just described, so as to obtain access to the rectum; then it is recommended to pass a catheter into the urethra of males, with the object of protecting that canal and the bladder, while in females the finger is to be introduced into the vagina for the same purpose. A blunt probe or finger is then pushed into the rectum, and the obstruction carefully broken down until the lumen of the intestine is sufficiently large for the passage of fæces.

Whether the atresia be anal or rectal, the raw surfaces should be smeared with boracic ointment, and a probe, catheter, or finger frequently passed through the new opening to prevent it contracting.

After-Treatment. — This need be very trifling. Beyond applying the ointment now and again, and giving an enema once a day for a few days, little else is required. The food should be of a laxative kind.

Prolapsus of the Anus and Rectum.

This accident is not at all infrequent in animals, but its more serious forms are oftenest witnessed in the Horse and Ox, and next in the Dog. Prolapse of the anus is the commonest and simplest form, as there is only permanent protrusion of the mucous membrane of the rectum, and this can be readily reduced, when recent, by manipulation; if some time has elapsed, however, and the membrane is swollen and more or less inflamed and abraded, scarifications, warm water fomentations, and dressing with astringent lotions, will be necessary, and if chronic, an operation to establish a complete cure must be resorted to.

The same observations apply to prolapse of the rectum when not attended with complications, such as invagination, which, if not speedily attended to, by reposition and disentanglement of the bowel, nearly always requires a serious operation.

In reducing prolapse of the rectum accompanied with invagination, skill and patience are necessary; for not only must the protruded bowel be carried within the anus, but it must be stretched out to its normal length, to get rid of the inversion. In the larger animals the arm and hand effect this, but in the smaller creatures a tallow candle, or something of a similar shape and smeared with grease, will suffice, the hind-quarters being elevated at the same time; straining after reposition should be combated by narcotics and enemata of a soothing character. Closing the anus by sutures, and applying compresses to that region, have been recommended.

When invaginated prolapse has existed for a certain time, great infiltration occurs, adhesion takes place between the peritoneal surfaces, and the mucous membrane is intensely congested, and perhaps cold, excoriated, and gangrenous. In such a condition the prolapse cannot be reduced, and excision is urgent. The

application of corrosive substances to slough away the protruded mass has been recommended and tried; but their use is not warranted, in consequence of the long time required to effect that object, their uncertainty, and the sometimes unfavourable results.

Ligation is the most successful method of amputation, and that which is generally preferred. A single ligature around the extruded mass has been employed, a broad wooden ring with a groove in the middle to retain the cord being inserted in the anus to permit defæcation; but this is not always satisfactory. Multiple ligation is in every way preferable, and is easily practised. By it, in the Crimea in 1856, I removed a mass of intestine weighing, it was calculated, about two pounds, and as large as an infant's head, from a Spanish mule;[1] recovery was complete.

Instruments and Appliances.—A strong needle sufficiently long to pass through the protrusion close to the anus, two or four pieces of aseptic whipcord (if the animal is large), or strong silk

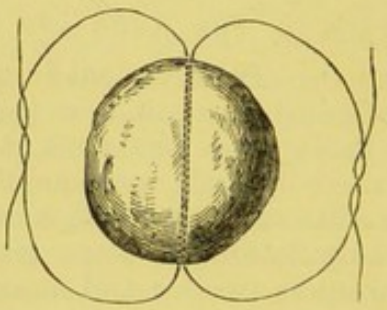


Fig. 374.—Double Ligation of Prolapsed Invaginated Rectum.

well waxed, a pair of pliers or strong forceps, a scalpel or bistoury, and forceps.

Position.—I have always operated on the Horse and Mule when they were in a standing position, with one or both hind-legs secured and a fore-foot held up; if the animals were unsteady, a twitch was applied to the upper lip or ear. But the pain attendant on passing the needle through the prolapsed intestine and tying the ligatures has always been so slight that there was no trouble with the animals in this position. The latericumbent position may be adopted for the larger animals, though it is not so convenient as the last-named; for the smaller animals it or any of the other positions can be tried.

Operation.—The parts are cleansed, and the tail being held to one side, the needle, armed with one or two pieces of cord or thread, is pushed vertically through the intestine, as close to the anus as possible, but without involving the skin, and as near the centre as possible; it is withdrawn by means of the forceps or pliers at the lower part, and removed from the ligatures, which are left in the mass (Fig. 374; see also Figs. 237, 238). The ends of one

[1] *Veterinarian*, 1857.

of these are carried round one side and tightly tied, the other being dealt with in the same way on the other side. The tumour is now completely ligated without the anal opening being interfered with; indeed, this is more patent than it was before the operation.

If considered desirable, a large portion of the mass may now be removed, care being taken not to cut too near the ligatures; this excision generally proves a great relief to the animal, and renders measures of disinfection and cleanliness more easily carried out, while enemata can be more promptly administered, should they be required. If bleeding occurs, the vessels can be twisted by the forceps.

The part is powdered with boracic acid, and the tail tied to one side by means of a surcingle round the body. If there is any attempt at straining, pressure may be applied to the loins, and a narcotic given. A solution of opium or cocaine can also be introduced into the rectum.

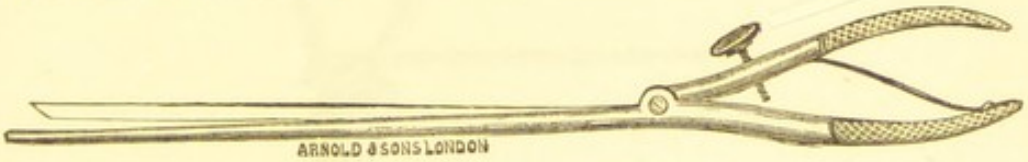


Fig. 375.—Straight Bistoury Caché.

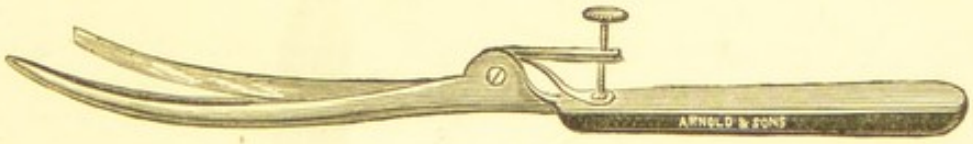


Fig. 376.—Curved Bistoury Caché.

After-Treatment.—In the course of two or three days, the tumour, or what remains of it, may be cut away; and if the ligatures do not slough out after two or three days more, they can be removed; but this is really of no consequence.

The diet should be laxative.

Operation for Anal and Rectal Fistulæ.

Fistulæ in the anus and rectum are not uncommon, and are often very troublesome. They are complete or incomplete, according as they have two openings or only one, and they are congenital or the result of injury or disease. Anal fistulæ are more easily treated than those between the rectum and vagina. Their presence is generally revealed by the constant discharge of pus in small quantities, and the opening may be discovered by using a speculum, such as that for the Cow or Mare's vagina, or by passing the finger or a probe into the intestine. They are very rarely witnessed in the smaller animals.

Instruments and Appliances.—These will depend upon the kind of operation decided upon. If the fistula is to be thrown open, a bistoury caché, straight or curved (Figs. 375, 376), with a

long concealed blade, will probably be required. A scalpel and forceps, as well as probes, should also be provided. If the fistula is in the rectum and likely to be troublesome to reach, a rectal dilator will prove advantageous (Fig. 377). Lint, water, and sponges may also be needed.

Position.—In the Horse the latericumbent position will be the best, and the animal should be placed under the influence of an anæsthetic, if the operation is likely to prove troublesome and protracted. The Cow can be operated upon in the standing position, the hind-legs being secured.

Operation. — Much will depend upon the situation and character of the fistula, in proceeding to operate, but the object to be achieved is to lay it completely open, and so convert it into a simple wound. Great care is necessary in doing this, so as not

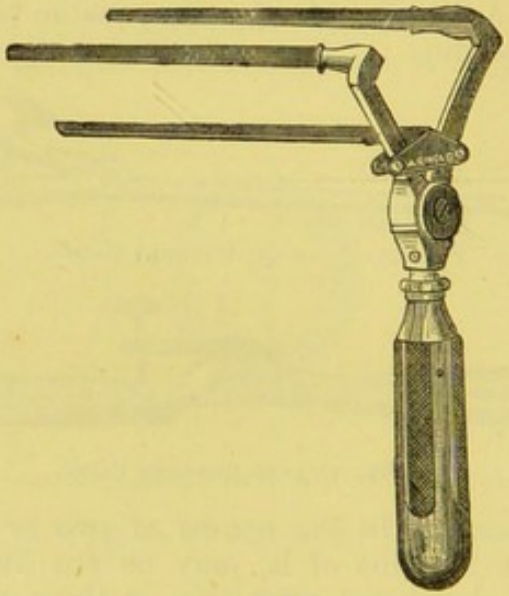


Fig. 377.—Rectal or Vaginal Dilator.

to injure the intestine. If the fistula is deep-seated, the anus will require to be dilated in order to afford space to manipulate in.

In some cases it may be necessary to divide a portion of the entire thickness of the sphincter ani, though this should not be done if it can possibly be avoided. In the great majority of cases no ill effects remain after the division, as union takes place in the course of time. If the anus is dilated, both hands may be introduced into the rectum, so that instruments can be better directed and manipulated. When the anus only is involved, the fistula is readily accessible to eye and hand, and the operation is greatly simplified.

After the anus has been opened up, if there is much hæmorrhage, it may be necessary to pack the rectum for a short time with lint (the tube had, of course, been emptied of fæces before the operation was commenced).

After-Treatment.—Soft and spare diet must be allowed for a few days. Beyond this, little else is required.

Operation for Anal and Rectal Tumours.

Tumours are sometimes present in the region of the anus and in the rectum of animals. At the anus they can be felt and seen, and even when existing in the posterior portion of the rectum, and especially if pediculated, they are often projected externally during defæcation, and may give rise to prolapse of the anus. They may or may not be a cause of inconvenience to the animal, and they may hinder expulsion of the fæces. If it should be found desirable to remove them, it may be accomplished as in the case of tumours elsewhere. In the rectum, if in the form of polypi, they can be removed by ligature, or more expeditiously by the ecraseur. Should hæmorrhage prove serious, it may be checked by a styptic, such as perchloride of iron, by tamponing the rectum with lint, and by injections of cold water.

CHAPTER III.

OPERATIONS ON THE ABDOMINAL WALL.

Operations on the parietes of the abdomen are generally undertaken with the view of reaching the cavity they assist in forming, or one or other of its varied contents, consisting chiefly of the organs concerned in digestion, absorption, generation, and depuration. From the earliest times it has been recognised that in animals the peritoneal cavity could be penetrated, and certain operations performed therein with more or less impunity. But only in recent years have operators ventured upon other and more serious manœuvres in that cavity; and though, for the reasons already stated, these cannot compare either in number or complexity with those resorted to by the surgeon of mankind, yet with increase in skill, courage, and resource, the veterinary surgeon may add to those we are now about to consider, when the value of the animal will warrant their performance.

Puncture of the Abdominal Wall. Tapping the Abdomen. Paracentesis Abdominis.

In gastrocentesis and enterocentesis the stomach and intestines are punctured through the abdominal wall to permit of the escape of gases that have been generated in these viscera; but the operation now about to be described is limited to puncturing the wall alone, for the evacuation of serous or other fluid that has collected in the peritoneal cavity. It is a simple operation, palliative only, as a rule, and is most frequently performed upon the Dog, being rarely required for the Horse, Ox, or Sheep. It is indicated in hydrops

ascites, when the pressure of the fluid on the diaphragm gives rise to dyspnœa and other grave forms of disturbance, and should not be resorted to unless these are urgent. The presence of a large quantity of fluid may be surmised from the distended and

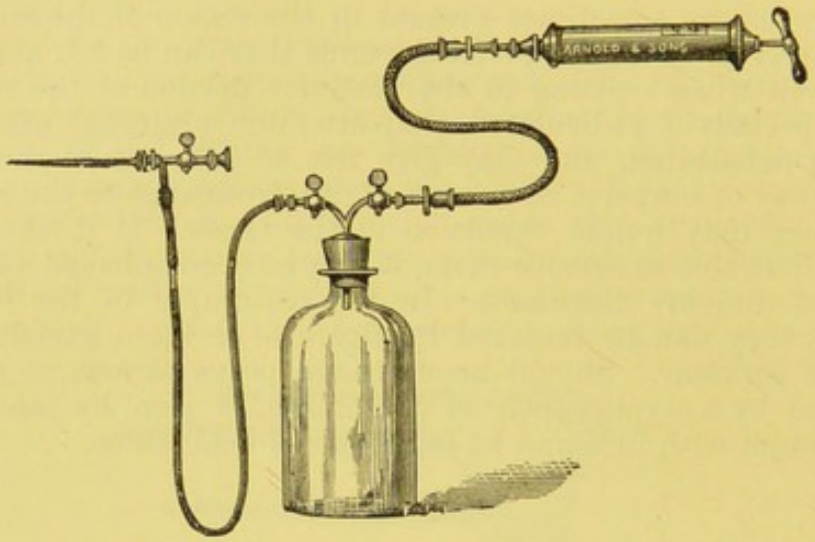


Fig. 378.—Simple Aspirator.

pendulous condition of the abdomen, but the most reliable sign is produced by placing one hand on the side of the belly and tapping the opposite side with the other hand; this causes undulation of the fluid to such a degree as to be felt.

Instruments and Appliances.—For the Dog, a very fine trocar and cannula, rendered aseptic, a wide and many-tailed abdominal

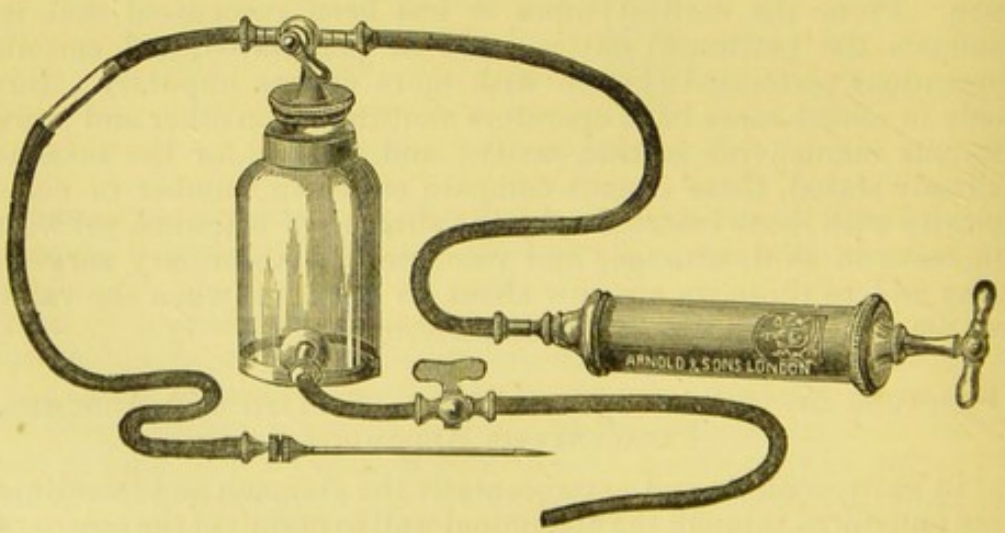


Fig. 379.—Aspirator with Escape-tube in Receiver.

bandage, scissors, razor, lint. For the larger animals a slightly wider trocar and cannula may be used. An aspirator is an excellent contrivance for withdrawing the fluid and guarding against septic infection (Figs. 378, 379).

Position.—In large-sized Dogs the operation may be performed while the animal is standing, but with large and small Dogs it is generally most convenient to place them in the latericumbent position. The same remark applies to other animals.

Operation.—The puncture may be made in either flank in the larger animals, but in the Dog the lower part of the abdomen is preferred, the needle being inserted at either side of the linea alba—the under side by preference, if the Dog is latericumbent—and at a point between the umbilicus and pubis. The skin at the seat of operation should be shaved and cleansed; the wide bandage applied round the abdomen, and the tails tied over the back, a small piece being clipped out at the place where the trocar is to be inserted. If the skin is thick or the animal unsteady, a minute notch may be made by scissors in a small fold raised immediately over the part, for the instrument to pass through more easily.

Technic.—The needle or trocar is pushed gently and slowly through the abdominal wall until the point has entered the cavity, when the trocar is withdrawn, or, if the aspirator be used, the entrance tap turned. Then the fluid commences to flow, and as it does so the bandage may be gradually tightened to expedite its escape, though, if the aspirator be employed, this constriction is not necessary at the moment. Flakes of lymph may stop the flow, when it will be necessary to clear the tube; or the obstacle may be the viscera, when moving the point of the tube to one side will get them out of the way.

When sufficient or all of the fluid has been withdrawn, the instrument is removed, a piece of aseptic lint placed over the puncture, and the abdominal bandage tightened to the required degree. To prevent it slipping backwards, it can be attached to a collar fastened round the base of the neck.

When the ascites is due to chronic peritonitis, a weak tincture of iodine injected through the cannula after the fluid has been evacuated, has been found most beneficial in checking recurrence of the effusion; but when this is due to disease in organs such as the liver or heart, the fluid will again accumulate, and require a repetition of the operation.

After-Treatment.—Beyond keeping the puncture wound clean, and making it aseptic by dusting with iodoform or boracic powder, no special treatment is necessary, so far as the operation is concerned. If this has to be repeated, the puncture should be made at a different point in the same region.

Laparotomy.

In describing operations on the stomach and intestines, allusion was more than once made to laparotomy as a preliminary to their performance. But it is not for these alone that abdominal section

has to be practised ; in operating on other internal organs in the abdominal cavity, as the generative and urinary, it has to be resorted to in order to reach them.

The abdominal wall may be incised at almost any part, though the most convenient situation in the larger quadrupeds, except in one or two special operations perhaps, is the flank; but in the smaller animals the cavity can be opened there or inferiorly, as circumstances may demand or convenience require. Much of the risk attending the operation, especially in the Horse, is obviated by the adoption of antiseptic measures; though it is not always possible to carry these out so completely as might be desirable in order to ensure absolute immunity from septicæmia, to which, however, all animal species are not alike predisposed, the Porcine being perhaps least, and the Equine most liable.

The preparations for the operation must depend upon the time allowed, the species of animal, and other circumstances.

Instruments and Appliances.—The number and kind of these will also depend upon circumstances, and also to a considerable extent upon the fancy of the operator.

For simple abdominal incision in the larger animals, especially if it has to be performed hurriedly, the instruments and appliances may be limited to a scalpel or bistoury, straight, angular, and blunt-pointed scissors, ordinary and bull-dog forceps, two Farabœuf's retractors to draw the sides of the wound apart, director, suture needles and material, sponges, iodoform or boracic powder and lotion, Gamgee's tissue and cyanide gauze. Everything likely to touch the wound should be rendered aseptic ; steel instruments may be sterilised by boiling, then placed in a tray containing carbolic solution (1 in 20). For the smaller animals a similar list of instruments and appliances will be found sufficient. It must be remembered that those for special operations on organs in the abdominal cavity must also be provided.

An anæsthetic apparatus and material should likewise be at hand, except for certain operations, as spaying young Pigs.

Position.—The position will be dorsicumbent or latericumbent, according to the circumstances of the case. In the larger animals it will generally be the latter, in the smaller animals the first-named position. The operation can rarely be attempted in the standing position, except in the Bovine species.

Operation.—The place in which the operation is to be performed should be as clean as possible, and apart from likely sources of contamination, such as manure-heaps, cesspools, etc. Before or after the animal is placed in position for the operation, the skin at and around the part to be incised is clipped, shaved, and rendered antiseptic. The animal is placed on its back, or on the right or left side, as may be convenient, and an anæsthetic administered ; if the latter is not employed, then the limbs must be secured; if it be one of the larger animals, and the position latericumbent, the upper hind-leg must be kept forward in some cases, but in the majority it will have to be drawn backwards,

even when anæsthesia is produced, to allow more room for manipulation.

It is advisable to have the skin covered before and behind the part with clothes damped by a 5 per cent. carbolic lotion, and the part itself sponged with one of 2½ per cent.

Technic. — The incision in the flank is made between the anterior spinous process of the ilium, the most convex part of the posterior border of the last rib, and the transverse processes of the lumbar vertebræ (Fig. 380); it is usually about four inches long, but may be more extensive if required. The direction of the incision is a matter of choice; it may be downwards and forwards, or downwards and backwards, the latter being sometimes preferred.

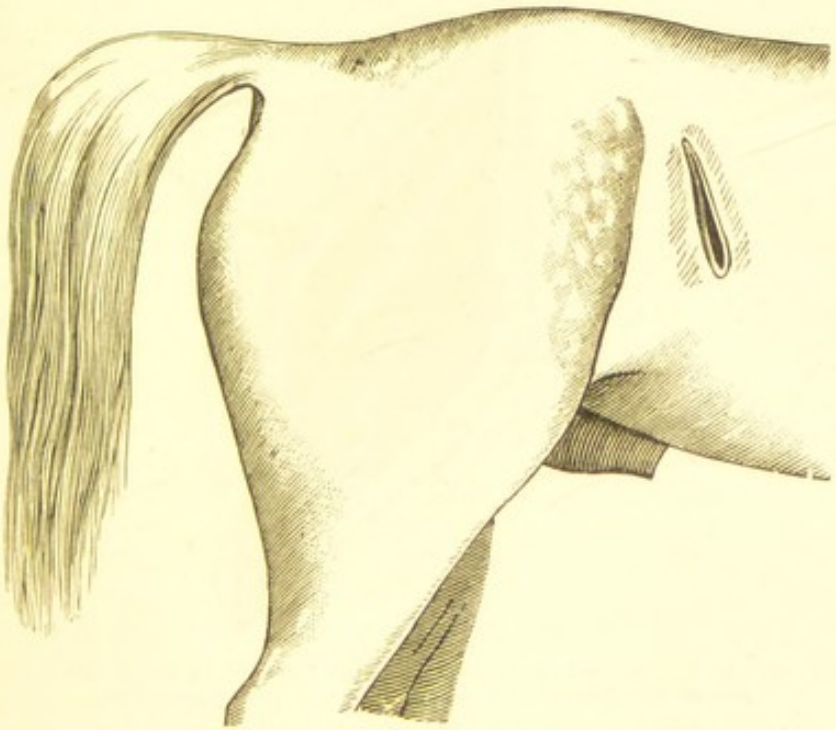


Fig. 380.—Situation and Direction of Flank Incision in Laparotomy in the Horse.

The opening into the abdominal cavity may be made entirely by cutting, the skin and muscles being rapidly divided, and the peritoneum perforated in the desired direction; but this makes a wound that is longer in healing than may be desirable, and also occasions severe hæmorrhage which is not without danger, and requires time to control. The following is the best method to adopt:

The skin and connective tissue are first cut through, then the external oblique muscle; with the finger or handle of a dissecting-knife the fibres of the internal oblique and transversalis muscles are separated to the extent of the wound—indeed, all the muscles may be separated in their fibres, so that cutting through them is dispensed with; the longitudinal division favours closer co-apta-

tion and more rapid healing than transverse section (Fig. 381). The wound being now carefully sponged out with the warm aseptic lotion, and hæmorrhage checked, the finger is pushed through the exposed fat and peritoneum, the opening being lengthened to the necessary extent by blunt-pointed scissors. The hand, damp with lotion, can now be passed into the abdominal cavity, and the necessary manipulations carried out, the wound being kept open, if desirable, by the broad retractors.

It must be remembered that the viscera should not be disturbed any more than is absolutely necessary, and the peritoneum in particular ought not to be irritated by handling, rubbing, or sponging, any more than can be avoided. The cavity is best

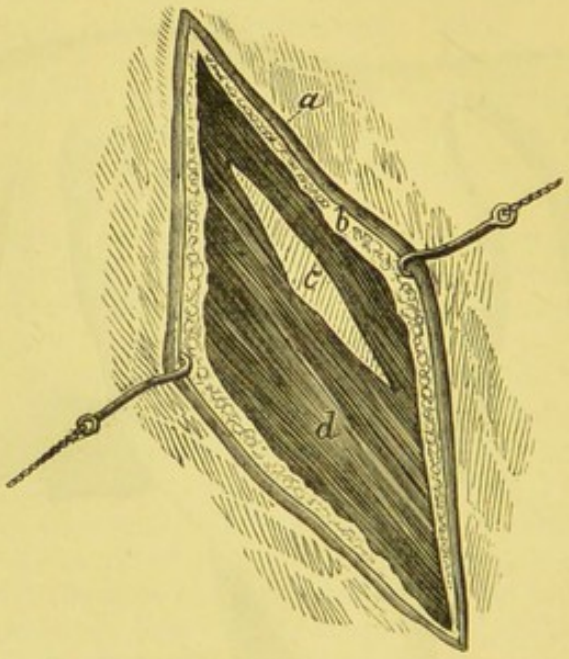


Fig. 381.—Flank Wound in Laparotomy, showing Incision through the Skin, and across the External Oblique Muscle. (After Macqueen.)

a, Skin; *b*, cut fibres of external oblique; *c*, direction of second incision, parallel with the fibres of internal oblique, the transversalis being seen at the bottom of the wound; *d*, internal oblique.

cleansed by warm sterilised water or weak solution of boracic acid.

To close the flank wound, bring the borders of the transversalis muscle together, cutting away any fat that may protrude; pass three or four sutures through the internal oblique muscle, and the same with the external oblique. The external wound is closed by strong silk sutures passed through the skin and muscle and tied before or behind the incision.

Macqueen recommends that a slit be made through skin and fascia, downwards and backwards, to two inches from the lower end of the wound, for the purpose of drainage. Dress the surface of the wound with iodoform, and allow the Horse to rise. A drainage-tube of glass or india-rubber should not be used; rather

insert a tampon of aseptic tow or cyanide gauze in the drainage wound, and apply more iodoform, and carbolised absorbent cotton or lint over the whole ; this may be retained by strips of adhesive plaster, or, as Macqueen advises, winding calico round the body, after protecting the cotton or lint with four layers of gauze ; over the calico are placed roller bandages secured with safety-pins.

In the smaller animals the wound need not be more than two or three inches in length ; the operation is carried out in a similar manner and with the same precautions as in the larger animals. If the incision is made in the inferior part of the abdomen, it should follow the linea alba, though that should not be cut. The skin and subcutaneous tissue are divided, either from the xiphoid cartilage to the umbilicus, or from the latter to the pubes ; the fibres of the rectus muscle are separated, not cut through, to the same extent, the fascia incised, and the peritoneum carefully opened. In the larger animals, when opening the abdominal cavity here, the same course is followed.

After-Treatment.—The Horse should be left at liberty in a loose-box, but, to prevent it tearing the dressings, a muzzle should be worn for a few hours. When the wound begins to discharge, the dressings may be renewed, but the drainage wound should not be plugged. If the wound is healthy, the lint, cotton, and gauze may be dispensed with, and only a dressing of iodoform covered by adhesive plaster employed.

OPERATION FOR UMBILICAL HERNIA.

Exomphalos, omphalocele, or umbilical hernia, either congenital or acquired, occurs in all the domestic quadrupeds, but more especially in the Equine, Bovine, and Canine species, and is seen either at birth or during early age ; rarely does it happen in adult life. Occasionally the tumour formed in the umbilical region is of considerable size, and is always of a definite, semi-globular shape, soft and elastic to the touch, and often of variable dimensions. It consists of a sac, the wall of which is composed of skin, connective tissue, and parietal peritoneum, and its contents are a portion of intestine—generally a section of colon or cæcum—or omentum, or both. By pressure of the fingers, the tumour can be temporarily reduced, and the more or less dilated umbilical ring felt ; this, with the other characters mentioned, and the absence of inflammatory indications, sufficiently differentiate umbilical hernia from an ordinary tumour or abscess, and should prevent serious mistakes.

In some cases spontaneous recovery takes place in very young animals, through gradual narrowing of the umbilical opening, but this is more likely to happen when the opening was originally rather small ; when the ring is widely dilated, there is little likelihood of a natural cure being effected, and these are the cases which demand the attention of the veterinary surgeon. For it

usually happens that, as time goes on, the tumour increases in size, and is an eyesore and inconvenience; this increase is accelerated if the animal chances to be fed on bulky, indigestible food. Not only this, but chronic inflammation may arise from external injury, and adhesion occur between the sac and contained intestine; or the latter may become strangulated or invaginated in the sac, and serious consequences ensue.

Treatment without operation is frequently tried, and sometimes with success when the tumour is not large and the animal is very young. In the larger animals trusses have been employed, with the object of keeping the contents of the tumour in the abdominal cavity until the ring has contracted sufficiently to hinder their passing through it again. Such trusses have been of various patterns, from a simple wide bandage passed round the body, and holding a pad or pledget of tow, on which some adhesive substance has been spread, against the part, the swelling having been previously reduced, to leather or metal compresses. One of the latter is a long and rather broad metal plate, fitting the lower surface of the abdomen, and having a rounded boss, one or two inches high, projecting from its upper surface; this projection fits into the umbilical ring, and may be covered with a thin piece of felt or flannel, the plate itself being firmly retained by a wide bandage at each end passing round the body. After being worn for some days, tumefaction occurs in and around the opening, which may prevent prolapse; if this happens, however, the skin is stimulated by the actual cautery or a blister, and a level-surfaced plate applied. The stimulant may be repeated until a crust has formed; the part is then blistered, and this crust eventually falls off. The method requires care in order to prevent extensive sloughing.

Pitch plasters have been successfully employed, as also such escharotics as nitric and sulphuric acids (often in a concentrated form), though there is obvious danger in the application of these, and they should not be resorted to until milder measures have been tried and failed. Mustard cataplasms have been recommended instead of these destructive agents, and the actual cautery in parallel lines over the sac is a milder remedy, which has found its advocates. The subcutaneous injection of a weak solution of common salt around the opening has also been successful.

The object in making these applications is to produce such an amount of swelling around the ring as will press the contents of the sac back into the abdomen, and so allow of time for the opening to close. This may be accomplished when the hernia is not large—no bigger than an apricot or peach—and the animal is so young that retraction of the ring is likely to ensue; the danger to be apprehended from their use is sloughing of the sac and escape of the intestine, or adhesion of the latter to the wall of the sac.

To effect a radical cure of otherwise incurable abdominal herniæ, the sac is got rid of, and the opening closed by (1) *ligation*, (2) *clams*, (3) *herniotomy*. We will notice these methods in succession. In

the meantime it may be remarked that, before attempting operation, it is advisable to have the bowels as empty as may be compatible with health ; this can be effected by allowing a diminished quantity of soft, easily-digested, and laxative food, and not giving either food or water for a few hours before operating.

The administration of an anæsthetic is also to be urged in all serious cases of operation for herniæ of the intestines. The tranquility of the animal, and the absence of violent muscular contraction, renders comparatively simple and easy what might be, without this precious boon, a most difficult, if not an impossible, task. I can call to mind cases of scrotal and inguinal hernia which might have been saved, and great anxiety and fatigue spared me, had I been able to avail myself of an anæsthetic, all my efforts having been thwarted by the struggles of the Horses during the operation.

1. Operation by Ligature.

Instruments and Appliances.—For single ligation, only a piece of strong waxed thread or whipcord, or a piece of elastic band, is necessary. For multiple ligation pieces of strong sterilised silk thread or waxed cord, and a straight or slightly curved suture needle to admit these, are required, with iodoform or boracic acid powder.

Position.—Dorsicumbent.

Operation.—In single ligation the hernia is completely reduced, great care being taken that the contents of the sac are entirely within the abdominal cavity. The skin of the sac is then raised up and held by an assistant, while the operator passes the ligature around its neck, tying it firmly, but not too tight, lest the skin slough off before adhesion has taken place at the ring. Nothing more is necessary, as in some days the ligatured skin comes away, and the adherent cicatrix prevents the sac reforming. This method generally succeeds when the umbilical opening is not more than about an inch in diameter. The wound is dressed with iodoform.

When the hernia is of considerable size and the opening large, to ensure success the ligature should be multiple, so as to cut off the sac in divisions. The hair may be clipped or shaved off, and the skin rendered aseptic in the usual way. The hernia is reduced, the skin lifted up in a longitudinal direction by an assistant, and the needle, armed with a double thread, is passed through the anterior end of the fold, close to the animal's body; the threads are cut close to the needle, and the ends of one of them tied firmly, the other thread being left to be tied with one of the threads of the next stitch, which is made in a similar manner, about an inch from the first. These stitches and tyings are to be carried on until the opposite end of the fold is reached, when the final tie embraces the remaining portion of the neck of the sac. Great care is needed to prevent the intestine being injured, an accident

likely to happen if the animal struggles; but, as has been urged, an anæsthetic should always, when possible, be employed in such cases.

The suture wounds should be well dressed with iodoform after the stitching is completed, and subsequently when discharge commences; or aseptic lint or tow may be applied over the whole and retained by a body bandage.

The sac sloughs off in about two weeks, when the cure may be regarded as complete except for the wound remaining, which soon heals if kept clean, and dressed with boric powder.

2. Operation by Clams or Clamp.

Obliteration of the hernial sac by means of a wooden or steel clam or clamp is generally preferred to ligation, especially when the umbilical opening is wide; though it is asserted that immediate union of the serosa at the ring does not occur with such certainty, also that the clam has a tendency to slip off. Both of these statements are true to some extent, and more especially if a wooden clamp is employed; but with a properly constructed steel instrument this is much less likely to happen. And even

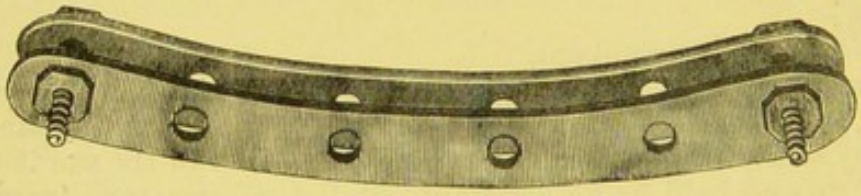


Fig. 382.—Combe's Perforated Clamp for Umbilical Hernia.

with the wooden one very large herniæ have been most successfully treated when a certain method was adopted. In these cases the clamp was, as always, in two pieces, but one of these was about a foot long, the other one-third less. The sac having been emptied and the skin raised in a longitudinal fold, the long piece of wood is applied to one side, close to the abdomen, and then on the opposite side, but below the long piece, the short one is placed, and both are tied together at the ends.

A combination of the clamp and ligature or pins is found in Combe's instrument, in which the sides are of metal brought together by screws at each end, and perforated at the sides by a number of small holes, through which sutures or steel pins can be passed. This is a very secure and effective clamp (Fig. 382).

Another clamp devised by Bordonnat acts in a similar manner, and is perhaps more convenient, as alternate pins or teeth are fixed in the opposing edges, and these penetrate the neck of the sac as the thumbscrews at each end are turned round (Fig. 383).

Pritchard's steel clamp, with serrated borders, is light, and suffices for the majority of cases (Fig. 384); though that of

Metherell is highly commended for its simplicity and effectiveness. It is composed of two stout steel blades that move upon a joint or pivot at one end, and are closed on each other like scissors by means of a rather long finger-screw that passes through a lateral eye at the opposite end of each blade (Fig. 385), by which any degree of pressure can be exercised on the fold of skin. If there is any apprehension of the clamp slipping off, which it should not

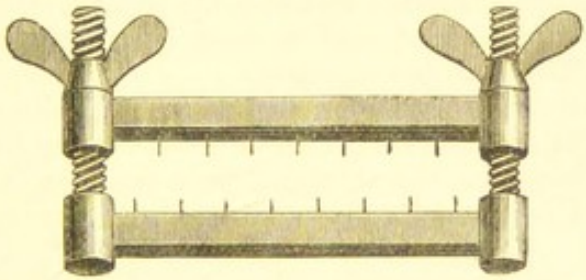


FIG. 383.—BORDONNAT'S DENTATED CLAMP.

FIG. 384.—PRITCHARD'S STEEL CLAMP FOR UMBILICAL HERNIA.

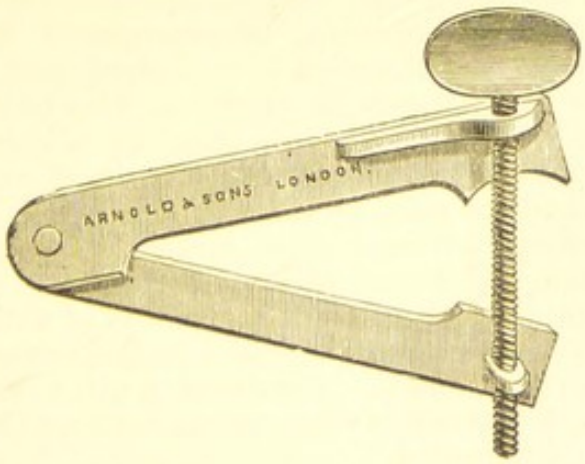


FIG. 385.—METHERELL'S STEEL CLAMP FOR UMBILICAL HERNIA.

do if properly constructed and applied, steel pins can be passed through the folds of skin close to it.

The steel clamps are applied to the neck of the hernial sac in the manner already described, and close to the surface of the abdomen, the skin being made smooth and free from creases.

After these operations the animal is uneasy, and shows signs of suffering, which last for some hours, and may be allayed to some extent by narcotics. The clamp usually falls off towards the end

of the second week, carrying with it the remains of the sac. The wound soon heals, though this is expedited by dressing it with iodoform or boracic acid.

3. Herniotomy.

When suturing the hernial sac fails, when the clamp is ineffectual, when adhesions have taken place between the sac and the ring, or when the intestine has become incarcerated and inflammation has begun, or necrosis is even imminent, then the only chance left is offered in herniotomy.

The procedure in this is the same in the preliminary steps as in the preceding measures. The animal, having been previously prepared, is placed in the dorsicumbent position, the skin of the tumour shaved and rendered antiseptic, and narcosis induced by an anæsthetic.

Instruments and Appliances.—These will depend upon the nature of the operation, and whether the parietal peritoneum is to be incised. A bistoury or scalpel, forceps, suture needles and strong silk thread, with antiseptic lotion and powders. A light steel clam (like Fig. 384) and some long, sharp-pointed steel pins should be at hand.

Operation.—The skin of the tumour is cut through to the extent of some inches, the incision being made from before to behind, but the peritoneum must not be opened except under certain circumstances. The skin is reflected on each side, and the peritoneal sac and its contents manipulated into the abdomen through the umbilical opening, the margin of which is made raw by means of the finger-nail or scalpel, and then brought together by as many points of suture as may be necessary, care being taken to bring the edges into close apposition. A sufficient extent of skin must be cut off to make it fit exactly over the sutured ring, and the sides of the wound are then brought firmly together by strong sutures. The surface is again cleansed by antiseptic lotion, and dusted with iodoform.

When the animal has arisen, a double fold of antiseptic lint or a pledget of tow or cotton-wool is placed on the surface, and a body bandage tied over the back. The dressing will have to be renewed in a few days, and possibly three or more times thereafter before the wound is quite healed.

If adhesions have formed in the hernial sac, so that reduction of the contents cannot be effected, then, after the skin has been incised in the manner just described, the parietal peritoneum must be perforated. This may be done with the knife or scissors, but not by the finger, which makes an irregular hole. Any adhesions or constrictions can now be torn away or cut through, and if the intestine is so distended with gas that it cannot be returned, it may be punctured with the intestinal trocar and cannula. Should it not be possible to reduce the hernia by taxis, owing to the smallness of the opening compared with the contents of the sac, the ring

must be incised by the probe-pointed bistoury, or scalpel and director, to the required extent.

Degive has been successful in curing cases in which the ring was very wide, the tumour as large as two fists, and the sac wall greatly thickened through attempts made with the clamp. An incision is made in the middle line at the posterior part of the tumour, the hernia is reduced, and one, two, or three strong steel needles or pins, according to the extent of the opening, are passed through the lips of the ring; to prevent injury to the intestines, the skin of the sac is pushed by the finger a little inwards at the lip through which the needle is about to be thrust. When the needles have traversed both sides of the ring, a light steel clamp, nearly eight inches long, five-eighths of an inch broad, and five-sixteenths of an inch thick, is placed above them (next the abdomen). At the end of eight or ten days the clamp falls off, and with it the tissues in its grasp. To support the clamp in position, a long tape is attached to each end, and tied over the back.

Umbilical hernia in the smaller animals is treated in a similar manner, but in the majority of cases a bandage or truss suffices, though sutures, and even Degive's plan, can be employed in the more serious cases.

After-Treatment.—The diet for some days should be rather scanty and easily digested. A muzzle should be worn until the tendency to tear off the dressings has subsided.

VENTRAL HERNIA.

Subcutaneous protrusion of the viscera through the abdominal wall, elsewhere than at natural openings, is the result of external injury, or, though rarely, arises from internal pressure by great muscular force. To congenital weakness of the wall has also been ascribed the occurrence of non-traumatic ventral herniæ.

This hernia is most frequent in the Horse and Ox, and may be found at any part of the abdominal wall, though it is usually seen at the sides; immense herniæ, however, have been witnessed at the inferior part of the abdomen. The sac is formed by the skin, and possibly by the skin muscle, seldom by anything else, as the other muscles and the parietal peritoneum are generally lacerated.

The sac usually contains intestine or omentum, but occasionally other viscera are lodged in it, such as a portion of the gravid uterus, the stomach, and even the liver. The signs of ventral hernia are those of umbilical hernia, with, in addition, those of inflammatory traumatism, such as pain and tumefaction, if the injury be recent, and which might mislead the inexperienced operator as to the nature of the case, and cause him to adopt inappropriate treatment. A careful examination is therefore demanded before an opinion is given or operative procedure determined on. When the inflammation has subsided, there is no difficulty, as a rule, in arriving at a conclusion. The soft, compressible character of the

tumour, the readiness with which it can be wholly or partially reduced, and the discovery of the opening into the abdominal cavity, are sufficient to form a decision upon. Occasionally, however, the veterinary surgeon meets with obscure cases, even chronic ones, in which diagnosis is not so easy, especially in the smaller animals. I know of two instances in which hernia at the lower part of the abdomen in pregnant Bitches was mistaken for mammary tumour, but which was really protrusion of the gravid uterus. In one of the cases the hernia disappeared after parturition; in the other case the veterinary surgeon, acting upon his diagnosis, proceeded to remove the supposed fibroid, but he opened instead the peritoneal cavity and uterus, and the death of the Bitch supervened.

Very often this kind of hernia does not occasion much inconvenience, and Horses will live for years, and perform even severe labour, without suffering from it; others, however, are sometimes indisposed, show symptoms of colic, and when the imprisoned intestine becomes constricted or strangulated at the opening, then the signs are those of strangulation of that viscus, and serious consequences may ensue.

The treatment will vary with the dimensions and situation of the hernia, and also with the condition of the tissues surrounding the opening in the abdominal wall. When the injury is recent, and there are considerable bruising and laceration, it may be desirable to wait until the inflammation is allayed and healing more or less completed, before attempting to effect a cure. The hernia may be temporarily, and partially, or even wholly, reduced until this occurs, by means of wide body bandages or adhesive plasters in strips; but if the skin is much damaged, the application of external pressure needs great care, as it may lead to sloughing and eventration. If it is resorted to, the material in contact with the skin should be very soft, elastic, and antiseptic. It has been suggested that the pressure might be made by the hands of assistants.

When it is considered necessary to cure ventral hernia, the treatment to be adopted should follow the lines sketched out for umbilical hernia. Irritants may be tried, but these demand much judgment and watchfulness.

Instruments and Appliances.—These are the same as for umbilical hernia.

Position.—The position in which the animal is placed will depend upon the situation of the hernia; if this is on the side of the abdomen, it will be latericumbent, the side to be operated upon being uppermost; but if the inferior region of the abdomen is the seat, then the position should be dorsicumbent.

Operation.—The animal should be anæsthetised. When there are no adhesions between the sac and its contents, then ligation or the clamp may succeed, what may be called the covered operation, or external herniotomy—*i.e.*, non-perforation of the parietal peritoneum, if it is not already torn—being preferred.

When herniotomy must be performed, and the peritoneum, if not already opened, has to be incised—internal herniotomy—the most favourable cases are, of course, those in which the abdominal wound is long and narrow, rather than wide. The incision through the skin must be cautiously made, so as not to wound the protruded intestine, or whatever it may be, immediately beneath it, and antiseptic measures ought to be closely observed. It is a good plan to raise a small fold of the skin and make a snip in it with scissors—rowelling scissors are best; then a director being passed beneath it, the scalpel or bistoury pushed along the groove makes the incision of the necessary length. This should always, when possible, be from behind to before, not transverse. If there are adhesions, these must be cut through with the greatest care, or broken down by the finger or handle of the scalpel. When the intestine has been returned to the abdominal cavity, the wound should be closed by means of Degive's steel pins and clamp.

If the intestine is strangulated by the constriction of the margin of the abdominal wound, so that it cannot be returned, dilatation of the opening must be effected with the necessary precautions; but if any portion of the viscus is absolutely gangrenous, it would be most imprudent to pass it into the abdomen, and it will then be a question whether resection should be attempted or the animal destroyed.

After-Treatment.—The after-treatment of ventral hernia is that of umbilical hernia.

INGUINAL AND SCROTAL HERNIA.

Hernia of the abdominal viscera through the inguinal canal occurs only in male animals, and in the female of the Canine species, as in these this passage remains more or less patent. In the Horse it is far more frequent in Stallions than Geldings, in which the canal is generally reduced in size by castration, and all the more if the operation is performed when the animal is young. In many cases there is a hereditary predisposition to inguinal hernia, particularly in the Equine species, and in some it is undoubtedly congenital. It is very often developed or increased by intra-abdominal pressure through severe exertion, violent contraction of the abdominal muscles and those of the hind-limbs, especially when the digestive organs are distended or the thorax is dilated, the viscera being then propelled towards the pelvic cavity; or the inguinal rings are unduly dilated, and permit the entrance of intestine or omentum, or both, into the canal. It sometimes follows castration, particularly in old Horses; and it not infrequently suddenly manifests itself in these, and gives rise to serious consequences. But it often exists for years without causing any great inconvenience, though, of course, there is always the risk of strangulation of the imprisoned intestine, and ephemeral attacks of colic frequently denote its presence.

Inguinal hernia is very seldom witnessed in the Ox or Sheep, but in the Canine species it is more common; in the male it is far less so than in the female, though in the latter it is not seen until after the first litter of Puppies has been produced, and then it may be the uterus (even gravid) which occupies the hernial distention, instead of intestine, omentum, spleen, or (exceptionally) bladder.

In the Pig, inguinal hernia is far from unusual, especially in young animals, and is undoubtedly congenital in them, if not hereditary; it appears in castrated as well as non-castrated Pigs, and both intestine and omentum may be displaced, though it is most frequently the former.

The predisposing cause of inguinal hernia is, as has been mentioned, abnormal width of the abdominal rings, which permits the entrance of viscera to the inguinal canal, and thence even into the scrotum in non-emasculated animals. In the Horse the normal length of the ring (it is only a narrow channel for the passage of the spermatic cord when the testicle has permanently descended into the scrotum) varies from less than an inch to two inches, but exceptionally it may measure as much as six inches, though considerably less than this will allow the passage of intestine or omentum; indeed, it may be surmised that these often enter the inguinal canal at the time the testicle is descending from the abdomen, and remain there for perhaps a long time without being visible or suspected.

Recovery sometimes occurs spontaneously, though, as a rule, this happens only in young animals; the hernia remains of the same size, or it may increase more or less rapidly, this depending upon the width, or rather length, of the inguinal rings. In scrotal hernia the tumour is sometimes of such a size as to be quite conspicuous, extending even below the hocks, and therefore interferes with the animal's movements. In young Pigs it attains a comparatively large volume, often the size of an orange.

In some cases, however, when the hernia is incomplete and limited to the inguinal canal, as in Geldings, a manual examination is required to detect it, the symptoms exhibited by the animal alone exciting suspicion of its existence. When the hernia is quite recent, it may cause the animal to evince signs of more or less severe colic, the body being extended, and difficulty experienced in bringing the hind-legs forward and flexing the hocks; if the animal be a Stallion, the testicle on the affected side is always retracted. If the intestine is not constricted, these symptoms will generally soon disappear, and the animal move and look as usual. But if constriction is great or long continued, the movement of the intestine and the circulation of blood in it are hindered, congestion, œdema, and inflammation set in, and then there are all the symptoms of strangulation of the imprisoned viscus, which are generally those of enteritis, except that the Horse, when not moving, stands as if about to micturate, or sits on his haunches.

A careful examination, if the hernia is scrotal, will probably discover the scrotum more or less distended ; and if inguinal, the swelling will be higher up, of course, the loop of intestine being perhaps almost entirely within the inguinal canal ; but a manual exploration *per rectum* is required to distinguish this condition. When inflammation has begun, the hernial tumour is painful on manipulation, and if the scrotum be involved, this will be enlarged, tense, hot, and the tumour irreducible ; whereas previously the swelling was elastic, easily compressed and reducible, the loop of

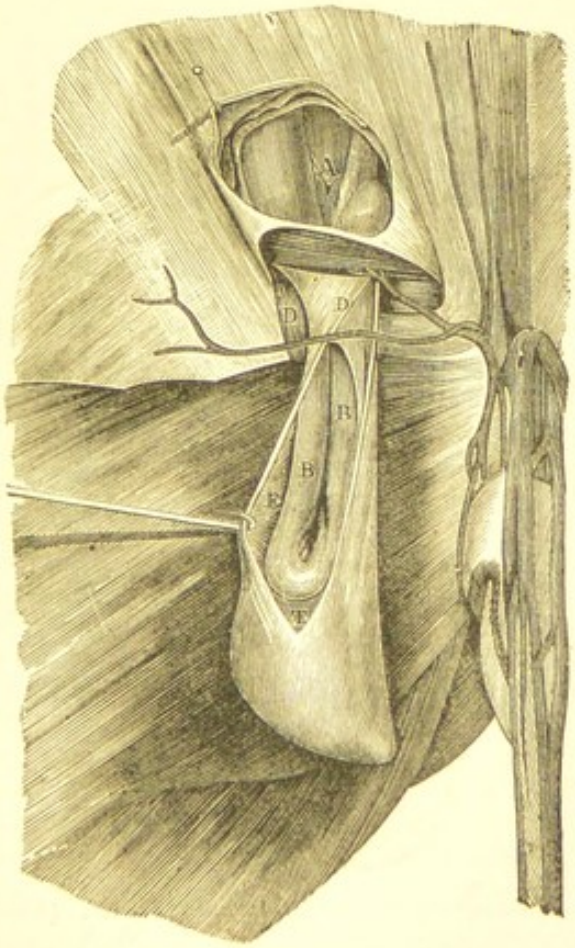


FIG. 386.—INGUINAL HERNIA. (After Girard.)

A, Intestine entering the ring ; B, B, loop of intestine in the vaginal sac ; D, D, neck of the vaginal sac ; E, interior of the vaginal sac ; T, testicle at the fundus of the sac.

intestine being often readily felt alongside the spermatic cord, and generally, if not always, on its internal side.

In inguinal hernia, the intestine or omentum, or both, as has been stated, enter the upper abdominal ring and pass into the inguinal canal ; if intestine, it forms a loop that hangs downward, and may extend into the fundus of the tunica vaginalis, in immediate proximity to the testicle, which in chronic hernia is nearly always atrophied. It is recognised in two forms—'incomplete' and 'complete' (Figs. 386, 387).

An 'interstitial' or 'false inguinal' hernia has also been described, but this is due to an accidental or pathological condition, and is of rare occurrence. Instead of the intestine passing through the abdominal ring and occupying the cavity of the tunica vaginalis, as in ordinary inguinal hernia, it enters an opening anterior to that ring. This opening is due to a defect in the abdominal muscles there, which is usually compensated for by a quantity of connective tissue. This is covered by parietal peritoneum, and in ordinary circumstances is sufficiently strong to sustain the strain imposed

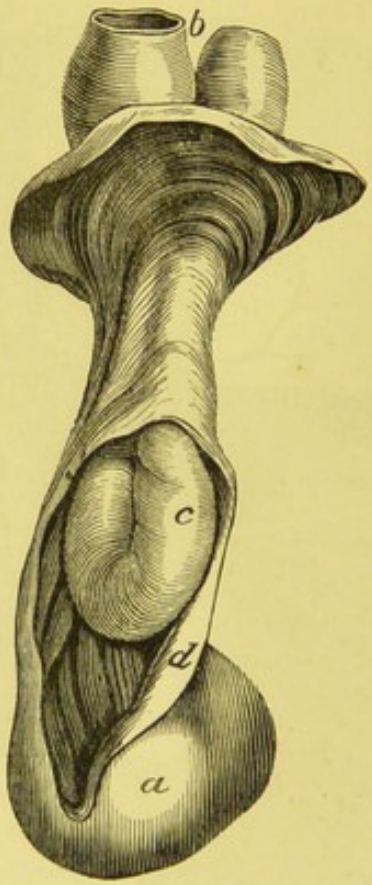


FIG. 387.—STRANGULATED INGUINAL HERNIA: HORSE. (After Hering.)

a, Exterior of the fundus of the hernial sac, formed by the tunica vaginalis; *b*, intestine entering the upper abdominal ring; *c*, loop of intestine in the inguinal canal and scrotum; *d*, internal surface of the vaginal sac.

upon the floor of the abdominal cavity by the weight of the viscera and contraction of muscles; but when the connective tissue is scanty or attenuated, or some extraordinary force has come into operation, the fibres give way, the peritoneum is torn, and the intestine or omentum, or both, pass through and become extra-abdominal; so that the hernia is extra-peritoneal, though included in the scrotum, the contents being covered only by the skin and dartos (Fig. 388), and not by the tunica vaginalis. But the difference between ordinary inguinal hernia and this extra-vaginal form is not easy to detect in the living animal before operation for reduction of the

hernia; then, however, there can be no mistake, as when the skin and dartos are incised, the displaced viscera are at once apparent without opening the vaginal sac. If the condition were suspected, an examination *per rectum* might assist in deciding as to its character. It is more serious than the usual form of inguinal hernia, because of its being external to the tunica vaginalis, and the readiness with which strangulation may take place.

In inguinal hernia, even when no inconvenience is experienced, it is advisable to obtain permanent reduction, because of the risk

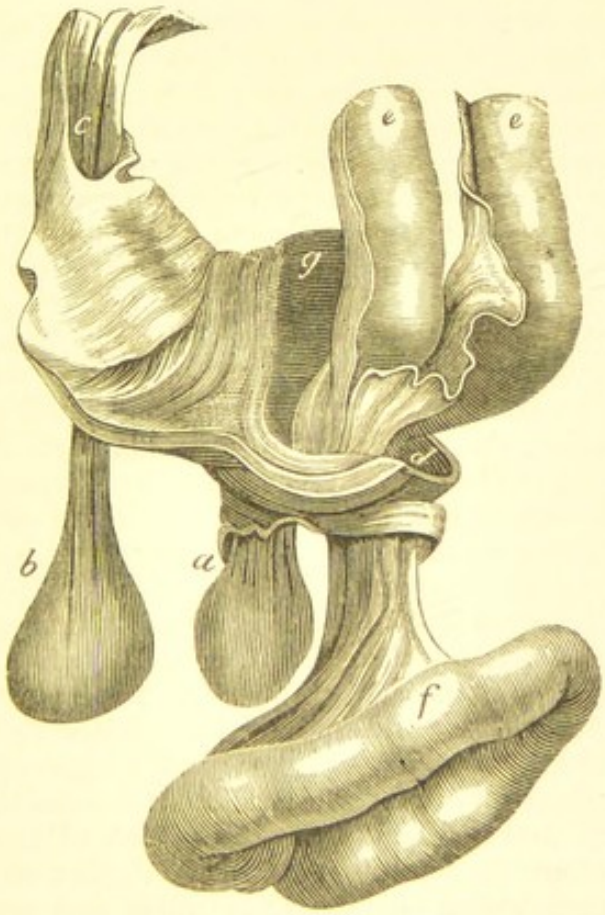


FIG. 388.—INTERSTITIAL INGUINAL HERNIA ON THE RIGHT SIDE: HORSE. (After Hering.)

a, *b*, Right and left testicles; *c*, left abdominal ring; *d*, pathological opening in front of the right abdominal ring; *e*, *e*, intestine passing into the opening, with, *f*, its herniæd portion *g*, abdominal ring.

that always attends displacement of viscera in such a narrow canal, which may be suddenly constricted at its openings during powerful contraction of the muscles that contribute to its formation, or the imprisoned intestine itself may so increase in volume that it suffers from compression. With this view, certain methods of treatment other than operation have been from time to time proposed and tried, the object being closure of the abdominal ring.

One of these is causing inflammation of the spermatic cord, so as to produce tumefaction and adhesion after the hernia has been

reduced, in order to occlude the abdominal ring. This swelling is induced by pulling the testicle downwards and forwards, while the cord is firmly rubbed between the fingers—the Horse being placed dorsicumbent—until it is swollen; or, after the hernia contents are returned to the abdomen, a bandage is firmly tied round the scrotum and above it, close to the abdomen, and left on for some hours, when swelling occurs which is stated to effect a cure; or irritants are applied repeatedly to the skin adjoining the inguinal ring, so as to excite effusion and swelling, which eventually disperses the hernia in young animals.

But the most certain and effective plan is the application of a clam over the tunica vaginalis, if the hernia can be reduced without dilating the rings; if it cannot, as in strangulated hernia, then these must be incised in order that the swollen contents be returned to the abdominal cavity. These operations we will now consider; but it will be perhaps useful if we glance at the anatomy of the inguinal canal, so as to be better able to comprehend the operative procedure. This canal (one on each side) is formed by certain abdominal muscles, and serves for the passage of the testicle into the scrotum at an early period of life, and the spermatic cord when this descent has taken place. In the Horse it is described as an infundibular or funnel-shaped canal, narrow above, wide below, two to three inches long, with two openings, one superior, the other inferior; the first, the *abdominal ring*, is in the floor of the abdominal cavity, and is a kind of oblique, slightly oval slit, from one to one and a half inches in length, directed outward and forward, about one to two inches from the pubis, and four to six inches from the linea alba; its anterior and inner border is formed by the small or internal oblique muscle, while the cremaster muscle and spermatic cord and crural arch bound its external and posterior border. The inferior or *inguinal ring* (Fig. 389) is also a narrow, elongated, but longer opening in the tendinous termination of the external oblique muscle, its posterior end being little more than an inch in front of the pubis; it is from three to four or five inches long, and, like the upper ring, is directed forwards and outwards, its inner and anterior border being formed by the small oblique muscle, and the external and posterior border by the reflected layer of the external oblique aponeurosis, known as the crural arch, or Poupart's ligament. In this way the inguinal ring is described as having two *pillars*, anterior and posterior, composed of fibres from the aponeurosis of the external oblique; and two *commissures*, external and internal, resulting from the union of the pillars at each end, the internal being limited by the prepubic tendon of the abdominal muscles. Through their relations with the two principal abdominal muscles, these two rings are extensible, and can also be slightly dilated when the hind-limbs are abducted and extended backwards. The canal is lined by the parietal peritoneum of the abdomen, which, descending into the scrotum as the tunica vaginalis, forms a sac or vaginal sheath in which the spermatic cord and testicle are sus-

pended ; this sac is attached to the margin of the abdominal ring, where it is in the form of a neck or cervix, which becomes somewhat contracted immediately below the ring and again dilates, so that in old Stallions the sac is not unlike an hour-glass in form. Through the canal there also passes from the abdomen, the external pudic artery, which supplies divisions to the scrotum, prepuce, etc., and

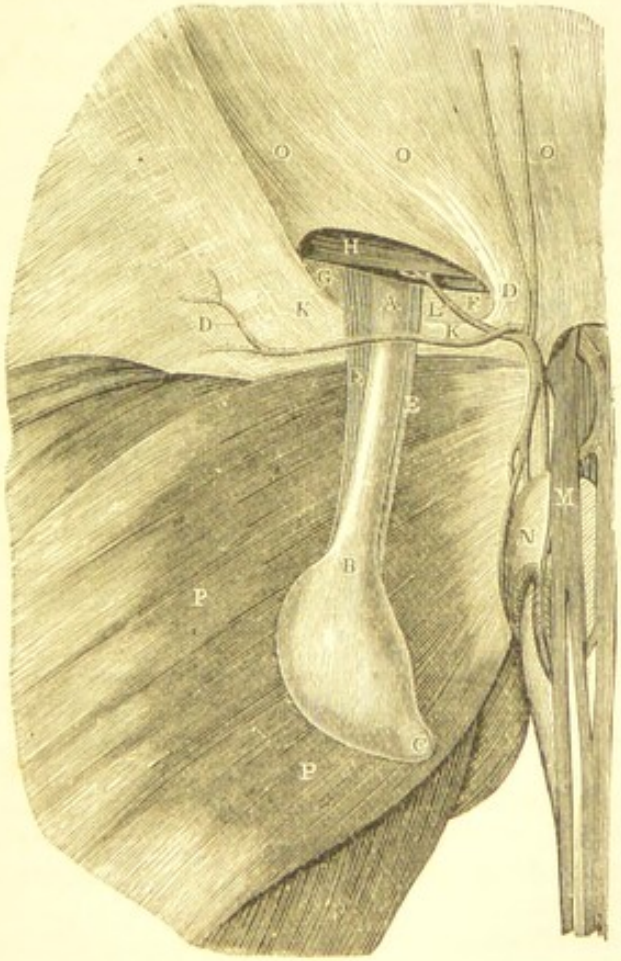


FIG. 389.—ANATOMY OF THE INGUINAL RING AND TUNICA VAGINALIS OF THE HORSE. (After Girard.)

A, C, Tunica vaginalis, in which are seen at A the neck emerging from the inguinal canal; from A to B a middle portion containing the spermatic cord, and B, C, the fundus containing the testicle; D, D, divisions of the scrotal artery coursing on the tunica, and which ramify on the pillars of the dartos; F, G, inguinal ring, or lower opening of the inguinal canal, the internal commissure of which (F) is circular, formed by white fibrous tissue crossing in different directions, and is inserted into the anterior border of the pubis; H, H, muscular band from the small or internal oblique muscle, forming the antero-internal margin of the inguinal ring; K, K, postero-internal margin of the ring, formed chiefly by an aponeurotic band from the great or external oblique; L, external pudic artery, passing transversely outward by different branches; M, veins of scrotum and penis; N, portion of the penis thrown back; O, O, O, tunica abdominalis; P, P, gracilis muscle.

the course of which it is well to remember. The prepubic artery, arriving at the posterior end of the abdominal ring, divides into two terminal branches, the external pudic or scrotal, and posterior abdominal. The former is the largest and most important, so far as the operation is concerned. Superiorly it lies loosely against the posterior border of the abdominal ring, bends downward,

leaves the canal, and goes to the scrotum. The other branch, the posterior abdominal, passes directly forward and downward, crosses the inguinal ring, and breaks up in the substance of the anterior and internal lip. It is accompanied by two veins that enter the abdomen and join the iliac vein.

In the Gelding there are only the remains of the spermatic cord and the external pudic artery in the inguinal canal.

It should be noted that the inguinal ring, a long slit in the vertical position of the hind limb, becomes more or less oval when the limb is carried outward and backward.

Instruments and Appliances. — For simple non-strangulated scrotal or inguinal hernia, these are: Scalpel, bistoury, or castrating knife; director, steel clamp, antiseptic lotions and dressings. Care should be taken to have a good clamp, as much of the success of the operations depends on it. It should be light, yet strong, the borders made to fit closely and evenly without springing, of good length, and with the screws and ends so guarded that they will not wound the thighs when the clamp is applied (Fig. 390).

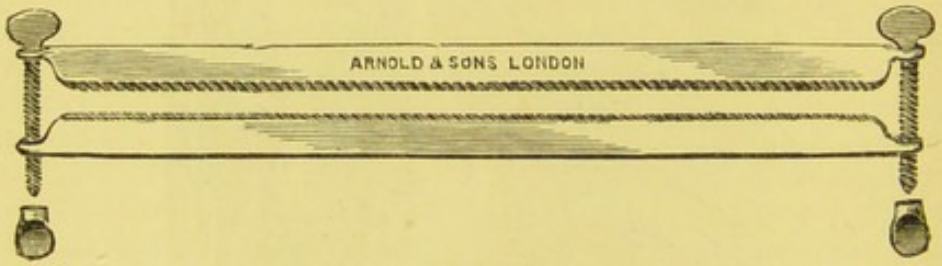


Fig. 390.—Russell's Inguinal Hernia Clamp.

If for strangulated hernia, then in addition to the above there will be required: A bistoury caché, or a probe-pointed one, with a very short cutting-edge near the end; suture needles and aseptic silk thread.

Position.—In all cases of abdominal hernia the animal should, whenever possible, be anæsthetised, as this renders what would otherwise be often a most difficult and prolonged, if not an unsuccessful task, a comparatively simple and safe one. This measure is all the more necessary the more serious the hernia may be. The remembrance of some appalling accidents occurring during operation on non-anæsthetised aged Horses compels me to emphasise this point. When the anæsthetic has been administered, the position is then made dorsicumbent, the hind-quarters being propped up and raised by bundles of straw, or bags filled with that material or sawdust.

Operation.—Should there be difficulty in reducing the hernia, the hind-limb of the same side should be drawn backward and outward, so as to favour dilatation of the rings of the inguinal canal. The scrotum and testicle are gently raised, and in many cases this, together with the relaxed condition of the abdominal muscles and the position of the animal, will cause the hernia to

quickly disappear; if it does not, then light and careful manipulation of the contents must be made through the scrotum, with the view of working them back in the inguinal canal; if this cannot be effected, then, while an assistant carries on this manœuvre, the operator endeavours to make it successful by passing one of his arms, oiled (the right if the hernia be on the left side, and *vice versâ*), into the rectum, and exercising skilful and guarded traction on the intestine close to the abdominal ring.

Reduction having been completely effected, then the application of the clamp has to be considered. Success has attended the use of the long steel clamp (Fig. 390) placed high up on the scrotum. The *modus operandi* is as follows: A piece of strong tape is placed round both testicles and scrotum, the latter having been previously asepticised; by means of this tape the scrotum is pulled away from the body as much as possible, and the clamp is put on over the whole, and made sufficiently tight by the screws to check the circulation in the bloodvessels. The clamp is made tighter by giving the screws two or three turns every day; so that in from ten to thirteen days the whole mass drops off, leaving a firm cicatrising surface, which should be kept clean and dry by powdering with boracic powder or iodoform. The animal is maintained standing from the time of the operation until four days after the parts have fallen off, sufficient exercise being allowed to control the swelling.

The pain is somewhat intense for twenty-four hours after the clamp is put on, and there is much tumefaction. Tetanus is said to be somewhat frequent, and it is not advisable to operate in this way on animals older than four years. The operation is certainly a radical one, as the cicatrix is thick and solid; it should be mentioned, however, that in exceptional instances cicatrisation is imperfect or incomplete, and sutures may have to be employed to thoroughly consolidate it.

To avoid the great pain induced by including the scrotum in the clamp, as well as to avert excessive tumefaction, the usual way to cure inguinal hernia is to proceed by cutting operation in the following manner:

Technic.—The Horse being anæsthetised, placed in the same position, and the hernia reduced, the operator, standing behind, grasps the testicle with both hands, left in front, right behind; the left having obtained a good firm hold of the spermatic cord, well beneath the gland, the right hand is disengaged, and by means of the knife or bistoury at one cut incises the skin and dartos in the middle line of the surface of the testicle, from before to behind; the fingers of the left hand, by drawing the skin downwards, opens the wound and causes the testicle and its envelopes to bulge; a slight incision cuts through the connective tissue and the cremasteric aponeurosis, and leaves exposed the tunica vaginalis, which must be left intact. The right hand now seizes the testicle, which is covered by the peritoneal sac, and by a movement of pressure and separation insinuates the fingers between it and the

external coverings, which are gradually pushed downwards; the left hand now grasps the testicle and raises it upwards, the fingers of the right freeing the sac from the connective tissue binding it to the scrotum, until it is quite isolated as high as the inguinal ring, and the testicle and its immediate appendage are clear for about two inches. The testicle still held well up in the right hand of the operator, he with the left hand puts on the clamp from before to behind, and as near the ring as possible, making sure that the hernia is completely reduced, the testicle and its appendages at a little distance from the clamp, and the scrotum well away from it. The instrument is then screwed or tied as tight as may be necessary by an assistant. In order to ensure a firmer closure of the hernial sac, before the clamp is put on the testicle, this, and with it, of course, the spermatic cord and tunica vaginalis, may receive a half or whole turn, and in this state be fixed by the instrument.

If the clamp, together with the testicle, are so heavy as to entail undue strain on the spermatic cord and serous sac, the weight may be sustained by an abdomino-perinæal bandage.

The clamp should be left on for four or five days, or even longer.

When the hernia is so very large as to lead to the belief that the abdominal ring is unusually wide, and that there is therefore danger of a re-descent of the intestine, and perhaps rupture of the remains of the serous sac, Möller employs a very short clamp, and making an incision through the skin sufficiently large to admit this, pushes it up to the inguinal ring, where it is secured, the skin being sutured over it. If no unfavourable symptoms appear, the instrument is not removed for a week, when the wound is healthy, and soon heals entirely with antiseptic treatment. The clamp should be rendered aseptic.

It has been mentioned that Geldings are not exempt from inguinal hernia, and when it is considered advisable to operate the procedure is somewhat different to the above. Every step is the same until the skin is to be incised. This having been made tense, an elliptical incision is made on each side of the castration cicatrix, so as to isolate this part, which is adherent to the tissues beneath; a cord or narrow tape is passed through, and by means of this it is raised, and the remainder of the skin and connective tissue is separated from the tunica vaginalis in the manner already described, and as high as possible. Before putting on the clamp, if there is any doubt as to the sac not being clear of intestine, it should be opened at the side and an exploration made with the finger. If the intestine is adherent to the tunica vaginalis, the adhesion must be divided most carefully by the finger, scissors, or knife; in doing this, rather than injure the bowel it is advisable to cut away the adherent portion of tunica vaginalis, and return the viscus with it to the abdominal cavity. Antiseptic precautions should be rigidly observed here.

The clamp is put on and secured in the same manner as in the Stallion, and, if deemed necessary, the sac may have half a turn round before it is compressed.

In *strangulated inguinal hernia*, the procedure is the same up to the point of reducing the hernia, which, owing to the condition of the imprisoned structures, demands great circumspection. Here reduction of the hernia must be promptly effected to save the animal's life, and if it cannot be accomplished by inguinal and rectal taxis, then it is necessary to proceed to dilate the abdominal ring, either inside or outside the vaginal sac. For the relief of strangulated enterocele, and especially if it be not desirable to remove the testicle, the extra-vaginal or subcutaneous operation is to be preferred.

TECHNIC.—Everything is done as in the previous operation until cutting the scrotum is arrived at. Then an incision, about two inches in length, is made at one side of the scrotum, between the testicle and the inguinal ring, through the skin, dartos, connective tissue, and cremaster, but not through the tunica vaginalis; the index-finger is introduced into the opening, and worked up to the constricting part, the herniotome (Fig. 376), or probe-pointed bistoury, is passed up flat along the finger, pressed carefully through the tight neck and ring without piercing the peritoneum, and the blade being turned with the cutting edge towards the border of the ring, a notch is made in it by gently withdrawing the knife. The external side of the scrotum is the most convenient for this operation, the notch being made in the ring at the outer side of the anterior end. If the cut in the constriction has been sufficiently deep (it should be no more), the intestine will either glide into the abdominal cavity spontaneously, or a little manipulation will cause it to do so. Before cutting the abdominal ring, the operator should be certain that the point of the bistoury or herniotome has passed within and slightly beyond it. The advantages claimed for this mode of releasing the imprisoned viscus are its simplicity and its rapidity; owing to the small incision in the skin, air is not admitted to the hernial sac or abdominal cavity, and the intestines are not soiled; the testicle is preserved; and the operation is not followed by accidents or complications. The method is also applicable to Geldings.

The wound is cleansed, dressed with iodoform, and a few sutures passed through the skin.

If it is decided to remove the testicle after the hernia has been reduced, this can be done at the same time, or afterwards, by the covered operation already described when treating of non-strangulated inguinal hernia.

Intra-vaginal herniotomy is sometimes resorted to, but if the animal be a Stallion, it necessitates removal of the testicle and great antiseptic precautions, as the intestines and peritoneal cavity are exposed to the air. The scrotum and tunica vaginalis are opened, the finger pushed up the inguinal canal to the seat of constriction, then the herniotome or bistoury is passed up and the ring most carefully incised in the same manner and place as has just been described. The intestine, after having been gently

cleansed with a weak warm solution of boracic acid, is allowed to descend into the abdomen; then a clamp is placed over the tunica vaginalis and spermatic cord as close to the inguinal ring as possible, the parts are dusted with a mixture of equal parts of iodoform and tannin, and otherwise treated as for simple inguinal hernia. If the opening is large, or the intestine is likely to re-descend and rupture the remains of the sac, the tunica vaginalis should receive a twist before the clamp is put on, and the skin may be fastened over the latter, or the abdomino-perinæal bandage may be applied to support the weight.

Inguinal hernia in the Ox may be treated in the same way as in the Horse.

If operation is necessary in the non-pregnant Bitch, narcosis is induced; the position is dorsicumbent, the skin is carefully cut through over the hernia, the peritoneum lining the sac exposed, but not opened, and isolated, when—the contained viscus having been returned—this membrane is gathered up and ligatured close to the inguinal ring.

In the Pig inguinal hernia is not rare, though operation for its cure is seldom practised. The covered operation is followed, and a ligature placed round the tunica vaginalis; or if the animal be old and not castrated, the clamp had better be used. It is recommended to remove both testicles, even if the rupture is confined to one side. If there are adhesions between the intestine and tunica vaginalis, the sac must be opened and separation carefully effected, and the viscus having been returned to the abdomen, a ligature or small clamp is placed on the outside of the tunica vaginalis, and left there until it drops off.

INTERSTITIAL INGUINAL HERNIA.

In interstitial inguinal hernia no attempt at operation should be made until reduction has been tried, and then only when the contents of the hernia are strangulated, and no other recourse is left save herniotomy, which may be looked upon as a somewhat desperate remedy.

Technic.—The Horse is anæsthetised, placed in dorsal decubitus, and, with every antiseptic precaution, the skin of the scrotum is incised in the usual way and direction; this incision exposes the imprisoned viscus, which must be covered by an aseptic cloth, while the finger is passed up alongside the tunica vaginalis towards the hernial opening, which should be found towards the anterior end of the abdominal ring. The opening, when discovered, may possibly be sufficiently dilated by gentle manipulation with the finger to allow the viscus to be pushed through; if not, the border must be notched by the herniotome to such an extent as to admit of reposition. When this has been accomplished, the opening should, if possible, be closed by strong silk sutures, and the wound in the skin sutured with the same material. If the animal is a Stallion, the testicle on the same

side should be removed by the covered operation, the clamp being placed close to the inguinal ring. The parts should be cleansed, dressed with iodoform, covered with some folds of aseptic tarlatan, and an abdomino-perinæal bandage worn until the clam comes off in four or five days.

The after-treatment is the same as that already described for other forms of inguinal hernia.

CRURAL HERNIA.

Crural hernia has been described as having been witnessed in the Horse, Cow, Ass, and Dog, though it is seldom recorded; nevertheless, as a portion of intestine may find its way into the crural canal through a rent in the fascia covering that space, or in some other way, it is well to examine the part, and indeed the inguinal canal as well, when an animal exhibits symptoms indicating colic or other bowel disturbance. The hernia may be produced by an accidental slip, fall, or strain, as during parturition; or it may be due to congenital defect.

The crural canal itself is of a triangular shape, and is formed by Poupart's ligament together with the iliacus, sartorius and internal oblique muscles; it lies immediately behind the abominal ring, though rather nearer the middle line, and is shut off from the abdominal cavity by the parietal peritoneum; it usually contains the crural artery and vein, with lymph glands.

The hernia is found high up on the inside of the thigh, where it is so small as to be scarcely noticeable, though it can be readily felt. It causes the Horse to move the limb stiffly, and if the contents of the hernia chance to be strangulated, then the usual symptoms of that condition are manifested, which an examination per rectum will confirm. This is a serious condition, and demands prompt attention. Recourse may be had to taxis, external and internal, to reduce the hernia, when the animal is in the dorsal position, and if unsuccessful, herniotomy must be adopted.

Operation.—The animal is placed in the same position as for operation in strangulated inguinal hernia. An incision about two inches in length is carefully made through the skin and connective tissue immediately over the tumour, and in a vertical direction, when the viscus in the canal is exposed. An attempt should be made to return it by gentle manipulation, and dilating the opening through which it has passed, by means of the finger or the knife. When it has been returned, the opening should be closed by passing two or three points of silk thread through the sartorius muscle and Poupart's ligament, and then suturing the skin wound. The part may be dressed with iodoform, and the usual bandage for this part applied.

After-Treatment.—The animal should be kept as quiet as possible, and not allowed to lie down for some days, nor yet exercised until the wound has quite healed. The diet should be laxative, and moderate in quantity.

PERINÆAL HERNIA.

Perinæal hernia has only, I believe, been observed in the female of the Bovine, Ovine, and Canine species; it would appear to be most frequent in the latter, and is due to protrusion of intestine into the pelvic cavity, either between the rectum and uterus, or the latter and the bladder; the last occurs oftenest in the Bitch. The cause of the hernia is not well known, but it is no doubt intra-abdominal pressure arising from severe contraction of the abdominal muscles or diaphragm, or from the weight of the viscera being thrown forcibly back during altered position of the animal. It rarely causes inconvenience except during parturition, which may be hindered if the hernia is large; but if strangulation of the intestine occurs, then the condition is serious.

The hernia usually occupies only one side of the perinæal region; in the Cow it is beneath the vagina, projects beyond the vulva, and may be as large, if not larger, than a cocoa-nut; in the Ewe it is to one side of the vulva, and may be the size of an orange; whereas in the Bitch it is between the root of the tail and the ischium.

The hernial tumour offers all the characters of an enterocele elsewhere—elasticity, capability of partial or entire reduction, variableness in size, etc.

It can be made to disappear in some cases by causing the animal to stand with its hind-quarters more elevated than the fore ones.

Operation.—This is not advisable, unless the hernia offers a serious obstacle to parturition, or the imprisoned intestine becomes strangulated. When operation has to be performed, the measures to be adopted are much the same as those described for umbilical hernia.

The animal is anæsthetised, placed latericumbent, the skin over the hernia cleansed and rendered antiseptic; an incision of sufficient length, and vertical in direction, is made in the skin, and the finger introduced through it and passed between the skin and peritoneum, now forming the sac. The intestine is gently manipulated back into the pelvic cavity, if there are no adhesions; if there are, then the sac must be opened and the adhesions separated, extreme care being observed in doing so, lest the bladder, uterus, or intestines be wounded. If these chance to be opened, then they must be at once sutured with fine aseptic silk.

The intestines returned, the sac is ligatured with silk, and the skin which covered it, having been diminished to a proper extent, is firmly sutured. The wound is dressed with the usual antiseptic powder, a pad placed over it, and a perinæal bandage applied.

After-Treatment.—Any symptoms of an unfavourable character that arise must be treated according to their indications. The wound itself only requires to be dressed once or twice. The animal should be kept for some time with the hind-quarters well raised.

PELVIC HERNIA.

This hernia, vulgarly known in this country as 'gut-tie,' appears to be more common in some countries than others, and is confined to the Bovine species. It is said to be most frequent in young Oxen, and is due to perforation of the peritoneum covering the spermatic cord; through this opening a portion of intestine—small or large—or omentum passes, and becomes strangulated. This occurs on the right side, owing to the rumen being on the left, and in the sacral region.

Unskilful castration is believed to favour its occurrence, and also severe exertion in ascending steep roads. It is only when strangulation of the intestine has begun that the existence of the hernia is revealed, though the symptoms are not altogether pathognomic, but are chiefly those shown in enteritis or peritonitis. An examination per rectum discovers what feels like a large tumour at the entrance to the pelvic cavity, on the right side, while nearer the middle of the cavity is found a hard tense cord—the spermatic cord. At an early stage the tumour feels soft, but later it is hard and painful.

Externally the hernia may, under certain conditions, be detected on the right side, and pressure there causes pain. Taxis per rectum may release the strangulated viscus, if it is not much swollen; in some cases a cure has been effected by tearing the spermatic cord, this being grasped through the wall of the rectum, by the full hand, and drawn forcibly backward. But this procedure is not always successful, and recourse must be had to a cutting operating.

Operation.—Laparotomy is performed in the right flank, as in the Horse; the hand being introduced into the abdominal cavity, and an opening made by the fingers through the omentum, the constricting spermatic cord is discovered, and the operator, assuring himself as to its identity, divides it by means of the bistoury caché, or, better still, by a pair of rowelling scissors, the handle of which should be tied by a piece of tape to his wrist.

The wound in the flank is closed in the manner already described, and is dressed antiseptically.

After-Treatment.—Attention to the wound is nearly all that is required. The diet should be light and soft for some days, and the hind-quarters kept slightly elevated.

WOUNDS OF THE ABDOMINAL WALL.

Traumatic lesions of the abdominal wall are frequent in the Horse, much less so in the Ox, and somewhat rare in the smaller animals; they vary from a simple wound of the skin to division of muscles and penetration of the abdominal cavity, with perhaps compound hernia of the viscera, usually intestines or omentum. It sometimes happens that the subcutaneous tissues, *e.g.*, the

muscles, may be lacerated without the skin being wounded, and the viscera may even be extruded through the laceration and form a simple hernia. The danger of such injuries depends upon their nature and extent; simple wounds without exposure of the abdominal cavity or protrusion of viscera, and especially if superficial, are comparatively free from danger, and give little cause for anxiety if promptly treated; while those in which there is extensive laceration, with prolapse of intestine, omentum, or other viscus, and particularly if these are wounded, bruised, injured by exposure to the air, or soiled by extraneous matters, are serious. Punctured wounds are also more or less dangerous, and the danger is increased because the extent of the damage cannot be exactly ascertained or remedial measures readily applied. But in the most serious cases, apparently, recovery need not be always despaired of, as veterinary literature teems with records of the cure of most formidable accidents of this kind.

All parts of the abdominal wall are exposed to injury, but the inferior regions are perhaps the most frequently involved. The greatest danger is to be apprehended from the occurrence of peritonitis when the abdominal cavity has been penetrated; to this inflammation the Horse is much more disposed than the other domestic animals, the Pig coming next, then the Ox, Sheep, and Dog.

Treatment.—This, of course, must depend upon the character of the injury.

Simple superficial wounds are treated on ordinary surgical principles. After cleansing and dressing with antiseptic lotion, the borders of the wound are brought together and maintained in apposition by means of narrow strips of pitch plaster; they are then powdered with iodoform and kept dry and clean.

Deep lacerated wounds are to be cleansed and dressed in the same way, torn shreds of tissue being removed, and the sides of the opening brought together by means of sutures deeply implanted, and all the more so when the wound is extensive and deep; the quilled suture is perhaps the most useful and effective in such cases, and the suture material, for the larger animals especially, should be of metal. To support the sutures, long strips of pitch plaster should be fixed across the wound at intervals, and when the wound has been closed, it must be covered with antiseptic powder and gauze, and a wide abdominal bandage applied round the body. The wound must be kept clean and dry, being dressed at intervals with antiseptic powder, and it may be, and indeed is nearly always, necessary to prevent the larger animals from lying down until cicatrisation is complete, as rest is absolutely necessary to ensure rapid healing.

If the smaller animals manifest a tendency to tear off the bandages and dressings, they should be muzzled until the wound is healed.

Punctured wounds are treated in a similar manner, but a word of caution is necessary in cases which demand exploration with

the probe or finger, as it is most important that these should be perfectly clean and asepticised; but such exploration should not be attempted unless there is urgent need for it—as when excessive hæmorrhage is present, or a foreign body is suspected to lie in the wound. If hæmorrhage is alarming, an attempt should be made to tie the vessels from which the blood escapes, or if this be not possible, styptics may be tried; but usually, if the wound is firmly closed, bleeding will soon cease, and it is well in all cases to free the injury from blood as much as possible, and to render it thoroughly aseptic. The wound is treated by suture in the way already indicated, the muscle wound being first closed by deeply-inserted interrupted sutures of strong silk, and the skin wound closed independently, but with the same material. As already mentioned, the quilled suture is to be preferred in closing such wounds in regions where there is much movement, or where the weight of the viscera imposes severe strain on the stitches. The wound is cleansed and dressed with antiseptic powder and gauze, and a bandage placed round the body to support the sutures and the dressings. The animal must be kept as quiet as possible, and, if a Horse or Ox, prevented from lying down for some days. If there is slight or no discharge from the wound, it should be interfered with as little as possible, the dressing being renewed after three or four days; but if unfavourable symptoms supervene, or the discharge is copious, it may be necessary to remove the bandage and dressings to ascertain the condition of the part. Should there be an accumulation of pus beneath the skin, drainage must be ensured by a dependent opening, inserting an appropriate tube, or, better still, a small roll of aseptic gauze, into the depth of the wound. It may be requisite also to cut through the skin sutures if the tension on them is very severe.

If, in the case of the Horse or Ox, and because of the sensitiveness or nervousness of the animal, or the situation of the wound, it is difficult to insert the sutures, the animal must be placed in the recumbent position; it will then often be advisable, before throwing it down, to employ an abdominal bandage, especially if there is any likelihood of bowel or omental protrusion; and it will also render the operation easier and more effectual if an anæsthetic is administered when the animal is recumbent.

Protrusion of viscera is a frequent and serious complication of abdominal wounds, these being generally intestine, omentum, or uterus; the gravity of the prolapse is due to the danger of septic peritonitis from the admittance of air or foreign matter to the peritoneal cavity, soiling, bruising, or wounding of the viscus, and the difficulty often experienced in returning and retaining it in the abdomen.

In the successful treatment of such cases, much depends upon averting septic peritonitis by thoroughly cleansing the prolapsed part before it is returned, gently sponging it with warm antiseptic fluid, then replacing it by delicate manipulation. If it be omentum, there is usually little difficulty in effecting its return, though should

this be not altogether possible, a large portion may be removed with impunity if the bloodvessels in it have been tied; this procedure, indeed, becomes imperative if the part is badly torn or gangrenous; if the remaining portion cannot be pushed into the abdomen, it is recommended to leave it in the wound, where it will become adherent and assist in closing the opening.

This treatment, of course, is not applicable to prolapsed intestine, which must be replaced; after being cleansed, this replacement is accomplished by patient and careful manipulation, the hands and instruments being previously rendered aseptic. Reduction is greatly facilitated if the animal be placed in the latericumbent or dorsicumbent position; but in the larger animals, before this is done, in order to prevent injury and infection a wide bandage, wetted with antiseptic fluid, should be applied over the bowel and tied round the body. If there is much distention of the bowel from constriction of the wound, the latter can be sufficiently enlarged, or the intestine itself may be punctured to allow the contained gas to escape.

When reduction has been effected, the wound is to be closed in the manner just described, and the same after-treatment adopted.

When the intestine is wounded, the case may be far from hopeless; after being cleansed, it should be sutured, as recommended when treating of bowel sutures; even when a portion is gangrenous, it may be advisable to resort to its resection, after the manner already indicated.

In animals the uterus, and even the bladder, has been successfully sutured when prolapsed through an abdominal wound.

In all cases of serious abdominal wounds, the food allowed should be easily digested, and given in small and frequent quantities.

OPERATIONS ON THE RESPIRATORY APPARATUS AND THE THORACIC CAVITY.

Operations on the respiratory apparatus are comparatively few in number, and are chiefly performed on the larger animals. The operations are limited to the air-passages and their complementary cavities in the head, the larynx, and the trachea. The Horse is nearly always the animal operated upon.

CHAPTER I.

OPERATIONS ON THE AIR-PASSAGES AND THEIR COMPLEMENTARY CAVITIES IN THE HEAD.

Nasal Cavities.

These cavities are sometimes the seat of operation for the removal of polypi, angiomata, and various neoplasms—such as carcinomata, sarcomata, lipomata, osteomata, and adenomata—and dermoid cysts, that sometimes develop on the turbinated

Fig. 391.—Operator's Protective Mask for Nasal Inspection of the Horse.

bones or the nasal septum. Owing to the great length of the Horse's face and the comparative narrowness of the nostril, it is impossible to inspect the cavities throughout their whole extent by the unaided eye; but with the assistance of an artificial illumin-

ating apparatus they can be scrutinised for a considerable distance. In making this inspection, the veterinary surgeon incurs serious risk when contagious disease is present, and in all cases the task is rendered unpleasant from the tendency of the animal to eject mucus into the face of the investigator. To obviate this unpleasant and dangerous accident, a leather or tin mask has been devised (Fig. 391); this completely covers the inspector's face, and is fastened at the back of the head by means of a strap and buckle; the eyes are of glass, and a thin piece of

Fig. 392.—Nasal Dilator.

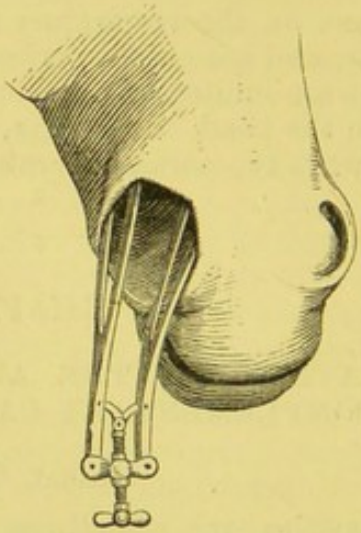


Fig. 393.—Nasal Dilator applied.

leather is attached to its lower border, so as to protect the mouth without impeding the scrutiniser's breathing. To open the nostril sufficiently without soiling the fingers, a nasal dilator has also been devised (Fig. 392); this consists of two hinged blades acted upon by a handle with a screw, which, on being turned in either direction, brings the blades nearer or pushes them further apart. When the blades are introduced within the nostril, this can be dilated to its full extent with far greater ease and effect than when only the fingers are employed, and these are not so liable to be soiled (Fig. 393).

Ordinary daylight is sufficient to illuminate the lower part of the nasal cavity, and when exposed to the full light of the sun it can be further illuminated; but if it is desirable to examine it higher, then reflected or artificial light is necessary. A reflector may be employed to increase the intensity of the illumination and throw

the light higher up in the cavity; another advantage in using it is that artificial light can be employed, as well as daylight. Friedberger and Fröhner use a slightly concave hand reflector, about four and a half inches in diameter, constructed on the same principle as the ophthalmoscope mirror (Fig. 394). In using it, the head of the animal is turned in the opposite direction to the light, and an assistant raising one wing of the nostril (if the dilator is not employed), the operator raises the other wing with his left hand,

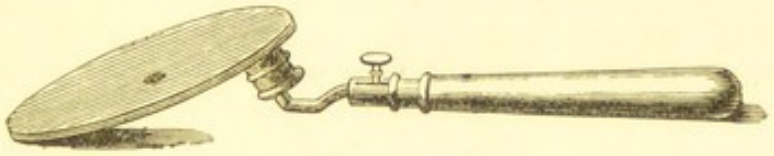


FIG. 394.—NASAL REFLECTOR.

and, holding the reflector in his right, throws the light into the cavity, looking through the aperture in the reflector with one eye, and closing the other to prevent the entrance of nasal discharge. Lustig has constructed two special nasal reflectors which have been found useful. These are of metal, one about four inches in diameter (Fig. 395), with a plane surface for illumination by sunlight; this is sufficient to illuminate the nasal cavity uniformly and with sufficient intensity; the other has the surface concave,

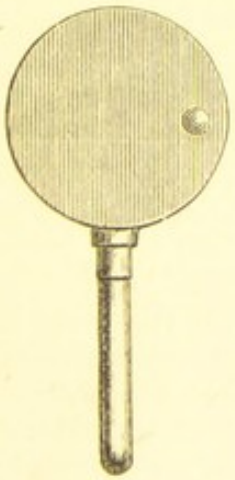


FIG. 395.—NASAL REFLECTOR WITH A RIVET HOLE AT THE PERIPHERY FOR THE PROTECTIVE DISC.

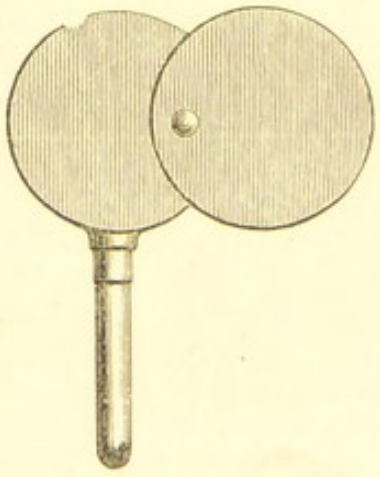


FIG. 396.—NASAL REFLECTOR WITH ITS PROTECTIVE DISC.

and throws the light on a limited point; but it cannot be used for long in a bright sun, as it concentrates the rays like a burning-glass, and will cause pain to the animal. To prevent nasal matters being snorted into the eye during inspection, when the operator does not wear a mask, a disc of metal of the same size as the reflector is attached to the one side by a rivet, on which it rotates, so that when in use this disc is rotated outwards, and covers the eye not in use (Fig. 396). One handle can be made to fit both

reflectors. They are employed in the same manner as the one first described.

Artificial light cannot be directly employed to illuminate the nasal cavity unless its source be shielded from the air passing out from them. To obviate this inconvenience, as well as to illuminate the upper portions of these cavities in a more perfect manner, one of the small electric lamps recently introduced, as Bayer's (Fig. 312), or Raymond's (Fig. 313), or that described and figured on page 280, answers fairly well; but the electric lamp specially devised by Polansky and Schindelka as a rhinoscope and laryngoscope is in every way preferable to all the means of illumination hitherto tried. This consists of a straight tube (Fig. 397, *a*), containing the light at its extremity (*b*), and fixed into

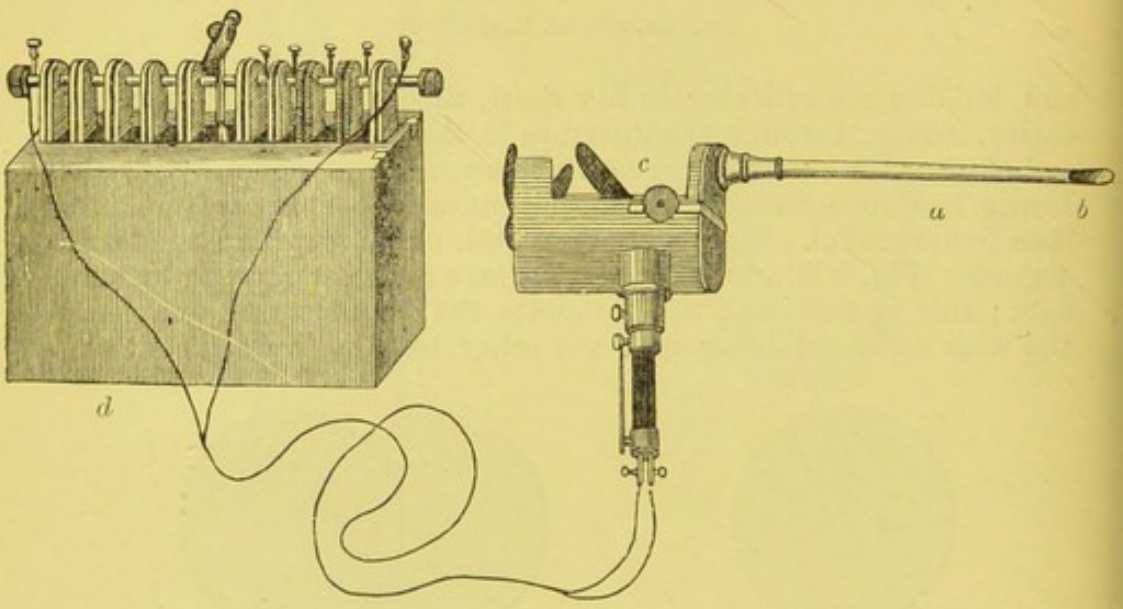


Fig. 397.—General View of the Panelectric Rhinoscope and Laryngoscope.

a panelectroscope (*c*), to which are attached the wires from the battery (*d*). The tube itself is about twenty-two inches in length, and half an inch in diameter (Fig. 398, R); the extremity is a cupola (G), which has an opening at the end or the side, or a long narrow opening on each side, according to requirement. This contains the lamp (L*a*), covered in by a glass plate; near the lamp is a rectangular prism (P), which is placed in the tube in such a manner that the image of the parts illuminated by the lamp is diverted into a small telescope in the body of the tube, by which a reduced picture is presented to the observer. At the opposite end of the tube are placed the pole-screws (L*e*) to hold the wires from the battery, as well as a contact-screw (C) for closing or opening the current. As the position of the screw corresponds with that of the lamp at prism at the other end, it may also be of use in showing in what direction the lamp is facing when inside the cavities. As the heat generated by the

lamp would prove injurious to the mucous membrane when long continued, a cooling apparatus has been applied to the apparatus in the form of two hollow processes (MV) let into the tube; to one of these the tubing of an india-rubber bellows (G′) is connected,

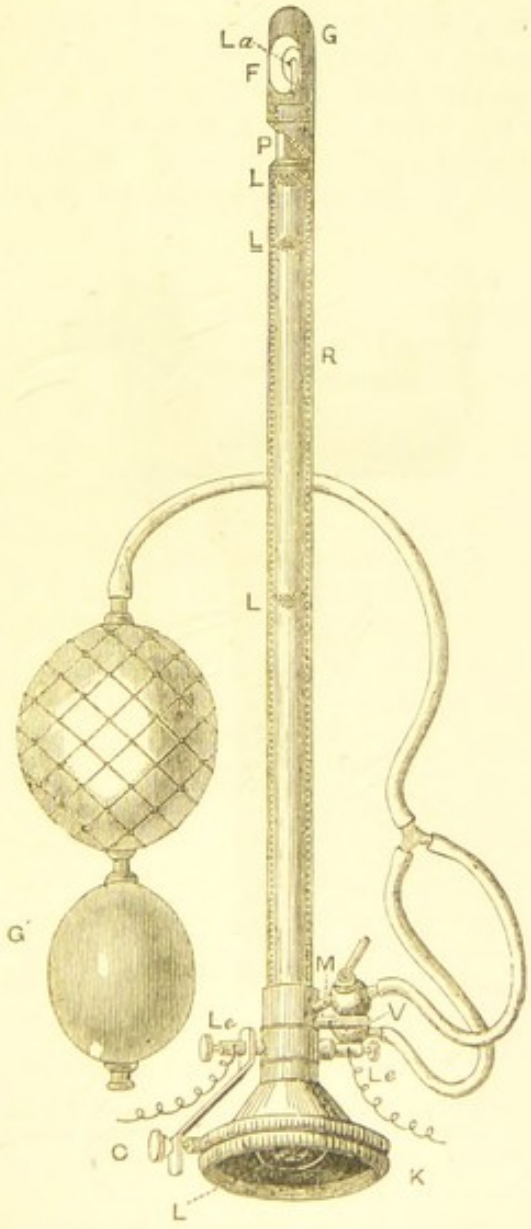


FIG. 398.—POLANSKY AND SCHINDELKA'S RHINOSCOPE.

R, Tube; G, its cupola-like extremity; L*a*, lamp; P, rectangular prism; L*e*, pole-screws; C contact screw; M, V, appliances for supplying cold air to the interior of the tube by means of the india-rubber bellows, G′; L, L, L, spiral spring in the tube; K, socket into which the tube fits, and which is fixed into the panelectroscope.

the other end being applied to a metal worm in a small tin pail, which is filled with a refrigerant solution. The cooled air is pumped in the tube at M, and escapes at V. There is a spiral spring near the end of the tube (L), by which it is fixed into a socket (K) thas fits into the panelectroscope. In order to prevent the lamp-glats

and the prism from becoming obscured by secretions while the tube is being introduced, there is an external movable sheath that can be drawn back sufficiently to uncover these parts when the instrument is in position.

The panelectroscope into which the tube is fixed (Fig. 399) is a kind of open box (G), with a concave mirror (S*p*) about two inches in diameter, a movable magnifying lens, and an infundibulum to receive the tube (T). The lamp is fixed by means of a screw (VK) to the wires (L*e*); a screw (C) attached to a plate (C*f*) lets on or shuts off the current. When the light falls on the mirror (S*p*), it is reflected parallel to the tube (fixed at T),

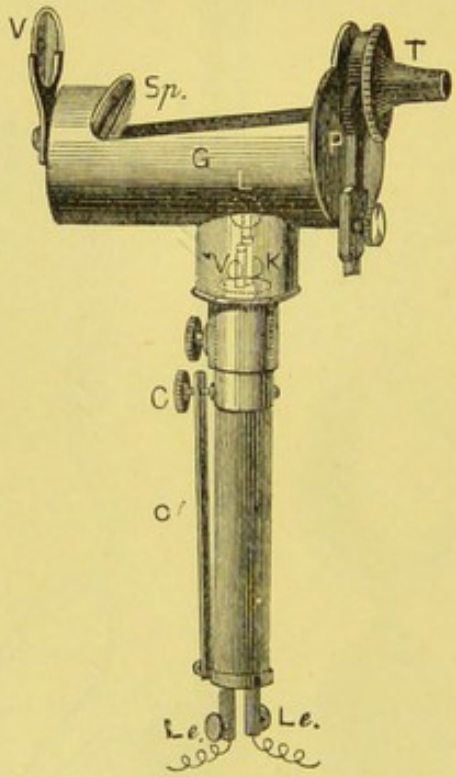


FIG. 399.—PANELECTROSCOPE.

Body of the apparatus; T, projection for fixing the tube to; L, lamp; V, magnifying lens; S*p*, reflector; V, K, lamp fixed on a running screw; L*e*, wires from the battery; C, C*f*, contact screw and plate.

and the image conveyed by this can be magnified by the other mirror (V).

Such is a brief description of this ingenious and useful apparatus. When it is to be used, the tube is plunged for a short time in warm water, in order to raise it to the temperature of the parts with which it is to be brought into contact, so as to prevent the glass from becoming obscured by condensation of watery vapour from the breath. It should also be smeared with glycerine to facilitate its introduction, which is effected by holding the tube in the right hand as if it were a pen, and passing it up the nasal chamber against the septum by a slight screwing movement. In

this way it can be pushed as far as the posterior nares and into the pharynx, and by means of it a perfectly clear picture can be obtained of the whole of the internal surface of the nasal chamber, or of the pharynx and larynx, a most important advantage in the operative surgery of these parts. Indeed, it might be employed for the inspection of every cavity into which it can be introduced.

OPERATIONS IN THE NASAL CHAMBERS AND MAXILLARY AND FRONTAL SINUSES.

These consist chiefly in the removal of tumours that form in the nasal cavities and in collections of pus from the sinuses, which have already been described at page 263. Sometimes foreign bodies are lodged in these cavities, and must be removed; and, though rarely, there may be hypertrophy or necrosis of the turbinated bones, which demands surgical treatment.

In the case of tumours, when they are in the lower part of the cavity there is not so much difficulty in ascertaining their nature, seat of attachment, or in effecting their removal, as when situated higher up. But even when low, and especially if attached to the outer aspect of the cavity, it is occasionally necessary to slit the nostril for some inches between the nasal and maxillary bones before removal can be accomplished. When the growth is high, or when necrosed turbinated bone has to be removed, trephining the nasal bone must be resorted to. This is usually done towards the junction of that bone with the frontal bone, as it is advisable to have the opening rather high than low; a line drawn parallel with the inferior margin of the orbital cavity is generally preferable for making the trepanation. In some cases it may be requisite to make a double opening, and remove the intervening piece of bone, in order to secure sufficient space for operation. In effecting this, the skin should be incised slightly beyond the length it is proposed to remove the bone, and from three to four inches parallel with the articulation between the nasal bones. A short incision is made across the perpendicular one at each end (Fig. 400, A), and the skin is dissected back from these lines sufficiently distant to allow the bone to be removed. The lower opening is then made with the trephine in the way pointed out at page 263, and the upper one at the desired distance—usually one and a half to two inches for the removal of tumours, large foreign substances, or portions of the superior turbinated bone. The bone between these openings is removed by means of the saw (Fig. 400, B). After the operation, the skin wound is closed by points of suture in the usual way.

Tumours, if accessible, may be removed by the fingers when they have a narrow pedicle, as in the case of polypi; a wire snare is useful, but if the tumour is very dense, as with osteomata, then a strong ecraseur and steel wire is necessary, or it

may be necessary to employ a chisel or gouge and hammer. When hæmorrhage is apprehended, the chain ecraseur is preferable. A curette is also serviceable in completing the removal, if the growth had a wide base.

Sometimes hæmorrhage is very copious, and must be checked. This can be done by plugging the nostril with lint, cotton-wool, or fine tow, steeped in some hæmostatic agent; but care must be taken that none of this drops into the larynx from the posterior

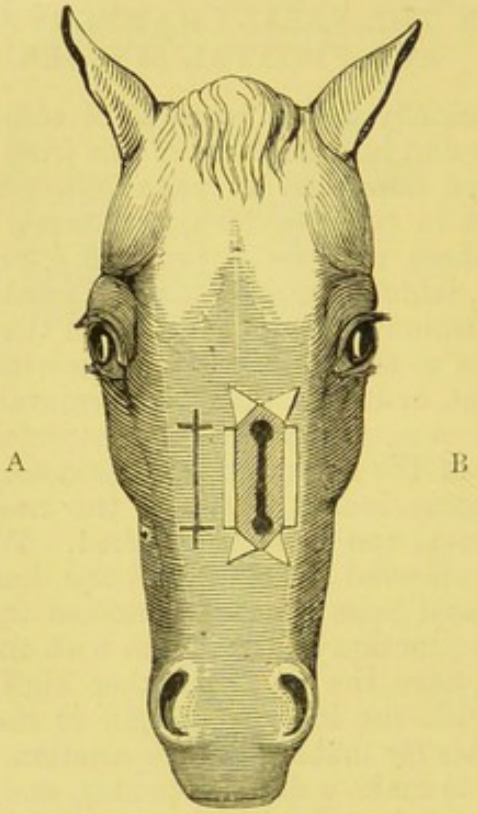


FIG. 400.—TREPHINING THE NASAL BONE.

A, Incisions through the skin; B, skin dissected back, the bone trephined at two points, the intervening bone removed, and the nasal chamber opened.

nares. To avoid this accident, and also to hinder the blood flowing into the larynx, the head should be kept vertical and as low as possible. To prevent the plug falling into the pharynx, it is advisable to have a piece of tape tied securely to it, and the end left to hang out of the nostril or fastened to the head-collar. If there is any likelihood of danger from laryngeal or tracheal obstruction, it may also be advisable to perform tracheotomy, and employ the tampon cannula for some hours.

OPERATIONS ON THE GUTTURAL POUCHES.

We may in this place consider the guttural pouches or sacs as appendages or diverticuli of the respiratory organs, as when involved in disease or any morbid condition they are more likely to interfere with respiration than with deglutition.

The morbid conditions usually described as requiring operative interference are *tympanites* of these sacs, and catarrhal inflammation of their lining membrane. This inflammation is usually of a chronic nature, and gives rise to an accumulation of pus that sometimes distends the cavity to a great extent and is discharged from the nostril, more especially during exertion, or when the head is held low.

Surgical Anatomy.—These sacs are situated, one on each side, behind the pharynx, and beneath the cranium and atlas; they are, it may be said, a wide expansion of the Eustachian tubes, the lining membrane of which forms their wall, and they are in contact with each other in the middle line, behind the

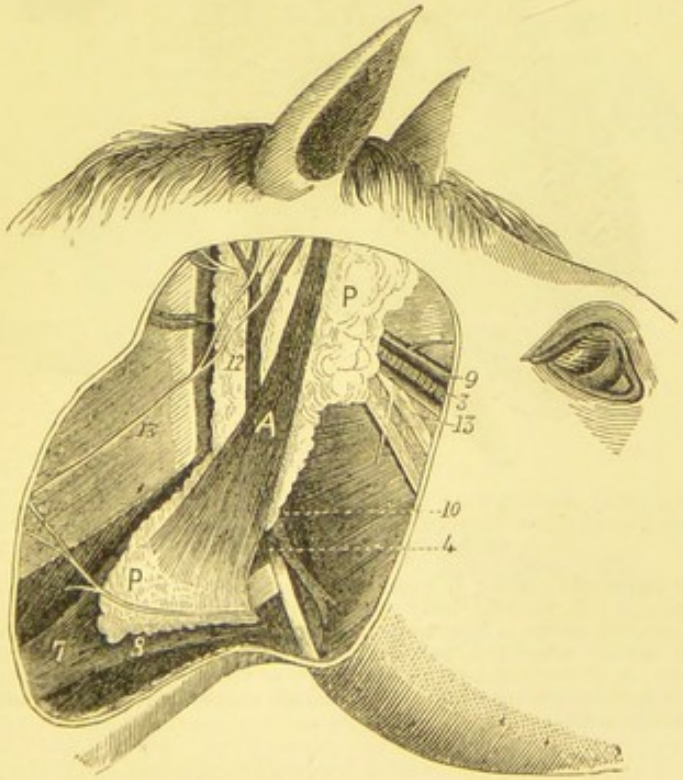


Fig. 401.—Surgical Anatomy of the Guttural Sac. (After Peuch and Toussaint.)

P, P, Upper and lower extremities of parotid gland; A, parotido-auricularis muscle; 3, transverse artery of face; 4, maxillo-muscular vein; 7, jugular vein; 8, glosso-facial vein; 9, transverse vein of face; 10, maxillo-muscular vein; 12, posterior auricular vein; 13, facial nerve; 15, auricular branch of second cervical nerve.

pharynx, where they occupy a large triangular fossa nearly corresponding externally to the parotideal region and to the base of what is known anatomically as 'Viborg's triangle.' Each sac has only one opening—that through the Eustachian tube, which opens by a narrow slit in the side of the pharynx at a short distance from the posterior nares, and is accessible from that opening of the nasal cavity. Externally each sac has, from without inwards, (1) the *skin;* (2)

subcutaneous connective tissue; (3) thin expansion of the *panniculus carnosus* muscle; (4) *parotido-auricularis* muscle; (5) *parotid gland;* (6) *small oblique muscle* of the head; (7) *stylo-hyoideus;* (8) *digastricus;* (9) upper portion of the *submaxillary gland.* Superiorly the sac is in contact with the *longus colli* muscle. The arteries on its external surface are: (1) the *occipital*, a branch of which passes over the outer surface of the styloid process of the occipital bone; (2) the *internal carotid* coursing upwards beneath the mucous membrane of the sac; (3) the *external carotid*, giving off the *maxillo-muscular*, *parotideal branches*, *posterior auricular*, *superficial temporal*, and *internal maxillary.* The veins are numerous, and pass to the jugular vein or its tributaries. The principal nerves are the

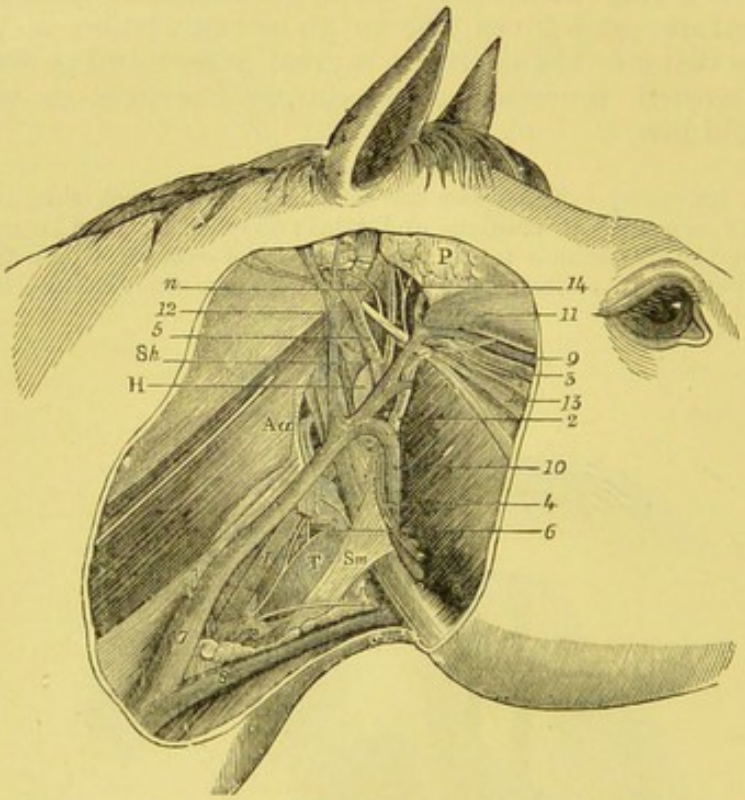


FIG. 402.—SURGICAL ANATOMY OF THE GUTTURAL SAC—DEEPER LAYER. THE SKIN, PAROTIDO-AURICULARIS MUSCLE, AND PAROTID GLAND HAVE BEEN REMOVED.
(After Peuch and Toussaint.)

P, Upper portion of parotid gland; D, digastric muscle; Sh, stylo-hyoid muscle; Sm, sterno-maxillaris muscle; T, thyroid body; H, posterior border of the larger hyoid cornu; 1, common carotid artery; 2, external carotid artery; 3, transverse artery of face; 4, maxillo-muscular artery; 5, posterior auricular artery; 6, thyro-laryngeal artery; 7, jugular vein; 8, glosso-facial vein; 9, transverse vein of the face; 10, maxillo-muscular vein; 11, anterior auricular vein; 12, posterior auricular vein; 13, facial nerve; 14, anterior auricular nerve.

facial, *pneumogastric*, *spinal*, *superior cervical ganglion of the sympathetic*, *hypoglossal*, and *glosso-pharyngeal*, all of which are on the outer surface of the sac, below the larger cornu of the hyoid bone and stylo-hyoideus muscle, except the *facial* nerve.

The wall of the sac is very extensible. In a medium-sized Horse each sac, without being distended, will hold from one-half to one-third of a pint, but fluid may be added to the amount of five or six pints; so that the cavity may be enormously distended by an accumulation of air, pus, or more solid material, which will give rise to pressure upon the larynx below, protrude into the pharynx, and render deglutition difficult, if not impossible; it will also push the parotid gland outwards, and even pass beyond it posteriorly and inferiorly.

Tympanites of the Guttural Pouch.

Distention of the guttural sac with air (*aërosacotomia*) has been described by several observers, but the condition must be rare, or it may be overlooked or mistaken for some other morbid state. It has been most frequently seen in young animals—Foals—and occurs in both sacs, the distention being sometimes so great as to cause severe dyspnœa. How the air enters the sacs has been a matter of conjecture. Certain authorities believe there must be

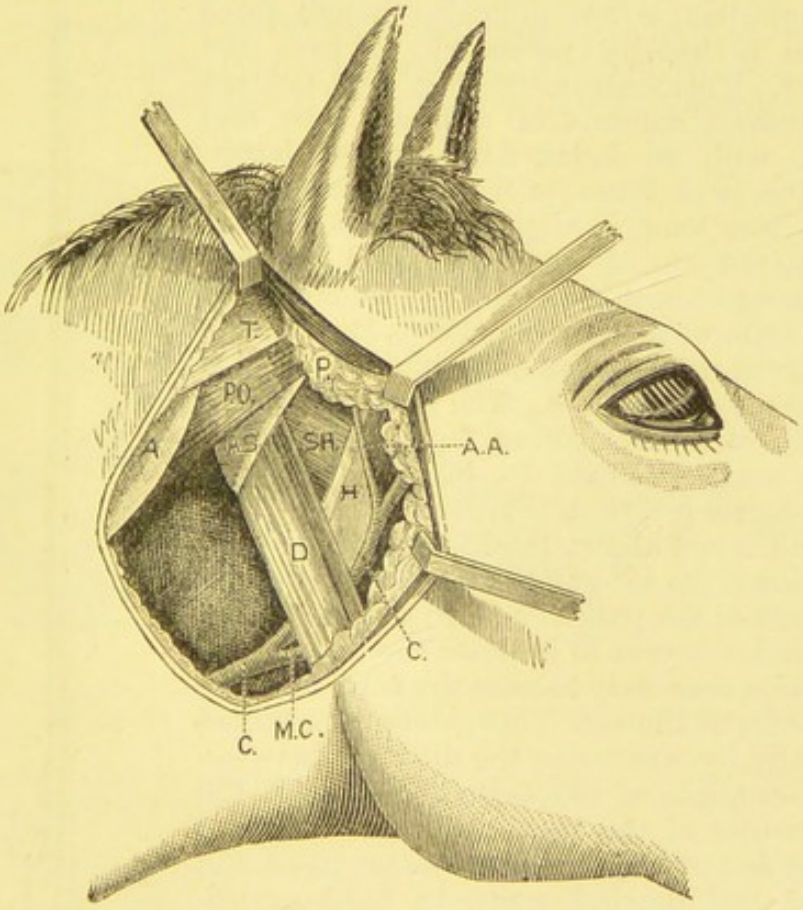


Fig. 403.—Surgical Anatomy of the Guttural Sac, showing part of its Cavity. (After Cadiot.)

P, Parotid gland; T, tendon of the complexus minor; A, atlas; P O, small oblique muscle of the head; A S, styloid process of the occipital bone; H, large cornu of the hyoid bone; S H, stylo-hyoid muscle; D, digastric muscle; C C, carotid artery; M C, external maxillary artery; A A, posterior auricular artery.

an abnormality in the Eustachian tubes, which permits the air to enter during swallowing, but prevents it escaping again; others think air may enter the sacs owing to paralysis of the soft palate, which then does not cover the opening of the Eustachian tube during deglutition. The sacs may also be distended with gas that has been generated during inflammation of their lining membrane.

The presence of air or gas is denoted by well-defined swelling of the parotideal region, which sounds tympanitic on percussion

and it is said that when pressure is applied a whistling noise is heard in the mouth, due to air rushing through the Eustachian tube into that cavity.

When dyspnœa is present, and likely to become dangerous, relief must be given by operation. This may be catheterism of the sacs, or opening them externally.

FIG. 404.—GUNTHER'S GUTTURAL POUCH CATHETER.

a, *a*, Extremities of the catheter; *b*, one of the openings at the curved end; *c*, handle; *d*, screw to fix the catheter in the handle; *f*, *f*, index; *g*, screw to fix the index on the handle.

CATHETERISM OF THE GUTTURAL SAC.

Catheterism is not difficult, though some practice is usually necessary to pass the catheter. This instrument (Fig. 404), devised by Günther, consists of a brass tube and handle, with an index fixed on the latter. The tube is of brass, is from one and a half to two feet long, is slightly bent at the extremity, the end of which is closed, but has an opening at each side (*b*); the other end fits on the stalk of the iron handle (*c*, *c*), which is also curved in the same direction, and is fixed there by a thumb-screw. The index (*f*, *f*) is in the form of a steel spring, from eight to ten inches long, attached to the handle by a thumb-screw (*g*), that moves in a long slot in the handle, and allows the index to be pushed up or down the side of the tube, according to the length of the patient's face; the upper end of the index serves to indicate the distance to which it is necessary to pass the tube to reach the interior of the sac. This can be ascertained externally by measuring the distance between the outer angle of the animal's eye and the lower border of the nasal cartilage; this will give the distance between the latter point and the sac, and the index can be fixed accordingly. Before using the instrument, it should be smeared with carbolised oil (5 per cent.).

Position.—The catheter can be passed into the Eustachian tube while the animal is in the standing position, a twitch being placed on the under lip or ear, the head being held immovable by an assistant, who extends it to an almost horizontal position in order to bring the posterior nares in line with the Eustachian tube (Fig. 405). But it is generally preferable to place the animal latericumbent, with the head raised, and the nose rather extended. If there is likely to be struggling while the catheter is being passed, it may be advisable to administer

an anæsthetic; and if there is any risk of asphyxia, tracheotomy should be previously performed.

Operation.—The index having been fixed at the measured length on the catheter, this is passed into the bottom of the nasal cavity, the point towards the floor, and pushed gently along until the index shows that the sac has been reached; then the handle is turned a little, and carried towards the septum nasi, so that the point of the catheter is inclined to the side; careful manœuvring will now quickly introduce it into the Eustachian tube and the sac, which will be made manifest by the index, and also by the absence of resistance to the onward pressure. The operator then removes the handle from the catheter, and the air or gas will escape. When this has been got rid of, an astringent or anti-

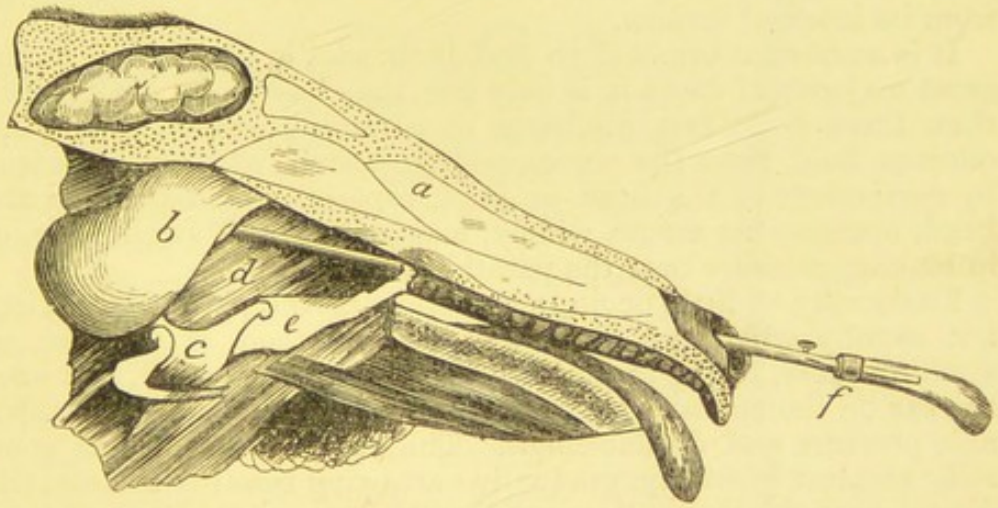


Fig. 405.—Longitudinal and Vertical Section of a Horse's Head, showing the Manner in which Gunther's Catheter is passed through the Nasal Cavity into the Guttural Pouch.

a, Nasal septum; *b*, left guttural pouch; *c*, larynx; *d*, pharynx; *e*, soft palate; *f*, catheter in left nostril, and entering the left Eustachian tube in the pharynx.

septic fluid (solution of boracic acid, for example) may be injected into the pouch through the catheter before it is withdrawn.

If this operation is not successful, then recourse must be had to the next to be described.

Opening the Guttural Sac externally.

The operation technically termed 'hyovertebrotomy,' or 'hypospondylotomy,' is resorted to when one or both of the guttural sacs is distended with air or fluid that cannot be removed from them by Günther's catheter. Reference has just been made to the presence of air or gas in them. The fluid is either mucus or pus, or a mixture of both, and its presence is due to hypersecretion of the normal product of the lining membrane of the sac, or to that which is the result of inflammation, more or less acute, that has extended from the pharyngeal mucous membrane

through the Eustachian tube during catarrhal affections. Owing to the formation of the tube, the fluid is retained; if this retention continues for some time, the watery portion is absorbed, and the remainder, undergoing decomposition, becomes more consistent, until it is semi-solid, and, owing to its being rolled about, assumes an ovoid or round shape; there may be several, or even a great number, of these masses in one sac, the number varying with their size. They are sometimes so dense that they have been designated 'chondroids'; their colour is dark yellow externally, and lighter inside. Usually, however, the contents of the sac consists of a pasty material that can be lifted out with a spoon, and it often contains small, whitish, nodular bodies. In rare instances a comparatively large quantity of food has been found in the sac, and tumours have also been discovered growing from its internal surface.

It is somewhat unusual to find both sacs involved, and in the great majority of cases it is only one that has to be dealt with; then there is at first discharge of a muco-purulent, usually inodorous fluid, from the corresponding nostril, which is increased by movements of the head or jaws, especially by depressing the head, opening the mouth widely, masticating and swallowing, or in making pressure over the parotideal region.

There may be little or no tumefaction in the parotideal region, but usually when the distention is great there is well-defined swelling there, owing to pushing outwards of the gland, and even the sac on the opposite side, though healthy, may suffer considerable pressure and displacement. The external swelling is generally greatest inferiorly, gradually narrowing towards the ear, and digital manipulation will reveal the character of the contents.

It has been mentioned that when the distention is great deglutition is difficult, if not impossible, while respiration may be noisy, both in inspiration and expiration—suffocation may, indeed, be imminent, if assistance is not timeously afforded. Under such circumstances, the animal itself finds relief by carrying its head round to the opposite side.

These symptoms should indicate the nature of the case, while internasal exploration by means of Günther's catheter will assist in fixing the diagnosis.

In acute cases, when impending suffocation is present, operative treatment will probably be limited to tracheotomy, in order to afford immediate relief; for it is usually only in those cases in which the inflammation in the sac has become chronic, and the accumulation has diminished somewhat in quantity, that its removal is determined upon. If it is sufficiently fluid, much, if not all of it, may be drained away by the catheter; but when it is semi-fluid this is not possible, and then evacuation by external operation becomes necessary. One method is termed 'hyovertebrotomy,' and is that which has been longest practised, being introduced by Chabert in the last century (1779); another—Viborg's operation—is rather different, and will be alluded to;

and another, Dietrich's, is also a modification of Chabert's, or, rather, a combination of this and Viborg's.

Operation.—The operator will have to decide beforehand which kind of operation will be most convenient under the circumstances, and likely to be the most complete in its results, as well as the least dangerous; for a study of the anatomy of the region will show that there are important bloodvessels and nerves in close proximity to the sac, as well as the parotid gland, and none of these should be injured. When the distention of the sac is considerable, however, the convexity it produces in this region renders the operation comparatively easier and less dangerous.

Fig. 406.—Hyovertebrotome.

Instruments. — The instruments required are: straight and curved bistouries; dissecting forceps; broad retractors; a long, curved, blunt-pointed seton needle; long, curved trocar and cannula (hyovertebrotome, Fig. 406[1]); torsion forceps; ligature silk; and a tracheotomy-tube, in case of need.

Position.—The sac has been opened while the animal was in the standing position, a twitch being merely placed on the lip; but this is inconvenient, and there is certainly more risk of accident than when the position is latericumbent. This is therefore to be recommended. The Horse is placed on the side opposite to that which is to be operated upon, with the head and upper part of the neck slightly raised, and the nose somewhat extended. It may be advisable to produce general anæsthesia, and if there is danger of suffocation, tracheotomy should be performed before the animal is laid down. If an anæsthetic is not administered, assistants should be employed to hold the head firmly, so as to prevent movement.

Technic.—Remove the hair from the skin over the parotideal region, from the atlas to the lower border of the laryngeal region, cleansing it thoroughly afterwards. From the middle third of the margin of the wing of the atlas make a horizontal incision forward through the skin for about one and a half or two inches; draw the skin slightly downwards and backwards, so that the upper angle of the wound will correspond to the tendon of the small complexus muscle; divide the subparotideal

[1] The one employed for enterocentesis (Fig. 359) might answer.

aponeurosis to the length of the incision, taking care not to wound the auricular vein or parotid gland, and avoiding the first and second pair of cervical nerves. An assistant, by means of a broad retractor, draws forward the anterior part of the wound, including skin, parotid gland, and aponeurosis. The operator passes his index-finger beneath the aponeurosis, backwards and outwards, so as to detach it from the muscles underneath by slight lateral and forward movements, until the finger meets with the larger cornu of the hyoid bone in front, and the occipital styloid process behind, between the two being the level surface of the stylo-hyoid and digastric muscles (Fig. 403). The assistant draws the retractor, so as to open the wound sufficiently to enable the operator to see the structures beneath, and especially the fibres of the stylo-hyoid muscle passing obliquely downwards and forwards. The internal surface of that muscle is in contact with the external wall of the guttural sac, and in its centre—which is at a point between the tuberous angle of the larger cornu of the hyoid bone in front and the styloid process behind—the puncture is to be made. In order to do this, the straight bistoury is held obliquely downwards and forwards, the edge directed towards the hyoid bone, and parallel with the fibres of the muscle; it is thrust to a depth of about half an inch. If the puncture is made to a greater depth, or with the bistoury held vertically, there is danger of wounding the internal carotid artery, which is immediately beneath, or some of the important nerves that pass along there. If the cutting edge of the instrument is directed upward, it may wound the posterior auricular artery or the facial nerve; or if downward, the external carotid will be endangered.

The puncture is enlarged by the index-finger, which should be rather forcibly introduced, so that the wall of the sac will not be pushed away by it; the opening having been made sufficiently large, the interior can then be explored.

A long, curved seton needle, with a blunt point, or the cannula only of the hyovertebrotome, is now passed downward in the sac, concavity outwards, in a direction parallel with the parotid gland, and towards its lower extremity, inclining the point rather inwards, until, being pressed outwards, it can be felt immediately behind the ascending branch of the lower jaw in the triangle (Viborg's), the base of which is formed by the margin of that ascending branch, the upper side by the tendon of the sterno-maxillaris muscle, and the lower side by the glosso-facial vein (Fig. 407, *b*). If the cannula of the hyovertebrotome has been employed, the trocar is passed down it, and pushed through the bottom of the sac and the skin at the centre of the triangle; if it be the seton needle, a small incision is made over its point in this situation, and the end of the instrument pressed through it; but neither must be withdrawn until a piece of tape has been passed through both openings in the sac by their means, so as to facilitate drainage, the ends of the tape being tied together.

Another method of operating consists in opening the sac from

Viborg's triangle, at the point just mentioned (Fig. 407, *b*). The hair is removed, and the skin cleansed at that part; an incision is made through the skin, parallel with the sterno-maxillaris muscle, to the extent of three or four inches, the cutaneous muscle and connective tissue are cut through, and a trocar and cannula are pushed into the bottom of the sac; the opening so made can then be easily enlarged by the fingers. This is usually a simple operation when the sac is well distended, and allows of complete evacuation.

A third mode of operating is similar to the first—is, indeed, a combination of the first and second—except that the upper incision (Fig. 407, *a*) is carried a little more forward beyond the wing of the atlas, and immediately behind the parotid gland. It is, in fact, about two inches behind, and in the same direction as the posterior border of the lower jaw, and is begun about the

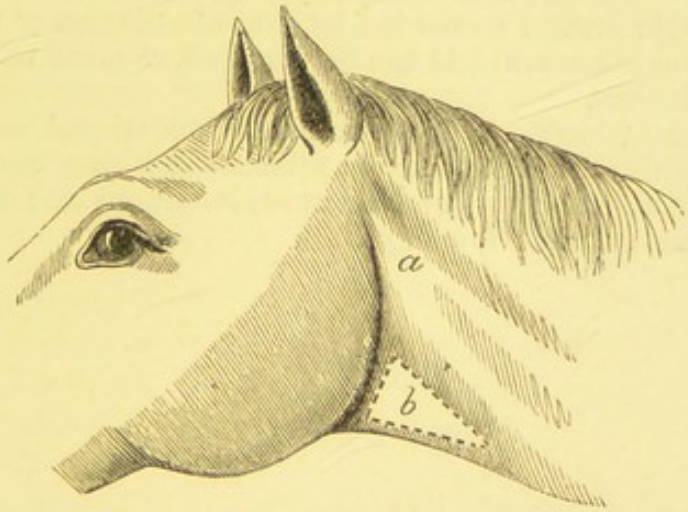


FIG. 407.—THE OPERATION OF HYOVERTEBROTOMY.

a, Point where the first incision is made in order to penetrate the guttural sac; *b*, point where the second incision is made in the centre of Viborg's triangle, which is shown by dotted lines.

same distance from the root of the ear, descending for two inches. The back lip of the incision is dissected off to expose the posterior border of the parotid, which is detached from beneath by the finger sufficiently to enable the operator to reach the occipito-styloideus muscle; this is perforated in the centre, at a point in front of the styloid process of the occipital bone, and behind the tuberous angle of the larger cornu of the hyoid bone, which is recognised by its yielding to pressure of the finger. The perforation is made in the same manner and with the same care as in the first operation, and the counter-opening in Viborg's triangle is also effected in the same way. Möller speaks of drawing the parotid to one side after making the first incision, cutting through the fascia of the throat muscles, and exposing the posterior border of the stylo-maxillaris muscle; then, without detaching the sac from its middle surface, the connective tissue

is put to one side by the fingers, and the point sought where the occipital artery is given off from the carotid, which is ascertained by their pulsating. An opening is made in the sac by introducing the left fore-finger, its front towards the arteries, and passing the bistoury behind it into the sac ; then, withdrawing the knife, but not the finger, the right fore-finger is inserted in the opening along with the left, to enlarge it to the required extent. This may be made sufficient to allow the hand or a spoon to be passed into the cavity for the removal of inspissated or semi-solid contents, which are not likely to escape freely from a depending orifice. In any case, the latter is nearly always necessary, and is made in the middle of Viborg's triangle by means of the blunt seton needle or trocar and cannula in the manner already described. From this lower opening, also, concretions may be removed by means of forceps, or a small blunt hook with a long handle.

When the operation is completed, the sac should be flushed out with tepid water, succeeded by a weak solution of boric acid.

Should the other guttural sac be involved, it must be treated in the same manner.

After-Treatment.—This is limited to occasional washing out of the sac with the boric solution, alternated with a weak solution of alum. If a seton has been inserted, it should not be allowed to remain more than a few days.

OPERATIONS UPON THE LARYNX AND TRACHEA.

These important portions of the respiratory apparatus are sometimes affected with disease, or meet with accidents which require operative interference, though the occasions for this are rare when compared with their frequency in mankind. We will first notice those in which the larynx is involved, and then refer to the operations on the trachea, though sometimes operations on or in the larynx necessitate interference with the trachea.

CHAPTER I.

THE LARYNX.

From its position, the larynx is well protected from external injury, though it is not entirely exempt, so that surgical intervention is usually limited to its interior. In long-faced animals, as the Horse and Ox, the upper margin of the organ is not readily accessible to the hand through the animal's mouth, and its interior is beyond it; while visual inspection is impossible, unless recourse be had to Polansky and Schindelka's rhino-laryngoscope, described when dealing with the nasal fossæ (p. 396). By means of this ingenious instrument the interior of the larynx can be distinctly examined visually, and its condition ascertained. But to perform operations therein, the organ must be opened externally, or access gained from below by incising the trachea. In this there is no difficulty, and the organ usually exhibits greater tolerance of surgical manœuvres than might be predicted by reason of the acute sensibility with which its lining membrane is endowed, particularly at the upper part.

In short-faced animals, as the Dog and Cat, a good view of the upper surface of the larynx can be obtained by opening the mouth wide and withdrawing the tongue, while depressing its posterior part by the handle of a spoon or a spatula.

Tumours on or about the epiglottis may be removed by the fingers, ecraseur, or wire snare, through the mouth, and foreign bodies may be reached and extracted by the same channel; but not if they are in the interior.

Laryngotomy.

When noisy breathing is present, or dyspnœa sets in without any assignable cause, and laryngeal obstruction is suspected, the larynx can be opened through the crico-thyroid membrane or ligament, or between the two branches of the thyroid cartilage and the cricoid cartilage in front, and an examination made with the

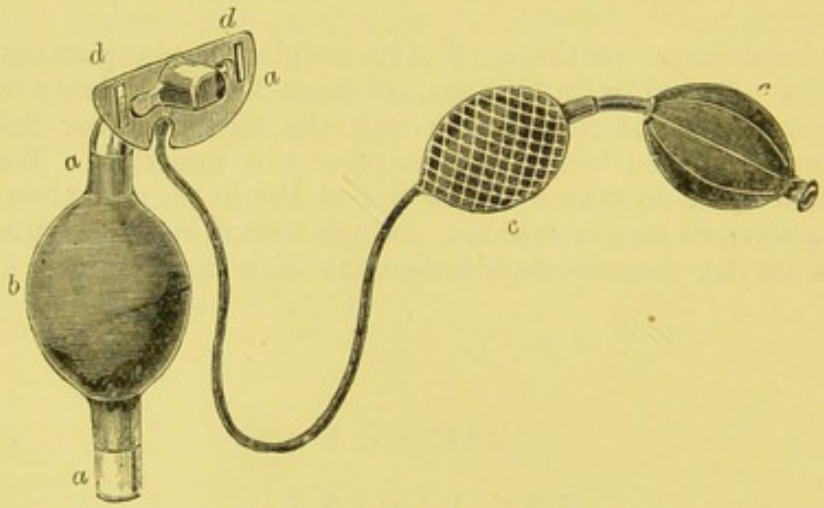


FIG. 408.—TAMPON CANNULA.

a, *a*, Cannula; *b*, tampon-bag; *c*, *c*, hand-bellows; *d*, *d*, openings for tape to tie round the neck.

finger; or if more space is required, the cricoid cartilage, and even one or two of the adjoining tracheal rings, may be incised there.

For the removal of any obstacle that interferes with the passage of air through the larynx, laryngotomy may be readily practised, though certain precautions are to be observed to prevent accidents. Among these is the prevention of suffocation, which may occur under certain circumstances; and even hæmorrhage into the trachea and lungs is to be avoided as much as possible. When there is a likelihood of this taking place, it is advisable to have in readiness for employment the tampon cannula introduced by Trendelenburg for such operations on mankind, and modified so as to be applicable to animals. This consists in reality of a tracheotomy tube, the part that lies in the trachea being longer than usual, and attached to this an india-rubber bag, that can be distended intra-tracheally by means of a hand-bellows communicating with it by means of a tube of the same material; so that the lumen of the trachea can be completely obstructed, so far as its

upper portion is concerned, while respiration is carried on through the cannula below. A slot on each side of the flange-plate allows a piece of tape to be fixed; this, when tied with the piece of tape on the opposite side around the animal's neck after the operation, keeps the cannula securely in its place. The hand-bellows and inflating-tube can be removed when no longer required on the cannula (Fig. 408). In a case of emergency, however, should this article not be at hand, a substitute for it can be made with

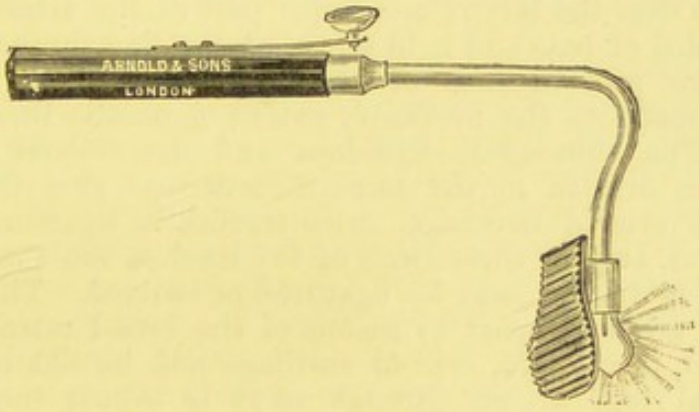


FIG. 409.—LARYNGEAL ELECTRIC LAMP.

an ordinary tracheotomy-tube, having around its tracheal portion a piece of fine lint securely tied round its upper part, and sufficiently large to block the channel of the trachea. Or, instead of this, a small bundle of lint or gauze, to which a piece of tape is attached, may be passed into the trachea above the ordinary tracheotomy-tube, this having been first inserted.

Instruments.—These are: a scalpel or straight bistoury; dissecting forceps; artery forceps; suture needles, and silk thread. If other than an exploration operation is intended, then instruments

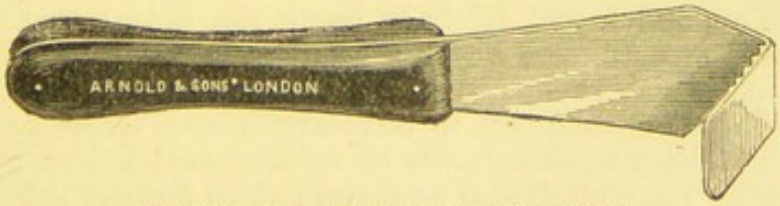


FIG. 410.—FARABOEUF'S BROAD RETRACTOR.

adapted for it must be also provided, as sharp-pointed scissors, straight, curved, or angular. It will generally be found very advantageous to have an electric lamp (Fig. 409), to introduce into the larynx from the wound, in order to illuminate the interior, and two broad retractors to dilate the wound (Fig. 410). The thermo-cautery may also be useful to suppress bleeding inside the larynx, should this be copious and other hæmostatics fail.

Position.—It is advisable to place the animal dorsicumbent in all cases, the body being propped up and the head and neck extended, the larynx and trachea being uppermost. If the larynx is to be merely explored, laryngotomy might be attempted in the standing position, especially if the animal be of a docile temper.

Technic.—If the Horse is nervous, and the operation of a delicate nature and likely to be protracted, anæsthetisation is necessary.

The skin over the larynx and upper part of the trachea having been denuded of hair and held tense, an incision through it, from the anterior protuberance of the thyroid cartilage down the middle, is made to the necessary extent, generally three or four inches. The subscapulo-hyoideus and sterno-thyro-hyoideus muscles are divided in the same direction, so that the thyroid membrane, cricoid cartilage, crico-trachealis ligament, and, if need be, one, two, or three rings of the trachea are made visible. Any bleeding vessels may be ligatured or twisted. The sides of the wound are held apart by means of the broad retractors, and the thyroid membrane, cricoid cartilage and its ligament, with the tracheal rings, are cut through, so as to expose the cavity of the larynx, which now may be perfectly explored and the necessary operations performed in it.

As before mentioned, the tampon cannula should be introduced if there is any danger of suffocation, or likelihood of blood or other matters passing into the lungs.

The whole interior of the larynx is rendered accessible to the eye and hand, and the apex of the epiglottis or summit of the arytænoid cartilages can easily be reached. So that in this way foreign bodies, new growths, diseased vocal cords, etc., can be removed, and diseased surfaces appropriately treated.

In the next article this will be more fully dealt with.

After-Treatment.—This will much depend upon what has been done in the interior of the larynx. If the hæmorrhage has been trifling, and is not likely to recur, the tampon cannula can be removed at once, or if bleeding or discharge is apprehended in the larynx, it may be left in for one or two days; but after that time it should be taken out to be cleansed, and steeped for a few seconds in a very weak solution of boracic acid before being reintroduced. Care must also be taken not to distend the tampon-bag too much, as the pressure it exercises on the tracheal mucous membrane is likely to produce serious injury. Indeed, it is a good plan to have the bag only partially inflated, and to insert the gauze or lint tampon just described immediately above it. If there is no necessity for a tracheal tube, then the edges of the divided muscles can be brought together, and the skin wound closed by a few sutures.

Arytænoidectomy.

Excision of one of the arytænoid cartilages, usually the left, is an operation performed on the Horse, in order to get rid of the respiratory noise emitted during exertion, and which is produced by the cartilage dropping more or less over the laryngeal opening, through degeneration, and consequent paralysis, of its elevator muscle; this degeneration in all, or nearly all, cases is due to change in the left recurrent nerve which supplies that muscle with stimulus, this change again being dependent upon the anatomical position and relations of the nerve.

The operation of arytænoidectomy has been followed by a fair amount of success, a good percentage of the Horses subjected to it having been restored to usefulness; and if the number has not been larger, this must be ascribed, not to the operation itself, but rather to the difficulty, so far as my experience enables me to judge, of controlling the healing of the wound made in the larynx. The operation, however, has in recent days been more perfected, especially by Möller and Cadiot, to whose descriptions I shall more particularly refer; and there is reason to expect that, ultimately, a greater proportion of animals which have undergone this laryngeal excision, and which were previously more or less useless and distressed when at work, will be rendered serviceable and free from suffering, even though the abolished respiratory sounds may not be altogether abnormal.

It is very rare indeed that both arytænoid muscles are affected with paresis or degeneration, and consequently that both their cartilages obstruct the entrance of air to the larynx; but in such exceptional cases it is indeed very questionable whether it would be advisable to resort to the excision of both cartilages. So that in this place we will only deal with the removal of the one generally at fault—the left.

Operation.—As in all other operations in which the Horse has to be thrown down, attention should be paid to the preparation of the animal. It should be well fed and watered some time before the operation, but nothing ought to be allowed in the way of food or water for a few hours previous to casting.

It may be as well to have the hair removed from the skin over the larynx as far forward as the hyoid bone, as low as the third or fourth tracheal ring, and up towards the lower end of the parotid gland.

Instruments.—These are more or less numerous, according to the requirements, real or fancied, of the operator. In this country they have been (1) the tampon cannula, described as desirable in the operation of laryngotomy (Fig. 408, p. 411); (2) long curved scissors (Fig. 411); (3) two broad retractors; (4) spring dilator (Fig. 412); (5) long laryngeal knife (Fig. 413); (6) short curved laryngeal knife (Fig. 414); (7) vulsellum forceps, with rack (Fig. 415); (8) special suture needle in handle (Fig. 416); (9) hook (Fig. 417). There should also be an

ordinary scalpel and forceps; a long pair of torsion forceps; silk thread or fine catgut for sutures; sponges, some small ones of which should be fixed to short sticks; antiseptic gauze and lint; iodoform and boracic powder. Vessels with water and antiseptic fluids for sponging ought likewise to be at hand. The electric

FIG. 411.—LONG LARYNGEAL SCISSORS.

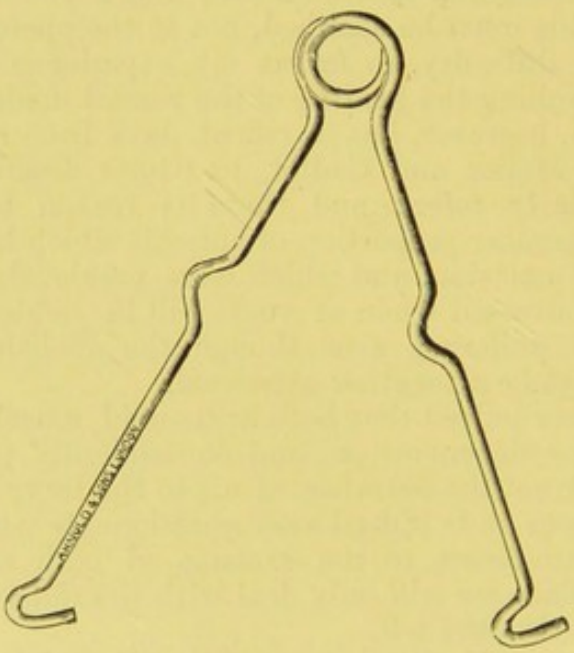


FIG. 412.—VACHETTA'S SPRING DILATOR.

FIG. 413.—LONG LARYNGEAL KNIFE.

FIG. 414.—CURVED LARYNGEAL KNIFE.

lamp will be found of great service in illuminating the interior of the larynx in this operation, and the thermo-cautery may also come in useful.

Position.—Dorsicumbent, after the animal has been cast and anæsthetised, the body being propped up by bags of straw on

each side of the shoulders and quarters; or if these are in the way of the operator, the body may be kept in this position by applying hobbles to the pasterns, and passing the rope over a beam above, or over a pole held by one or two men at each end of it. The head is well extended on the neck, and resting on the occiput, the anterior aspect of the laryngeal region being uppermost.

Technic.—The animal having been anæsthetised, fixed dorsi-cumbent, the head extended on the neck, the nude skin over the larynx and trachea washed and cleansed with an antiseptic, the operator places himself at the right side, and with the scalpel makes an incision through the skin in the middle line, from the prominence of the thyroid cartilage as far as the second or third tracheal ring; this exposes the sterno-thyro-hyoid and subscapulo-hyoid muscles, which are incised to the same extent at their raphé, and

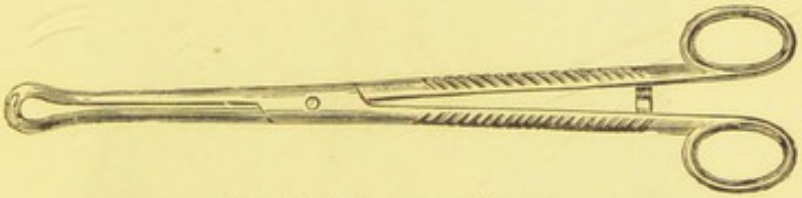


Fig. 415.—Vulsellum Forceps.

Fig. 416.—Laryngeal Suture Needle.

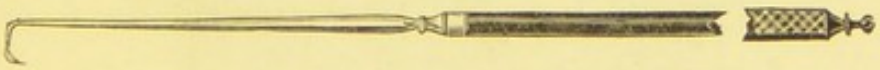


Fig. 417.—Laryngeal Hook.

the connective tissue beneath is cut through so as to lay bare the cartilages of the larynx and trachea. Bleeding must be suppressed by cold-water sponging, applying bull dog forceps to cut vessels, or torsion or ligature of these. The sides of the wound being held apart by the broad retractors, the point of the scalpel is passed into the crico-thyroid ligament at the body of the thyroid cartilage, and carried down in the middle line through that ligament, the cricoid cartilages, crico-tracheal ligament, and the first and, if need be, the second tracheal ring. Care must be taken not to wound either of the vocal cords, by pushing the scalpel, held vertically, through the thyroid ligament only to a very slight depth, and, if possible, no blood should be allowed to enter the trachea; this is prevented by inserting the tampon cannula at once, and inflating the intra-tracheal bag, so that it will fill the trachea without making injurious pressure on the mucous membrane. The proper degree of inflation can be ascertained by passing two

fingers of the left hand into the trachea and against the bag while this is being distended. Should the cannula show a tendency to slip forwards after inflation, this may be hindered by a loop of tape or cord passed round it, and the ends held between the fore-arms of the animal by an assistant.

The cannula having been arranged so that respiration is carried on freely, and the escape of blood into the lower part of the trachea rendered impossible, excision of the immovable arytænoid cartilage is proceeded with. In carrying this out, the electric lamp will be found most advantageous, as the interior of the larynx

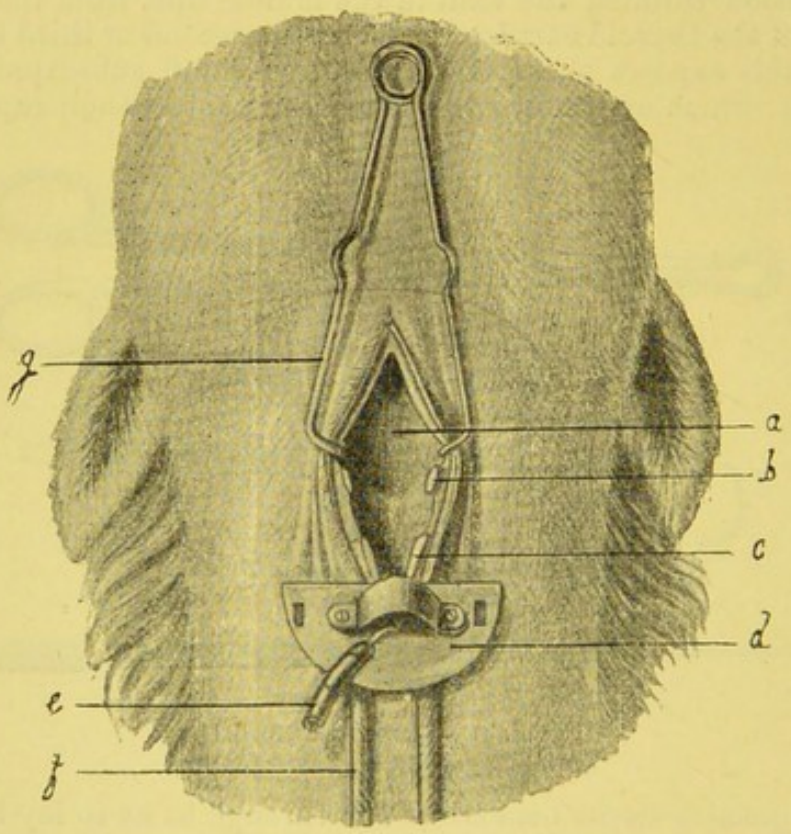


FIG. 418.—THE LARYNX AND TRACHEA OPENED FOR THE OPERATION OF ARYTÆNOIDECTOMY. (After Cadiot.)

a, Cavity of the larynx; *b*, cricoid cartilage; *c*, first tracheal ring; *d*, tampon cannula inserted; *e*, inflating-tube divided; *f*, cord to hold back the cannula; *g*, spring dilator.

can be fully illuminated, the condition of the arytænoid cartilages ascertained, and the different stages of the operation scrutinised; while the sides of the wound being held widely apart by the spring dilator and broad retractors, there is sufficient room afforded for the necessary manœuvres at the back or bottom of the laryngeal cavity. With the long knife the mucous membrane and inter-arytænoid ligament are cut through by an incision commencing at the upper and inner border, or a little within it—so as to spare as much of the mucous membrane as possible—of the cartilage (Fig. 419 *c*), and continued round its

inferior margin to the attachment of the vocal cord in it (*d*); this margin of the cartilage is then seized by the vulsellum forceps, and by means of long pointed scissors this attachment of the vocal cord is cut through (Fig. 420); then the cartilage is carefully dissected forward by dividing the mucous membrane and crico-arytænoid and thyro-arytænoid muscles along its inferior border (Fig. 421); this done, the mucous membrane at the upper or anterior border is detached downwards by means of the scissors, curved knife, or handle of scalpel, the cartilage being carried towards the middle line when dissecting its lower border

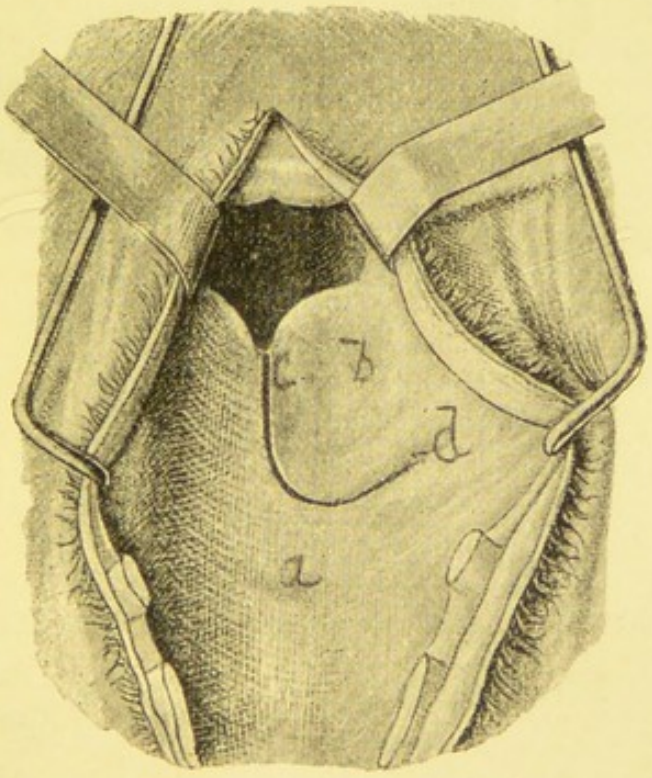


FIG. 419.—INCISION THROUGH THE MUCOUS MEMBRANE OF THE IMMOVABLE ARYTÆNOID CARTILAGE.

In order to show this more distinctly, the wound in the skin and muscles has been carried farther forward than is necessary in the operation. *a*, Interior of the larynx; *b*, left arytænoid cartilage; *c*, commencement of incision through the mucous membrane; *d*, termination of the incision.

and outer surface, and drawn backwards and upwards on removing the membrane from its upper border. The point of the knife or scissors should always be kept in contact with the cartilage, so as to shave it, as it were, and the mucous membrane must be carefully preserved, as well as the laryngeal ventricle and the tissues (muscular, etc.) behind the cartilage. While the cartilage is being separated in this pushing or shaving manner from the arytænoid and thyro-arytænoid muscles on its posterior surface, a small artery (a branch of the thyro-laryngeal) may be divided, and if so, torsion is necessary, as the resulting hæmorrhage is embarrassing to the operator. The cartilage, still held

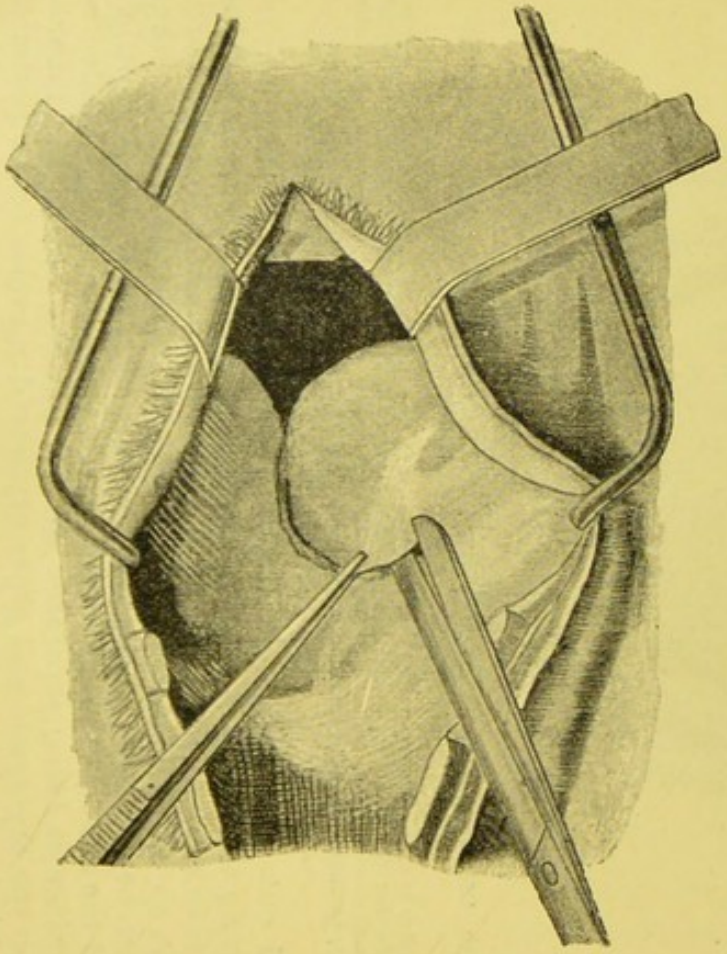


Fig. 420.—Separating the Vocal Cord from the Arytænoid Cartilage.

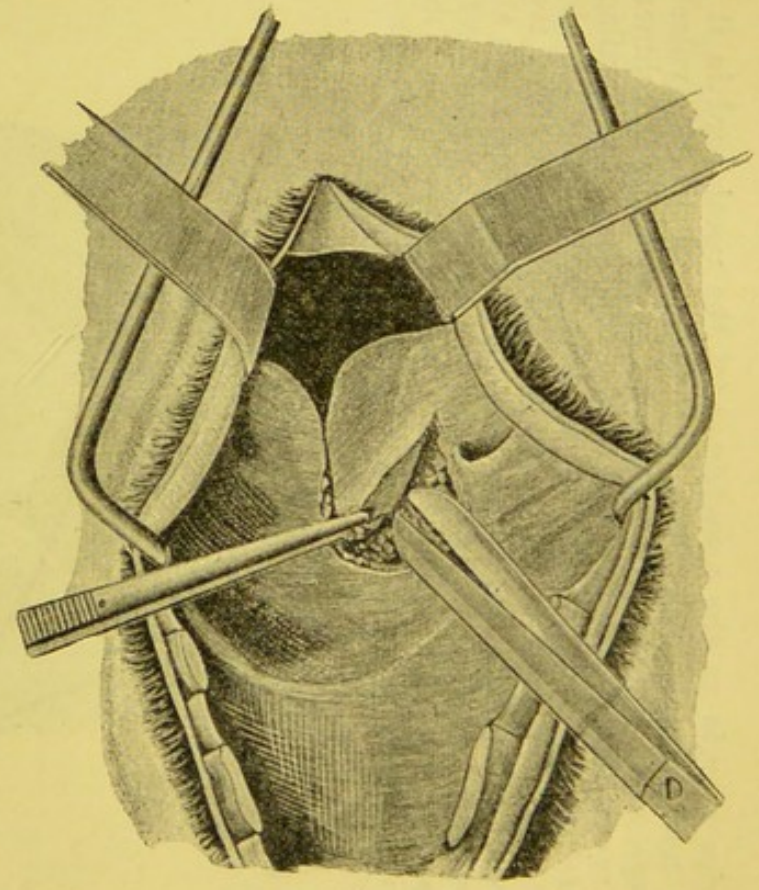


Fig. 421.—Dissection of the Arytænoid Cartilage at its Lower Border and Posterior Surface.

by the vulsellum forceps, is raised up and cut through near its supero-posterior or articular angle in an inward direction by the long knife or button bistoury, which is held obliquely downwards and forwards, so as to act on the posterior surface, immediately in front of the cricoid cartilage (Fig. 422). Sometimes the arytænoid cartilage is partially calcified, and some force is needed to cut it; this is best done by a slight sawing movement, care being taken that the knife does not slip. It is a little difficult to disarticulate the cartilage, but this should always be done when possible, as

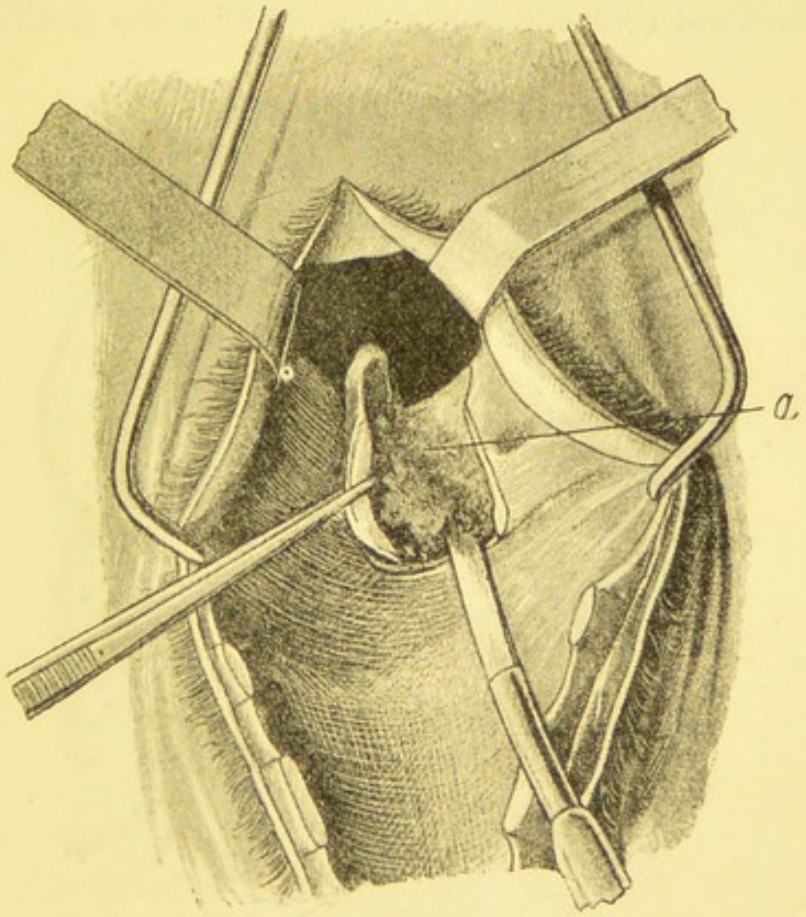


FIG. 422.—DIVISION OF THE ARYTÆNOID CARTILAGE AT ITS ARTICULAR ANGLE.

a, Small divided branch of the thyro-laryngeal artery.

the wound heals much better than when a portion is left to granulate slowly, and perhaps act as an irritant.

The remainder of the dissection of the arytænoid cartilage at its upper surface can be accomplished by means of the long curved scissors, which are passed almost vertically beneath it (Fig. 423) while it is held up, and made to push away forward the fibres of the arytænoideus muscle; the cartilage is at last detached without any injury to the neighbouring parts, and should a fragment remain, it may now be taken away by dissecting it out with the scissors.

During this dissection there will have been effusion of blood, and mucus may pass in from the pharynx; these should be frequently removed by means of the small sponges tied to sticks or held in forceps, and washed out in cold water.

The resulting wound and its margin should present a clean, even surface, which may be dressed with boracic solution before the operation is completed by suturing the mucous membrane over it. This is a great improvement in arytænoidectomy, as before it was introduced, in those cases that I had had operated upon, it was deemed necessary to remove the superfluous membrane, together with the vocal cord, which hung flaccid after the cartilage was

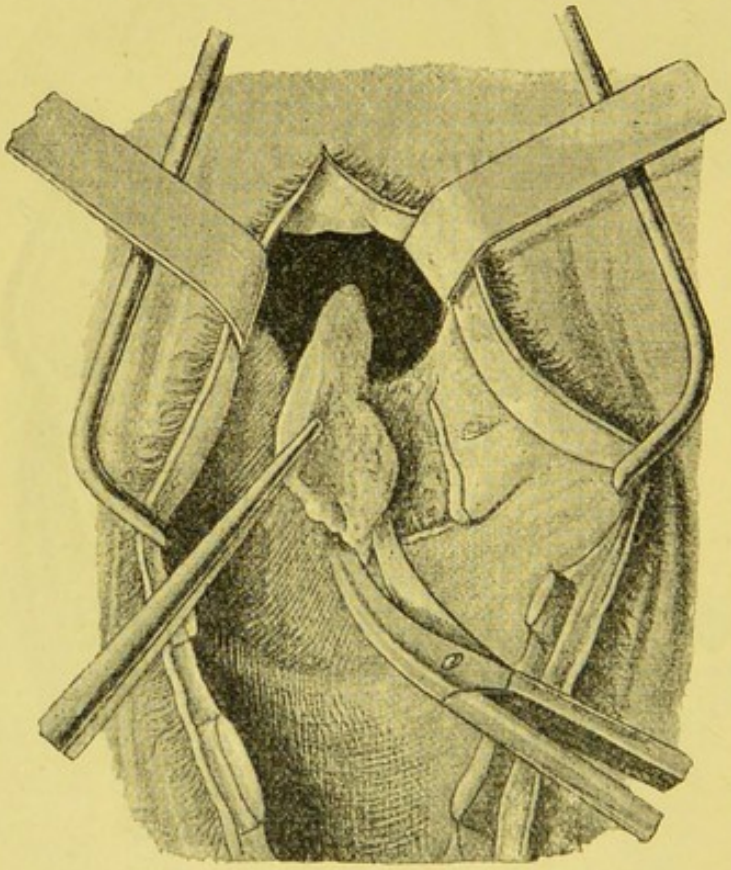


Fig. 423. Excision of the Arytænoid Cartilage by Means of the Curved Scissors.

excised. Now it is unnecessary, as, when the borders of the membrane are brought together, it is rendered tense and even, and the vocal cord is maintained close to the side of the larynx; while excessive granulation, hitherto a formidable obstacle to rapid and favourable healing, is largely prevented.

The anterior and posterior borders of the membrane are brought together over the wounded surface by two or three sutures of prepared silk or, preferably, fine catgut. The threads are sixteen to eighteen inches long, and one of them is threaded into the laryngeal suture needle, which is passed through the anterior lip of the wound about one-third of an inch from the middle line,

from before to behind, and through the corresponding part of the opposite lip (Fig. 424), where one side of the thread is withdrawn from it by means of forceps, the other being carried back with it when it is pulled out again. In this way both lips are perforated by the thread, and two more sutures having been passed parallel in the same way, they are then tied so as to bring the margins of the wound together, but without dragging the mucous membrane. This tying may be achieved outside the larynx, the knot being tightened when the finger is passed with it on to the surface of the wound. Coaptation should be close, without wrinkles or puckers, and the ends of the threads cut off near the knots. The surface

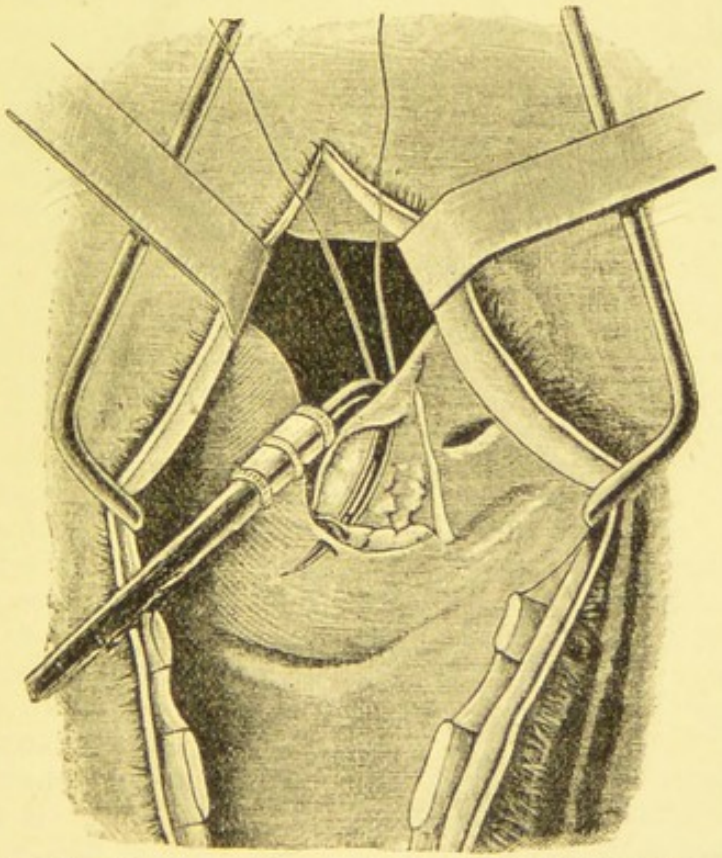


FIG. 424.—MANNER OF SUTURING THE LARYNGEAL MUCOUS MEMBRANE.

may then be gently pressed down to make the membrane lie close on the tissues beneath (Fig. 425).

The surface is covered with boracic powder, the outside of the neck cleaned, the cannula fixed in position by tapes in the apertures in the flange, which are tied round the neck and to the mane. It may be remarked that Cadiot recommends filling up the laryngeal cavity with cotton-wool, or long flat plugs of that material and iodoform gauze tied by threads, which are fixed outside the neck, to prevent their being swallowed. He also states that the external wound should be closed by two sutures—one through the muscular tissue, the other in the skin; the latter should be placed in front of the cannula, and be sufficiently strong to keep that tube in its

place, in addition to the other fastenings. Plugging the larynx is undoubtedly advantageous for twenty-four hours, though the tampon must not make much pressure; but the external sutures are scarcely necessary, as they must soon be removed in order to have the laryngeal wound dressed.

The animal is allowed to get up after the effects of the anæsthetic have passed off. Care must, of course, be taken that no foreign matter enters the cannula when the Horse is rising, or afterwards; and, to keep the external wound clean, a piece of gauze should be placed over it, retained by a bandage fastened round the neck. The

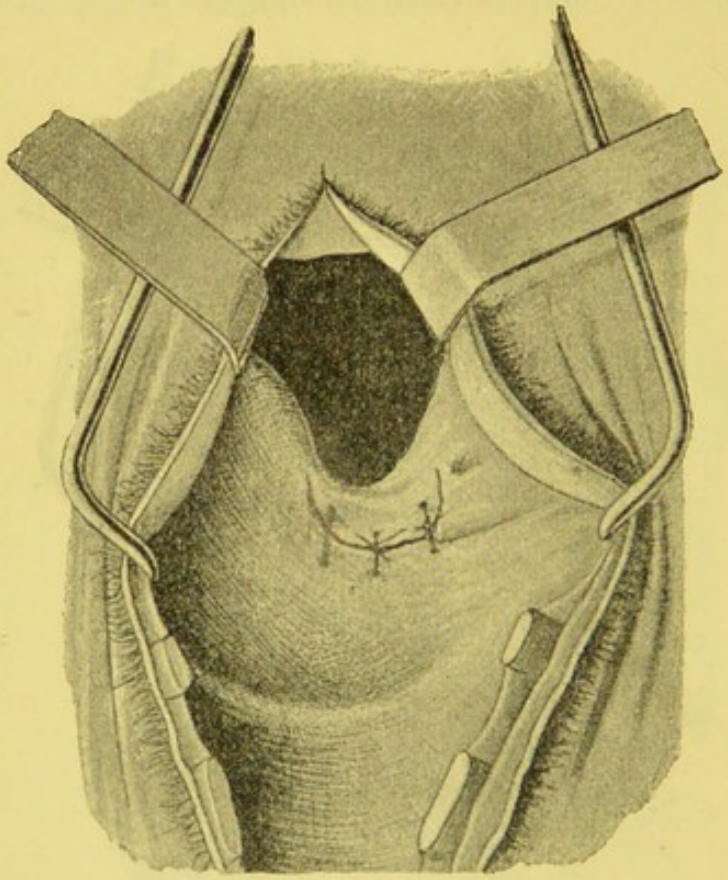


FIG. 425.—THE MUCOUS MEMBRANE SUTURED OVER WOUND, AFTER EXCISION OF THE ARYTÆNOID CARTILAGE.

animal is now conveyed to a loose-box, where it is left at liberty, the floor being covered with moss litter or soiled straw litter.

AFTER-TREATMENT.—It is better to withhold food and water for some time—from twelve to twenty-four hours after the operation; then tepid water should be given to drink, and a small allowance of meadow hay to eat. If oats are given, they should be scalded. Water ought to be allowed frequently—indeed, it is well to have it always within reach in a bucket on the ground; the hay also should be eaten from the ground.

With regard to the intra-laryngeal wound, this should be disturbed as little as possible. If the larynx is packed with cotton or wood wool, or gauze, and the packing is not tight, it may be

left for two or three days, unless there is much discharge, when it should be changed. If it is not packed, and there is discharge, this can be mopped up with wood-wool, especially from around the tampon of the cannula; but the interior of the larynx and trachea should not be meddled with any more than can be helped. Powder of iodoform and tannin (one part of the former to three of the latter) can be blown over the surface, or a weak solution of carbolic acid applied by means of a sponge. Should granulations spring up too luxuriantly, they may be checked by touching them with solid nitrate of silver; but if the operation has been skilfully performed, this treatment is rarely necessary, and the intra-laryngeal wound heals quickly.

On the third or fourth day, if the case has gone on favourably, the cannula and tampon may be removed, and the tracheal wound cleaned; but no fluid must be allowed to pass down the trachea. The larynx can then be better examined. Hitherto water and food will have escaped from the wound during deglutition, and it is to prevent these and the discharges from passing into the bronchi that the tampon has been kept inflated around the cannula.

When only a very small quantity of water escapes from the wound, and none by the nostrils, during swallowing, and the animal exhibits no respiratory discomfort when the cannula is removed and the hand is placed over the opening, then the tube may be discontinued; but if there is any likelihood of food or fluid falling into the trachea, the tampon cannula must be inserted again, and worn until there are indications that it can be dispensed with.

The external wound is to be kept clean, and allowed to close; when the cannula is finally removed, this takes place rapidly, so that after the second week it generally requires no further attention, and in three or four weeks is quite closed. Care is still required in feeding, food that is easily swallowed and digested being allowed for a considerable time.

The animal will take its own exercise in the loose-box for a month or six weeks, when it may be allowed gentle walking in hand for a like period; but the respiratory organs must on no account be strained by a faster pace or hard work for three months at least. Even at the end of that period, if, after a short trot or canter any noise is heard in respiration, only gentle exercise must be permitted for a longer time. I attribute the majority of failures that have come to my notice to two causes—not suturing the mucous membrane after removal of the arytænoid cartilage, and allowing the patients to have active exercise or to go to work too soon. But even under these disadvantages there were some excellent recoveries, consolidation of the intra-laryngeal cicatrix taking place more rapidly in some subjects than in others. In all cases it will probably be found advantageous to allow the animal to have a run at grass for a month or two, after the external wound has healed.

The most frequent unfavourable sequelæ are due to accidents

during the operation, such as wounding the adjacent mucous membrane or the remaining arytænoid cartilage by knife, scissors, or suture needle, by which there is produced great tumefaction, perichondritis, and sometimes a worse state of affairs than the operation was intended to remedy; pneumonia from the passage of foreign matters (food and water, blood and discharges, etc.) into the lungs, and which in the great majority of cases, by exercising reasonable care, might be avoided; excessive granulation of the intra-tracheal wound, which is not likely to occur if the sutures retain their hold, and if the wound is not irritated. Deformity of the tracheal rings which have been divided may happen through inflammation in their texture, and the distortion may greatly reduce the lumen of the tube, while calcification to some extent may be looked for; or diminution of the lumen of the trachea through inflammation or gangrene, produced in its mucous membrane by the severe pressure of an over-inflated tampon-bag. Sometimes the channel is almost

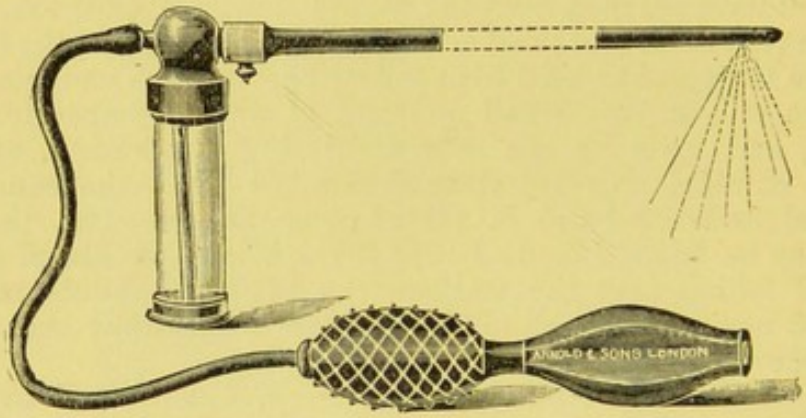


FIG. 426.—BAYER'S LARYNGEAL IRRIGATOR.

closed, but this accident can be prevented by moderate inflation of the bag, or wrapping it in gauze, according to Cadiot.

In some cases, also, there remains a persistent cough, due to morbid sensibility of the laryngeal mucous membrane; and in others the escape of food and water from the nostrils, observed immediately after the operation, continues to some extent, owing to the laryngeal wound having healed irregularly.

But these unfortunate results will, in all probability, be less frequent as the operation and its after-treatment become perfected, and operators are more expert. In the meantime, when there is reason to believe that the laryngeal wound is not healing kindly, direct inspection being prevented by closure of the tracheal opening, or when cough is troublesome, direct medication may be attempted by means of Bayer's laryngeal irrigator (Fig. 426). This is a long, narrow elastic tube, closed at the end, but having an opening at one side; the other end is attached to the stopper of a bottle in which is fixed a syphon-tube; at the other side of the stopper another india-rubber tube is fixed, which is provided with a hand-bellows. The first tube is passed up the nostril into

the pharynx, the opening at the end being downwards and opposite the larynx. By means of the hand-bellows, the fluid medicament —astringent, anodyne, or other remedy—in the bottle is sprayed into the larynx.

CHAPTER II.

OPERATIONS ON THE TRACHEA.

Operations on the trachea are usually performed when there is obstruction to the free passage of air through the tube, and the function of respiration is consequently impeded and life more or less endangered, or the utility of the animal is impaired. The obstruction may be in any part of the upper air-passages, or in the trachea itself. Sometimes medicines are administered through an opening in the trachea, and occasionally the tube is opened for the purpose of exploration, or the performance of operations above or below the opening so made. The Horse is the animal most frequently operated upon, and among the few operations practised on the trachea the oftenest resorted to is tracheotomy.

Tracheotomy.

Tracheotomy is usually practised on animals when it is necessary to allow air to pass directly to and from the lungs by the artificial opening so made, and when from any cause there is an obstacle to its doing so freely through the natural passages above the opening. As has just been said, it is also performed when it is desired to operate in or on the larynx or in the trachea itself, because of the presence of disease, growths, or foreign bodies; or medicines may be administered through the trachea. And tracheotomy is also most advantageous in preventing straining, especially in cases of difficult parturition in the Cow, when such straining interferes with remedial measures. Very frequently the operation has to be hurriedly undertaken in urgent cases of dyspnœa from obstruction in the upper air-passages, when there is no time for preparation; and in other cases it is practised when there is no immediate danger to the animal, so that there is ample opportunity to accomplish it with every precaution. Sometimes it is resorted to as a temporary measure; at other times it is adopted with a view to permanency.

Operation.—The operation of tracheotomy is in principle the same in all the domestic animals, the only difference in details being due to their size. As the Horse is far more frequently operated upon than any of the others, we will deal only with that animal.

It may be remarked that the surgical anatomy of the tracheal region is simple, so far as this operation is concerned. The seat of operation is in front of the tube, and usually about the part where the upper and middle third of the trachea meet, in the space formed by the convergence of the subscapulo-hyoideus muscle of each

side above, and the divergence of the two branches of the sterno-maxillaris muscle below. Here the trachea is only covered by the skin, a thin layer of the panniculus carnosus, and the sterno-thyro-hyoideus muscles; beneath these are the cartilaginous rings of the trachea, joined to each other by their ligaments (Fig. 427). The important bloodvessels and nerves that pass down the neck are behind the trachea and away from the seat of operation.

Instruments.—In very urgent cases, when there is no time to be lost in opening the windpipe and the proper instruments are not at hand, the operation may be roughly performed with a pocket-knife, which is plunged into the tissues at the front of the neck, at the part indicated above, the trachea opened, and the wound

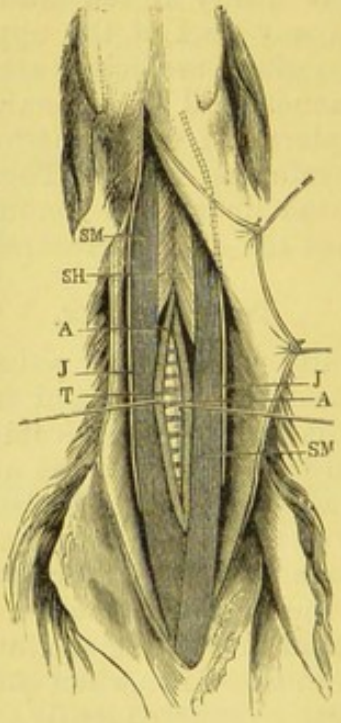


Fig. 427.—Anatomy of the Tracheal Region. (After Peuch and Toussaint.)

A, A, Sterno-thyro-hyoideus muscle; SM, sterno-maxillaris muscle; SH, subscapulo-hyoideus muscle; J, J, jugular veins; T, trachea.

extended vertically downwards to the necessary extent, the sides of the opening being kept sufficiently apart by the fingers to allow the air to pass freely to and fro through it until something can be devised to keep the aperture patent. The relief afforded in severe cases of dyspnœa from obstruction above the opening is most gratifying, and apparently out of all proportion to the rough simplicity of the procedure. As a temporary expedient, a rather strong piece of wire may be so shaped as to keep the tracheal wound dilated; the spout of a tin kettle[1] and the neck of a

[1] On one occasion, while in camp during manœuvres, I was called in the middle of a very dark night to a troop Horse on the picket-line. The animal was lying on the ground, bellowing like a bull, the tongue protruded from the mouth, and

bottle have been so employed, and other means may be adopted; care must be taken, however, that the article used does not fall into the trachea.

When the operation can be performed deliberately, of course the result is more satisfactory, from a surgical point of view. Then the instruments may be: (1) A scalpel or pointed bistoury; (2) dissecting forceps; (3) curved scissors; (4) two broad retractors or the spring dilator (Fig. 412); (5) sharp-pointed tenaculum; (6) artery forceps; (7) tracheotomy-tube or cannula. Rowelling scissors will be found advantageous in cutting through the skin. For removing portions of the tracheal rings, so as to admit the tube or cannula, various tracheotomes have been devised, such as those of Vandermarken, Brogniez, Thompson, and Spooner (Fig. 428), which cut a regular opening in the trachea; but little is to be gained by their use, and the expert operator can manage very well without them. It may be noted, as a matter of curiosity, that a tracheal trocar and cannula (Hayne's) have been devised to obviate the ordinary operation, and also dispense with the tracheotomy-tube. The cannula is short and wide, and has an opening in both sides at its middle. It is passed

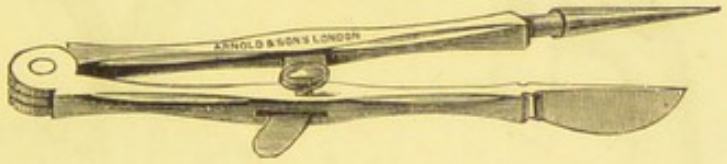


FIG. 428.—SPOONER'S TRACHEOTOME.

through the sides of the trachea, and on the trocar or stilette being withdrawn respiration is carried on through the aperture in the middle and at each end of the cannula, which then has a flange or washer screwed on to keep it in place. But there are several serious objections to this instrument, which have prevented its coming into general use.

The tracheotomy tubes are of numerous patterns, from the simple temporary cannula, with an almost rectangular curve at some distance from the middle, and a broad flange or shield at one end to rest against the neck, and in which is a hole at each side for a tape or strap, to keep the article in the trachea (Fig. 429); to the more or less complicated and perfected instrument, which is self-retaining and easy of adjustment, and may be worn for a very long time without causing much damage. It would not be very profitable to describe in detail even a tithe of these cannulæ, the best of which are those of Leblanc, Renault (Fig. 430), Degive, Peuch, Field, and Arnold's two patterns. All these are

other indications of impending death from suffocation. So urgent did the case appear that I considered there was no time to send some distance for surgical instruments; so the trachea was at once opened with a pocket-knife, the opening being dilated by the fingers, and in a few minutes the animal rose and began feeding. As the stertorous breathing commenced as soon as the fingers were withdrawn from the wound, a temporary cannula was made from the spout of a pewter tea-pot.

self-retaining, and may be worn for a long time, the simpler pattern of tube with flange, and fastened to the neck by a strap or tape, being only of a provisional character. Field's cannula (Fig. 431) is of a similar form and construction to that of Degive

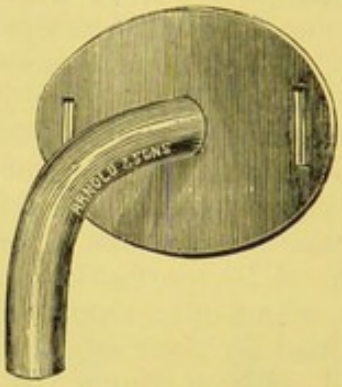


Fig. 429.—Simple Provisional Tracheotomy-Tube.

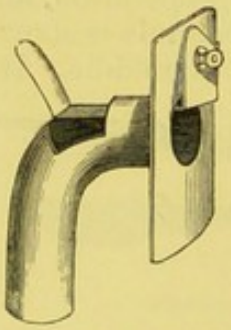


Fig. 430.—Renault's Tracheotomy-Tube.

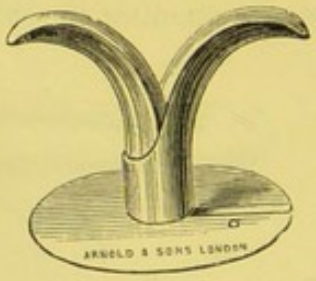
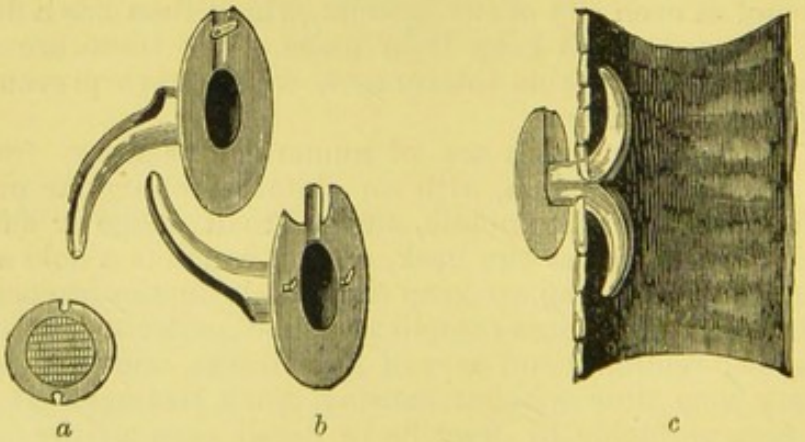


Fig. 431.—Field's Self-retaining Tracheotomy-Tube.



a *b* *c*

Fig. 432.—Arnold's Self-retaining Tracheotomy-Tube with Gauze Cap.

a, Gauze cap ; *b*, tube separated ; *c*, tube *in situ*.

and Peuch, which one of Arnold's patterns also closely resembles (Fig. 432), though it has a gauze cap in front, to prevent the entrance of foreign bodies. Arnold's 'Reliance' tracheotomy-tube is of recent introduction, and it is certainly very simple

and perfect, being a modification of, and improvement on, the best of those hitherto produced (Figs. 433, 434). It has a sliding arrangement, by which the portions composing it are held firmly and closely together; the weight is considerably reduced through only one shield or flange being required, while the internal flanges or lips are rounded, so that the tracheal mucous membrane is not injured by them. There is no danger of accidental unfastening of the pieces, owing to the secure manner in which they are held

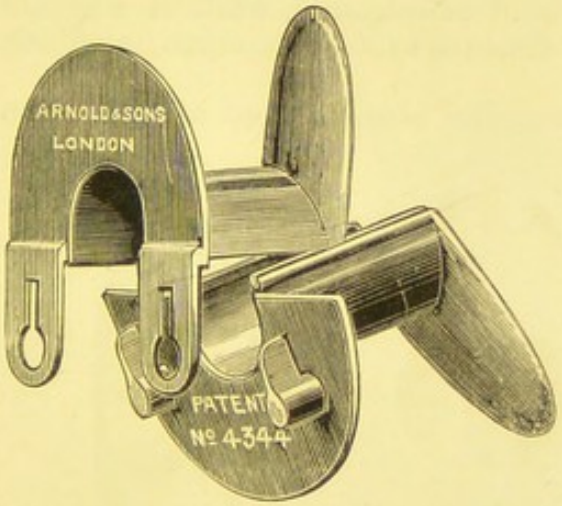


FIG. 433.—ARNOLD'S 'RELIANCE' TRACHEOTOMY-TUBE DISJOINED.

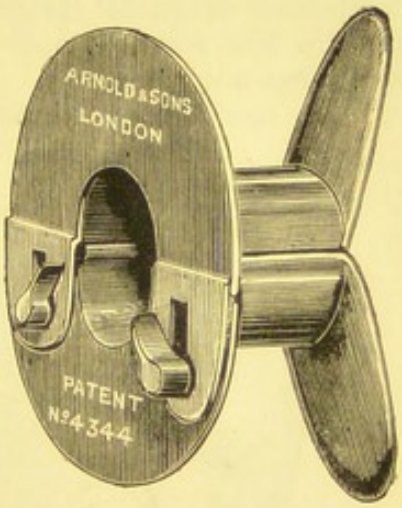


FIG. 434.—THE SAME PUT TOGETHER AND SECURED.

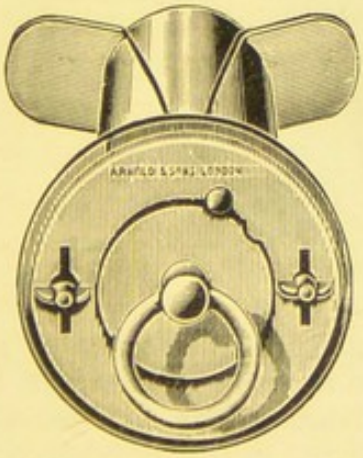


FIG. 435.—ARNOLD'S IMPROVED NELSON'S TRACHEOTOMY-TUBE—FRONT VIEW.

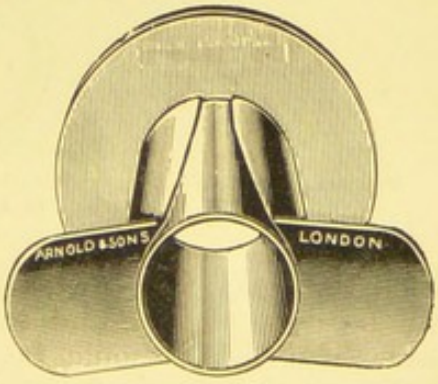


FIG. 436.—THE SAME—BACK VIEW.

together; and the metal of which it is composed does not corrode or oxidise.

But perhaps the best tracheotomy-tube yet introduced is that known as Arnold's Improved Nelson's Tube, which is even simpler than the last, and quite as efficient, if not more so. The adjoining figures will give an idea of its construction (Figs. 435, 436, 437), and from these it will be seen that it is perfectly adapted for either provisional or permanent use. It has also a

plug to insert, when necessary, in the opening, and from which it can readily be removed.

It is necessary to remember that a tracheotomy cannula should be as light as possible; of a sufficient size to admit an ample supply of air to the lungs; made so as to retain its position in the trachea without injuring the mucous membrane and the intervening tissues, or becoming displaced; capable of being readily inserted and removed; simple in construction, so as to be easily cleaned and repaired; made of a material that will not corrode, and will withstand frequent cleaning and disinfecting, while it will not irritate the wound; and of dimensions to suit small, medium, and large animals.

It is most essential to have the cannula kept always clean

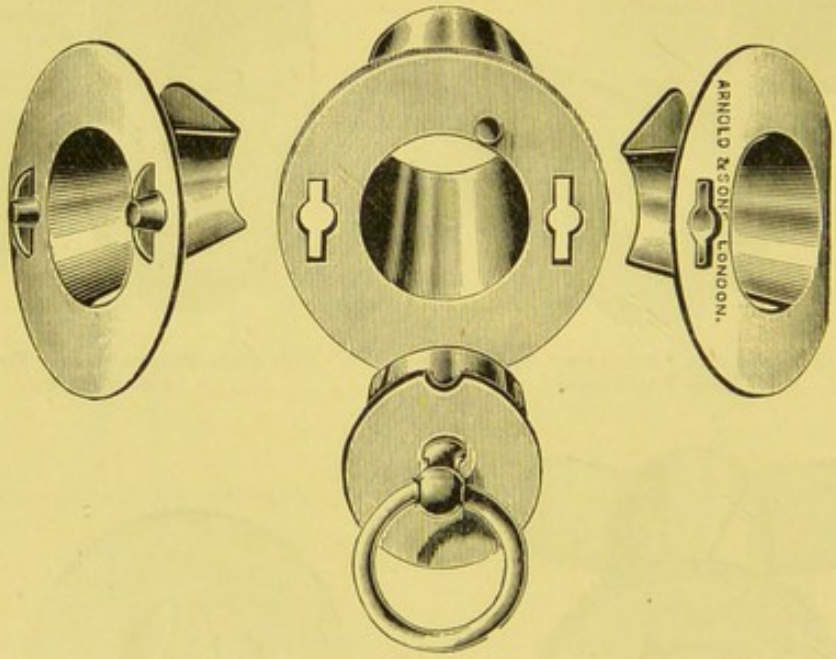


FIG. 437.—ARNOLD'S IMPROVED NELSON'S TRACHEOTOMY-TUBE—THE PIECES SEPARATED FOR CLEANING.

while in use, by frequent washing and disinfection; if this cannot be done at once and the instrument be replaced in the trachea, then there should be a duplicate ready for insertion when the other is removed.

Position.—Standing is the most convenient position, and that in which the operation is nearly always performed. Some animals require no restraint, especially if they are suffering from dyspnœa; but with others the operator has to guard himself from injury and ensure quietness by having one of the fore-limbs held up, or both fore-limbs shackled, or the twitch applied to the nose, ear, or lower lip. It may also be necessary to have the Horse backed against a wall.

TECHNIC.—If there is time, the hair should be removed to an extent of four inches at the seat of operation, and the

skin disinfected. The animal's neck is extended, and the head well elevated; a vertical incision is made through the skin in the middle line of the trachea at the part already indicated, and in extent varying with the size of the animal and the cannula —usually from two to three inches. This incision may be made with the knife, but preferably by raising a transverse fold of skin and snipping it through by rowelling scissors.

The pretracheal muscles of each side are separated in the middle by cutting the connective tissue that unites them, and, together with the skin, are drawn apart by broad retractors, or Vachetta's spring dilator (Fig. 412), so as to expose the trachea,

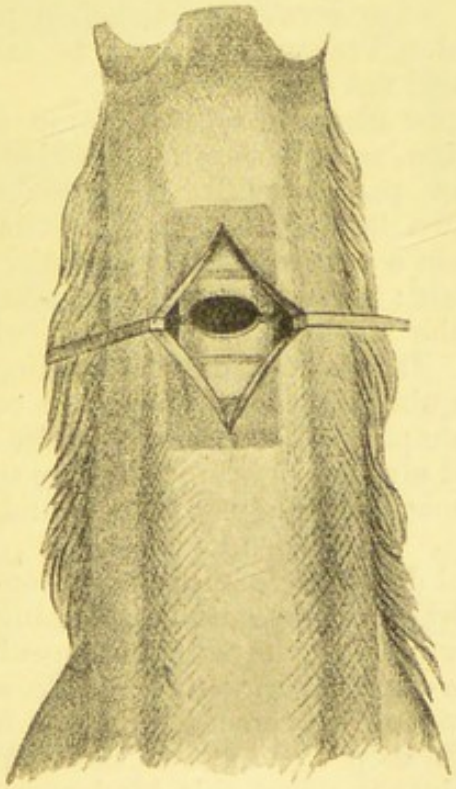


FIG. 438.—OPERATION OF TRACHEOTOMY. (After Cadiot.)

The figure shows the wound through the skin and muscles, which are held back on each side by broad retractors, and the elliptical opening in the trachea made by partial excision of two of the tracheal rings.

from the surface of which the connective tissue is dissected. The trachea is now to be opened for the reception of the cannula, and this may be done in either of three ways: (1) Making a simple vertical incision through two, three, or four of the cartilaginous rings, and inserting the cannula between the incised ends; (2) making a square hole, by cutting through two or more of the rings a short distance on each side of the middle line, and removing the intervening portions; (3) making a transverse elliptical opening by removing as much of two rings as may be necessary, without dividing them completely.

The latter method, introduced by Brogniez many years ago,

is certainly the best, so far as ulterior results are to be considered, and is that which should always be adopted when circumstances permit. It is also simple (Fig. 438). The operator inserts the pointed tenaculum in the interannular ligament joining the two rings, and holding this tense by the left hand, with the right he pushes the point of the knife through the ligament to one side of the middle line, cuts through the lower border of the upper ring in a semi-elliptical or horizontal curve to the necessary distance on the other side of the middle line, taking care not to cut through the entire breadth of the ring; the upper border of the lower ring is excised to a corresponding extent, and the ligament cut through at each end, but without removing the tenaculum, which takes away the detached portions when the opening is finished. Precautions must be taken that nothing falls into the trachea, not even blood.

The wound is now cleansed with a damp sponge, moistened with boracic solution, and the cannula inserted; if this is in two portions, the lower part should be introduced first, then the upper, and the two fastened together. It is advisable, when practicable, to fasten a narrow strip of aseptic gauze around the neck of the cannula; indeed, this is necessary if the latter is rather small for the tracheal opening, into which it should fit somewhat closely. It is better that the opening should be rather dilated by the cannula than that the rings be completely divided, and the elliptical shape of the opening permits of this dilatation. The cannula should also be sufficiently long in the neck to prevent squeezing the tissues between the shield and the inner flange or bend.

In simple vertical division of the rings without excision—which is often practised when the operation is urgently demanded, and there is no time for making the elliptical opening, skin, muscles, and trachea may be cut through with the knife, and to the required extent, by one drawing movement, and the fingers of the left hand introduced to keep the sides of the wound apart until the cannula is passed into it. But this kind of opening should not be made when time will allow of the above, as the divided rings are liable to become deformed and bent inwards, and so narrow the lumen of the trachea. The square opening, first sanctioned by Viborg, should never be practised, and for the same reason. It was to avoid this mutilation and distortion of the cartilaginous rings that Lafosse, and subsequently Gowing, recommended merely incising the ligament between the third and fourth rings, and inserting a flattened cannula into the opening. Gowing's instruments (Fig. 439) differ from that of Lafosse, in having a trocar for the introduction of the cannula between the rings, and a movable shield by which it can be adapted to a thick or thin neck.

After-Treatment.—Attention must be paid to keeping the cannula and the wound clean, and preventing, if possible, the formation of fungoid granulations by having the instrument

properly adjusted, and using dry antiseptics, such as boric or alum powder. This is the more necessary if the cannula has to be worn for a considerable time (it may be worn for years if care is taken); but there is nearly always a tendency to diminution in the lumen of the trachea and size of the wound where the artificial opening is made; this demands the enlargement of the aperture and the excision of the granulations. It is very necessary that the stable in which the animal is kept, as well as its surroundings, should be in the best sanitary condition, in order to guard against septic pneumonia and putridity of the wound.

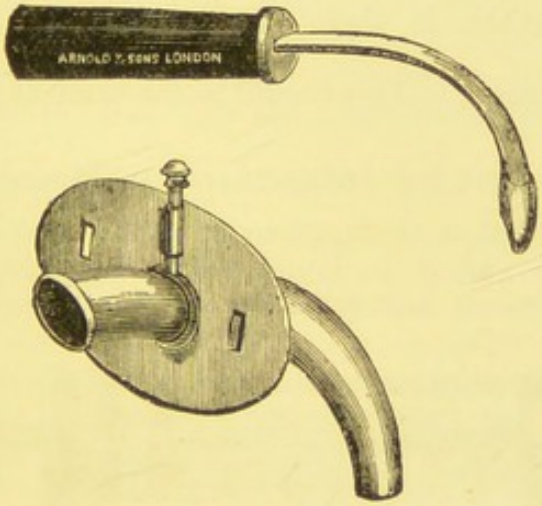


FIG. 439.—GOWING'S INTER-ANNULAR TRACHEOTOMY TROCAR AND CANNULA.

When the cannula is no longer required, the wound closes rapidly after it is removed; but until it closes it may be useful to place a fold of gauze over it, which is retained by a pitch plaster.

SUB-CRICOID OR LARYNGO-TRACHEOTOMY.

This operation, suggested by Krieshaber, consists in making an opening in front of the ligament (*crico-trachealis*) between the cricoid cartilage and upper ring of the trachea, into which the cannula is inserted. It has several advantages over the common operation of tracheotomy, especially if the cannula is to be constantly worn, as this is not so conspicuous when the Horse is at work; it less frequently leads to deformity and stenosis of the respiratory channel, and it has even been asserted that, when the operation has been performed for stenosis of the larynx, wearing the cannula for some time has brought about a cure by the internal pressure it has exercised. The operation also permits examination and surgical or medical treatment of the interior of the larynx.

OPERATION.—This is somewhat similar to tracheotomy. The position is the same, as are the instruments; the cannula should be one of the new pattern—in two portions, and short and light.

Technic.—The neck being elevated and head extended, the operator, standing in front, feels for the ligament, which is readily recognised in the depression in which it is situated, between the upper ring of the trachea and the cricoid cartilage. The hair is removed from this part, and the skin cleansed. An incision is made in the middle line through the skin, extending from the cricoid to the third tracheal cartilage, then through the subjacent muscles to the same extent, separating the sides of the wound by the spring dilator or broad retractors, so as to expose the crico-tracheal ligament, which is incised horizontally in its middle, and sufficiently long—two to two and a half inches—to admit the cannula, which is then passed into the opening as in tracheotomy.

After-Treatment.—This should be the same as in tracheotomy.

Operation for Intra-tracheal Medication.

The administration of drugs by intra-tracheal injection is becoming popular, as it is found to be advantageous in some diseases, and also in bronchitis caused by parasites in the air-

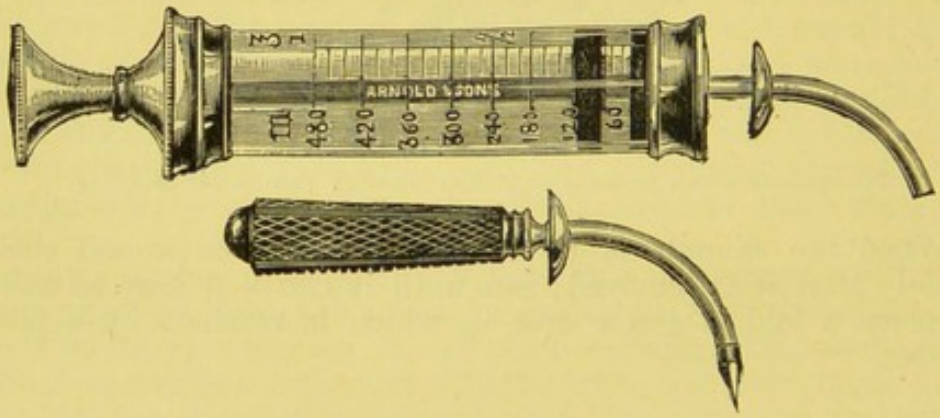


Fig. 440.—Poulton's Intra-tracheal Syringe, with its Trocar and Cannula.

passages, particularly of Calves and Sheep (Lambs), in which the timely exhibition of small doses of chloroform in this way has been followed by excellent results.

Operation.—This is of the simplest kind. The instruments are a pair of rowelling scissors—if the animal has a thick skin, to make a very small notch with—and a special syringe with trocar and cannula; the latter should be curved, to prevent the back of the trachea being injured. The best form is Poulton's (Fig. 440).

Technic.—The animal is held in a convenient position, with the head elevated; a minute opening is made in the skin (if it be thick) in front of the trachea,[1] and the trocar and cannula are pushed through it into the air-tube, the point of the curved trocar being directed downwards. The trocar is then withdrawn, leaving

[1] It is advisable to draw the skin a little upwards before the puncture is made, so that, after the operation, it may cover the tracheal wound.

the cannula in the trachea, and the tube of the syringe (which contains the medicament) being fitted into its external opening, the contents are pushed through it, after which the cannula is carefully withdrawn.

CHAPTER III.

OPERATIONS ON THE THORAX.

Operations on or in the chest of animals are few, and are seldom required, or rather justified, beyond those demanded in cases of accident; so that when compared with those now practised on and in this region in man, they are insignificant in number.

Thoracocentesis, or Paracentesis Thoracis.

When serous or purulent effusion has taken place in the thoracic cavity to such a degree as to seriously interfere with respiration by compressing the lungs, impeding the movements of the diaphragm, and hindering the blood circulation, relief—temporary or permanent—is afforded by withdrawing a sufficient amount of it, so that the impeded organs can perform their function. The presence of fluid is indicated by certain symptoms the animal presents, and by physical signs elicited by percussion and auscultation, which also reveal the extent of effusion. If it is desired to ascertain the character of the fluid effused, puncture of the chest wall with an exploring needle is necessary.

The operation is much less successful in animals than in man, for obvious reasons, one of the most important being the inutility of rib excision (thoracotomy), so often practised with benefit in human surgery; but it would doubtless be more frequently beneficial in its results if resorted to earlier, and carefully conducted. In the Dog it has proved more successful than in the Horse. In itself the operation is simple, and if skilfully performed is attended with little danger.

In Solipeds, in consequence of the structural peculiarity of the infero-posterior portion of the mediastinum, the effusion is generally bilateral, even when it takes place on one side; but in other species in which that septum is complete, it is confined to the side of the cavity in which it has been thrown out. This difference is in favour of the operation in Solipeds, as any part of the right side can always be selected for thoracocentesis; whereas on the left side the heart and pericardial sac occupy a large space, and are rather in the way; they have therefore to be avoided. In very exceptional cases, as when pleuritic exudate obliterates the perforations in the mediastinum, the effusion may be limited to one pleural sac, and that is, of course, the one to be evacuated, whether it be the right or the left, as in the case of the Ox or Dog. This condition can be ascertained by percussion and

auscultation, but most certainly by the exploring needle, which does little harm.

With regard to the question whether the whole or only a portion of the effusion should be abstracted, opinions differ. As the operation is usually performed, the whole of the fluid cannot be withdrawn, but a very considerable portion may; and if the effusion is so great as to have attained a high level in the chest, it is possible that, by rapidly reducing it to a low level, serious consequences may arise, such as pulmonary hæmorrhage and emphysema, disordered circulation, syncope, etc., due to sudden alteration of intra-thoracic pressure. But instances are recorded in which all the effusion has been removed without any accident of this kind, and I have repeatedly, in Horses, withdrawn all the fluid as low as the site of puncture by means of the aspirator (which certainly removes it slowly), and observed no other signs than those of great relief.

Instruments.—These may be rowelling scissors, scalpel, ordinary trimming scissors or razor, a vessel for the reception of the fluid that is to be abstracted, and a suitable trocar and cannula, or an aspirator.

The cannula usually employed for the Horse and Ox varies from one to two inches in diameter (Fig. 441), according to the rapidity with which the effusion is to be evacuated, but a small size is to be preferred.

Fig. 441.—Trocar and Cannula for the Operation of Thoracocentesis.

As the operation should be carried out with antiseptic precautions, and as there is danger in the external air gaining admission to the pleural cavity, the employment of the aspirator (Figs. 378, 379) is recommended, not only because it obviates this danger, but it is much more effective than the trocar and cannula.

The instruments, especially the trocar, should be carefully disinfected before and after use.

Position.—In all animals the standing position is the best; indeed, it is the one spontaneously assumed by them when suffering from thoracic effusion. Restraint is rarely necessary.

Technic.—If the trocar and cannula are to be employed, the hair should be removed from the skin at the seat of operation. This should be, in the Horse, on the right side, between the sixth to the ninth sternal ribs—preferably the seventh or eighth costal interspace, and towards the upper part of its lower third, or a little above the subcutaneous thoracic vein; in the Ox, in the eighth interspace; in the Dog, in the seventh or eighth; and in the Pig, in the eighth or ninth interspace. If it is necessary to operate on the left side in the Horse, the ninth intercostal space

may be selected, but the point of the trocar should be directed slightly backwards.

The skin should be well cleansed, and a small incision made through it with the knife, so as to render the passage of the trocar easier. I have always made this incision, however, with the rowelling scissors, by lifting up a small fold of the skin, and snipping it through to a minute extent. The skin is first pulled up above the point where the perforation will be made beneath it, so that when the cannula is withdrawn the puncture may be covered by sound skin when this is allowed to fall down again.

The subcutaneous muscles may be cut through, but this is not necessary. The handle of the trocar is held in the right hand, the index-finger and thumb passing along the cannula to within an inch of the extremity, and the point is entered close to the anterior border of the posterior rib, and pushed obliquely downwards through the muscles by a semi-rotary movement, the ends of the two fingers preventing its going too far; the cessation of resistance indicates its having entered the chest, and the trocar having been withdrawn by the left hand, the cannula is maintained by the right, the thumb being held over the opening while the fluid escapes, to be ready to stop the entrance of air. If the aspirator is used, the needle (which is more easily passed into the chest) is inserted in the same manner, the tap in it being closed until it is attached to the tube of the air-exhausted receiver, when the two taps being opened, the fluid is sucked into the vessel, its flow being perfectly controlled by these taps. When the vessel is full, the aspirator needle need not be removed; its tap only is closed, and the tube disengaged from it; the vessel is emptied of the fluid, the air in it pumped out, its tube is attached to the needle, and the evacuation recommences.

If the aspirator with the escape-tube fixed to the bottom of the receiver (Fig. 379) be employed, then the procedure is more simple, as the tap at the top of the receiver has merely to be shut, and that of the escape-tube opened to empty the receiver; when this is effected, the escape-tube is closed, and the air pumped out of the receiver; this done, the top tap is opened, and the thoracic fluid is again withdrawn. It will be found convenient to place the receiver on a stool or chair as near the animal as possible.

The cannula or needle is liable to become obstructed, either by coagula or by contact with the lung; but the fluid may be induced to flow again either by moving the end of the instrument in the chest, or passing a disinfected wire or fine probe through it. With the aspirator the amount of fluid and its character can be easily seen, and there is no danger of air entering the thoracic cavity if attention is bestowed; but with the ordinary cannula there is always this risk, and though I cannot call to mind any ill-effects which I could ascribe to the accident, except, perhaps, empyema, yet some operators have laid stress on the necessity for excluding the air, and have devised or suggested means for this purpose. One of these is passing the outer end of

the cannula, after penetration of the chest wall, into a piece of india-rubber tubing, the other end of which is immersed in water contained in a bucket.

Billroth's paracentesis instrument (Fig. 442) is constructed on this principle. The cannula has a stop-cock near the handle-end, which is expanded, and through which the trocar or stilette passes. At the side is given off a branch, which is also provided with a stop-cock, and to which is attached a piece of india-rubber tubing. When properly managed, this instrument prevents access of air to the chest, and the india-rubber tubing, through which the fluid steadily escapes, acts as a syphon, an advantage over the ordinary cannula, which at first permits the flow of a full stream, but this gradually decreases until it becomes influenced by the breathing, when it only comes by intermittent jets, the air being sucked in in the intervals, until at last it ceases altogether; though there may still be a large quantity of fluid in the cavity, and the end of the cannula is in the midst of it. This disadvantage can, however, be overcome to a certain extent by passing a piece of small flexible tubing through the cannula to its

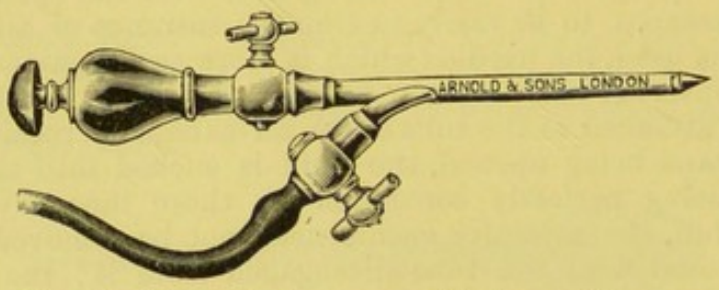


Fig. 442.—Billroth's Paracentesis Trocar and Cannula.

end, leaving a portion projecting beyond the outer extremity; through this the effusion will flow much more steadily than through the cannula itself. The suction exercised by the tubing in Billroth's cannula maintains a continuous flow; should this be interrupted by flakes of lymph, the tap has only to be shut on the side branch, opened on the end, and the trocar pushed through.

But even this instrument is greatly inferior to the aspirator (Fig. 379), with the tap and tube at the bottom of the receiving vessel, which, in addition to its powerful suction, can be emptied while the fluid is running into it, without any risk of entrance of air.

A trocar and cannula devised by Reul is somewhat similar to Billroth's, and also permits the introduction of medicaments and washes into the pleural sac. The cannula has a tap near its handle-extremity, and nearer its middle is a vertical tube, also provided with a tap, above which is attached a piece of india-rubber tubing about nineteen or twenty inches long, which has towards its middle a small glass cylinder, and is surmounted by a little funnel, into which the medicament can be poured (Fig.

443). When this apparatus is to be used, the india-rubber tubing is removed, the trocar and cannula passed into the chest, the trocar withdrawn, and the effusion allowed to escape, the tap on the vertical tube being closed. When fluid is to be injected, the tap on the trocar is closed, the other opened, and the india-rubber tube fixed and held upright by an assistant, while the medicament is poured into the funnel. The injection can be passed into the pleural cavity as rapidly or slowly as may be desired by regulating the tap. As soon as the fluid returns to the glass cylinder, the tap beneath it is closed, and the trocar removed.

When sufficient fluid has been abstracted, the cannula or needle is withdrawn and the skin pulled over the puncture. The

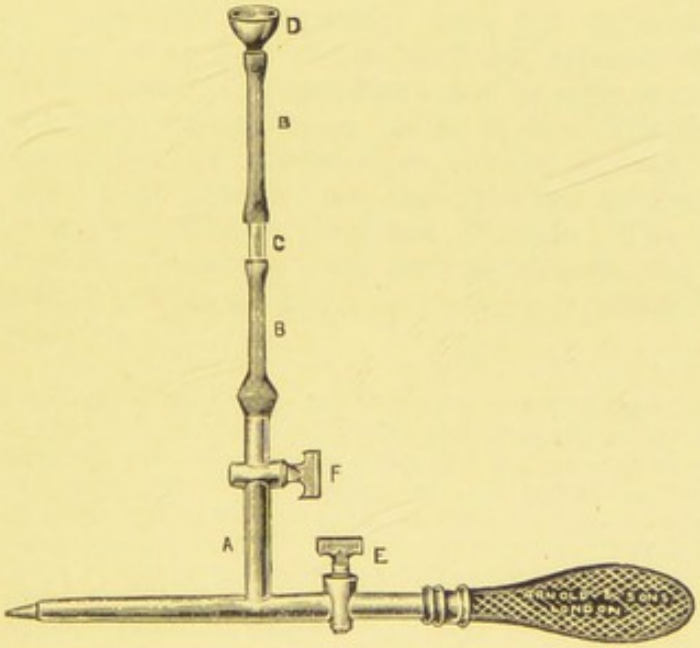


FIG. 443.—REUL'S TROCAR AND CANNULA FOR THORACOCENTESIS AND THORACIC MEDICATION.

A, Vertical tube on the trocar, with a tap, E, and continued by an india-rubber tube, B, which has in its middle a glass cylinder, C, and is surmounted by a funnel, D. The trocar itself has a tap, F.

wound may be cleansed with boracic or sublimate solution, and dressed with iodoform or boracic powder. If necessary, and it is generally so, the operation may be repeated in the same intercostal space or one anterior to it, but the same precautions must be observed.

Idiopathic empyema is rare in the Horse, and I have only met with one case; but suppurative pleuritis as a result of injury to the chest wall, or even as a sequel to thoracocentesis improperly carried out, is not infrequent. The pus is removed in the same manner as serous effusion, and it may be of great benefit to wash out the thorax afterwards and inject astringents, antiseptics, stimulants, or absorbents. In such a case Reul's trocar (Fig. 443) will be of service, and the fluid injected, after washing out

the cavity with warm distilled water, may be iodine tincture, 10 parts; potassium iodide, 1 part; distilled water, 100 parts. In chronic cases, as much as 30 parts of iodine tincture and 4 parts potassium iodide have been added to the 100 parts water. Solutions of sublimate (1 in 5,000), of sodium chloride (5 in 100), or of carbolic acid (5 in 100), have also been employed. These must be warmed to the temperature of the body.

In the Dog thoracocentesis has sometimes to be performed. The aspirator, with a fine needle, is in every way preferable to the trocar and cannula, however small they may be; and as the fluid may be confined to one pleural sac, that is the one which must be operated upon.

OPERATIONS ON THE URINARY APPARATUS.

THE urinary apparatus of animals does not so often require surgical intervention as that of mankind, for reasons which need not be referred to here. Nevertheless, the occasions on which it is necessary to resort to operation on or in the different parts of which it is composed, for the relief or cure of disease, accidents, or defects, are by no means rare, though their frequency varies considerably in the different domestic animals. The Horse we may place first in this respect, the Dog second, the Ox next, and the Pig, Sheep, and Goat last, the Cat very seldom receiving operative attention.

SURGICAL ANATOMY.—The organs and structures entering into the formation of this apparatus in the male are: the kidneys and their ducts, the ureters; the bladder and its canal, the urethra; the penis and its covering or sheath, the prepuce. In the female there is no penis, but the vagina may be included, though we shall omit dealing with it until we come to treat of the generative apparatus; of the organs mentioned, the kidneys may also be excluded, as they have not yet been subjected to operative treatment in animals, so far as I am aware. So that we shall deal chiefly with operations on the bladder, urethra, penis, and prepuce. The male will be dealt with first, then the female, in describing each operation; and a glance at the surgical anatomy of the different organs and structures will be found of advantage, in order to comprehend the procedure in these operations.

The *bladder*, an ovoid or pyriform sac, is situated in the pelvic cavity, where it occupies more or less space, according to the amount of urine it contains; if distended, its fundus projects into the abdominal cavity. It rests on the pelvic bones, and is in relation (superiorly) with the rectum in the male and the uterus in the female. It is retained in position by true ligaments, which are, in the male, the lateral (attaching it to the sides of the pelvic cavity) and the recto-vesical (between it and the rectum); in the female, the latter is supplanted by the vesico-uterine ligament. In the Horse the anterior portion of the bladder only is covered by peritoneum, the other membranes of which it is composed being mucous (internal) and muscular; the latter is thin in the Horse, and its fibres pass in various directions; a quantity of loose connective tissue covering this muscular tunic where it does not receive a peritoneal layer brings the organ into contact with adjacent organs, while a vascularised connective tissue loosely binds the muscular and mucous membranes. It is divided into three regions: fundus, body, and neck or cervix, which is the posterior portion; and internally it shows three openings, two of which—in the upper part of the body, towards the cervix—are those of the ureters, the third being in the cervix and constituting the commencement of the urethra. The muscular layer of the bladder does not form a sphincter around its neck, as there is a special muscle (Wilson's) a short distance from the cervix.

The *urethra* is the membraneous canal with erectile walls, which commences at the cervix of the bladder and terminates at the free extremity of the penis. It proceeds at first horizontally backwards, then bends downwards at the ischial arch to leave the cavity of the pelvis, placing itself between the two roots or *crura* of the corpus cavernosum, and passes forward in the channel formed on the surface of that body until it arrives at the end or glans of the penis, where it terminates in forming a small round prolongation, the *urethral tube*. In its

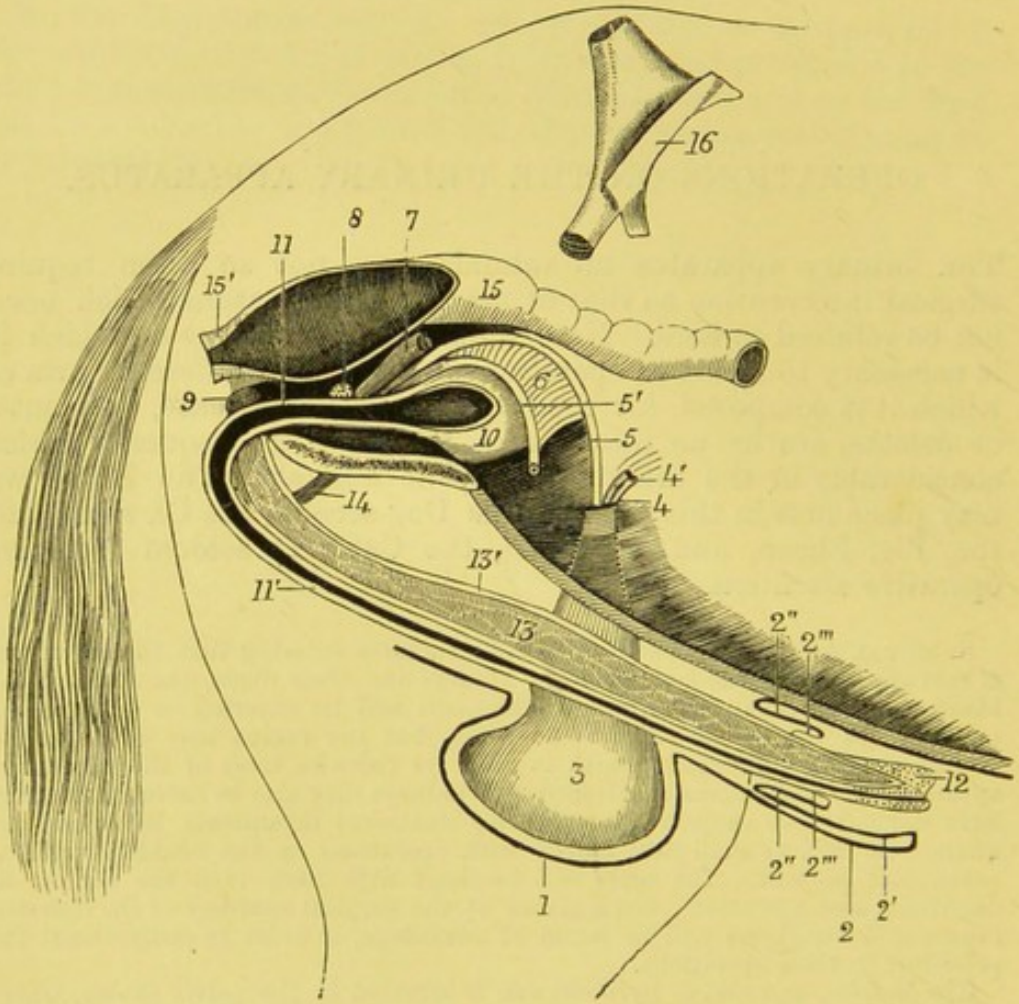


FIG. 444.—SEMI-DIAGRAMMATIC GENERAL VIEW OF THE GENITO-URINARY ORGANS OF THE HORSE: MALE. (After Gurlt.)

1, Scrotum; 2, outer fold of prepuce; 2', inner fold of prepuce; 2", outer fold of upper part of prepuce; 2"', thin glandular skin reflected on the penis; 3, tunica vaginalis of the left side of the scrotum; 4, left abdominal ring, through which vessels and nerves (4') and left vas deferens (5) pass, together with the right vas deferens (5'), attached to it by the serous duplicature (6) named Douglas's fold; 7, left vesicula seminales; 8, left prostate gland; 9, left Cowper's gland; 10, bladder; 11, membraneous portion of the urethra and its extra pelvic portion (11'); 12, glans penis; 13, corpus cavernosum and its fibrous envelope (13'); 14, left ischio-cavernous ligament; 15, rectum and anus (15'); 16, portion of anterior spinous process of ilium.

course it is divided into two very distinct portions: the *intra-pelvic*, the shortest, and the *extra-pelvic*, the most extensive, and which is supported by the corpus cavernosum; the first division is generally named the *membraneous* or *prostatic portion*, and the second the *spongy portion*, because it is surrounded by erectile tissue. Internally, the canal is narrow at its origin towards the neck of the bladder; then it dilates to form the *bulbous portion*, which continues until it has bent round the ischial arch, when it contracts to the width it maintains until it terminates. Its dimensions are, of course, increased during the passage of urine

or semen. Behind the urethral tube there is a small oval space, the *fossa navicularis.* In the upper wall of the canal, near the cervix of the bladder, are the openings of the prostate gland, which form two lateral lines of minute perforated tubercles, between which is the *urethral ridge, veru montanum,* or *caput gallinagus,* on the sides of which the ejaculatory ducts open ; behind this, again, are the excretory orifices of Cowper's glands. The erectile covering of the urethra lies outside the mucous membrane, and does not envelop the intra-pelvic division, but commences a little above the ischial arch, behind Cowper's glands, by a very thick bulging portion, the *bulb of the urethra,* and terminates in front by another bulbous enlargement, into which the end of the corpus cavernosom or *glans penis* enters. The structure of this covering is that of all erectile tissues, being a network of communicating cavities, with elastic septa containing muscular tissue. The urethra has several muscles : the *urethral sphincter,* erroneously designated Wilson's muscle, composed of transverse fibres encircling the membraneous portion of the canal ; the *accelerator urinæ,* surrounding it from the ischial arch to its termination, and divided into two lateral portions by a median raphé passing along the entire posterior and inferior surface of the urethra ; the *compressor of Cowper's gland ;* and the *transversus perinæi,* a thin band, scarcely distinguishable from the *retractor ani,* and extending from the ischial tuberosity to the mesial line of the perinæum, where its fibres join those of the accelerator urinæ.

The urethral sphincter prevents the escape of urine by compressing the membraneous portion of the urethra, and hinders the semen from entering the bladder ; the accelerator urinæ ejects the semen from the urethra ; the compressor of Cowper's glands pulls back the membraneous portion of the urethra and these glands, while compressing them ; and the transversus perinæi dilates the bulbous portion by drawing it out laterally.

The urethra is supplied with blood by the bulbo-urethral arteries and the dorsals of the penis, while voluminous veins—frequently varicose—and satellites of the arteries, carry it away ; a rich plexus of lymphatics lies beneath the mucous membrane, its main branches passing to the inguinal and sublumbar glands.

It is also to be noted that the urethra is covered in the perinæal region by two superposed fibrous layers, the most superficial of which is immediately beneath the skin, and is elastic ; it arises from the inner side of the thighs, where its fibres are mixed with those of the dartos ; it covers the perinæum, and its fibres disappear on the sides of the sphincter ani, from which it receives some muscular fibres. The deep layer is composed of white fibrous tissue, and covers the accelerator urinæ and ischio-cavernous muscles ; above it disappears around the rectum, and below it expands between the thighs ; at the sides it insinuates itself between the erector penis and semi-membranosus muscles to be attached to the ischiatic tuberosity, and it is prolonged into the pelvic cavity between the bladder and rectum, where it forms two spaces, a defæcatory space and a genito-urinary space.

The PENIS, in form and structure, is somewhat different in the various species of domestic animals. In all it commences at the ischial arch with the spongy portion of the urethra, passes down between the thighs and the two dartoid sacs containing the testicles, and is prolonged forward beneath the abdomen. All the portion comprised between the ischial arch and the scrotum is deeply covered by the surrounding structures, and is named the *fixed portion* of the penis ; the remainder, its anterior moiety, is its *free portion,* as it forms a detached mass sustained by a cutaneous fold or sheath, the prepuce. The fixed portion is lodged in the perinæal region and between the thighs, where it is enveloped in arteries, veins, and nerves and a large quantity of connective tissue. The free portion (Fig. 445) lies in the prepuce during the passive state of the organ, but projects from it when in a state of erection sometimes when diseased, or when it cannot be retracted. Normally, it is covered with numerous papillæ, and its base shows an annular enlargement, due to the presence of a small mass of yellow elastic tissue beneath its enveloping membrane, while the extremity, or *glans,* is also a considerable circular body limited behind by a salient ridge (the *corona glandis*), which is notched inferiorly, and during copulation becomes greatly enlarged and expanded. The mass of the penis is chiefly composed of the erectile mass designated *corpus cavernosum,* which is attached by two portions or *crura*

to the ischial arch posteriorly, and terminates anteriorly in the glans ; the upper or dorsal aspect is thickest, and the inferior surface is channelled throughout its extent by a deep furrow, in which the urethra is lodged. At its commencement the corpus cavernosum is covered by two erector muscles (*ischio-cavernous*) ; it has at this part a double suspensory ligament, which proceeds from the inferior surface of the sacrum as two flat bands that descend in front of the anal sphincter,

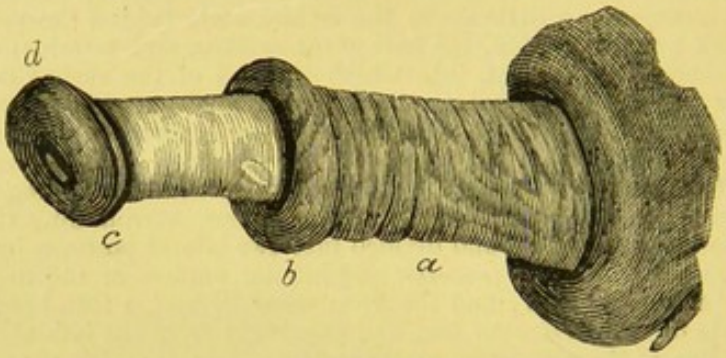


Fig. 445.—Free Portion of the Horse's Penis.

a, Base ; *b*, elastic ring on anterior portion of base ; *c*, glans ; *d*, corona glandis.

unite in the middle below the anus, and, covering the accelerator urinæ muscle in the perinæal region, are eventually lost in its texture near the free extremity of the penis. Composed of non-striped muscular tissue, this ligament concurs, with the natural elasticity of the fibrous envelope of the corpus cavernosum, to retract the penis when it has been protruded. This envelope is white and elastic, and remarkable for its thickness, especially on the dorsum ; from its inner surface are given off fibres or bands, which divide the cavity it encloses

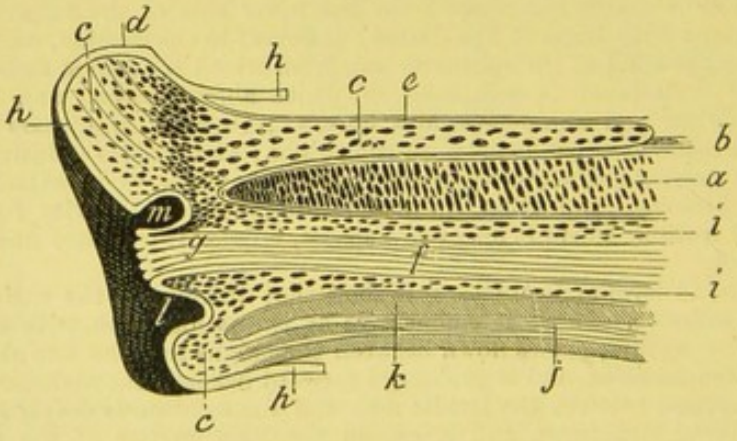


Fig. 446.—Section of Free Portion of Horse's Penis. (After Franck.)

a, Termination of corpus cavernosum in the glans penis, with (*b*) its fibrous envelope ; *c*, *c*, *c*, erectile tissue of the glans penis, with its small interspaces ; *d*, corona glandis ; *e*, enveloping membrane (*fascia penis*) of erectile tissue of glans penis ; *f*, urethra ; *g*, urethral tube ; *h*, *h*, *h*, skin of glans penis ; *i*, *i*, erectile tissue of urethra ; *j*, muscle of urethra ; *k*, fasciculi of retractor penis muscle ; *l*, urethral sinus ; *m*, fossa navicularis.

into numerous spaces ; one of these bands, passing from above to below, and extending from the junction of the crura at the commencement of the corpus cavernosum to near its termination, forms a more or less incomplete portion (*septum pectiniforme*). Other elastic and contractile bands, composed of white and yellow tissue and non-striped muscular fibres, circumscribe the cavities in which are lodged the essential portion of the erectile tissue ; this is made up of net-

works of capillary bloodvessels interposed between the smaller arteries and veins, which also show minute dilatations, and are adherent to the lamellæ; the capillaries themselves are extremely thin in their walls. The arteries of the corpus cavernosum and dorsales penis pass into the erectile structure, and offer a special arrangement there, particularly towards the base of the organ; their walls are very thick, and they divide into bouquets of branches which enter the areolæ, where they either terminate in a *cul-de-sac*, or, which is more frequent, give off small branches that are convoluted in a spiral manner (the *arteriæ helicinæ*). The spaces or areolæ are in reality venous sinuses, which during erection of the penis are distended with blood. The collateral veins of the arteries arise near the surface, and form large vessels coursing along the dorsum of the organ; the nerves proceed from the internal pudic and great sympathetic.

The PREPUCE, or SHEATH, protects the free portion of the penis, and sustains it when in a flaccid condition; it is a cavity formed by a fold or involution of the abdominal skin, and is entirely effaced when the organ is in a state of erection. The inner fold of skin, on arriving at the free portion of the penis, becomes closely reflected over and envelops it and so forms a circular *cul-de-sac* when it is reflected. This lining integument of the prepuce is fine, thin, and irregularly plicated, is destitute of hair, and holds a middle place in structure between the skin and mucous membranes; it has also a great number of perspiratory and sebaceous or preputial glands, that secrete sweat and an unctuous peculiar-smelling matter (the *smegma præputii*). The inner fold of skin is applied above to the tunica abdominalis, while below and on each side, within the two layers of integument, is an expansion of yellow elastic tissue, the lateral portions of which are inserted into the tunica, and form the suspensory ligaments of the prepuce.

In the MARE the urethra is very short (about two to three inches), and has no corpus spongiosum as in the male, though it has a muscular coat; after a short course in the texture of the floor of the vagina, it opens into the vulvar cavity by an orifice (the *meatus urinarius*), provided with a large valve, one border of which is fixed, and the other free and inclined backwards, in order to direct the flow of urine outwards. The urethra is much wider than that of the male, and is of uniform width throughout; the meatus is from three and a half to five inches from the external opening of the vulva.

In the male of the Bovine species, the penis (Fig. 447) presents some notable differences from that of the Horse. The organ is very long and comparatively narrow, has a double sigmoid or S flexure behind the scrotum, and is carried well forward underneath the abdomen, terminating in a tapering point. The urethra is about three feet long and one-fourth of an inch in width at its commencement, but it gradually diminishes until it is even less than half that size at its termination, which is not provided with a urethral tube, as in Solipeds, and is only a narrow slit. Internally, it shows immediately beyond the neck of the bladder a short and very salient veru montanum, that divides into two prominences, which subside as they proceed backwards; near the ischial arch is a valve, the free border of which is directed downwards, and covers a depression that is about an inch deep; the walls of the membranous portion are thicker than in the Horse, and have erectile tissue and a sphincter muscle which is very thick below and at the sides, its fibres being inserted into a *raphé* on the upper surface. At the ischial arch, where it bends downwards, the erectile tissue becomes more abundant to form the bulb of the urethra, but the prominence at this point is chiefly due to the accelerator urinæ muscle (Fig. 447, 10), which is largely developed here, but only extends a short distance beyond the arch. The penis is enclosed at the perinæum in an aponeurotic sheath, which is covered by the ischio-tibial muscles; this sheath is double, the superficial layer being continuous with the dartos of the scrotum, but the deep layer is thin and inelastic. In front of the pubis is the double curve (18, 18′), the first with its convexity forwards, the second being backwards where the suspensory ligaments join it and continue along its sides. The prepuce (13) is much narrower than in the Horse, and is more advanced beneath the abdomen; it has at its opening a bunch of long stiff hairs. It is moved by four muscles: two posterior or *retractors* (14), which draw the prepuce backwards, and concur in exposing the penis at the moment of its erection; and two anterior or *protractors*, which carry

forward the prepuce to its former position when erection has ceased. In the corpus cavernosum the channel for the lodgment of the urethra is not a simple groove, but is transformed into a complete canal by a narrow layer of the fibrous envelope of that body, which is little developed, and has internally a longitudinal

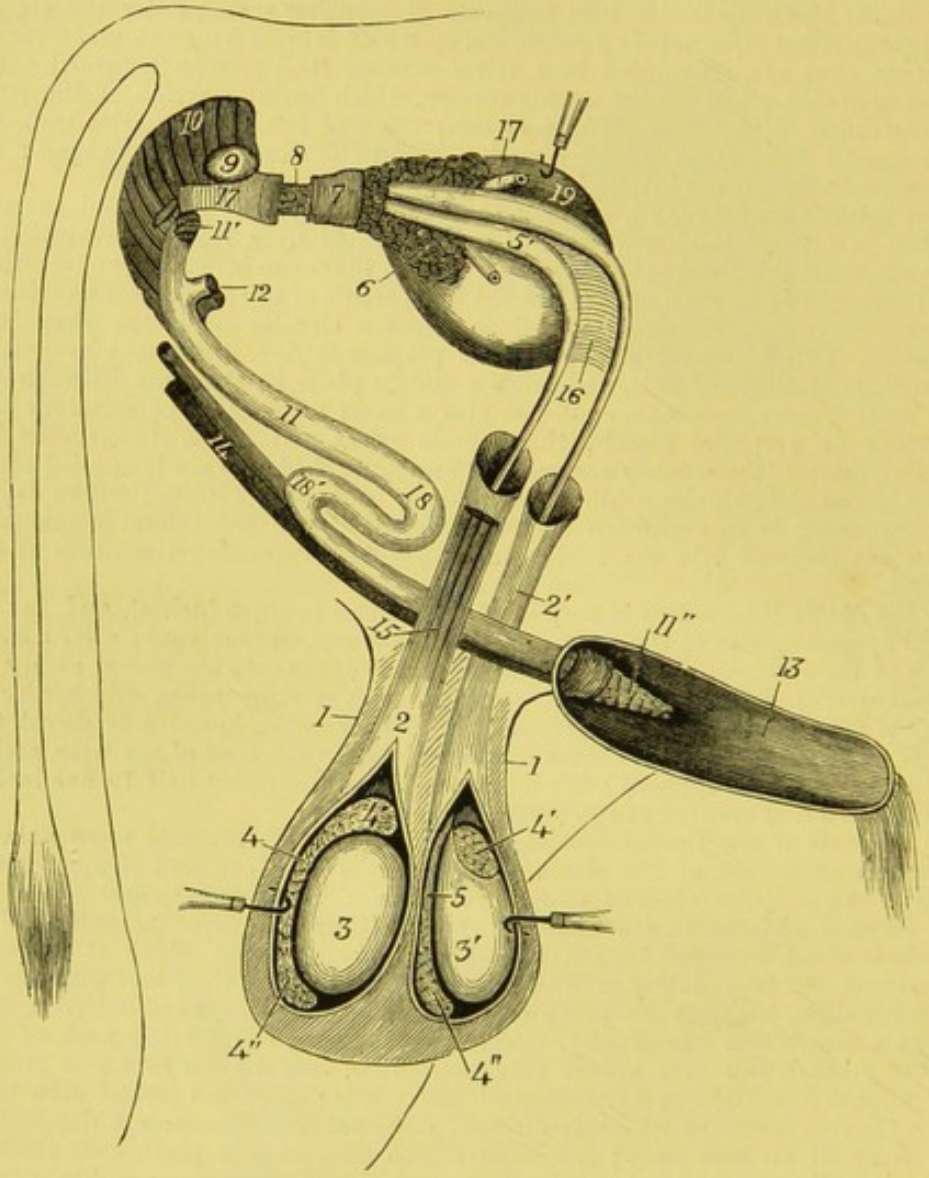


FIG. 447.—GENITO-URINARY ORGANS OF THE BULL: SEMI-DIAGRAMMATIC.
(Altered from Gurlt.)

1, Scrotum; 2, 2', vaginal sac on right and left side, partially opened; 3, outer side of right, and 3', inner side of left, testicle; 4, body of the right vas epididymis, its caput (4), and its cauda (4''); 5, vas deferens, and (5') enlarged ampulla or bulbous portion; 6, vesiculæ seminales; 7, Wilson's muscle surrounding the commencement of the urethra; 8, portion of Wilson's muscle on the prostate gland; 9, Cowper's gland; 10, accelerator urinæ; 11, penis, and (11') section of one of its crura; 11'', extremity of the penis; 12, section of its ischial or suspensory ligaments; 13, prepuce opened; 14, section of retractor muscles of the penis; 15, section of right cremaster muscle; 16, Douglas's fold; 17, ischial flexure of the penis, and (18, 18') its double flexure behind the scrotum.

fibrous cord; it is only slightly distended during erection. In the act of copulation the penis is lengthened by the straightening of its flexures, and when erection ceases the organ is retracted into the preputial cavity by its suspensory ligaments, which reform its double inflection behind the scrotum.

In the Cow the bladder (Fig. 448, *d*) is enveloped in peritoneum as far as its neck; it is of considerable capacity, but its walls are thin and ligaments short. The openings of the ureters are close together, and at the fundus the mucous membrane shows a small fossa which is terminated by a narrow canal that terminates in a *cul-de-sac*, and constitutes a free appendage about half an inch long and the thickness of a goose-quill. The urethra does not offer any characteristic difference from that of the Mare, except that it is somewhat longer (four to five inches). Wilson's muscle is much thicker, and at the meatus, below and in front of the valve, is a fossa or diverticulum (Fig. 448, *f*) about an inch in depth, the presence of which the operator should remember when attempting to pass a catheter or other instrument into the bladder.

In the RAM the spongy portion of the urethra is not enveloped by the corpus cavernosum, as in the Bull, but in a furrow in that body, as in the Horse. The penis has the same inflection as that of the Bull, and the extremity, which is tapering, is remarkable for two lateral folds disposed like wings at the base of the glans, but one of these is so little developed that the head of the penis looks asymmetrical. The urethra is only about one to one and a half inch long, is very narrow, and is prolonged by a thin vermiform appendage from one to two

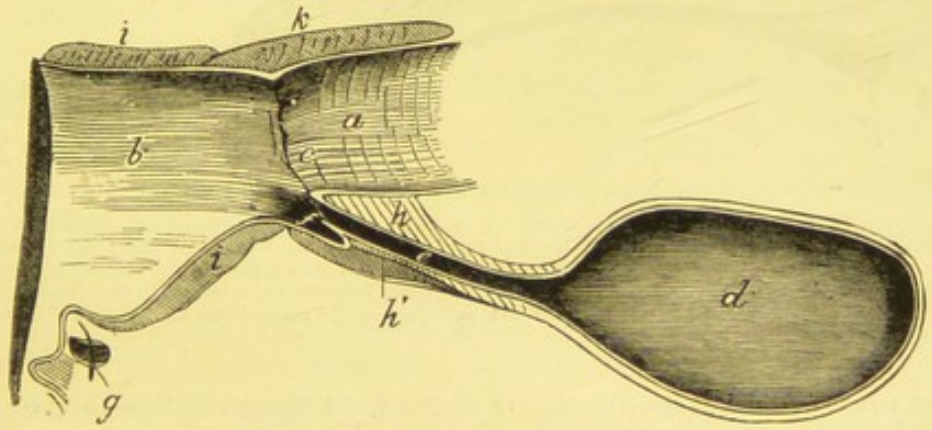


FIG. 448.—SECTION OF THE VULVA, VAGINA, AND BLADDER AND URETHRA OF THE COW. (After Franck.)

a, Vagina; *b*, vulva; *c*, opening of Gärtner's ducts; *d*, bladder; *e*, urethra; *f*, diverticulum below the valve of the urethra; *g*, clitoris and fossa beneath it; *h*, *h'*, *k*, Wilson's muscle (showing at *h* bundles of loose fibres); *i*, *i*, constrictor of the vulva.

inches long, and curved backwards, in which the opening appears as a longitudinal slit. In the EWE the urethra is guarded with a valve at the meatus, as in the Cow.

In the BOAR the penis resembles that of Ruminants, except in the absence of the muscles of the prepuce and in being twisted in a spiral manner at the extremity when flaccid. The prepuce is longer and narrower comparatively than in Ruminants, and at the upper part of its orifice, near the umbilicus, is a special pouch formed by a duplicature of the skin, with a thin layer of muscular fibres between; this sac opens into the urethra, and secretes an unctuous, disagreeably-smelling matter that mixes with the urine. The penis of the boar has inflections similar to those of Ruminants. The pelvic portion of the urethra is comparatively very long, and the tube opens by a narrow slit at the external extremity. In the SOW the urethra is short and wide, and there is no vulvo-vaginal valve, as in Ruminants, but at each side of the meatus urinarius is a small fossa surrounded by a ring.

In the DOG the urethra is proportionately very long in its pelvic portion, and towards the ischial arch shows an enlargement or bulb, though this is smaller comparatively than in the Ox, and the accelerator urinæ muscle is continued for a greater distance around it. The penis (Fig. 449) is long and pointed, and its posterior half is constituted by the corpus cavernosum, which is little developed; while the anterior moiety has for its base a bone, the penien or penial bone

(*os priapi*), an elongated conical body, which is curved on its sides so as to form a furrow on its under surface for the lodgment of the urethra when it leaves the fibrous channel of the corpus cavernosum (Fig. 449, 2). The anterior apex of the bone partly assists in forming the point of the penis, and its base is closely united to the end of the corpus cavernosum, the middle septum of which is very dense, and is fixed in the bone. The bone is about two inches long, and almost entirely constitutes the basis of that portion of the penis contained within the prepuce, and, in addition, this part has two erectile enlargements, an anterior and posterior (Fig. 449, 6), the first of which is analogous to the glans penis of the Horse, and is formed by an expansion of the erectile tissue of the urethra; the second is supplementary, and begins at the base of the free portion of the penis, where the skin of the prepuce is folded in a circular manner around it. It is from one to one and a half inches long, pyramidal in shape, and embraces the upper border and sides of the bone; its base, which is posterior, is thick, and in front it

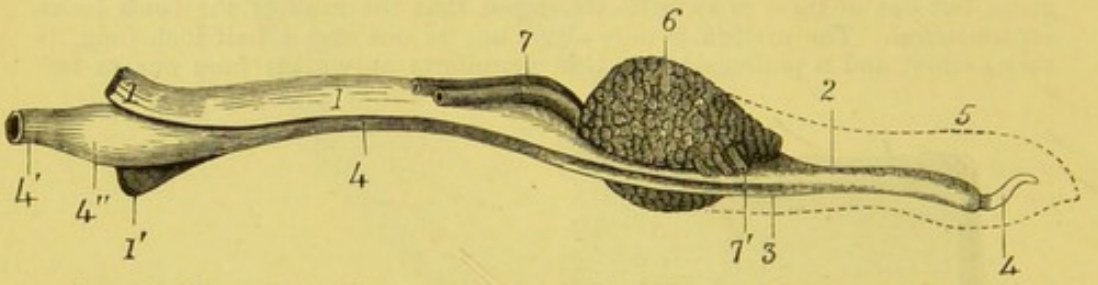


FIG. 449.—PENIS OF THE DOG, SEEN FROM THE RIGHT SIDE AND BELOW. (After Gurlt.)

1, 1, Corpus cavernosum and (1') its crura; 2, os penis or priapi; 3, groove in the penial bone for the reception of the urethra; 4, junction of the penial bone with the urethra; 4', section of the urethra; 4'', bulb of the urethra. The dotted line 5 shows the distended erectile tissue of the glans penis, and (6) its bulbous enlargement injected; 7, veins leaving the bulbous enlargement at its posterior extremity, and (7') veins from the glans entering its anterior extremity.

thins away beneath the erectile tissue of the head. Although contiguous, these two vascular masses are independent of each other; the posterior has no communication with the corpus cavernosum, and possesses two special veins, which pass backwards in the lateral groove (Fig. 449, 7). Two small muscles pass from the crura of the penis and proceed forward to unite in a common tendon, which is inserted into the dorsal surface of the organ, in this way resembling the cord of a bow. The subpenial cords are present, as in the other animals. The prepuce is narrow and long, and, as in Ruminants, it has protractor muscles.

CHAPTER I.

OPERATIONS IN OR ON THE BLADDER.

CYSTIC AND URETHRAL CATHETERISM.

WHEN the bladder from any cause becomes unduly distended by retention of urine, or when it is desirable to remove decomposed urine or any other fluid from that viscus, and this cannot be otherwise effected, then a tube or catheter is passed along the urethra into the bladder, and by its means the contents are withdrawn.

Several causes may occasion distention of the bladder, among these being primary or sympathetic tonic contraction of its

sphincter, paralysis of its muscular tunic, pressure or obstruction due to calculi or sabulous matter in its cavity, or to external pressure on its cervix. It also occurs sometimes as a result of accident or disease. The existence of the condition is marked by inability to micturate, even when strenuous and oft-repeated efforts are made by the animal to do so, no urine, or only a very small quantity, being voided. Other symptoms may be manifested, more or less indicative of the pain and discomfort attending this serious condition, which may also be ascertained in the larger animals by a manual examination *per rectum*. In certain cases, careful manipulation of the distended bladder through the inferior wall of the rectum may cause expulsion of the urine.

Catheterism is most frequently practised on the male Horse, not so often on the Mare; for the Dog it is more often necessary than for the Bitch; and in male Ruminants and the Pig, because of the inflections in the direction of the penis, alluded to when describing the surgical anatomy of that organ, it is scarcely possible to pass a catheter along the urethra into the bladder, as can be done in the Horse and Dog. Consequently, catheterism in them is limited to the anterior portion of the urethra. In female animals catheterism is less frequently necessary than in males, and is less difficult, because of the comparative shortness and width of the urethra.

We will first consider cystic catheterism in the Horse and Mare, then in the Dog and Bitch, and finally treat of urethral catheterism in male Ruminants and the Pig, and cystic catheterism in the females of these animals.

Cystic Catheterism in the Horse.

Instruments.—These are chiefly catheters of different kinds and sizes, according to requirement and species and sex of animal. Brogniez's catheter for the Horse was a cylindrical copper cannula, prolonged by a curved elastic portion composed of longitudinal springs enclosed in a spiral steel spring covered with leather; at its extremity was an olive-shaped piece of horn perforated by a number of small openings communicating with the interior of the tube; the opening at the other extremity was square, and the instrument had a ring at each side. It had a square stilette of steel furnished with a handle, and terminated by a button spring. This was to serve as a support to the cannula while it was being passed through the urethra, and had to be withdrawn when the bladder was reached. This form of catheter is still in use, but it has been largely superseded by others of lighter and more flexible materials. Some of these are composed of wire twisted in close spiral to form the tube, which is covered with smooth material, and the stilette is made of whalebone; others are made of india-rubber, but those generally in use in this country are of gum elastic, and answer the purpose admirably (Fig. 450). When merely required for the withdrawal of urine or other fluid from

the bladder, the ordinary form is sufficient; but when it is necessary to wash out the interior of the viscus, the catheter with a double channel is most convenient and useful (Fig. 451), as it serves not only to empty the bladder, but when a mount is applied to the upper end a clyster syringe can be attached to it which will inject not only water or other cleansing and disinfecting

FIG. 450.—VESICAL CATHETER: HORSE.

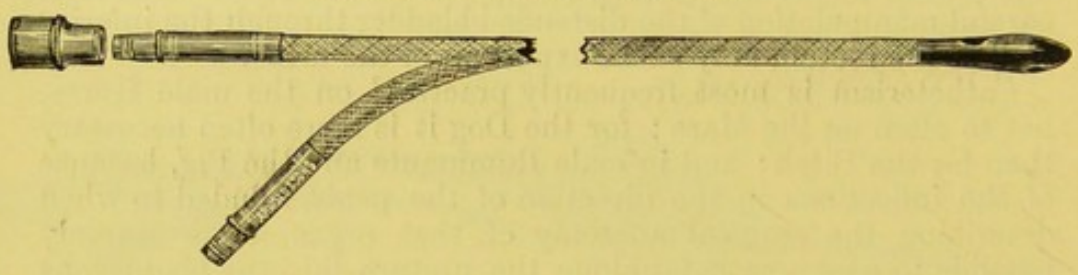


FIG. 451.—VESICAL CATHETER: HORSE. DOUBLE CHANNEL FOR WASHING OUT THE BLADDER.

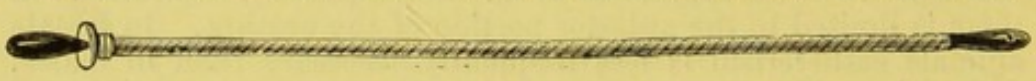


FIG. 452.—SPIRAL GUM-ELASTIC VESICAL CATHETER: MARE.

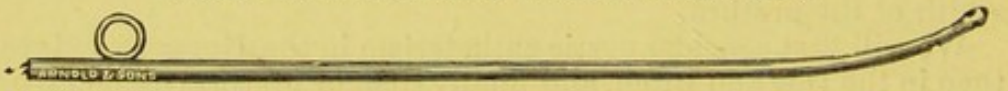


FIG. 453.—METALLIC VESICAL CATHETER: MARE.

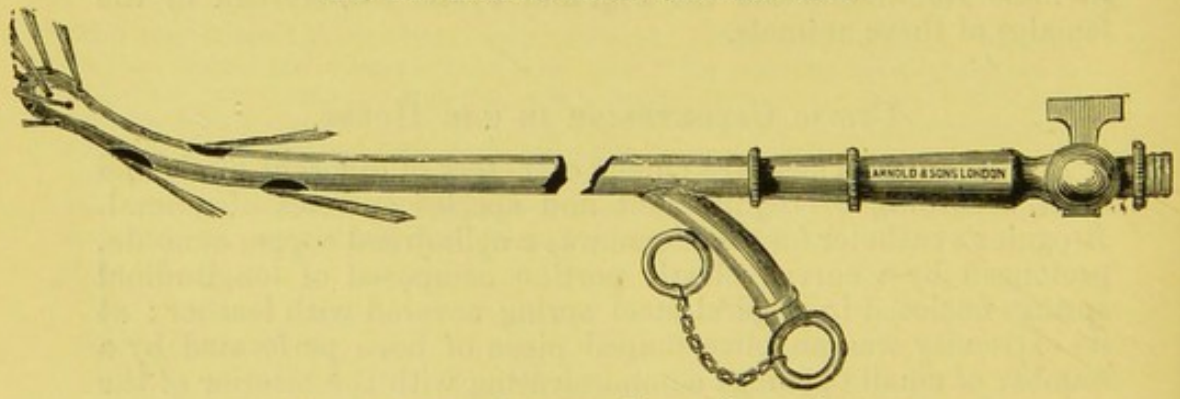


FIG. 454.—VESICAL CATHETER: MARE. DOUBLE CHANNEL.

FIG. 455.—VESICAL CATHETER: DOG. ELASTIC GUM WEB.

fluid, but also medicaments. This, of course, can be done by means of the single-channel catheter, but not so effectively. For the Mare a shorter and larger catheter can be employed, and it may be either of gum elastic (Fig. 452), or metal slightly curved (Fig. 453). A double-channelled metal catheter is also in use (Fig. 454), and is employed for the Mare and Cow with the

same object as that for the Horse; to it a quart syringe can be attached.

For the Dog, a web gum-elastic catheter is most suitable; it should be of different lengths and calibres for small, medium, and large-sized Dogs (Fig. 455).

An important point to observe with regard to these catheters, is to have them perfectly clean within and without, and immediately before use they should be immersed in a disinfecting fluid. When about to be employed, they must be smeared externally with a disinfected lubricant, such as carbolised glycerine, vaseline, or olive-oil.

Position.—With the larger animals, it is most convenient to pass the catheter when they are in the standing position; with the Dog the dorsicumbent position is most suitable.

In the standing position, the Horse and Mare usually require to be secured by a sideline on the right or left hind-pastern, or hobbles on both hind-pasterns; a twitch on the nose or underlip may also be necessary. One of the fore-limbs should be held up by an assistant.

Operation.—The rectum is first emptied. If the animal be a Horse, it is advisable to have the interior of the prepuce washed out, so as to free it from the sebum which often collects there in great quantities; then the penis has to be withdrawn to some extent from the prepuce, and to do this the operator places himself on the right side, passes his right hand into the prepuce, seizes the head of the penis, and, placing the first finger in the urethral sinus, by gentle and continued traction the organ is gradually brought out and held by an assistant; to hold it more securely a cloth may be tied round it, behind the glans. The urethral tube is now visible, and the catheter, disinfected and lubricated, and having its stilette, is introduced into the urethra, and pushed steadily and carefully onwards—it deviates slightly to the left—until it reaches the ischial arch; at this point the stilette is withdrawn about six inches, to allow the end of the tube to bend upwards and forwards; this is greatly facilitated by gently manipulating the end, which can be felt in the perinæum. When the catheter reaches the pelvic portion of the urethra, it readily goes on to the bladder; but if it does not, a hand in the empty rectum will guide it there. An assistant can hold the handle of the instrument and push gently while the operator manipulates it in the perinæum or rectum. On entering the bladder, the urine escapes through the tube, and the stilette is withdrawn. When the bladder is evacuated the catheter is removed by introducing the stilette as far as the ischial arch, then slowly, steadily, and carefully withdrawing the whole from the urethra, pushing the stilette to the end as the tube is being pulled out. In passing the catheter, the operator must be on his guard against unsteadiness and abrupt movements on the part of the Horse, which might lead to injury of the urethra, such as tearing of its mucous membrane and the formation of a false passage.

Catheterism is easily practised on the Mare, owing to the shortness and width of the urethra, and the ready accessibility of the meatus on the floor of the vagina, so that an expert operator has no difficulty in passing his finger into the urinary canal. The catheter may be of larger diameter than that required for the Horse, and need not be more than eight inches long. The animal is secured in the same manner as the Horse.

As has been mentioned, the meatus urinarius is situated on the floor of the vagina, at from four to six inches from the entrance of the vulva, at the junction of that cavity with the vagina, and at the bottom of a kind of wide valve stretching to the lower surface of the cavity, which covers the meatus. The index-finger of the left hand is passed beneath the valve to the meatus, and the catheter, smeared with carbolised glycerine, is pushed beneath that finger by the right hand, guided into the urethra and forward into the bladder.

In the Dog the operation is comparatively simple. The animal is placed dorsicumbent or latericumbent, the latter being the best position in some cases. The front of the prepuce is pushed back behind the corona of the penis, which is made to protrude, so that the orifice of the urethra is exposed; into this the lubricated catheter of a suitable size is introduced and passed slowly backwards, the stilette being gradually withdrawn as the tube is carried round the ischial arch into the bladder, when it is altogether removed. When the urine has ceased to flow, the stilette is partially inserted, and the tube withdrawn.

In the Bitch the catheter can be readily passed into the bladder.

In Ruminants catheterism of the bladder is impossible, because of the double curve of the penis, which only allows the catheter to pass into the portion of the urethra adjoining the scrotum.

In the Cow the operation is carried out in the same manner as in the Mare, but the operator has to remember that there is a fossa or diverticulum below the meatus, into which the catheter is liable to pass if care be not taken to avoid it, by keeping to the upper surface of the urethral wall.

There is no difficulty with the Ewe.

Puncture of the Bladder—Cysto-Paracentesis.

Puncture of the bladder is indicated when that viscus has become dangerously distended, owing to obstruction to the escape of urine through the urethra, and all other measures for its evacuation have failed. This condition is perhaps most frequently observed in the Bovine species, and it always occurs in male animals. Females do not require the operation, as they can be readily relieved from retention of urine in other ways.

Over-distention of the bladder may be suspected from the symptoms the animal exhibits, and confirmation of the suspicion

is established by a manual examination *per rectum* in the larger creatures. In the Horse the greatly-enlarged viscus can be easily felt beneath the rectum, extending more forward than usual; in Bovines it is also as much enlarged, but its extension is rather in a lateral direction; while in the Dog and Pig, in which an examination *per rectum* is not so convenient, the bladder projects well into the abdomen, and can be felt externally in the prepubic region. It cannot be detected at this part in Horses and Cattle.

In the larger animals the bladder can be most effectively punctured through the rectum, and also from the perinæum. In the Dog and Pig it is best reached from the lower part of the abdomen, close to the pubis.

Puncture through the rectum is perhaps the simplest operation, and is that recommended for adoption in the case of Cattle which are to be killed, and their flesh consumed as food soon afterwards. But perinæal puncture is considered preferable by some operators, because there is much less danger of cystitis ensuing than when the urine is withdrawn through the rectum, the communication between it and the bladder exposing the latter to fæcal contamination, while the urine can also be drawn off as it accumulates, by means of the cannula inserted through the perinæal wound.

Instruments.—A trocar and cannula, similar to one of those employed for puncturing the intestine of the Horse (Fig. 359), suffice for cysto-paracentesis through the rectum. For perinæal cysto-paracentesis, a bistoury or scalpel and forceps, a long straight trocar and cannula of somewhat small calibre, with antiseptic dressings, are required; while for the Dog and Pig, which are operated upon in the hypogastric region, a fine trocar and cannula are necessary, or, better still, an aspirator may be employed for them. Indeed, there is every reason to recommend the use of the aspirator (such as that shown in Fig. 379) for either rectal or perinæal puncture in the larger animals, as it greatly simplifies the operation, and renders it much safer, because the needle is so much smaller than the cannula.

Position.—The larger animals should certainly be operated upon in the standing position, as there would be great risk of rupturing the bladder if an attempt were made to throw them down. The hind-limbs should be secured, in order to ensure the safety of the operator, and other means of restraint may be required. The Dog and Pig are placed latericumbent.

Operation—*Puncture through the Rectum.*—In puncturing the bladder through the rectum, the latter must be emptied as completely as possible of the fæces it contains. The right hand, holding the trocar and cannula—the point of the trocar being slightly withdrawn into the cannula or guarded by one or two of the fingers—is passed into the rectum until it is immediately above the bladder, when it is raised so as to bring the instrument into a vertical position, point downwards; then the latter is pushed through the floor of the intestine into the bladder to a depth of two or three inches, and between the cervix and body

of the viscus, so as to avoid entering the peritoneal cavity. On the trocar being carefully withdrawn the urine escapes into the rectum; when the bladder is sufficiently emptied the cannula is removed. Little can be done to the wound, though, to avert fæcal infection of the bladder, the rectum may be plugged with a quantity of antiseptic tow, lint, or cotton-wool for as long as possible or as may be necessary.

When the aspirator is employed, the same procedure must be observed in using the needle, though plugging the rectum is scarcely required, as the puncture made in it is quite insignificant.

Puncture through the Perinæum.—In puncturing the bladder through the perinæum, a vertical or slightly oblique incision of about an inch in length is made in the skin beneath and close to the anus, and to the right or left side of the urethra; the connective tissue beneath is divided to some extent by the knife, finger, or, better still, a long probe, towards the neck of the bladder, the distended condition of which is a serviceable guide for the operator. The long thin trocar and cannula are passed into the opening, directed forward alongside the urethra, and pushed into the bladder; in some circumstances it is of advantage to fix the bladder by a hand introduced into the rectum before the trocar is thrust into it.

The trocar is withdrawn, and the cannula is gradually advanced deeper into the bladder as this becomes emptied of urine. The cannula may remain *in situ* for a day or two if necessary, or it may be removed at once. The cutaneous wound should be closed by one or two sutures. The prostate gland or vesicula seminales may be wounded by the trocar, but this accident is not of much importance.

Puncture through the Abdomen.—This is best done in the Dog and Pig with the aspirator. A small incision having been previously made through the skin to one side of the linea alba, in the lower part of the flank, the needle is steadily pushed into the most prominent part of the tumour formed by the distended bladder, and the tap being turned, the urine passes rapidly into the receiver. If a trocar and cannula are employed, they are introduced into the bladder in the same way; the animal being latericumbent, it is necessary to make gentle pressure with the hands on both sides of the body towards the flanks, in order to expedite the flow of urine and empty the bladder.

There is little danger from the operation, and especially if antiseptic precautions are attended to.

Cystotomia Perinealis—Ischial Urethrotomy—Lithotomy—Lithotrity.

These designations are given to an operation for the removal of calculi from the body or cervix of the bladder of domestic animals, the first two designations being applied to the part cut into in order to reach the stone, and the other two to its removal

from that receptacle. Calculi occur in the bladders of all the domestic animals, but are perhaps most frequently observed in the Horse. Though undoubtedly the great majority are formed in that receptacle, yet there is reason to suppose that some are commenced in the kidneys and find their way by the ureters to the cavity of the bladder, where they may become greatly increased in size if they remain there.

In herbivorous animals urinary calculi are, chemically, nearly always chiefly composed of carbonate and triple phosphate of calcium, the carbonate forming about 80 per cent. of the whole; there is also a small quantity of magnesia, with a variable amount of organic matter, and sometimes sufficient iron to impart a reddish tinge to the whole; very rarely there is a little silicic acid. Their shape is far from uniform, though they are usually ovoid, but much depends on their situation in the bladder for the shape they assume. Their volume and weight varies exceedingly, from masses weighing twenty and more ounces, to fine granular particles which form a kind of sabulous deposit; their surface may be smooth, though their shape is quite irregular; but the greater number have a more or less rough exterior, some being formed of large nodular accretions composed often of calcium oxalate; indeed, though cystic calculi found in the Horse are remarkably uniform in chemical composition, yet exceptionally specimens are met with which are almost entirely made up of that substance.

Many are visibly composed of concentric layers, regular or irregular; others do not exhibit this structure so distinctly; others, again, appear homogeneous or are full of spaces and crevices. The outer portion of some is much softer than the inner, others are dense and compact throughout, and others, again, are entirely soft and friable.

In Sheep some cystic calculi have been reported as composed of magnesium and calcium phosphates and silicic acid.

In carnivorous animals cystic calculi are usually composed of ammonium oxalate, and are of mulberry shape; others of calcium carbonate and phosphate with ammonium urate, and which are generally the largest in size; and others are made up of cystin and a variable proportion of lime salts—these are soft and readily broken up

Cystic calculi do not always cause visible disturbance, and very large ones have been accidentally discovered in aged Horses after death, which had never been known to exhibit symptoms of urinary derangement during life. To this circumstance may be due the notion that these calculi are rare in the Horse. When they do cause inconvenience this is at first little noticeable, and only increases gradually if the stone is not very near the neck of the bladder. Their presence is indicated by frequent attempts at micturition, some of which, when the obstruction is at the cervix, are abortive, and others more or less imperfectly accomplished after much straining. 'The urine is discharged in small quantities at brief intervals, and the completion of the act is signalised by a

deep grunt indicative of pain. The desire to empty the bladder is more frequent and urgent during and after exertion, and particularly marked when the pace has been quick. Every now and again while at work the animal pauses in its movements, and essays to stop. If permitted to do so, the body is at once extended, and a small quantity of urine is discharged. When the calculus is large, rough, and free to move in the cavity of the bladder, hæmaturia is almost an invariable result of exertion, and whenever the latter is immediately followed by the former, the case should be regarded with suspicion, unless some other and more obvious cause is revealed. In some instances the penis is projected from the prepuce, and again retracted at short intervals, and we have seen it remain in a pendulous condition during the whole period of the disease, to return again only after the operation of lithotomy.

'The discharge of urine is sometimes effected in a continuous stream, sometimes the flow is suddenly interrupted and broken by the movement of the calculus towards the neck of the bladder, and occasionally it passes away involuntarily in small quantities. After the bladder has been freely emptied the anus undergoes a repetition of spasmodic contractions. Now and again the stone becomes impacted in the cervix, resulting in obstruction and over-distension of the bladder, with the usual train of symptoms indicative of abdominal pain. In some examples of the disorder the gait during progression is wide and straggling, and during quiescence the limbs are occasionally raised from the ground, as if in pain' (*Axe*).

In the majority of cases there is little difficulty in diagnosing the existence of calculi when the above-mentioned symptoms are noted, though sometimes when the bladder is inflamed or is the seat of tumour, or the kidneys are diseased, some of these symptoms are remarked. An examination of the organ *per rectum* will tend to confirm the diagnosis, but the introduction of a sound into its interior by the urethra affords the most reliable evidence, if the instrument can reach it. But this in some very rare cases is not easy, as when the stone is lodged in a depression or sac in the floor or fundus of the bladder. It should be remembered that stones of large dimensions occasion much suffering when their surface is rough and they are free to move about with the motion of the body. The mucous membrane is greatly irritated, and it and the subjacent muscular coat become thickened. As a result, the walls of the viscus lose their extensibility, and do not yield to the pressure of the urine; this compels frequent micturition, while the inflammation set up leads to suppuration and the formation of false membranes.

Smooth calculi, on the contrary, and such as are lodged in pouches or herniæ of the mucous membrane, cause much less disturbance, and, as has been remarked, may not occasion suspicion of their presence. And when calculi are not completely encysted, but are merely lodged in a shallow pouch, the symptoms are not

uniformly severe, but are marked by sudden remissions at long or short intervals.

In searching the bladder for stone through the urethra, its cavity is allowed to become moderately distended with urine, when, first in a standing and then in a recumbent position, the well-oiled sound is passed into it. The instrument is moved slowly backward and forward with a slight rotatory motion, so as to bring its metallic extremity into contact with the entire area of the bladder, noting any roughness, irregularity of surface, resistance, or particular sound it may convey. If the result is not satisfactory, the position of the animal (being latericumbent) is changed to the other side, then to the back until the interior of the bladder has been thoroughly explored.

When the substance felt through the rectum is a calculus, its contact with the instrument will be made known by the rough and resisting character of the touch, and by the sound emitted when struck. 'It ought ever to be borne in mind that there are limits to the toleration of the instrument by the mucous membrane of the bladder which require to be respected, and, besides, a constant care in the manipulation of the sound; the too long employment of it at one time should not be permitted. In all cases in which the detection of the stone is not accomplished in a reasonable time—depending on the state of the bladder—the operation should cease, to be again resumed at some future time when the irritation produced in the mucous membrane has subsided. Neglect of this simple precaution may convert cystic irritation into acute cystitis, or even induce a fatal renal or peritoneal complication' (*Axe*).

When doubt still exists as to whether the substance felt is really a calculus, the urethra should be opened by perinæal section (to be presently described), and the organ again explored through the opening by means of a shorter sound, or by the index-finger of the left hand, the right hand in the rectum at the same time carefully pressing the bladder back towards the perinæum, so as to bring the body or bodies within reach; for it should be remembered that there may be more than one stone present.

A diagnosis of calculus having been arrived at, its extraction has to be considered, and the mode of operation decided upon. In Man the supra-pubic operation can be practised with comparative safety, but it cannot be adopted in the larger animals, not only because the pelvic flexure of the colon is interposed, but also because of the risk of peritonitis; as the peritoneal cavity would require to be opened, and this also involves the danger of bowel prolapse through the wound in the floor of the abdomen, owing to the horizontal position of the creatures. Neither can extraction nor crushing of the stone through the non-incised urethra, as in Man, be ventured upon, because of the great length of that canal in the Horse, and, in addition, its curvatures in the Ox. The recto-vesical operation has been recommended for those cases in which the easiest, and by far the most successful, method

is unsuitable ; but it is now seldom heard of, probably because of the frequent occurrence of cystitis that ensued. Nevertheless, it might be adopted in very exceptional cases.

The usual operation is removal of the calculus through an opening in the urethra immediately above the ischial arch, by which the cavity of the bladder is easily and directly accessible, and extraction of the stone nearly always effected without incising that receptacle. This is the operation which will receive most attention here.

Hitherto we have been treating of cystic calculi in the larger male animals, but it must not be inferred that they do not occur in the females ; on the contrary, they are frequently the subjects of these formations, which occasionally reach a large size in them. Owing to the shortness and comparatively great width of the urethra in these females, somewhat large stones can be removed through it from the bladder by means of forceps, without any cutting ; but patience is required to effect gradual dilatation of the canal to the necessary dimensions, by means of the lithotomy forceps, or a dilator to be presently described. When this cannot be achieved without cutting the urethra, this canal may be incised at the side or upper corner, either partially or throughout its entire length.

Lithotomy is, in the majority of cases, a comparatively simple operation, and is usually well borne by herbivorous animals, but it is not so favourable in the carnivora. In the following description the Horse is the animal chiefly dealt with.

Previous to the operation it is advantageous to allay any disturbance—systemic or cystic—which may be present, by therapeutic or dietary treatment. If there is much cystic irritation, it can be combated by washing out the bladder two or three times at intervals (by means of the double-channel vesical catheter) with a warm and very weak solution of boracic or carbolic acid, and the administration of moderate doses of potassic bicarbonate several times a day. The animal ought to be rested for a few days, and the food should be of a laxative nature, and given sparingly immediately before and after the operation. Just before that event the rectum should be well emptied, and the tail-hairs, if long, plaited and tied up.

Instruments and Appliances.—The instruments and appliances required for the operation will depend upon the circumstances of the case, and also to some extent upon the operator's skill and manipulatory aptitude. Some of the following would be deemed superfluous by one operator, and essential by another. They are : Lancet-pointed scalpel (Fig. 456) ; probe-pointed scalpel (Fig. 457) ; dissecting forceps ; grooved director ; grooved whalebone staff (Fig. 458) ; three-bladed dilator with screw action (Fig. 459) ; metallic sound for searching the bladder through the perinæal wound (Fig. 460) ; lithotomy scoop (Fig. 461) ; whalebone probe ; pair of smooth spoon-bill forceps for hard calculi (Fig. 462) ; pair of spiked spoon-bill forceps for calculi with a soft

FIG. 456.—LITHOTOMY KNIFE: SHARP POINT.

FIG. 457.—LITHOTOMY KNIFE: BLUNT POINT.

FIG. 458.—LITHOTOMY STAFF: GROOVED.

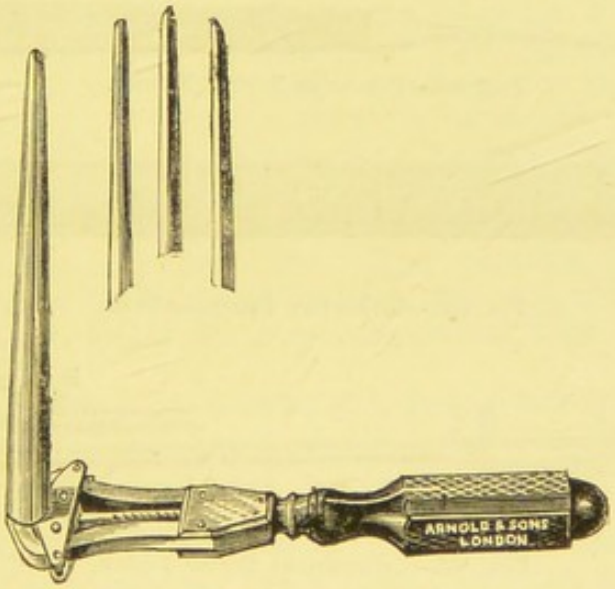


FIG. 459.—SCREW THREE-BLADED DILATOR.

FIG. 460.—LITHOTOMY PROBING SOUND.

FIG. 461.—LITHOTOMY SCOOP.

FIG. 462.—LITHOTOMY FORCEPS FOR HARD CALCULI.

friable exterior (Fig. 463); curved needle for suturing the perinæal wound (Fig. 464); lithotomy drainage-tube (Fig. 465). When the stone is too large to be easily extracted whole by the spoon-billed forceps, or when for other reasons it is deemed advisable to break

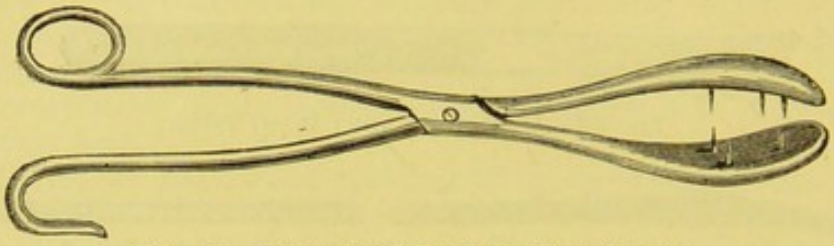


Fig. 463.—Lithotomy Forceps for Soft Calculi.

Fig. 464.—Perinæal Suture Needle.

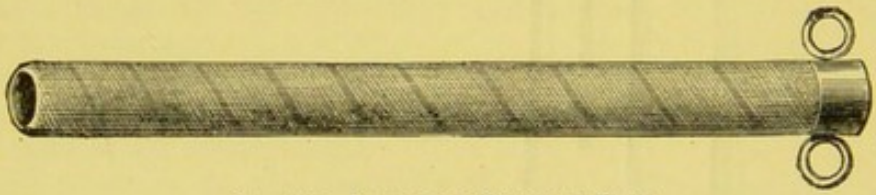


Fig. 465.—Lithotomy Drainage-Tube.

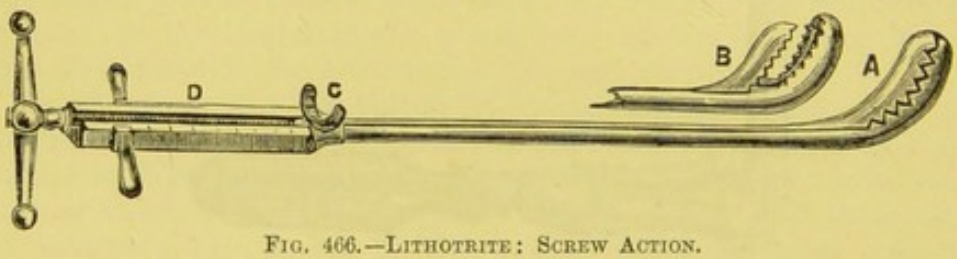


Fig. 466.—Lithotrite: Screw Action.
A, Jaws closed; B, jaws open.

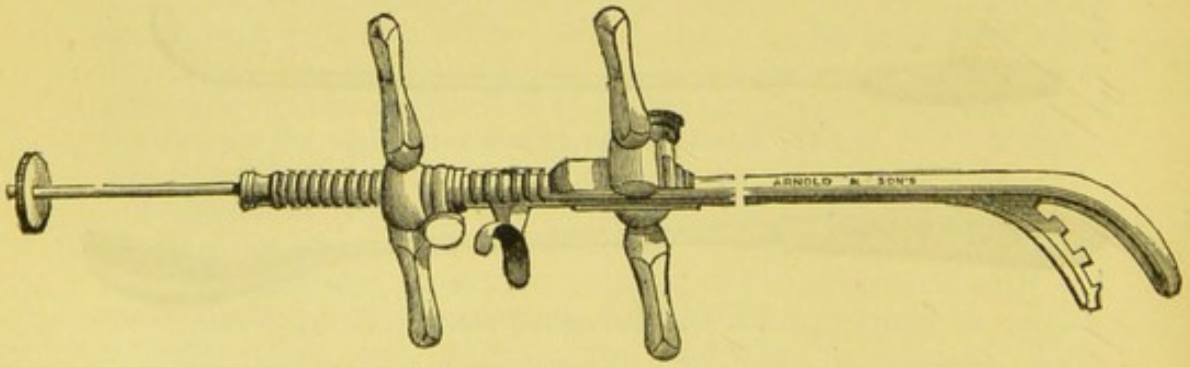


Fig. 467.—Arnold's Lithotrite.

or crush the stone, then it is necessary to employ a lithotrite. There are various patterns of this instrument, but they are all constructed on the same principle. Axe's lithotrite is very serviceable, as from its screw action and central and lateral serrations it possesses a great disintegrating power (Fig. 466); Arnold's

lithotrite (Fig. 467) is a powerful instrument, and meets every requirement. On the Continent the lithotrite of Guillon (Fig. 468) and that of Bouley (Fig. 469) are perhaps those most in favour; the first acts in a similar manner to Axe and Arnold's patterns, while the second is the spoon-bill forceps closed by a strong screw. The English patterns are in every respect preferable, because of their lightness and at least equal efficiency.

If it is decided to produce insensibility, the necessary apparatus should be at hand, as well as disinfecting materials.

Position.—In the larger animals the operation can be performed in many cases in the standing position, and it appears to be this which is usually preferred on the Continent. The same restraints are employed as in vesical catheterism; the animal to be operated upon is placed in the stocks, or the hind-limbs are secured by hopples, and a twitch is applied to the upper lip, if it be a Horse. The tail is held up by an assistant. The recumbent position is preferred by many operators, and it certainly is more advantageous, when the calculus is being sought for or extracted, than the standing position. If an anæsthetic is to be administered, which is advisable, this position must be adopted. The only drawback is the risk of injury to the bladder, if this is distended with urine when the Horse is thrown down. The operation may be carried out in the latericumbent position, but, as a rule, the dorsicumbent position will be found the most convenient after anæsthesia has been induced.

Operation.—The hind-limbs are drawn forwards, the rectum having been previously emptied, the penis and prepuce cleaned, the hind-quarters raised, and (if dorsicumbent) the body propped up and steadily maintained. The urethra must be distended, and with this object in view the penis is withdrawn from the prepuce and held by an assistant; the urethra can then be distended by injecting warm carbolised water into it by means of a syringe; or a vesical catheter, well oiled, may be passed into the bladder or a little beyond the ischial arch; or a lubricated grooved staff is introduced into the urethra and pushed carefully onward by the assistant. The operator then, placing himself behind the animal, guides the instrument round the ischial arch into the membraneous portion of the urethra, while his right hand in the rectum directs the point into the bladder. If the staff is employed, the groove in it is brought to face the perinæal raphé, and the assistant is directed to press the portion he holds towards the abdomen. The same object—the dilatation of the membraneous urethra—is effected by the water injected into it, and by the catheter, but the grooved staff renders the incision in the perinæum more practicable, and is recommended by Axe, whose directions are mainly followed; however, the catheter is often employed.

Technic.—Everything being now prepared, the skin of the perinæum is made tense with the left hand, and the right hand, armed with the lancet-pointed scalpel, incises it in the middle line, where the urethra is made prominent, the incision extending

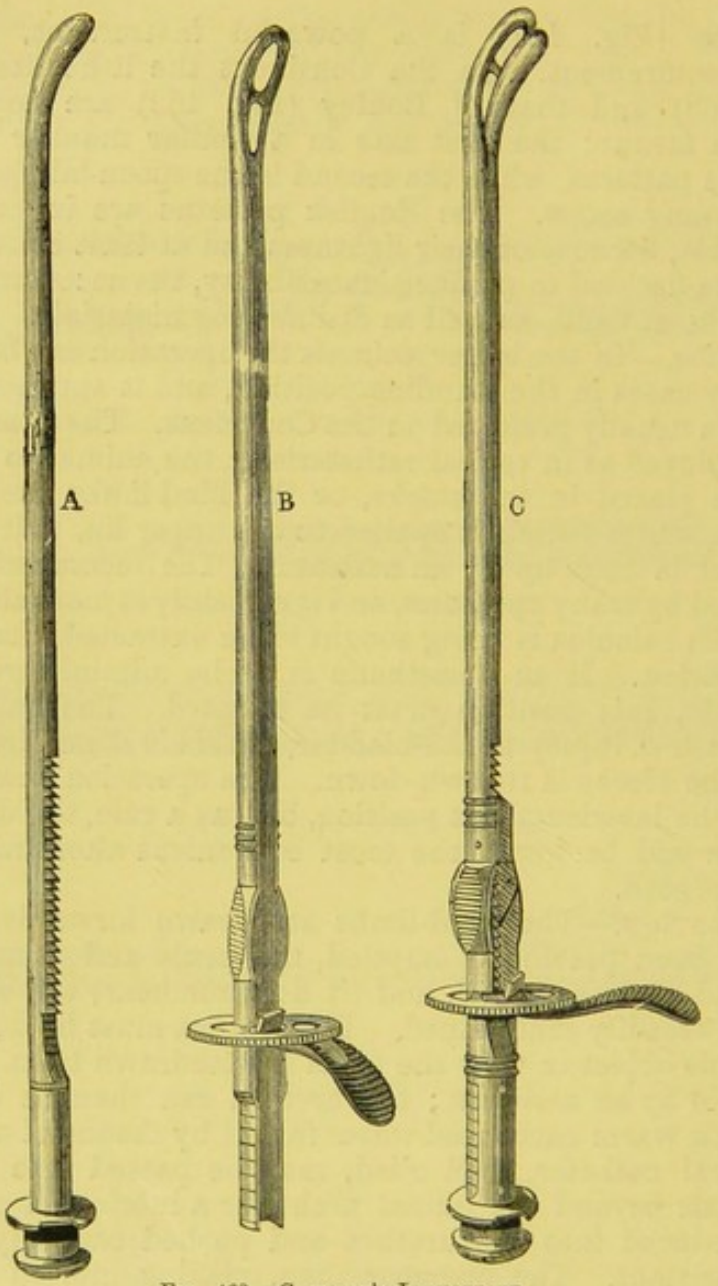


FIG. 468.—GUILLON'S LITHOTRITE.
A, Male branch; B, female branch; C, both branches put together.

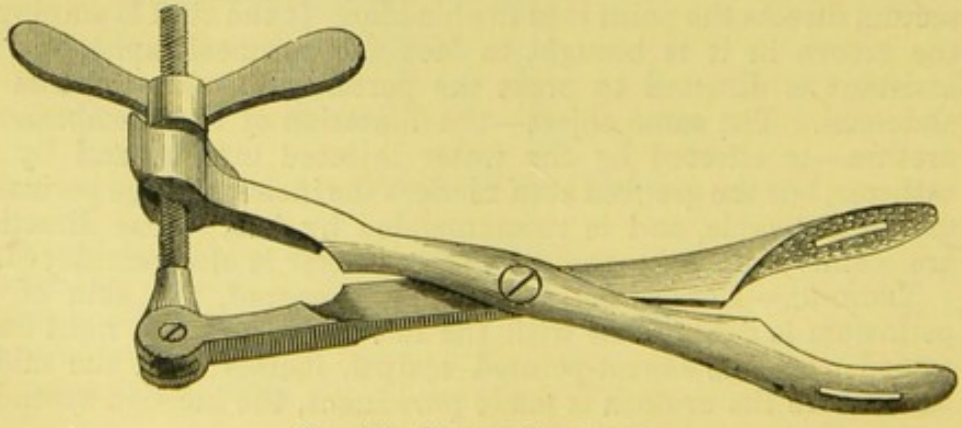


FIG. 469.—BOULEY'S LITHOTRITE.

from the ischiatic arch to within about an inch of the anus. The perinæal fascia is divided, the retractor muscle of the penis exposed and put aside or cut through in a vertical direction, the point of the scalpel pushed into the urethra, so as to pass into the groove of the staff at about the level of the ischiatic arch, and moved from right to left in order that the flanges of the groove may be distinctly felt. With the knife now well in the groove, the section is continued along this towards the anus, stopping within an inch or so of that orifice. A round-pointed whalebone probe is introduced into the groove and passed along it into the bladder, when the staff is withdrawn, and the index-finger of the right hand following the course of the probe into the same cavity, the probe in its turn is withdrawn. If a probe is not employed, it is often difficult to find the urethral opening to the bladder when the sound or catheter is withdrawn. Instead of the probe and finger, a grooved director may be passed into the bladder from the wound, and into its groove the bistoury caché or blunt-pointed scalpel can be carried forward, and the urethral incision enlarged by cutting, while withdrawing the knife; this part of the operation demands great care, so as to avoid wounding the rectum—a serious accident.

An opening sufficient in size having been made, the bladder is explored, so as to determine the size, physical characters, and relations of the calculus, as well as the condition of the interior of the bladder. Digital exploration may be attempted with the index-finger of the left hand, the right hand in the rectum pushing the bladder backwards, so as to bring as much of its interior as possible within reach of the finger, though at best only a limited portion beyond the cervix can be felt. The blunt probe and metallic sound will afford assistance at this juncture.

The membraneous urethra and neck of the bladder must be dilated to permit the passage of the calculus, the amount of dilatation depending on its volume. This is effected by the blades of the spoon-bill forceps (Fig. 462) gradually separated, or, better still, by the screw-bladed dilator (Fig. 459), the long blades of which are passed into the urethra and pushed towards the bladder, when, the handles of the instrument being gently compressed, the blades slowly diverge, and the necessary dilatation is accomplished. It is to be remembered that very abrupt dilatation is injurious, and that it must be effected gradually. If the stone is so voluminous that the urethra cannot be widened sufficiently without risk of laceration, 'a touch of the knife along the urethral surface of the prostate' is necessary; and if the prostate gland is enlarged so as to encroach on the urinary canal, Axe advises its incision before attempting to dilate the urethra, the resulting hæmorrhage being largely controlled by the pressure and stretching influence of the dilator. With skill and patience, it is surprising how widely the neck of the bladder may be dilated; it is stated that the hand has even been passed through it. Axe recommends that the patient be placed on its right side after dilatation has

been effected, the operator himself lying behind on his left side. The form and size of the forceps to be employed in removing the stone will depend upon the volume, consistence, and seat of the latter; if it lies in a depression in the bladder, the curved forceps is most convenient; but if free and readily accessible, the straight or curved forceps will suffice. When the superficial portion of the calculus is found to be loose and friable, and consequently breaks down under the pressure of the ordinary forceps, the spike-billed forceps (Fig. 463) will afford a more secure hold, the spikes penetrating the outer crust and fixing themselves in the denser portion beneath, while complete disintegration is avoided.

The forceps, warmed and oiled, and held in the left hand, is introduced into the bladder, and the right hand is passed into the rectum to steady and direct the stone, which is distinctly heard and felt coming into contact with the instrument. The blades must be opened and closed repeatedly with a grasping movement, also turned first in one direction then in another, until the calculus is seized. Should this procedure prove unsuccessful, the forceps is withdrawn, the calculus is carried backward by the hand acting through the wall of the rectum, and held firmly against the neck of the bladder while the blades of the instrument are slid carefully over it. This manœuvre is all the more necessary if the parietes of the bladder are thickened and contracted from long-continued irritation. In such cases it should be remembered that injecting a quantity of warm water into the bladder distends the viscus, and gives the forceps more freedom to move about, while rendering the stone more accessible.

In taking a firm hold of the calculus, care must be had that the mucous membrane of the bladder is not included in the forceps; this the operator can assure himself of by turning the instrument and moving it backwards and forwards. If the membrane is included in the grasp of the forceps, these movements will be hindered, when the blades should be relaxed so as to free it. As vesical calculi are nearly always ovoid in shape, it is essential that they are so seized that their long diameter corresponds with the long axis of the forceps, so that they lie lengthways in these. If they chance to be seized transversely it may be very difficult, if not impossible, to extract them, and it is therefore necessary to turn them. This can be done by drawing the stone well up to the neck of the bladder, and by means of the index-finger bringing it into the desired position, while the blades of the forceps are slightly relaxed. Then extraction can be proceeded with.

The force required to effect removal will, of course, depend upon the size of the calculus; large stones, and especially those with a very rough surface, require a considerable amount of traction and judicious manœuvring to carry them through the cervix and urethra. Before attempting removal the stone must be firmly held by bringing both hands to bear on the handles of the forceps, the blades of which should be so placed that their

flat surfaces are lateral and their edges vertical. A steady and continuous pull, gradually increasing in intensity, is now made and continued, with a slight rotatory movement and an occasional trifling alteration in the direction of traction—at one time pulling a little to the left, at another to the right, now upward, then downward, and so on. If the wound be not sufficiently large, a gentle touch with the scalpel here and there at the point of resistance will facilitate extraction, or the dilator may be employed to enlarge the aperture and the urinary passage. The injection of a little glycerine, white of egg, or thick oil, may also prove advantageous. When the calculus is loose and friable on the surface, the resistance met with in extraction may cause disintegration of its outer portion, and cause the escape of the more solid part from the forceps into the bladder, where it must again be secured. The reduction in size, and the more solid hold it affords, now make its removal all the more easy.

When removed, the stone should be examined so as to ascertain whether it is complete, or if there are others in the bladder, which is very rare. Should there be one or more remaining, the surface of that just removed shows corresponding flattened or concave facets marking the points of contact between them. Removal of these is effected in the same manner as the first.

Axe mentions that it sometimes happens that when part of the stone is encysted or encapsuled, only that portion which projects into the cavity of the bladder can be removed. Such a condition would be indicated not only by the altered form of the stone generally, but also by the broken surface on the portion removed. As to attempting to extract the remaining fragment, the justification for this will depend upon the depth of the depression or capsule. If it is shallow, the scoop (Fig. 461) will probably dislodge it; but if it is deep, curved forceps may be needed, unless there is a quantity of urine or water in the bladder, which may tend to widen the sac and permit the straight forceps or the scoop to be insinuated.

The stone having been removed, the bladder is well washed out with warm carbolised water injected into it by a small enema syringe, the passage being kept open by the dilator. Care must be taken that this cleansing is thoroughly performed, and that all fragments of stone are taken away either with the forceps or scoop.

If the interior of the bladder is healthy, the perinæal wound may be closed at once by three or four sutures, though this is rarely necessary; but if there is ulceration, granulations, or pseudo-membranes, a lithotomy-tube (Fig. 465) should be introduced into the bladder, and retained there until the irritation has been allayed by frequent injections of warm water, in which there is a small quantity of carbolic or boracic acid. All tubes introduced into the bladder should be previously well cleansed and disinfected.

The animal ought to be kept quiet for some days, with the tail tied to one side; the skin beneath the perinæum should be smeared with carbolised lard or glycerine, to prevent excoriation, and the wound

kept clean and disinfected. The diet should be light and relaxing, and an enema may be administered at frequent intervals.

Lithotrity or Lithotripsy.

In some instances the calculus is found to be too voluminous to be extracted whole, without inflicting serious injury on the parts it has to pass through ; it must then be reduced in size, by crushing it in the bladder. Lithotripsy or lithotrity, as this act is named, is merely a continuation of lithotomy ; instead of the forceps being employed to remove the stone, a special instrument —the 'lithotrite' (Figs. 466, 467, 468, 469)—has to be used. With regard to the best form of instrument to be selected, this will largely depend upon the experience of the operator; but those represented in Figs. 466, 467, will probably be found the most convenient and effective.

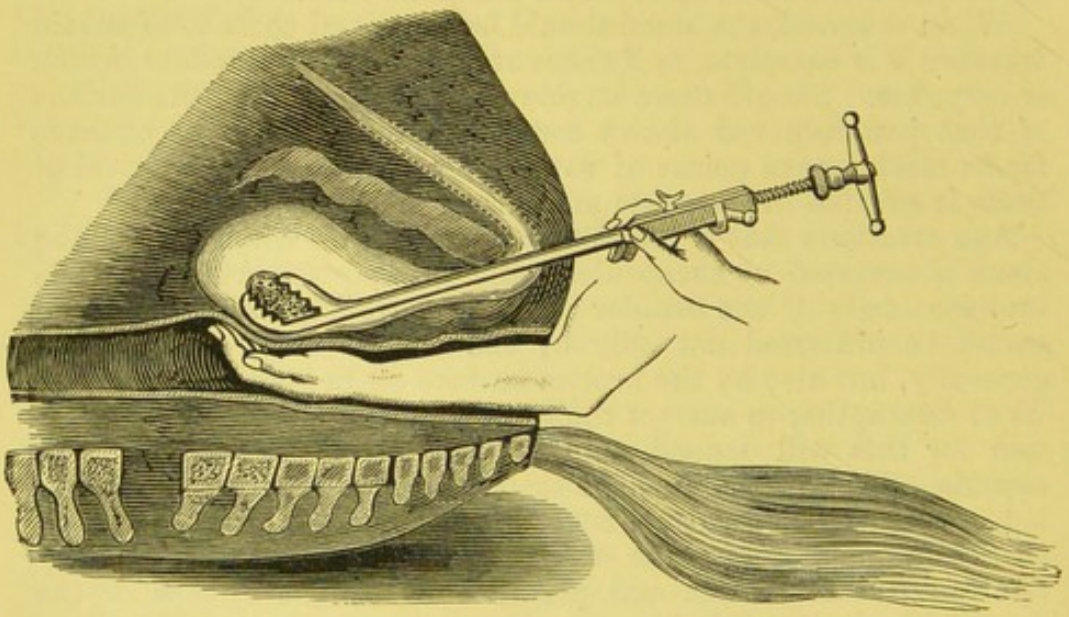


Fig. 470.—Lithotrity. Manipulating the Calculus into the Jaws of the Lithotrite. (After Axe.)

The instrument, warmed and well oiled, is introduced carefully into the bladder through the wound, and the blades are then drawn apart sufficiently to receive the stone, which has to be placed fairly between them. To accomplish this, the lithotrite should be held by one hand applied near the blades, the screw handle being held by an assistant, who steadies the instrument while the stone is placed between the serrated surfaces. With the other hand in the rectum, the operator proceeds to manipulate the stone (Fig. 470), so as to pass it between the jaws of the lithotrite, where the assistant secures it by turning the screw handle. A half-rotation and a side-to-side movement is now given to the instrument, to make sure that the mucous membrane is not included, and then the screw is turned until the stone is crushed.

When this is accomplished, the screw is reversed in movement, and the fragments released; these are removed by means of the forceps and scoop, aided by repeated injections of warm carbolised water. In some cases the operation of crushing cannot be completed at the first operation, or even at the second; in these instances a few days should intervene between the attempts. The treatment of the wound, and the after-treatment, should be the same as for lithotomy.

Recto-Vesical Lithotomy.

In very rare cases medio-perinæal section for the removal of calculus, without or with crushing, fails because of the great size of the stone, and then recourse must be had to recto-vesical lithotomy if the animal is to be relieved, though the operation is not without danger, one of the serious results being fistula of the rectum.

The animal is placed latericumbent, anæsthetised, then turned upon its back as for lithotomy. An incision is made through the lower part of the sphincter ani and termination of the rectum adjoining the crura of the penis; the prostate gland and cervix of the bladder having been exposed, the staff is introduced into the urethra as for lithotomy, and pushed on towards the bladder; when it has reached the membraneous portion, the groove in it is cut down upon in the direction of the prostate, the index-finger of the left hand is introduced into the urethra, and by means of a probe-pointed bistoury the incision is extended through the gland and the cervix of the bladder, even into the body of that viscus if necessary, so as to allow of the passage of the calculus, which is extracted by the forceps.

The borders of the wound are brought into contact by silk sutures, and a short elastic catheter may be inserted into the bladder through the surgical wound, to drain away the urine. In suturing the wound, if no drainage catheter is inserted, the urethra should be closed by two or three fine stitches, to prevent infiltration of urine into the subcutaneous tissues. The further treatment is similar to that described for medio-perinæal section.

Lithotomy in the Mare.

Vesical calculus is somewhat rare in the Mare, because of the short and wide urethra, and its straight and direct course from the bladder—conditions which favour the discharge of solid particles along with the urine.

Nevertheless, calculi are occasionally discovered in the bladder of Mares; they give rise to irritation, and their presence is indicated by several of the symptoms observed in the Horse. Their removal, however, is comparatively easy, and almost free from danger; to apply the term 'lithotomy' to the operation is scarcely correct, as incision is rarely, if ever, necessary. When the stone is of small size, it may be extracted while the animal is in the

standing position, a twitch on the lip and a sideline, or two hopples on the hind-limbs, being sufficient restraint.

The neck of the bladder is gradually dilated by means of the fingers, and the lithotomy forceps are introduced into the cavity with one hand, while the other hand in the rectum moves the calculus between the blades; careful traction is then employed in carrying it through the urethra.

When, however, the stone is so large that its extraction in this way is impracticable, the animal must be placed in a recumbent position and anæsthetised. If, after dilatation of the cervix vesicæ and urethra, the stone is still too voluminous for removal entire, then it must be crushed with the lithotrite, and the pieces removed in the manner already described. In altogether exceptional cases, it may be inadvisable to resort to crushing, and to extract the calculus whole. Then the urethra may be incised laterally or superiorly, to the necessary extent; this can be done with impunity. As a result of the manipulation, incontinence of urine sometimes occurs and persists for some time; but it gradually disappears, and all the more rapidly if cold water be injected into the bladder at frequent intervals.

Calculi in the Bladder of Bovines.

Calculi are sometimes found in the bladder of Cattle, male and female, and if they give rise to serious disturbance, they may be removed by following the procedure described for extraction of these foreign bodies in the Horse and Mare.

Calculi in Canines.

Dogs, male and female, suffer from the presence of cystic calculi more frequently than is perhaps suspected, though I can find no mention of attempts made for their removal. A similar procedure to that adopted for the Horse and Mare would probably be successful in removing them, though the difficulties, owing to the smaller size of the animal, and for other reasons, would be greater. The forceps must be small in proportion, and a canine catheter would suffice for a staff.

Tumours in the Bladder.

Tumours in the bladder are not very infrequent in the Equine and Bovine species; they are benign or malignant. The symptoms they occasion when they become large, resemble those produced by cystic calculi; the urine, in addition to being turbid, also contains blood and blood coagula or pus in the majority of cases, with deposition of lime salts after standing for a short time. An exploration *per rectum* or *vaginam* will detect their presence; the chief difference between them and calculi will be their consistency, which is soft, and their being attached to the inner coat of the bladder, and therefore more or less immovable.

In the Mare and Cow, in favourable cases, the growths might be removed through the urethra, after that canal has been dilated; the ecraseur, a wire snare, or polypus forceps, should be employed to excise them. In the Horse, the urethra must be opened and dilated as for lithotomy.

After removal of the tumours, warm emollient, anodyne, or astringent, but antiseptic fluids, should be injected into the bladder, and the case otherwise treated as after the operation of lithotomy.

Prolapse and Inversion of the Bladder—Vaginal Cystocele.

This accident, under ordinary circumstances, is only witnessed in female animals, and perhaps more frequently in the Mare than the Cow, though it is also met with in the Pig. Prolapse usually occurs during parturition, when the floor of the vagina is lacerated, and the bladder passes through the rent into that passage. In exceptional cases the muscular coat of the vagina may be alone involved, the mucous membrane remaining intact; but in the great majority of accidents of this kind both tunics are torn. In either case there is found in the vagina a *round*, *smooth*, and *light-coloured* fluctuating tumour attached to the floor of the canal by a more or less *broad* pedicle, below which the meatus urinarius can be seen or felt. The most striking pathognomonic feature of this kind of tumour is its rapid growth, in consequence of the accumulation of urine in the interior of the displaced bladder, the fundus of which is towards the vulva, and the cervix is directed forwards, the position of the viscus being the reverse of normal; the fundus, by pressing on the urethra, which is doubled on itself, prevents the urine from escaping, and in this way is produced a rapidly enlarging vaginal tumour, which in a few hours may acquire a diameter of from eight to ten inches.

In inversion the bladder is turned outside in, and protrudes into the vagina through the urethra; the accident may happen before or after parturition, and also in the non-pregnant animal. It is not an infrequent sequel of operations in the interior of the bladder. The Mare and Cow are predisposed to this form of cystocele, by reason of the urethra being so short, wide, and straight. During parturition the inverted bladder may acquire such dimensions from retention of urine as to entirely fill the vagina, and project beyond the vulva during the expulsive efforts of the animal. It has just been stated that, in prolapsus, the tumour is *smooth* and *light-coloured* (peritoneum), especially at an early stage; in inversion, on the contrary, the tumour is somewhat *hard* though elastic, more or less *red*, with a *corrugated surface* (mucous membrane) and *two small ridges or folds* a short distance apart, marking the openings of the ureters; it is also bound to the floor of the vagina by a short *narrow* pedicle. Examining the lower part of the vagina attentively, the meatus urinarius cannot be discovered anywhere; but on the red, soft,

and pulpy surface of the tumour will be observed the two small openings of the ureters, from which a fluid is continually oozing, and which may be recognised as urine by its colour; this fluid may even be ejected with considerable force should the animal strain.[1] In the course of time exposure to the air dries the surface of the tumour, which becomes dark in colour from extreme congestion or blood extravasation, and begins to slough; if the urine cannot escape because of closure of the urethra, the bladder will probably rupture if the tension on its walls is not relieved by evacuation of the urine.

Prolapsus is a much more serious accident than inversion, because of the peritoneal cavity being opened, and the probability of septic peritonitis ensuing if the wound in the vagina is not promptly closed. In inversion, on the contrary, the prognosis is generally favourable, and the organ may be repeatedly inverted and returned without suffering much damage; indeed, inversion of some weeks' duration has been successfully treated.

Operation.—The principal indication in *prolapsed* bladder is reposition of the viscus as quickly as possible, through the laceration in the floor of the vagina, after it has been carefully cleansed and disinfected. This task, however, is not always easy, as, after hernia has taken place, the bladder soon becomes distended, and the consequent increase in size hinders its return by the rent through which it previously passed into the vagina. In the majority of cases compression of its walls will not suffice to evacuate the urine, as the weight of the bladder presses upon the doubled urethra. In such a case an attempt may be made to introduce a very flexible catheter into the bladder through the urethra, and puncture of the viscus has been successful when catheterism was not tried or had failed; a fine trocar and cannula being inserted

[1] When this accident occurs during parturition, the greatest care is necessary to distinguish the prolapsed or inverted bladder from the fœtal envelopes; mistakes have frequently been made, and a fatal result has been the consequence. In one of my works ('Veterinary Obstetrics,' 2nd edition, p. 352) I have laid particular stress on the diagnosis of inverted bladder, the most frequent form of the accident, in describing the symptoms as follows: Protruding through the opening of the vulva, or immediately within the labia, will be discovered a tumour of a pyriform shape, and varying in size and colour according to the duration of the accident. Sometimes this tumour will be seen hanging from within the vagina by a kind of pedicle, for at least eight or nine inches, and will contain two or three pints of fluid. At times the protruded part will be nothing more than a thickening of the bladder, produced by strangulation and inflammation; and it will be changed from its normal colour to that of an inflamed surface, or, if it has been hernied for some time, to a darker hue. Sometimes it will become gangrenous and slough; at other times its surface appears rugged and plicated, and on occasions a large quantity of blood will have exuded from it. Should there exist any doubt as to the nature of the tumour, the meatus urinarius must be looked for; if that cannot be discovered, then the greatest circumspection should be exercised. The attachment and situation of the protrusion should be noted, and also whether it is continuous with the vagina. The nipple-shaped prominences that mark the openings of the ureters into the bladder should likewise be looked for, as their presence will at once denote the case as inversion of this viscus, as will also the escape of urine from them.

obliquely into the upper—now the lower—part of the bladder, so as to make it pass for a certain distance between the coverings before it enters the cavity. Reposition is easily effected when the urine has been withdrawn; indeed, it sometimes occurs spontaneously before the bladder is quite empty. Recurrence of the prolapse may be prevented by introducing a quantity of warm water into the bladder through the urethra, or by suturing the laceration in the floor of the vagina, which is possible if it is not far from the vulva. In all cases an endeavour should be made to close the rent, in order to prevent urine filtering through it into the peritoneal cavity and setting up peritonitis; but if this cannot be done, the urine should be carefully and frequently removed from the bladder by means of the catheter, so as to avoid the necessity for micturition, the laceration being protected by a cloth during the operation.

Inversion offers more chances of a favourable result when reduction is effected than prolapse, and especially if reposition is accomplished before the texture of the bladder has become much thickened, or its mucous membrane inflamed or bruised. The hind-quarters are raised somewhat, the hind-limbs secured, and, after carefully cleaning it, the sides of the viscus are gently pressed by the left hand and the fundus by the right hand, until it is felt receding somewhat, and if the urethra is sufficiently wide it may be pushed through it by the fingers. But if the urethra is too constricted for this digital replacement, then a stick with a round blunt point, a female catheter, or a probang, may be employed. This is placed against the fundus of the bladder, and gently but steadily pushed forwards into the urethra, and onwards until the viscus is properly adjusted in the pelvic cavity. Should there be much straining, bleeding from the jugular vein may be resorted to, or an opiate may be administered. Injecting warm water into which 2 or 3 per cent. of alum or tannin has been dissolved, is useful in relieving congestion of the mucous membrane, and preventing recurrence of the inversion. Repeated recurrence is not infrequent; but it may be checked by these injections, so as to distend the bladder, by pencilling around the meatus with nitrate of silver, dashing cold water on the vulva, and walking the animal about until the irritation has subsided.

Amputation of the Bladder.

Amputation of the bladder is resorted to when it is inverted and cannot be replaced, or its mucous membrane is so injured that it would be likely to slough if the viscus were replaced. The operation is a serious one in its results, so far as the animal is concerned; for the urine, having no receptacle in which it can be contained for a certain time, dribbles more or less continuously from the vulva, and, running down the thighs, excoriates them. In rare cases, in the course of time the vagina becomes more or less sacculated by the weight of the urine that passes into it from

the ureters, so that this fluid accumulates there, and is from time to time ejected in large quantities.

Instruments and Appliances.—These will depend upon the manner in which the bladder is to be removed. A scalpel may be necessary, but strong ligature silk or an elastic band are the chief requisites.

Position.—The operation is best performed in the standing position, the hind-limbs being secured.

Operation.—The bladder having to be removed by means of a ligature, great care is necessary in placing this, so that the openings of the ureters remain free for the escape of the urine. These canals enter the wall of the bladder obliquely, and pass back towards the cervix on each side, where their orifices are to be seen in the inverted viscus at its upper surface and about half an inch apart, when it is drawn sufficiently down. The part where the ureters enter the mucous membrane has a soft, jelly-like, protuberant appearance, in the middle of which will be observed two very small openings in the centre of a little papilla. If there is any doubt about them, it may be removed by passing a probe into them, directing it towards the body of the bladder.

Technic.—Having discovered the orifices of the ureters, the ligature is passed around the bladder some distance behind the cervix, so as to leave these canals unobstructed; the ligature is drawn tight and tied in such a manner that it may be made tighter from time to time, if the elastic ligature is not employed. Care must be taken that the ligature does not slip forward and close the ureters; if there is any likelihood of this happening, a needle may be passed through the tissues immediately in front of the ligature.

If the elastic ligature is employed, it will not be necessary to tighten it after the first tying. After applying the ligature, if the fundus is distended it may be punctured. It is generally advisable not to amputate the remainder of the bladder immediately, but to wait until solid adhesion has taken place between the peritoneal surfaces at the seat of ligation.

After-Treatment.—In a few days after the operation the bladder is gangrenous, and it gradually sloughs away; until the process is completed, the interior of the vagina and the skin about the vulva and thighs should be kept clean, and smeared with some protective ointment; if the ligature is not elastic, it must be tightened from day to day. When separation of the gangrenous from the healthy portion has taken place, the latter is drawn into the vagina, and nothing unusual is then discernible, unless it be the urine trickling from the inferior commissure. To prevent excoriation of the skin of the thighs, it should be covered with a bland resinous ointment where the urine is likely to run over it.

CHAPTER II.

OPERATIONS ON THE URETHRA.

OPERATIONS on or in the urethra are not often necessary in animals, for obvious reasons; when they are demanded, it is generally in cases of obstruction to the flow of urine occurring at some portion of the canal, and due most frequently to the presence of calculi which have escaped from the bladder, especially in the Ox, the sigmoid flexure in the penis of this animal particularly predisposing it to this accident. Malformations, stricture from accident or disease, and injuries, sometimes require surgical intervention.

OPERATION FOR URETHRAL CALCULI.

Urethral calculi never occur in the urethra of the Mare, because of its comparatively great width and shortness, as well as its straight course; they are also rare in the Horse, a circumstance likewise due to the comparatively considerable width of the urethra. When a calculus does become lodged in it, there are the usual general symptoms of retention of urine, and the obstruction of course causes distention of the bladder and the portion of the urethra between it and the stone; this distention can be felt externally in the Horse, and pressure upon the bladder, *per rectum*, does not diminish it, or only causes the urine to dribble from the extremity of the penis. In some instances the calculus can be felt in the urethra externally, and in all cases the passage of the catheter or sound indicates its presence and fixes its location. In very rare instances the stone is lodged towards the end of the urethra, posterior to the glans penis.

In the Bull and Ox, which are most frequently the subjects of urethral calculi, owing to the narrow lumen and tortuous direction of the canal, the stone is almost constantly intercepted in its course from the bladder at the outward or first flexure of the urethra, above and in front of the scrotum (Fig. 447, 18); exceptionally it lies at the second flexure (Fig. 447, 18[1]), or between it and the first.

In the Ram urethral calculi are rare, and when they do occur they are found not far from the sigmoid curve of the tube near the extremity of the penis, beyond which the urethra projects.

In the Dog these calculi are generally fixed in that portion of the urethra which lies in the furrow of the os penis, or immediately behind that bone.

The operation for removal of a calculus from the urethra of the Horse is similar to that for the extraction of a cystic calculus, the opening into the canal being made in the same manner, and immediately over the cause of obstruction. If the bladder is

much distended, and there is risk in casting the animal—as there generally is—the operation must be carried out in the standing position, the animal's hind-limbs being secured; but placing it in the stocks is a better procedure.

The incision in the urethral wall itself should be no larger than will admit of the calculus being withdrawn through it. The wound may or may not be sutured; if it is not it gradually closes, the only attention it requires being cleanliness.

When the calculus is towards the end of the urethra, it can be removed by forceps, the penis being withdrawn from the prepuce by means of a cloth passed round the glans; this is held by an assistant. If the stone is large, gradual dilatation of the urethra by the forceps will be necessary; it may even require to be crushed.

In the Bull and Ox, in consequence of the greater difficulty in reaching the calculus when it is lodged about the flexures, and especially when rupture of the bladder from over-distention is apprehended, it may be advisable to open the urethra in the ischial region to allow the urine to escape, and it may even be possible in some cases to remove the stone through this opening. But it is generally necessary to extract it through an incision made into the canal either in front or behind the scrotum.

When the animals are quiet, this may be done in the standing position, but in nearly all cases they have to be placed lateri-cumbent—usually on the left side, and the uppermost hind-limb drawn forward out of the way. The incision in front of the scrotum is preferred by some operators, as the penis is more accessible in that situation. The penis is withdrawn as much as possible from the prepuce, in order to straighten the flexures in it, and a longitudinal incision made through the skin and urethra over the calculus, which is then extracted. When the latter cannot be reached, the index-finger is passed into the cutaneous wound (this should be about three inches long) and hooked round the penis, which is to be pulled out, the urethra opened at the desired point, and the obstruction removed. It is well to make sure that the canal is then quite clear by passing a probe or sound through it. The operation behind the scrotum is somewhat similar. The incision is made four or five inches behind that part, and about three inches in length; the retractor muscle is divided by some surgeons, and the penis pulled forward; the urethra is then opened, and the stone withdrawn by forceps. The wound need not be closed by sutures, as it gradually heals spontaneously.

For the removal of calculi in the urethra of the Ram, the procedure is similar to that adopted in the case of the Bull if they are situated towards the curves. If, however, they are located near the free extremity of the urethra, this portion of the tube is usually excised, when they cannot be readily removed by forceps.

In the Dog the presence of a calculus in the urethra is indicated by the symptoms, and the indication is confirmed by the evidence

afforded on passing a metallic sound or catheter up the canal. The calculus may be lodged beyond the os penis, or in the groove of that bone.

The animal is placed latericumbent and anæsthetised. The prepuce is pushed back behind the glans and the penis protruded; a catheter is introduced into the urethra as far as the stone, and given to an assistant to hold, while an incision from half to one and a half inches long is made through the skin over the calculus, and a smaller one through the urethral wall. The stone can now be removed if it is not fixed in the penial furrow; if it is lodged there, however, and is larger than the opening into the furrow, its extraction is difficult, and it may be necessary to crush it by means of strong narrow-bladed pliers or cutting forceps, removing the pieces carefully and washing out the urethra through the wound.

Care must be taken to prevent sloughing, caused by the urine becoming infiltrated into the tissues around the wound before this has completely healed. This can be averted in many cases by keeping the wound clean and as dry as possible, and dressing it freely with borax and iodoform powder. The diet should be vegetable, to which small quantities of soda bicarbonate are to be added. To prevent constriction of the urethra during the healing process, and subsequently, a bougie or sound should be frequently passed along the urethra beyond the place where the incision was made.

CHAPTER III.

OPERATIONS ON THE PENIS.

Operations on the penis are few, and are generally limited to the removal of tumours—benignant and malignant—and amputation of the organ. The removal of tumours does not demand special notice, as the principles which apply to their extirpation elsewhere are applicable to those that form on the penis.

Amputation of the Penis.

Amputation of the penis is indicated when the organ is the seat of epithelial, papillomatous, or cancerous degenerations. It is also rendered necessary when the organ is seriously injured by wounds, or when it is fractured; when it is prolapsed by paralysis, as sometimes occurs in the Horse as a sequel of influenza or accident, or in cases of irreducible paraphymosis; when it is deeply ulcerated or gangrenous; or when there is irremediable stricture of the urethra in the free portion of the organ, or that tube is so encrusted with lime salts that the escape of urine is impeded.

The Horse and Dog are the animals most frequently operated upon, and the free portion of the penis is that which is usually

excised, as there is rarely any necessity for going beyond this; though, in order to reach the whole of the part to be removed and to get into sound tissue, it is sometimes necessary to divide the prepuce in the middle for a certain distance.

Instruments and Appliances.—Bistoury or scalpel and dissecting forceps; bull-dog forceps; metallic sound and catheter; suture needles; silk suture thread; sponges, water and antiseptics; iodoform or boric powder. If removal by the actual or thermo-cautery is determined upon, then the instruments for this purpose must be provided; or if by ligature, strong whipcord or an elastic band is required.

Position.—This may be dorsicumbent, but the latericumbent position is perhaps the most convenient, the animal being placed on the right or left side, with the uppermost hind-limb drawn upwards or forwards out of the way.

Operation.—The animal should be previously prepared for the operation by suitable diet, and by thoroughly cleaning out the cavity of the prepuce. Immediately before casting, the bladder, if full, must be emptied by means of an oiled catheter, and the tail, if long, ought to have the hair plaited and tied to one side of the body. When the animal is recumbent an anæsthetic should be administered.

These and the following observations are more especially applicable to the Horse; amputation of the penis in the Dog will be described hereafter.

Technic.—In order to prevent retraction of the penis before the operation is completed, and which is sometimes the cause of much trouble, after the organ has been withdrawn to its full extent from the prepuce, and an oiled sound or catheter is passed into the urethra for a considerable distance, it is advantageous to tie a piece of wide tape firmly around the penis beyond the part that is to be amputated; the ends of this tape are to be held by an assistant, who also keeps back the prepuce, while another assistant holds the extremity of the organ and keeps it moderately tense. The tape keeps the penis extended, and also prevents hæmorrhage. Amputation may now be effected by immediate excision by knife, ecraseur, or cautery, or by the more tedious method of rigid or elastic ligature.

Excision by the knife is carried out as follows: A circular incision is made through the skin on the dorsum and sides of the penis, behind the portion to be amputated, but not through the urethral surface; another incision is made from each end of the circular one, backwards and obliquely inwards, so that the two will converge and meet in the middle line, about two inches behind the circular cut. In the triangle thus formed the tissues covering the urethra are dissected from that tube, so as to expose it; then the urethra itself is dissected from the corpus cavernosum to a short distance—about an inch in front of the circular incision, where it is divided transversely. The corpus cavernosum is now cut through transversely at the circular skin incision,

the dorsal artery of the penis is seized and ligatured, any other bleeding vessels being also tied or twisted. The sound or catheter is removed from the urethra, and into this a director is passed, with the groove towards the lower surface of the tube; the scalpel or bistoury is carried along the groove, and the urethra is slit in the middle line to the extent of one or two inches, according to circumstances. The skin of the penis is pulled forward over the stump, and joined in the middle line by two or three sutures, and then the mucous membrane on each side of the slit portion of urethra is attached to the skin by means of a curved needle and fine silk, so as to form a wide triangular notch or space, in the middle of which is the meatus or entrance to the

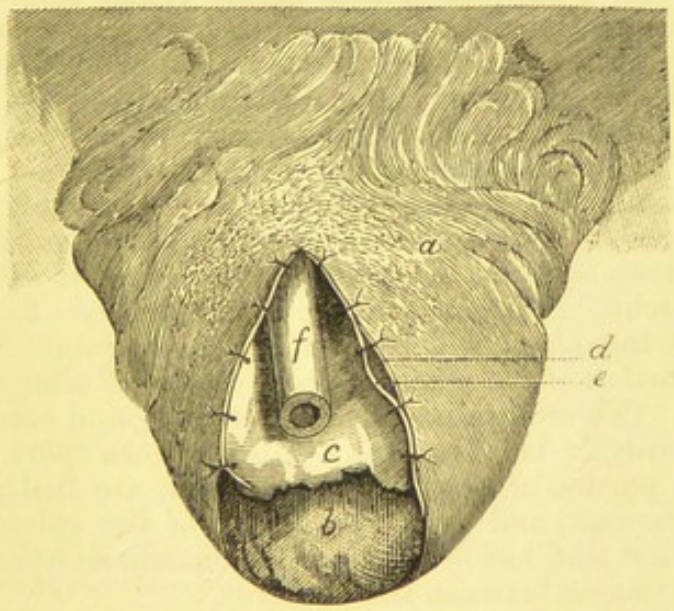


FIG. 471.—VIEW OF REMAINS OF HORSE'S PENIS AFTER AMPUTATION. (After Cadiot.)

a, Inferior aspect of penis; *b*, section of corpus cavernosum; *c*, urethral mucous membrane; *d*, *e*, margins of skin and urethral mucous membrane being brought together by suture (this part of the operation is completed on the opposite side); *f*, sound passed into the urethral canal.

urethral canal. The sutures attaching the mucous membrane on each side need not be more than three or four (Fig. 471).

The corpus cavernosum may be first excised, then the urethra dissected off, slit, and sutured to the skin; but the other procedure is generally preferred, as hæmorrhage does not interfere so much with detachment of the urethra.

Hæmorrhage is to a great extent prevented by ligation and torsion of the vessels, and also by suturing the skin of the penis over the end of the stump and the opened-up end of the urethra again over the skin; but it is well to make sure, before the animal is allowed to rise, that there is no danger of severe bleeding. Care must also be observed in suturing the mucous membrane to the adjacent integument, as it is somewhat thin and easily torn, even by slight traction.

Excision by the ecraseur is sometimes resorted to in order to render amputation bloodless, though this is not always the case with this instrument unless a strong chain is employed, the toughness and density of the white fibrous tissue entering into the composition of the penis not infrequently proving too resisting for a defective chain. The operative procedure is the same as in excision by the knife, so far as detachment and division of the urethra are concerned; the chain of the ecraseur is then placed around the penis, behind the portion to be amputated, and the screw is turned slowly and steadily until the chain has cut completely through the corpus cavernosum. To avoid accident, however, it has been found more satisfactory to tighten the chain until the resistance offered by the white fibrous tissue is great, when a ligature is tied tightly round this tissue; the chain of the ecraseur is removed, and the almost detached penis is cut off by the knife. The isolated portion of the urethra is then slit for a short distance and the sides sutured to the end of the stump in the manner already described, in order to prevent stricture of the canal at this point.

Amputation by the cautery has also been practised in order to avert hæmorrhage, though this object is not often attained, as the dorsal vessels of the penis are so large that it is difficult to form an eschar sufficiently thick and adhesive to resist the pressure of the blood when the temporary ligature around the proximal portion of the penis has been taken off after amputation is effected. The urethra is exposed, detached, and cut through as already described; two ligatures a short distance apart, and placed behind the portion of penis to be removed, are tied around the corpora cavernosa, and the red-hot wire of the galvano-cautery, or a somewhat thin but broad steel blade made as hot as possible, divides the tissues between the ligatures.

Amputation by ligature is more protracted and painful than either of the above methods, and has little to recommend it save the avoidance of primary and secondary hæmorrhage. The ligature may either be strong silk, whipcord, or elastic material. The latter is to be preferred, as it renders unnecessary the frequent tightenings which have to be made when the inelastic ligature is employed. The urethra is isolated by the horizontal V-shaped incision through the skin covering it, the two lines meeting posteriorly; the tube is dissected from the corpus cavernosum, cut through a little in advance of the line of incision, and detached a short distance behind that point (Fig. 472, *c*), so as to be quite clear of the ligature, which is then tied firmly around the body of the penis (Fig. 472, *b*). A short cannula is fastened in the urethra by a wide piece of tape; this should be worn for some days until the healing process is complete in the tube, and there is no longer danger of constriction by cicatricial contraction. After some days, when the tissues are nearly cut through by the ligature, removal of the penis may be effected by the knife at the distal side of the constriction without much risk of hæmorrhage, so as to expedite

the operation. Consecutive hæmorrhage in either of the e methods of operation can generally be promptly checked by throwing cold water against the prepuce.

The disadvantage of all these methods of operating except the first, is that the urethra cannot be slit, and the sides sutured to the end of the stump, so as to keep the canal open and not likely to become narrowed.

Whichever the method of operation resorted to, it is advisable to insert a good-sized cannula in the urethra on the completion of the operation, and to keep it there for a few days until the wound has healed.

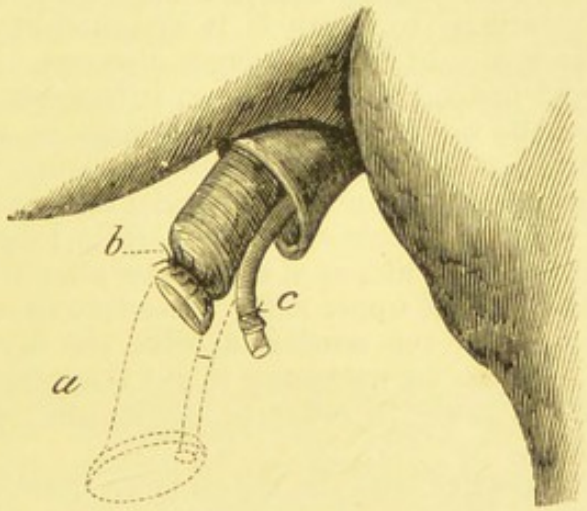


FIG. 472.—AMPUTATION OF THE HORSE'S PENIS BY ELASTIC LIGATURE. (After Berdez.)

a, Portion of penis to be removed; *b*, elastic ligature applied beyond this part; *c*, urethra detached from the portion to be removed (at the transverse line in the dotted section), and a short cannula fixed in it.

AFTER-TREATMENT.—The animal should be placed in a stall and kept tied up for some days; the diet must be limited, easy of digestion, and not very nitrogenous. If indications of severe pain are exhibited, anodynes—as opium or chloral—may be administered; in some cases in which depression is shown, it may be necessary to give stimulants. If the bladder is not spontaneously evacuated within a few hours after the operation, gentle pressure applied to that viscus through the rectum will effect the expulsion of the urine. When amputation has been made by immediate incision, the wound should be examined in a day or two afterwards, the hand, well oiled, being introduced into the prepuce with great care, in order to avoid bleeding; the remains of the penis will be found at the far end of the preputial sheath as a rounded protuberance, the sutures and notch—if amputation has been effected by the knife—being felt at the face of the swollen mass. The stitches should not be removed until they are felt cutting through the tissues, when they can be divided by blunt-pointed scissors; the ligatures on the arteries should be allowed to slough off. Great cleanliness must be observed,

especially when suppuration sets in, the interior of the prepuce being frequently irrigated with a weak solution of chinosol or carbolic acid; but no attempt should be made to withdraw the penis, lest damage be done to the cicatrising stump, and the sutures and ligatures in it disturbed. If there is much swelling, warm water fomentations should be applied to the prepuce, and gentle exercise allowed. If erections of the stump are rather frequent, and there is a likelihood of the sutures being torn away thereby, the application of cold water douches will subdue them.

In the Dog the penis may be amputated at any part, but excision is usually effected behind the os penis by means of the knife, the bloodvessels being tied, and the urethra left a little longer than the stump, to which it is attached by sutures, as in the Horse, after being slit up for a short distance. The ecraseur may be employed instead of the knife, so as to avert hæmorrhage; but in this case the urethra will be dealt with by the knife, and must not be included in the chain of the ecraseur. If excision is to be made through the bone of the penis, the urethra must be first dissected from the groove in which it is lodged; then the bone is sawn through by means of a fine saw after the soft tissues have been divided on the upper side; these tissues are afterwards drawn over the end of the bone and, with the divided urethra, sutured there. It may be necessary to slit the prepuce in amputation of the Dog's penis, in order to render the operation more easy and effectual.

When it is imperative that the entire penis must be excised, as sometimes happens, this may take place at the ischial arch. To facilitate the operation, it is advisable first to remove the testicles; then the prepuce is cut through on the under surface by scissors, commencing at its opening and extending backwards to the perinæum; the penis is dissected from its attachments, a catheter is passed into the urethra for its entire length; that canal is opened immediately beneath the anus, and its mucous membrane is pulled out and secured to the skin on each side by sutures. The catheter is withdrawn, and the penis is cut off by the chain of the ecraseur. A triangular piece of skin is excised on each side of the middle line, including in the base of the triangle the skin and mucous membrane of the prepuce, the apex of the triangle extending to the under surface of the pubis. The margins of the wound are now brought together by sutures. If this skin is not removed, a pendulous fold will remain after the operation, and the lining membrane of the prepuce continuing to secrete will make the parts foul and unhealthy. The same precautions must be observed in the after-treatment of the wound as have been recommended for the Horse.

Phimosis.

Phimosis is a condition due to constriction of the prepuce towards its orifice, and consequent inability to protrude the penis; micturition may also be difficult from the obstruction at the end of

the urethra. The constriction is rarely congenital, and is usually caused by injury or inflammation of the prepuce, induced by disease or the introduction of irritating substances into its cavity.

It is observed in the males of all the domestic animals, but is most frequent and serious in some, because of their anatomical or physiological peculiarities. In the Ox, Sheep, and Dog, for instance, the natural narrowness of the prepuce renders it more easily obstructed by tumefaction than that of the Horse, which is wide and extensible.

Phimosis rarely requires operation except in some infrequent cases, when scarification or slight incision of the orifice of the prepuce by knife or scissors, and the passage of a probe between it and the penis to break down any adhesions that may have formed during acute inflammation, will prove effective. Cleanliness, warm fomentations, and the application of astringent and anodyne remedies, supplement this treatment.

If incision of the prepuce is necessary, this can be made to the necessary depth at its margin on one or both sides, or inferiorly; the wound may be kept open, if desired, by inserting a pledget of tow in it.

Paraphimosis.

This is the opposite condition to phimosis, more or less of the penis being outside the prepuce and cannot be drawn into it, owing either to tumefaction of the latter or to disease or injury of the organ itself. For the reasons already stated, and especially because of the prolonged period of copulation, the Dog is most liable to this condition; the Ox, Sheep, and Pig are rarely affected, owing to the penis having a very rudimentary glans; while the Horse, though it has the glans largely developed, is not much exposed to the accident because of the width and extensibility of the prepuce, though this animal, next to the Dog, most frequently requires operative treatment. In the Horse it sometimes occurs as a sequel of castration, when the inflammation following some modes of operating extends to the prepuce. Injury during copulation, or by whips or sticks, or morbid growths on the penis, are often the cause of paraphimosis; paralysis of the penis has also been mentioned as a factor in its production, or even as constituting the condition itself.

In the Horse the treatment varies with the causes and the parts involved. If in the prepuce is located the obstacle to retraction, an examination will reveal the cause and afford an indication for its removal; if the penis itself is incapable of being retracted because of injury or disease, appropriate treatment must be adopted. Scarifications of the prepuce or penis may be required. In chronic cases of preputial tumefaction, massage has been recommended, preceded by the inunction of emollients; when the penis has been swollen for a considerable time and there is little pain, a bandage of some elastic material may be wound around the glans, allowed to remain for a short time,

then removed, and attempts made to return the penis into the prepuce; this may have to be repeated. To prevent recurrent prolapsus, one or two sutures may require to be passed through the orifice of the prepuce after the penis has been returned. In some cases reduction is impossible, or is not likely to be permanent, and then amputation is imperative.

In the Dog the condition is generally more troublesome and the case more serious, owing to the presence of the penial bone. Fomentations to cleanse the parts, astringent lotions, and a suspensory bandage, may be tried in recent cases; or, after cleansing the penis and prepuce, the animal may be placed dorsi-cumbent, the parts smeared with olive-oil, and attempts made to pull the prepuce over the swollen penis. Should this not succeed, then a small slit may be made in the margin of the prepuce to permit of reposition of the organ. It sometimes happens, however, that the penis is so much damaged through ulceration or gangrene of the soft parts, and necrosis of the bone, that amputation has to be resorted to.

OPERATIONS ON THE GENERATIVE APPARATUS.

Operations on the generative organs of the domestic animals are perhaps the most frequent of any practised by the veterinary surgeon. This frequency is chiefly due to the universal custom of castration to which many of the males, and also sometimes the females, are submitted, with the object of making them more tractable, and therefore more serviceable to man; or rendering their flesh and other products more abundant in quantity and superior in quality; as well as with the view of inducing precocity, and modifying disposition and external form.

Operations on the generative organs are also, of course, demanded for the removal or correction of abnormal conditions, for the cure of disease, and for the repair of injuries occurring to these organs; but these operations are far less frequently needed than is the case with the human male or female.

We shall first deal with the operations practised on the female organs of generation in the different species of animals, and afterwards discuss those to which the male sexual organs are submitted.

OPERATIONS ON THE FEMALE GENERATIVE ORGANS.

The female sexual organs on which operations are performed are the ovaries, uterus, vagina, clitoris, and the mammæ and teats. But before describing these operations we will glance at the anatomy of this apparatus, so as to understand more satisfactorily the obstacles to be surmounted, and the difficulties that may arise in carrying them out. The apparatus commences at the vulva and terminates internally at the ovaries. The mammæ and their appendages are situated externally, and are not immediately connected with the other organs—at least, anatomically.

Surgical Anatomy—Vulva.—This is the external opening of the genito-urinary canal (*rima pudendi*), and when its muscles are not in a state of contraction it is a mere vertical slit, bordered on each side by a lip, and above and below by a commissure.

In the Mare the labia are thick, and are covered by fine, smooth, pigmented skin which is rendered soft by sebaceous matter; internally they are lined by mucous membrane, which is lubricated by viscid, odoriferous mucus, and is

continuous with that of the vestibulum vaginæ. The superior or dorsal commissure is acute, and is separated from the anus by the perinæum ; the inferior or ventral commissure is rounded in shape, much thicker, and more prominent. The labia contain a constrictor muscle. At the inferior part of the vulvar cavity, near the commissure, is the clitoris, a small erectile body analogous to the male corpus cavernosum, and about two to three inches in length ; it arises from the ischial arch by two roots or crura, has a rudimentary erector muscle, and, after being attached to the symphysis pubis by means of a suspensory ligament, it passes backwards and projects upwards into the vulva by its free extremity, which is enveloped in a cap of mucous membrane, the prepuce of the clitoris.

In the Cow the labia are thicker and more prominent ; the ventral commissure is acute, and has a tuft of long hairs ; the clitoris is long, thin, and flexuous ; and the glans is much smaller.

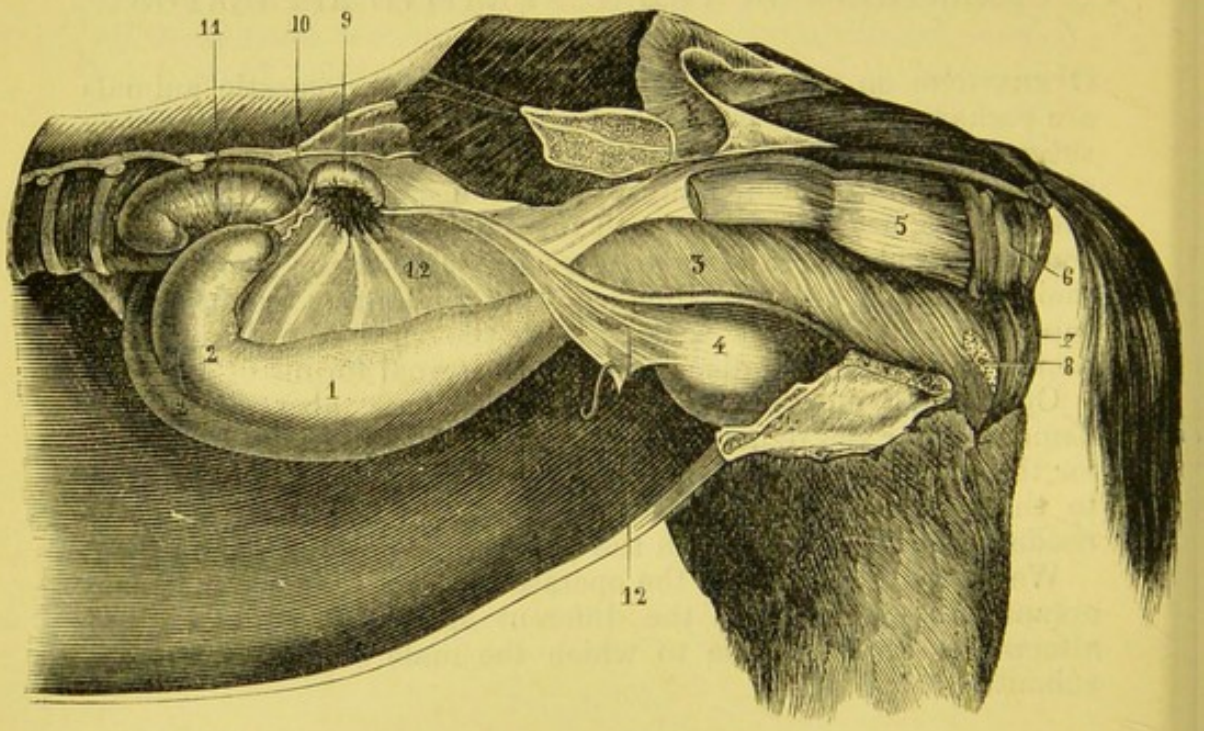


Fig. 473.—Generative Organs of the Mare, *in situ*. (After St. Cyr.)

1, Body of uterus ; 2, 2, cornua of uterus ; 3, vagina ; 4, bladder ; 5, rectum ; 6, sphincter ani ; 7, constrictor muscle of the vulva ; 8, bulb of the vagina ; 9, ovary and fimbriated extremity of oviduct ; 10, oviduct ; 11, kidney ; 12, 12, broad ligament.

In the Sheep and Goat the labia have several external folds, and the ventral commissure terminates in a point.

In the Sow the ventral commissure is more acute than in Ruminants.

In the Bitch the vulva is triangular in shape and acute at its ventral commissure.

The Cat has a small bone in the clitoris.

In animals which have not been bred from, the vulva is narrow and the labia are firm and regular in shape ; but in those which have had young the opening is larger, and the labia are also enlarged, flaccid, and more or less wrinkled.

Vestibulum Vaginæ.—The vulva is succeeded by the *vestibulum vaginæ*, on the floor of which, and about four to six inches from the inferior commissure, is the opening of the urethra, guarded by a valve so disposed as to prevent the urine flowing into the vagina ; here the vestibule is partially separated from the vagina by the hymen, or *valvula vaginæ*, a membraneous fold of mucous membrane most distinct in young animals, beneath or through which is the opening leading from the vestibule to the vagina, and which is small in creatures that

have not had connection with the male, or have not given birth. The vestibule has at each side a mass of erectile tissue that terminates in a rounded lobe; these masses arise from the ischial arch, are covered by a constrictor muscle, and their cells are greatly distended with blood during copulation.

In the Cow are two racemose glands—the glands of Duvernoy or Bartholin—one on each side of the vestibule, near the labia; they are placed vertically, are about the size of a large almond, and the lower end of each terminates, near the *ischio-clitoridis* muscle, in a long duct that unites with its fellow to form a kind of sinus, which opens into the vestibule, about four inches from the vulva. The peculiarity of the urethral valve of this animal has been already described (p. 449).

THE VAGINA (Fig. 473, 3).—The vagina succeeds the vestibule at the situation of the valvula vaginæ or hymen, and is a cylindrical, musculo-membraneous canal, leading from that cavity to the uterus; it is placed almost horizontally in the pelvic cavity, with the rectum above, the bladder and urethra below, and the walls of the pelvis and ureters on each side.

In the MARE the wall of the vagina is somewhat thin, supple, and very extensible, and is composed throughout its length of the internal mucous and the external muscular membrane, with, at its anterior portion, a covering of peritoneum. The mucous membrane adheres very closely to the muscular layer, and shows on its internal surface a number of deep longitudinal folds, between which are smaller transverse ones; these folds are all the more numerous as dilatation of the vagina has been frequent by repeated parturitions. At the anterior part

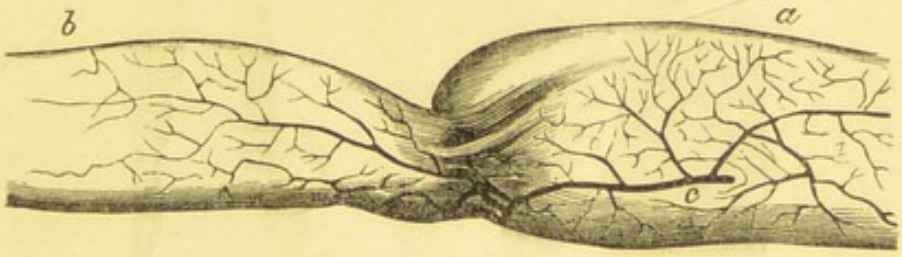


FIG. 474.—ARRANGEMENT OF ARTERIES ON THE ANTERIOR PORTION OF THE VAGINA, AND CERVIX AND POSTERIOR DIVISION OF THE BODY OF THE UTERUS. THE UPPER SURFACE OF THE VAGINA HAS BEEN TURNED OVER SLIGHTLY TO THE LEFT. (After Cadiot.)

a, Vagina; *b*, uterus; *c*, vaginal artery.

of the canal, and projecting into it, is the cervix of the uterus, a cylindro-conical prominence, surrounded by a deep depression, where the mucous membrane forms the *fornix vaginæ;* this depression, or vaginal *cul-de-sac*, is well marked when the vaginal wall is tense, but it is nearly effaced when this is relaxed. The surface of the membrane is copiously supplied with mucus. The muscular membrane is composed of unstriped fibres, which are traversed by numerous small bloodvessels; for about five or six inches posteriorly it is loosely attached to the rectum above and to the pelvis below, and at the sides by means of a quantity of wide-meshed connective tissue, a circumstance which renders the walls of the vagina comparatively easily perforated, and consequently exposes the animal so injured to peritonitis, pelvic cellulitis, protrusion of the intestine into the genital canal, or to a complication of these conditions. Its anterior portion is covered by peritoneum, which is reflected from it on to the rectum in such a manner as to leave a space—the recto-vaginal *cul-de-sac* or pouch; below this membrane is reflected in a similar way on the bladder to form the vesico-vaginal *cul-de-sac*, and it is also reflected from it on the sides of the pelvis. Anteriorly the peritoneum is closely attached to the muscular coat.

The vagina is supplied with blood by the vaginal artery (Fig. 474) and other branches of the internal pudic; these are most numerous on the sides of the canal.

In the Cow the vagina does not differ from that of the Mare, except that it is longer, its muscular membrane is thicker, and on each side of the meatus urinarius is a duct, Gaertner's canal; the peritoneum also covers more of the

vagina, and in consequence of this the *recto*-vaginal pouch extends farther back than it does in the Mare.

In the Sow there is no distinct vaginal valve; the mucous membrane has numerous longitudinal folds anteriorly, as well as a multitude of fine points, which are the openings of excretory ducts of glands analogous to the prostate.

In the Bitch there is nothing noteworthy in the vagina from a surgical point of view.

Uterus (Figs. 473, 1, 2; 475, *a*).—The uterus of the Mare is a membraneous sac situated in the sublumbar region of the abdominal cavity, at the entrance to the pelvic cavity, which contains its posterior portion. It is formed of two portions—the body and cornua. The first is a simple cylindrical sac, slightly flattened above, and continuous with the vagina by means of its cervix, which protrudes into that canal; above it is the rectum, beneath it the bladder and

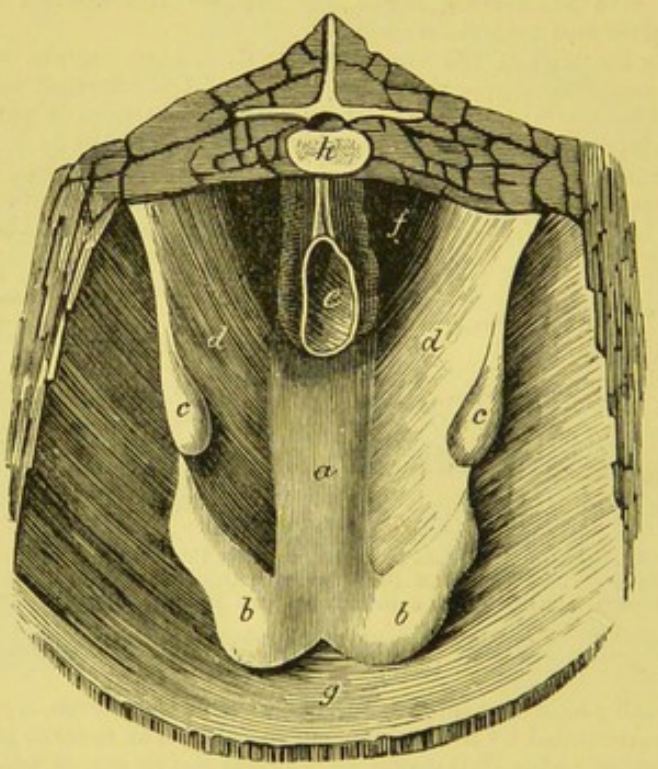


Fig. 475.—Transverse Section of the Body of the Mare, in Front of the First Lumbar Vertebra, showing the Upper Surface of the Uterus, and the Attachment of the Ovaries on the Broad Ligament. (After Cadiot.)

a, Body of the uterus; *b*, *b*, cornua; *c*, *c*, ovaries; *d*, *d*, broad ligaments; *e*, section of rectum; *f*, pelvis; *g*, abdominal wall; *h*, first lumbar vertebra.

pelvic flexure of the colon, and on each side are the pelvic walls and the intestines.

The cornua (Fig. 475, *b*) are really a division of the anterior part of the body into two lateral elongated portions, cylindro-conical in shape, which proceed forward and upward among the intestines, and which terminate in a *cul-de-sac*, in the centre of which, internally, is a small prominence, with an opening in the middle, the commencement of the oviduct or Fallopian tube.

The uterus is composed of three membranes: a mucous internally, middle muscular, and external serous—the peritoneum. The mucous membrane is very thick, and possesses numerous glands; it is continuous with that of the vagina, and lines the cornua and oviducts. The muscular is firmly attached to the mucous membrane, and has its fibres passing in two directions, longitudinal and circular, the latter being most numerous and dense around the cervix. The peritoneum envelops the whole of the uterus, adhering closely to the muscular mem-

brane until it passes over the anterior part of the vagina. It also constitutes the broad ligaments, which are a fold of this membrane proceeding from each side of the lumbar vertebræ, passing downward in a wide band, measuring from four to six inches at its anterior border, and about six to eight inches from each other; they are inserted into the upper surface of the cornua and the sides of the body of the uterus, being continuous with the peritoneum covering that organ. Between the cornua this membrane forms a particular fold or frænum, which is only slightly developed in Solipeds. The broad ligaments suspend the uterus from the sublumbar region, while it is fixed posteriorly by its continuity with the vagina. Blood is brought to the uterus by the uterine and utero-ovarian arteries, and is conveyed from it by corresponding veins, which are very large. Indeed, in animals which have produced young the bloodvessels of the uterus are remarkable for their great volume and tortuousness, and for the close adherence of the veins to the textures around them. The arteries freely anastomose

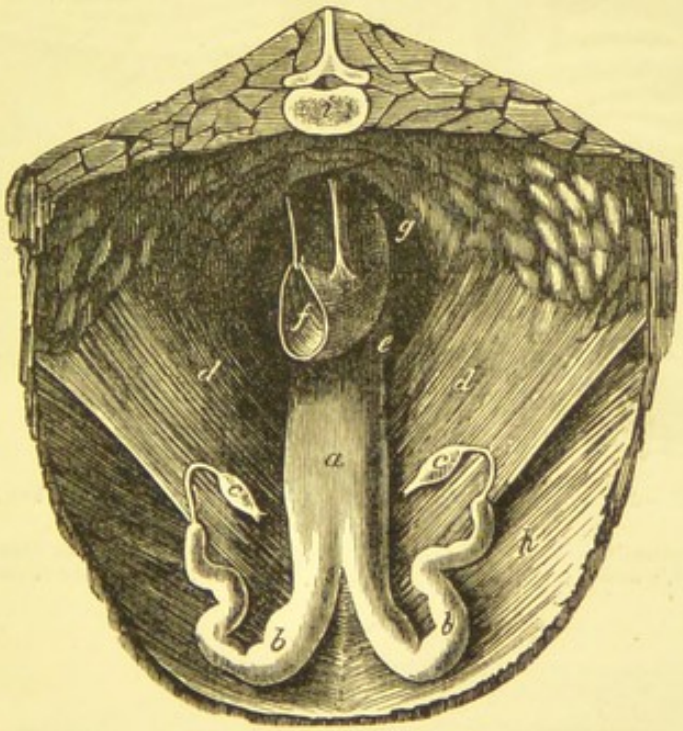


FIG. 476.—TRANSVERSE SECTION OF THE BODY OF THE COW, IMMEDIATELY IN FRONT OF THE LAST LUMBAR VERTEBRA, SHOWING THE UPPER SURFACE OF THE UTERUS, AND THE ATTACHMENT OF THE OVARIES TO THE BROAD LIGAMENT. (After Cadiot.)

a, Body of the uterus; *b*, *b*, cornua; *c*, *c*, ovaries; *d*, *d*, broad ligaments; *e*, vagina; *f*, section of the rectum; *g*, pelvis; *h*, abdominal wall; *i*, last lumbar vertebra.

and ramify through the muscular and mucous membranes, forming fine and coarse networks that finally terminate in the veins; these latter, destitute of valves, in addition to their considerable size, form large and numerous plexuses.

During pregnancy the relation of the uterus to adjacent organs is much altered, and, besides its increasingly exaggerated volume as the gravid state advances, its muscular and mucous membranes become highly developed, as well as exceedingly vascular.

The uterus of the Cow (Fig. 476) is not so advanced in the abdominal cavity as that of the Mare, neither is it so long or large, while the cornua are thin and tapering at their extremity. Instead of curving up towards the lumbar region, as in the Mare, it bends down in the direction of the floor of the abdomen. The broad ligaments (Fig. 476, *d*, *d*) are also larger than those of the Mare, and at their origin in the sublumbar region their free margin, which passes obliquely downward and backward, measures about a foot. A notable peculiarity is observed in their insertion into the uterus and cornua; instead of being fixed in the sides

of these, in the Cow they are attached to their under surface ; so that the uterus and cornua lie on the broad ligaments, which in this way are like a triangular web, one angle of which is under the uterus, and the other two angles are attached to the tuberosities of the ilium. This arrangement explains the slight torsion outwards and upwards of the cornua.

In the SHEEP and GOAT the uterus does not differ to any important extent from that of the Cow.

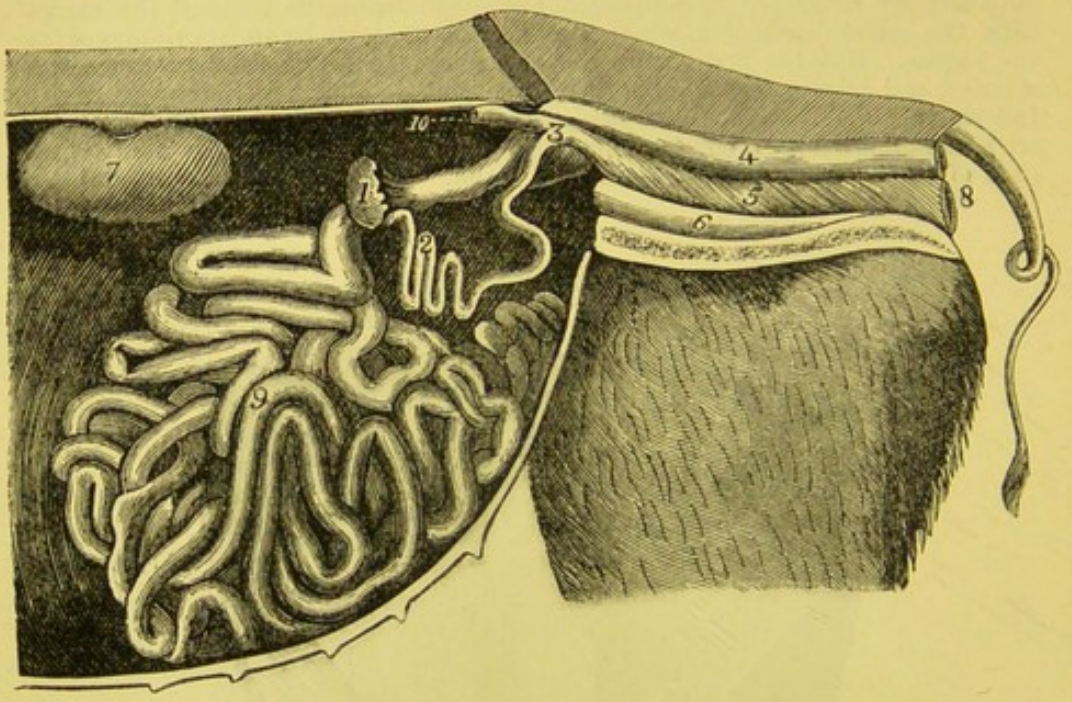


FIG. 477.—ANTERO-POSTERIOR SECTION OF THE BODY OF A VERY YOUNG SOW. (After Peuch and Toussaint.)

1, Ovary; 2, flexuosities of one of the uterine cornua ; 3, body of the uterus ; 4, rectum 5, vagina ; 6, bladder ; 7, kidney ; 8, vulva ; 9, intestine ; 10, remains of one of the divide cornua.

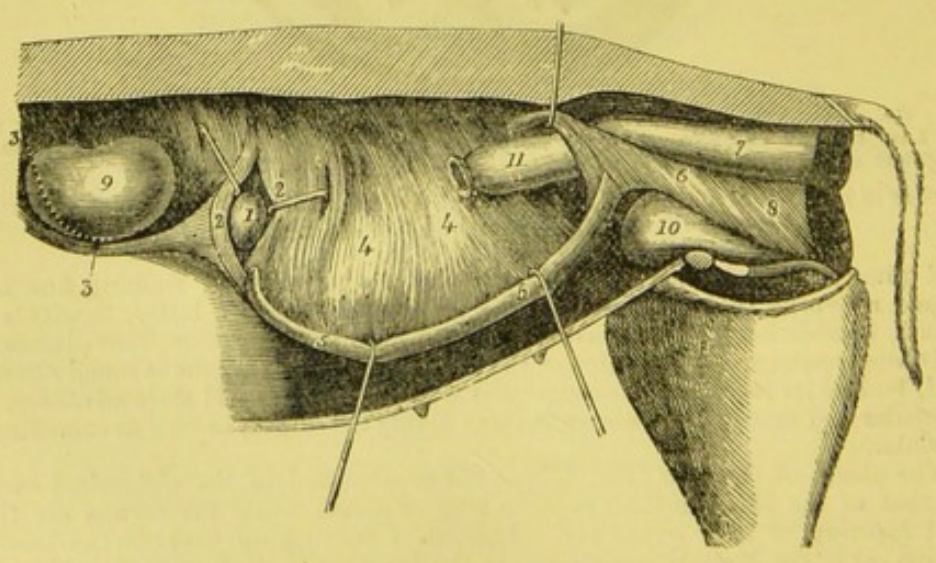


FIG. 478.—GENERATIVE ORGANS OF THE BITCH. (After Peuch and Toussaint.)

1, Ovary ; 2, 2, double of the broad ligament, which is opened to show the ovary lodged in the kind of capsule formed by the fold ; 3, internal fold or layer of the broad ligament, which is inserted into the sublumbar region ; 4, 4, broad ligaments ; 5, 5, uterine cornu ; 6, body of the uterus ; 7, rectum ; 8, vagina ; 9, kidney ; 10, bladder ; 11, descending colon.

In the Sow the body of the uterus (Fig. 477) is short, but its cornua are very long and flexuous, and float among the intestines; its cervix does not project into the vagina, and the cavity of the latter and that of the uterus are continued into each other without any marked limit between them.

In the Bitch (Fig. 478) and Cat the uterus is disposed as in the Sow; but it is necessary to note the arrangement of the broad ligaments in the former animal. They are very long and contain fat, like the omentum; they extend as far forward as the hypochondrial region, where they form two layers, the external of which is attached within the last rib, and the internal is fixed in the sub-

Fig. 479.—Attachment of the Ovary to the Broad Ligament in the Mare. (After Cadiot.)

a, Ovary; *b*, its hilus; *c*, oviduct; *d*, uterine cornu; *e*, ligament of the ovary; *f*, broad ligament.

lumbar region, behind the diaphragm. They diminish in size as they pass forward, so that the anterior border of the external layer, which carries the ovary, is shorter than the middle portion of the ligament; this more firmly fixes the extremity of the cornu towards the hypochondrium. It results from this arrangement that, in removing the ovaries by operation, both cannot be extracted through the same opening if this is made in the flank, so that in order to take away the two ovaries an incision must be made in each flank, if that situation is preferred.

When operating on the uterus of pregnant animals, it is well to remember the

different kinds of placentation ; in the Mare and Sow it is diffused ; in the Cow, Ewe, and Goat it is localised in the form of tufts (cotyledons) ; and in the Bitch and Cat it is zonular.

Ovaries (Figs. 473, 9 ; 475, *c*, *c* ; 479, *a*).—The ovaries of the Mare are situated in the abdominal cavity, some distance from the pelvic cavity, and about three to four inches from the sublumbar surface, where they are suspended, one on each side, a little behind the kidneys, by the vessels passing to and from them, and by a small cord of non-striped muscular fibres—the ligament of the ovary—that attaches each ovary to the uterus ; they are supported by the anterior border of the broad ligaments of the uterus (Fig. 479), where they hang enveloped in a triangular fold or sac of peritoneum, which again forms ligaments

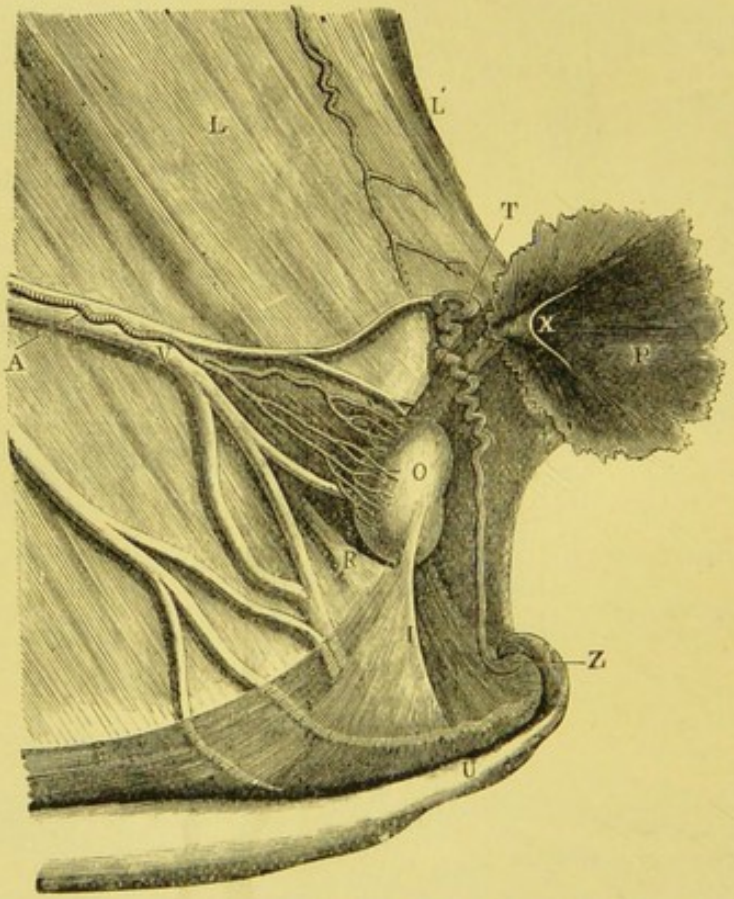


Fig. 480.—Ovary of the Cow. (After Gourdon.)

U, Cornu of uterus ; L, broad ligament ; L', anterior border of broad ligament ; O, ovary ; R, peritoneal fold enclosing ovary ; S, superior border of that fold forming the superior ovarian ligament ; I, inferior ovarian ligament ; A, ovarian artery ; V, ovarian veins ; T, Fallopian tube or oviduct ; P, pavilion of that tube ; X, upper orifice of the tube ; Z, inferior portion of the tube.

for them. They are ovoid in shape, though slightly flattened on the sides, and vary in size from that of a hazel-nut to that of a pigeon's egg ; sometimes they are quite level on the surface, at other times this is very irregular, owing to the projection of large ovisacs. About the middle of their lower border they show a more or less oblique fissure or hilus, which gives attachment to the pavilion of the oviduct and serves as a useful guide to the operator (Fig. 479). The ovary is supplied with blood by the utero-ovarian artery, which gives off thick flexuous branches that ramify in the spaces formed by the proper covering of the organ ; the blood is carried away by large veins that compose a plexus around it—the bulb of the ovary—and ultimately terminate in the posterior vena cava, near the renal veins. The oviduct or Fallopian tube (Fig. 473, 10) is a long, narrow, and

very flexuous canal lodged in the broad ligament, near its anterior border; it commences at the ovary by a free expanded extremity—the pavilion of the tube, or ostium abdominale, which opens into the abdominal cavity near the hilus of the ovary; the margin of this opening is fimbriated, and is attached to the external side of the ovary. The other extremity terminates at the end of the uterine cornu.

In the Cow the ovaries (Figs. 476, *c*, *c*; 480, O; 481, *a*) are situated nearer the pelvic cavity than in the Mare, and are in proximity to the body of the uterus and the cornua. They are relatively much smaller than those of the Mare—about the size and shape of a haricot bean or a large almond. They are suspended in a similar manner to the ovaries of the Mare, and are attached to the inner surface, near the anterior margin of the broad ligaments, by a serous layer lined by bundles of fibrous tissue (Fig. 481).

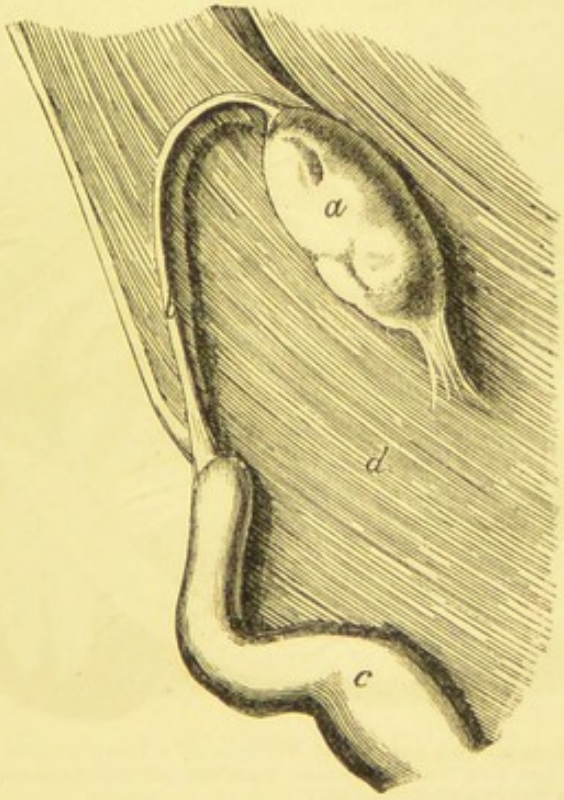


FIG. 481.—ATTACHMENT OF THE OVARY TO THE BROAD LIGAMENT IN THE COW. (After Cadiot.)

a, Right ovary; *b*, oviduct; *c*, cornu; *d*, broad ligament.

The arrangement of the ovaries in the SHEEP and GOAT is similar to that in the Cow.

In the Sow the ovaries (Fig. 477) are situated within the broad ligaments, very near the extremity of the uterine cornua. When the animal is about a month or six weeks old, they are the size of a lentil, and at six months they are as large as a filbert, and have a lobulated appearance as in Birds, due to the numerous ovisacs projecting beyond their surface; the oviducts are less flexuous, but proportionately much longer, than in the other animals.

In the BITCH the ovaries (Fig. 478) are placed in the sublumbar region, and lie in a fold of the broad ligaments, which forms a kind of cup for them; they are usually concealed by fat.

It should be observed that in animals, and more especially in the Mare and Cow, the ovaries are sometimes considerably altered in size, form, and structure. Not only do they become atrophied as old age advances, but this change in

volume may also be due to disease in them or in other organs or tissues in their vicinity. They are also liable to enlargement from the presence of new growths or tumours; these are commonly cysts, simple or multilocular, containing fluid, but they may also be dermoid. The more serious tumours or new growths, such as the sarcomatous, carcinomatous, or fibromatous, are rare, though ovarian tuberculosis is not infrequent in Cattle. When affected with any of these, the ovaries may acquire great dimensions.

As the ovaries of female Poultry are sometimes removed, with the object of making the birds sooner fit for the table, and rendering their flesh more tender and succulent, it is considered necessary to give a short description of their generative organs. It should be noted that, in practising ovariotomy on Fowls, the left ovary only has to be extirpated, as the right one becomes atrophied in very early life. When the Fowl is three or four months old, the left ovary is situated in the sublumbar region of the same side, with the corresponding kidney above

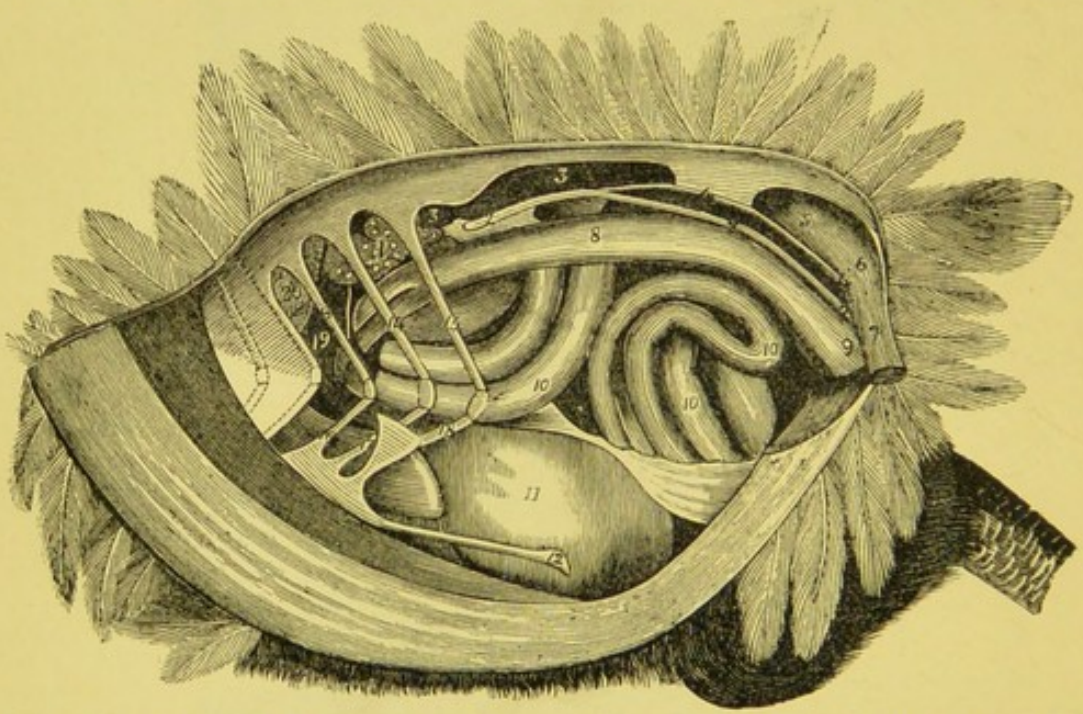


FIG. 482.—LATERAL VIEW OF THE ABDOMINAL VISCERA OF A FOWL THREE AND A HALF MONTHS OLD. THE LEFT LEG AND CORRESPONDING PORTION OF THE ABDOMINAL WALL HAVE BEEN REMOVED. (After Peuch and Toussaint.)

1, Left ovary; 2, 2, oviduct with (2') its opening into the cloaca; 3, 3, left kidney; 4, uterus and its junction with the cloaca (4'); 5, bursa of Fabricius with (6) its cervix; 7, cloaca; 8, rectum and its junction with the cloaca (9); 10, 10, 10, intestine; 11, gizzard; 12, left apophysis of sternum; 13, 14, 15, posterior ribs; 16, 17, 18, costal apophyses of the sternum; 19, left lobe of the liver; 20, posterior portion of left lung.

and behind it, the posterior border of the lung in front, and the liver and intestines beneath it (Fig. 482). The ovary is composed of a mass of various-sized vesicles or ova, and looks like a bunch of grapes; the organ is already well developed in birds from three to four months old. The oviduct is long, very flexuous, wide, and dilatable; it begins near the ovary by a non-fringed pavilion, and terminates in the cloaca by a somewhat narrow orifice.

MAMMÆ (Fig. 483).—The mammæ are glandular appendices to the generative organs. In the MARE they are two in number, and are placed beside each other in the inguinal region, about nine inches in front of the vulva. In early life they are rudimentary, but become developed as age advances, and attain their full development when the animal is capable of reproduction, and more especially at the termination of pregnancy. They appear as two somewhat hemispherical masses separated by a shallow furrow, and each has in its centre, at the side of the mesian line, a conical prolongation, slightly flattened at the sides—the teat,

nipple, or mammilla, which is perforated by several orifices from which the secretion of the gland escapes. The two glands are retained in position by the thin fine skin covering them ; they are also attached to the abdominal tunic by means of several short and wide elastic bands proceeding therefrom.

In structure each udder has an envelope of yellow elastic fibrous tissue, with glandular tissue, the milk sinuses and lactiferous ducts, and excretory canals or milk ducts. The elastic envelope joins that of the opposite gland in the middle line, and is strengthened by the wide bands sent off from the abdominal tunic ; it sends into the gland numerous prolongations which, crossing each other, form partitions that divide the mass into lobes and lobules, which are in this way somewhat independent of each other ; so that one or more may be diseased or disordered in function without the others being involved. This envelope is closely adherent to the skin through the medium of a thin, but dense, layer of connective tissue. The glandular tissue is arranged as in other conglomerate glands, being composed of acini or cæcal vesicles clustered around the lactiferous ducts, which terminate in the lacteal sinuses. These are situated a little above the base of the teat, and are generally two in number—one behind the other :

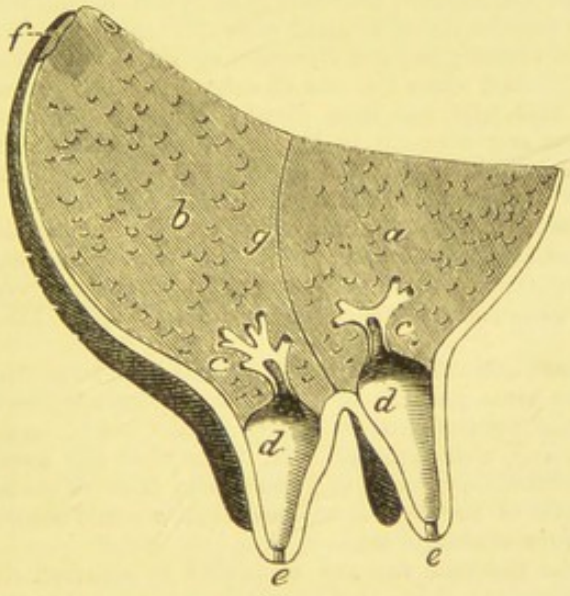


FIG. 483.—SECTION OF COW'S UDDER.

a, Anterior quarter ; *b*, posterior quarter ; *c*, *c*, section of milk ducts ; *d*, *d*, milk sinuses or cisterns ; *e*, *e*, orifice of teat ; *f*, large lymph gland in the posterior quarter ; *g*, partition between the quarters.

there may, however, be three, and even four, sinuses. They nearly always communicate with each other, and are prolonged into the teat by a corresponding number of terminal and independent canals whose orifice is always very narrow, and are seen at the free extremity of the teat, which is obtuse and rounded. Collectively these canals are much wider at the base of the teat than at its ends, and their orifices are usually behind each other, and about a line apart ; they are lined by a fine membrane which is continuous with the skin ; the latter is very closely adherent to the teat. The length of the teats varies with use ; the elastic and dartoid tissue surrounding them, and which is composed of non-striped circular and longitudinal fibres, renders them capable of a kind of erection under the influence of stimuli. The extremity of the teat is well provided with this tissue, which acts as a sphincter, and prevents the passive escape of the milk. Connective tissue, bloodvessels, nerves, and lymphatics complete the structure of the mammæ. The arteries are from the external pudic, and the veins are of two orders—deep, which follow the arteries, and superficial ; they are very numerous, and finally enter the large abdominal subcutaneous vein. Capillaries form a rich network around the alveoli.

In the Cow the situation and structure of the mammæ (Fig. 483) are the same as in the Mare, but each lateral mass, though enveloped in a single fibrous capsule, is made up of two quite distinct glands—or 'quarters,' as they are commonly designated—the limits of which are marked externally by a slight depression. Each gland, of course, has its corresponding teat, much more developed than that of the Mare, so that the Cow has four mammæ and four teats. The glands are compacted into a rounded mass, which is very large, and more or less pendulous. When they are in active function, in the centre of each, at the base of the teat, there is only one large sinus, which is the general confluent of all the lactiferous ducts, and it opens externally through the teat by a single canal; this is widest at its commencement and narrow at its termination at the end of the teat, the walls of which are very thick, elastic, and retractile. Sometimes behind the four teats rudimentary ones are observed, but they are generally imperforate, though in rare instances they have not been so, and milk has passed through them.

The teats of the Cow are generally from two and a half to three and a half inches in length; the two anterior ones are usually longest, and the corresponding quarters are largest. As in the Mare, the dartoid tissue around the end of the teat, acting as a sphincter, prevents passive flow of the milk from the orifices of the excretory ducts; for if a small cannula, scarcely larger than one of these ducts, be inserted slightly beyond the opening in the teat, the milk immediately flows through it. And when the end of a teat has been wounded, or when the elastic tissue of this part has been divided in the performance of an operation, there is no longer any obstacle to the emission of the secretion, which escapes continuously. As in the Mare, the supply of blood is derived from the external pudic artery, the branch of which, on each side, on reaching the glands divides into two principal trunks, one of which goes to a corresponding 'quarter': that which is destined for the posterior gland bends at a right angle backwards, the branch of the anterior quarter—the largest—descending vertically, to become subdivided into numerous ramuscles and terminal twigs. The veins are arranged as in the Mare.

In the SHEEP and GOAT there are only two mammæ, as in the Mare, though they are formed on the same plan as in the Cow. They are also inguinal, somewhat hemispherical, and voluminous, especially in the Goat; each gland is provided with a single conical, well-detached teat. The Goat has sometimes, in addition, two posterior rudimentary teats, and the milk sinus of each ordinary teat is so large, and the wall of the teat is so thin, that in some cases it is capable of containing nearly three ounces of milk.

In the Sow the mammæ are ten or twelve in number, disposed by pairs in parallel rows extending from the inguinal region to beneath the thorax, and distinguished as inguinal, abdominal, and thoracic. They have not, as in the larger animals, any sinuses, the milk ducts of each teat joining directly to form a variable number of canals that open at the free extremity of the teat by from five to ten orifices.

In the BITCH there are eight or ten mammæ, arranged as in the Sow; when they are ten in number they are disposed on each side as two pectoral, two abdominal, and one inguinal.

CHAPTER I.

OPERATIONS ON THE OVARIES.

Ovariotomy—Oöphorectomy.

Though disease or derangement in the functions of the ovaries necessitating operation in the human female are far from infrequent, they would seem to be rare in the domestic animals, if the paucity of cases recorded in veterinary literature be accepted as evidence. These organs appear to be remarkably exempt from inflammation and its results in these creatures, though cysts—often of a large size—and tumours are sometimes discovered affecting them; but the discovery is usually accidental, and happens either in the course of operating on these organs, or after death.

When the ovaries are involved in disease or their function is disordered, the symptoms are generally so obscure as to render diagnosis extremely difficult, though nymphomania occurring in Mares or Cows is usually attributed—and often correctly—to an abnormal condition of these organs, such as the presence of cysts or tuberculous deposits in their structure. A more or less certain diagnosis of the state of these organs can only be arrived at, in the larger animals, by a manual exploration of them per rectum, or, with more certainty and accuracy, through an opening made in the upper wall of the vagina.

The ovaries may be removed through the wall of the vagina—intra-vaginal ovariotomy; through the rectum—intra-rectal ovariotomy; or through the abdominal wall—laparo-ovariotomy. All these methods have been practised, but the two first have been most frequently resorted to in the large animals, as the ovaries can be easily reached by the hand and arm when introduced into the vagina or rectum, though in recent times the vaginal method is generally favoured, as there is less risk attending it. Laparo-ovariotomy is sometimes adopted for the Mare and Cow, but it is not to be recommended when the intra-vaginal procedure can be resorted to; operation through the abdominal wall is the only practicable method in the case of the smaller animals, the incision being made at the flank or at the linea alba.

It may be remarked that the operation is one of the oldest practised on animals, and was known long before the Christian era. In the days of Aristotle, Varro, and Pliny, the Mare, Cow, Sow, Ewe, and Camel were castrated, though we have no information as to the procedure, nor yet as to the reasons for operating. In the middle of the seventeenth century, Bartholin, of the Copenhagen University, alludes to it, and leads us to infer that the Mare and Cow were often castrated at that time in Denmark, the ovaries being removed by an opening made in the flank. It was also evidently resorted to at this time in France, where,

at the commencement of the eighteenth century, the castration of Mares was interdicted by special legislation; the ovaries were extracted through an opening in the flank or in the floor of the abdomen.

These situations would appear to have been the only ones selected until 1850, when Charlier (France) advocated the vagina as a preferable channel for the extraction of the ovaries, certainly a most important advance in animal ovariotomy, and he devised special instruments to facilitate the operation. Since that date modifications have been introduced, the most valuable of which, perhaps, have been those of Colin and Cadiot.

Ovariotomy in the Mare.

As has been mentioned, ovariotomy was practised extensively in the seventeenth century, the flank being selected for incision, and in the eighteenth century the operation was recommended for the suppression of œstrum in the Mare; but it is only in recent years that it has become recognised as safely practicable, and as really advantageous in cases of vice or nymphomania, when animals so affected are useless as servants, and even dangerous to other animals and to mankind, because of uncontrollable viciousness. Horses are often emasculated for the same reason, and the result is nearly always most satisfactory. The operation is also, of course, indicated when the ovaries are discovered to be so seriously diseased that the animal's utility is diminished or its life is endangered.

It has just been stated that the ovaries may be removed through the rectum, but this situation has now, and for obvious reasons, been abandoned, and intra-vaginal ovariotomy is preferred for large and fully-developed animals; but when these are too young or of small size, and there is not sufficient space for the hand and arm to act in the vagina, then the flank or floor of the abdomen is the most suitable situation for incision.

In order to ensure a favourable result in the case of the Mare, season and surrounding conditions, as well as the state of health of the animal, ought to be studied. The operation should be undertaken when the weather is mild and dry, the stable sanitation good, and the Mare free from febrile, inflammatory, or infectious disease; the period of œstrum should be avoided. Of course, in the case of a Mare seized with violent nymphomania, it may be necessary to operate without much consideration for these precautions, though their observance will otherwise greatly influence complete and rapid recovery from the operation.

The operator may select any of the procedures alluded to, but our description will be limited to three for the Mare—Charlier's, Colin's (as modified by Cadiot), and that by incision at the flank.

Charlier's Method.

Instruments and Appliances. — Charlier devised a dilator (Figs. 484, 485) with expanding sides to widen the vagina and

keep its wall tense during the operation, and particularly while making the incision through its upper part; as when the hand is first introduced into that canal it contracts rather firmly, and there is no room for manipulation. Subsequently he modified this dilator, and made it more of a rest to steady the hand when cutting through the roof of the vagina (Fig. 486). It is about ten or eleven inches long without the handle, and is merely a round

FIG. 484.—CHARLIER'S VAGINAL DILATOR EMPLOYED IN OVARIOTOMY. THE INSTRUMENT IS CLOSED.
A, Central band of the dilator; C, C', lateral spring bands; B, projecting point to be inserted into the os uteri; D, stem; E, handle, with a screw end (F), which serves to expand the lateral bands.

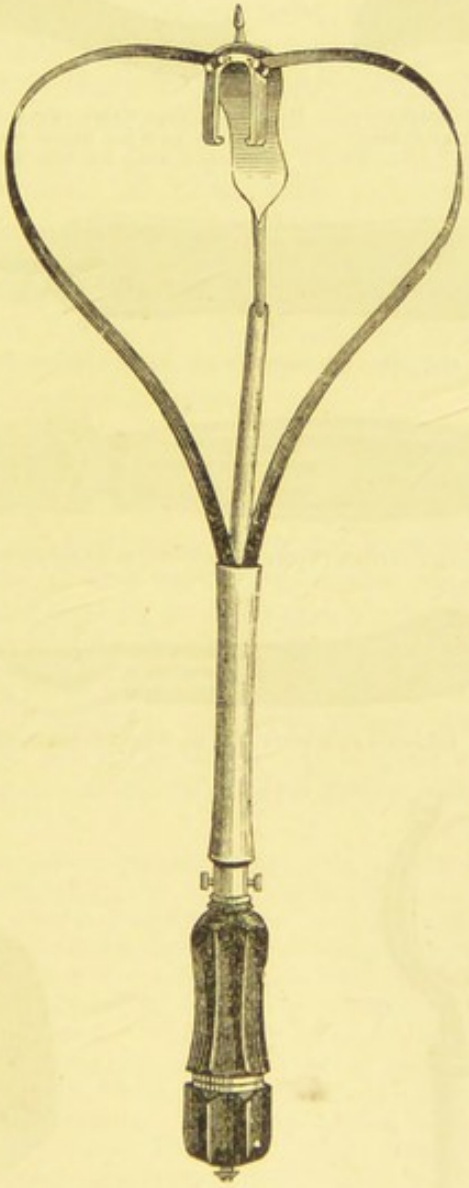


FIG. 485.—CHARLIER'S VAGINAL DILATOR. OPENED.

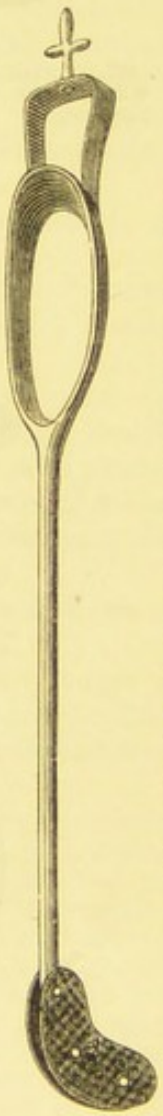


FIG. 486.—CHARLIER'S MODIFIED VAGINAL DILATOR AND HAND-REST.

iron stalk terminating in two successive openings, the first of which is six inches long and about three inches wide; this is for the reception of the hand. The opening in front of this is three and three-quarters inches long and three and a quarter inches wide, and gives the distance from the cervix uteri to the point where the perforation in the vagina should be made, while it keeps the vaginal wall tense; a pivot at the front of both instru-

ments, from one to two inches long, is intended to pass into the os uteri and steady them. The knife for making this perforation must be a *bistoury caché*, with a short handle and concealed movable blade. There are several patterns of these. One devised by Charlier for this operation fits well into the hand, and

FIG. 487.—CHARLIER'S OVARIOTOMY KNIFE WITH THE BLADE PROJECTING.

FIG. 488.—THE SAME, WITH ONE SIDE OF THE HANDLE MOVED OFF TO SHOW THE MANNER IN WHICH THE BUTTON ACTS ON THE SPRING.

FIG. 489.—OVARIOTOMY KNIFE WITH SLIDING BLADE.

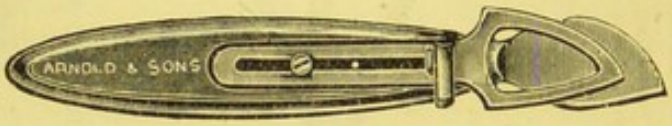


FIG. 490.—OVARIOTOMY KNIFE WITH SLIDING GUARD.

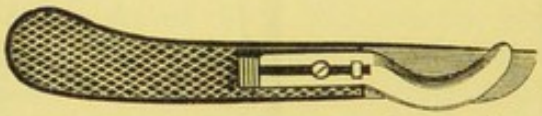


FIG. 491.—OVARIOTOMY KNIFE WITH SLIDING GUARD.

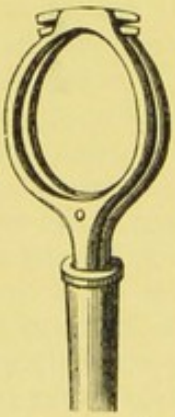


FIG. 492.—JAWS OF CHARLIER'S OVARIOTOMY FORCEPS.

FIG. 493.—CHARLIER'S THIMBLE FOR OVARIOTOMY.

the blade is easily projected when required, by pressing on the button of a spring which acts on the blade (Figs. 487, 488). The blade may be a sliding one, and made to project by the finger pushing the button on it forward (Fig. 489); or the blade may be fixed, and protected by a sliding guard that can be made to

uncover or cover it, as required (Figs. 490, 491). In a case of emergency, an ordinary short bistoury or scalpel can be used if the blade is wrapped round with twine to about an inch from the point, which must be carefully concealed by the fingers when the knife is being carried into or withdrawn from the vagina. A knife with a metal handle is preferable to any other, as it can be more perfectly disinfected. Charlier removed the ovaries by torsion, and employed a long forceps, the blades of which were opened or closed by a sliding tube moving on the handle (Fig. 496). The ends of the blades were wide, and adapted for holding the pedicle of the ovary securely (Fig. 492); he also used a rough-faced steel thimble (Fig. 493) that fitted on the thumb, and served to give a good grip of the ligament of the ovary while this was being twisted off (Fig. 496). A pair of long-bladed, blunt-pointed, curved scissors is necessary.

Antiseptic fluid* and sponges should also be provided, no matter what the procedure may be.

Position.—In this operation the standing position is in every way the best, as manipulation is much easier, and the ovaries are more readily found and excised.

The Mare is placed in the stocks, a twitch is placed upon the upper lip, the hind-legs are tied to the heel-posts by wide bands, and a sling-band is placed under the belly to prevent the animal lying down. The tail may also be raised high by means of a long band fastened round it and carried over the upper transverse bar of the stocks; this helps to sustain the hind-quarters.

An assistant should be placed at the animal's head, and one or two behind to assist the operator.

Operation.—A purgative may be given with advantage, or sloppy diet allowed for some days. It is also advisable to keep the animal fasting for at least twelve hours before it is operated

* The value of antiseptics in surgery, great as it is in all operations, is perhaps most so in those performed on or in the abdominal cavity or its contained organs, and successful results greatly depend not only upon the skill and care with which the antiseptics are employed, but also upon the antiseptics themselves. It is therefore essential that those which have been proved to be most efficient, and least hurtful to the tissues or the general system of the animals operated on, should alone be employed. What have hitherto been considered the most reliable, such as carbolic acid, corrosive sublimate, and iodoform, have serious drawbacks, not the least of which is their toxicity, which renders their use troublesome, and even dangerous. The introduction of an antiseptic which is quite as effective as any of these, and which, while possessing other advantages as an antiseptic, deodoriser, and powerful germicide, is at the same time non-poisonous, must prove a real boon to surgeons no less than to sanitarians and physicians. Chinosol appears to fulfil all these *desiderata*. It is a more powerful germicide than carbolic acid, does not coagulate albumin like corrosive sublimate and some other antiseptics, is a potent deodoriser, is non-poisonous and non-irritant, is readily soluble in any proportion in warm and cold water, and remains active for an indefinite period; it quickly penetrates the skin and other membranes, favours granulation, and does not act injuriously upon or stain iron or steel, an advantage which disinfects instruments. This new chemical compound, which belongs to the quinoline group, appears destined to take the place of all other disinfectants, and will prove indispensable in medicine and surgery.

upon; and for a day or two, morning and evening, the vagina should be washed with soap and water, and injected with a 3 per cent. solution of chinosol, creolin, or carbolic acid, or a 1 per 1,000 solution of mercury bichloride. When the operation is about to commence, the rectum is emptied, and a warm-water enema administered; if the bladder contains much urine it must be evacuated, either by gentle pressure on it through the rectum, or by the catheter. Then the vulva and adjacent parts are well sponged with either of the antiseptic fluids, the vagina receives an injection of one of them, and is wiped out with a pledget of aseptic lint.

The hands and arms of the operator should be thoroughly asepticised both before and at intervals during the operation, and the instruments ought to be treated in the same way. The hand must not be passed into the genital canal any more than is absolutely nccessary, as it is very essential that as little air as possible should be allowed access to it.

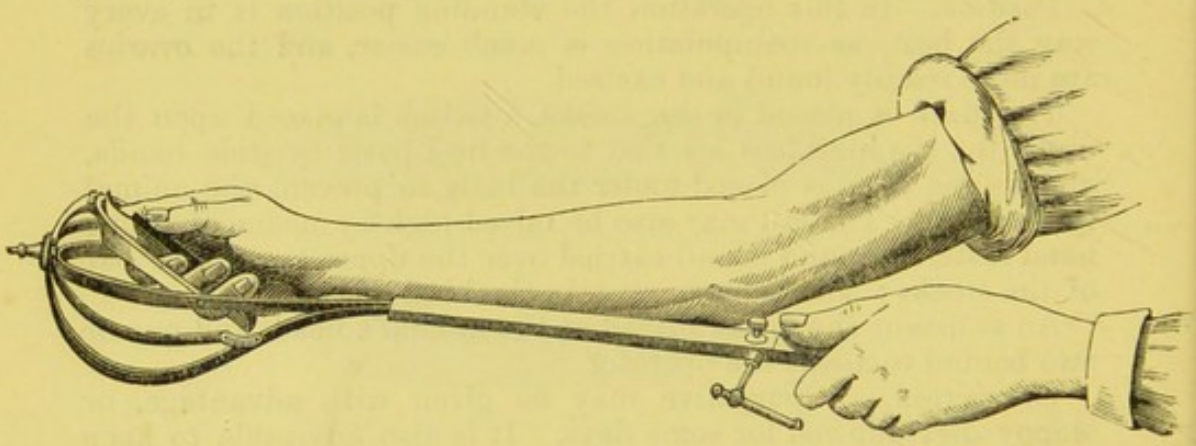


FIG. 494.—INCISION OF THE UPPER WALL OF THE VAGINA, SHOWING THE POSITION OF THE RIGHT HAND ON CHARLIER'S DILATOR.

If the animal is very sensitive and irritable, it may be well to induce semi-narcosis by causing it to inhale ether, or administering chloral hydrate either in draught or by enema. As a rule, however, narcosis is not necessary, as nearly all animals stand the operation well.

TECHNIC.—The preceding preliminaries apply to Charlier's and to Colin's procedure; we now deal with Charlier's technic. The vaginal dilator, having been slightly warmed and lubricated with aseptic oil or grease, is gradually passed by the left hand into the vagina, and guided there by the right hand until the pivot at the end reaches the cervix uteri, when it is pushed into the os, the flat of the instrument being horizontal. The vagina at first contracts spasmodically, and it was to counteract this that the expanding dilator was devised. But this contraction soon subsides, and with the modified non-expanding dilator the hand then moves about freely, and the vaginal wall becomes extended and tense. The knife, which has been carried by the

right hand when first introduced into the vagina, now has its blade exposed, and the upper wall is pierced, then incised by a sharp and short drawing cut from before to behind, making an opening about two inches long. To make certain that the wall is perforated, the operator should feel the peritoneum by passing his finger through the opening. The dilator and knife are now withdrawn, and the opening is made larger, if necessary, by the fingers. This perforation of the vaginal wall is perhaps the

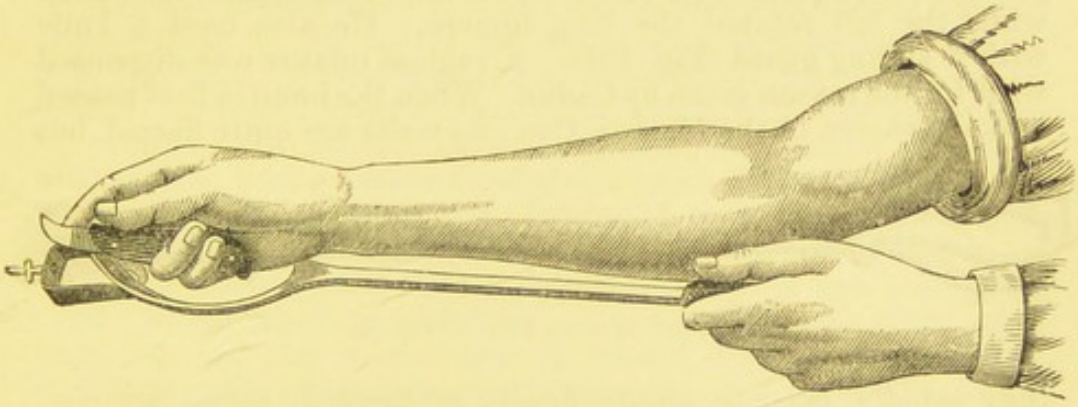


FIG. 495.—INCISION OF THE UPPER WALL OF THE VAGINA, THE RIGHT HAND RESTING ON CHARLIER'S MODIFIED DILATOR.

most important step in the operation. The search for the ovaries now takes place, but to avoid repetition this part of the operation will be described when dealing with Colin's procedure.

The ovaries having been found, the right one is first removed by passing the long forceps, closed, into the vagina and through the wound, opening the jaws by pulling down the sliding tube, seizing the ligament of the ovary, pushing up the sliding tube so as firmly to close the jaws of the forceps, elongating the ligament a little

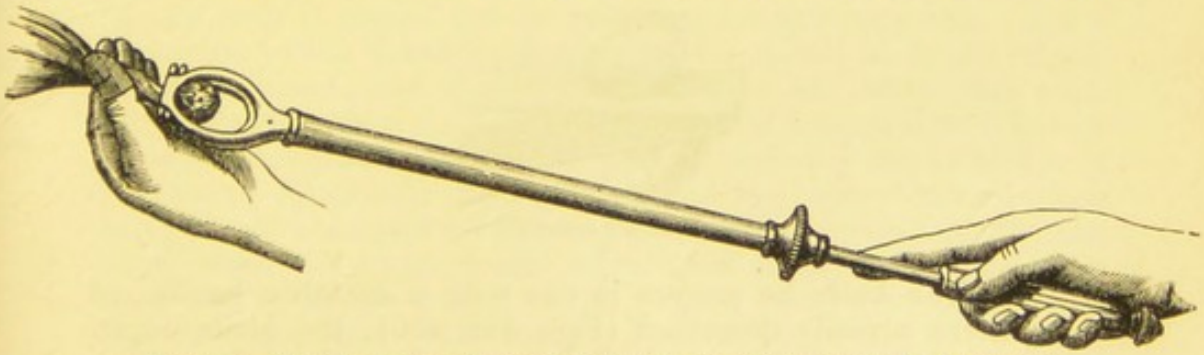


FIG. 496.—TORSION OF THE OVARIAN LIGAMENT AND BLOODVESSELS IN CHARLIER'S METHOD OF PERFORMING OVARIOTOMY.

by gently withdrawing the forceps, then rotating them slowly and regularly so as to make a kind of cord of the ligament, which is held beyond the jaws of the forceps by means of the finger and thumb, the latter being armed with the thimble (Fig. 496); the organ in this way is soon torn off. The same course is pursued with the second ovary. The operation did not occupy more than five or six minutes in Charlier's hands.

Colin's Method.

This method is much simpler than that of Charlier, and is that which has been practised by Cadiot and others with great success. Up to the operative technic everything is the same in both methods. Colin only employed as instruments a torsion forceps (Fig. 497), resembling that of Charlier, and instead of a thimble to assist in holding the ligament of the ovary he used a special spring forceps (Fig. 498), which was firmly held by the right hand while the left rotated the long forceps. He also used a knife with a sliding guard (Fig. 491). A vaginal dilator was dispensed with, for the reason given by Cadiot. When the hand is first passed into the vagina of the Mare or Cow, its walls are quite flaccid, but

Fig. 497.—Colin's Torsion Forceps.

they rapidly become spasmodically contracted, soon, however, to become extended and tense, so as to form a large oval cavity, widest at the cervix uteri, where the hand may move about with the greatest liberty; this extension of the vaginal wall causes it to come into close contact with the surrounding parts, and it may even displace the rectum so much as to meet the roof of the pelvis. This condition lasts for some minutes, sufficiently long to allow ovariotomy to be accomplished.

For torsion forceps Cadiot has rightly substituted the ecraseur, first suggested for this operation by Delafond. The instrument should be long, at least twenty inches, and the chain sound and

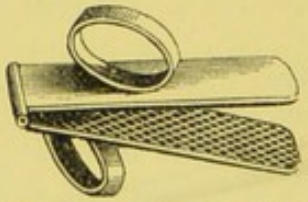


Fig. 498.—Colin's Limiting Forceps.

strong. The knife he prefers is one with a metallic handle, of the pattern already described (Figs. 489, 490); the blade ought to be very sharp on one or both edges and at the point, about an inch long, and from one-third to half an inch broad. He insists upon the employment of antiseptics.

Technic.—The right hand, well lubricated and armed with the knife, the fingers being brought together into a conical form, is pushed through the vulva into the vagina, towards the cervix uteri, kept there slightly moving about until its cavity is dilated and walls tense to the necessary degree. The knife is then held fully and firmly in the hand, sloping slightly upwards, the cubital

border of the hand being downwards; the blade is uncovered to its full extent by the thumb, and pushed smartly forward through the upper wall of the vagina at one thrust; the puncture should be in the median line, about two inches from the cervix uteri, and opening into the recto-vaginal *cul-de-sac*, which has been referred to when dealing with the anatomy of this part. The blade is then covered, the knife laid on the floor of the vagina, and the puncture explored to make certain that it extends through all the membranes of the vagina into that sac; if the peritoneum can be felt, then the perforation is complete. Should the puncture be incomplete, the knife has to be picked up, the blade uncovered, and a second thrust made, in the same situation if possible. In making these punctures, if the knife is held as directed, so that it passes through the vaginal wall in an obliquely forward direction, there is no danger of wounding the posterior aorta or its branches, nor yet the rectum.

Being assured that the abdominal cavity is penetrated, the knife is deposited on the floor of the vagina, the blade being covered, and the index-finger is passed through the puncture, which it gradually enlarges until the thumb can also be passed through, when the membranes are torn in the direction of the median line by forcibly separating these fingers until they can be moved freely about, when the middle finger is also introduced. In this way the opening is enlarged until the entire hand can be inserted into the abdominal cavity, which in the Mare is necessary, owing to the advanced position of the ovaries. In order to reach the ovary of either side, the hand glides forward along the body and cornu of the uterus until the fingers come into contact with the organ, which is so readily recognised by the touch and by its situation towards the extremity of the cornu, beyond the pelvic cavity and above and to the side of the rectum, that it should not be mistaken for anything else. Yet a projection of the floating colon containing a ball of fæces might, to the inexperienced operator, seem to be an ovary; but such projection is softer than the ovary, and is preceded or followed by other projections, while the gland is isolated at the border of the broad ligament. The position of the ovary having been ascertained, the hand is drawn back to the perforation, the left hand passes the warmed and asepticised ecraseur alongside the right arm up to the wound in the vagina, where the hand carries it to the ovary; the chain, being pulled out by the fingers to form a sufficiently large loop, is made to encircle the ligament of that body in the manner shown in Fig. 499. The operator holds the shank of the instrument with the left hand, near the vulva, to steady it, and an assistant turns the handle or lever as directed. The loop of the chain being fairly round the ligament, and nothing else, the lever is slowly turned until this is tightly enclosed; then, the operator holding the ovary and the end of the instrument in the palm of the hand, the lever is turned at such slow speed that, to avert hæmorrhage, three minutes or more should be allowed for

the textures to be cut through; when this is done, any tissue remaining in the chain is freed from it, the instrument, hand, arm, and ovary, as well as the knife, are withdrawn from the vagina, and the operation is completed so far as the amputation of one ovary is concerned. The hand and arm, as well as the instruments, having been thoroughly washed and rendered aseptic, the same procedure is gone through in the removal of the other ovary. It will be observed that the hand has not been brought outside the vulva during the whole time of removing one ovary; this is rather fatiguing for some operators, but it has its advantage in greatly diminishing the risk of serious consequences.

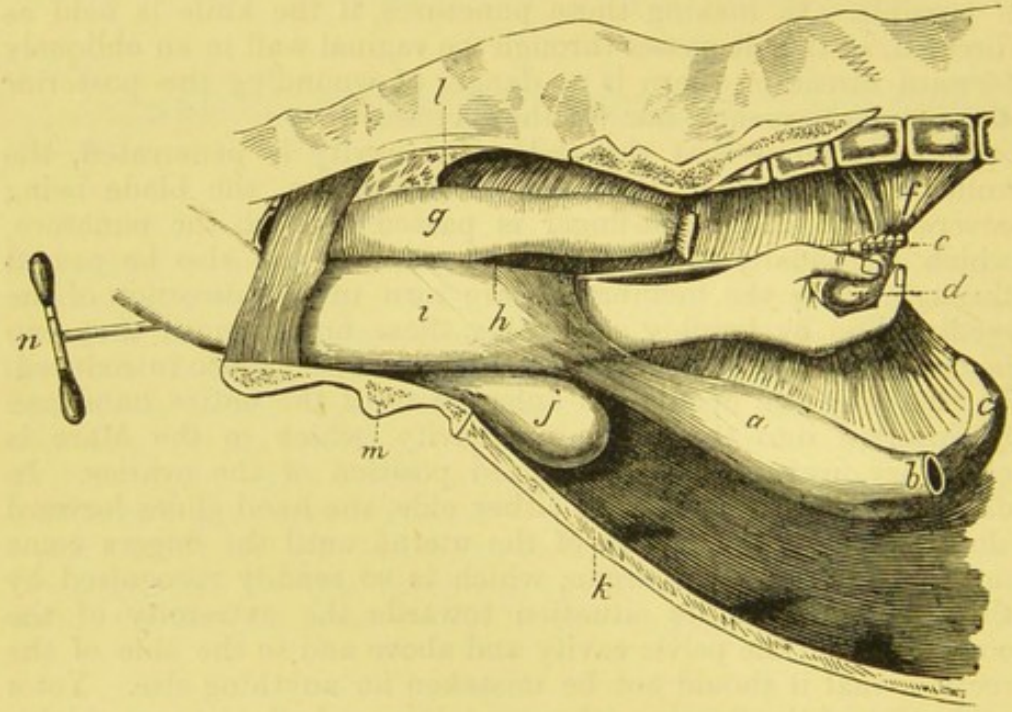


FIG. 499.—VERTICAL ANTERO-POSTERIOR SECTION OF THE ABDOMINAL AND PELVIC CAVITIES SLIGHTLY TO THE RIGHT OF THE MIDDLE LINE, SHOWING THE INTERNAL GENERATIVE ORGANS OF THE MARE AND REMOVAL OF THE LEFT OVARY, WHICH IS HELD IN THE RIGHT HAND OF THE OPERATOR. THE CHAIN OF THE ECRASEUR IS AROUND THE OVARIAN LIGAMENT. (After Cadiot.)

a, Uterus; *b*, right cornu divided; *c*, left cornu; *d*, ovary; *e*, ovarian ligament; *f*, broad ligament; *g*, rectum; *h*, recto-vaginal *cul-de-sac*; *i*, vagina; *j*, bladder; *k*, abdominal wall; *l*, recto-sacral *cul-de-sac*; *m*, pelvis; *n*, handle of ecraseur.

The ambidextrous operator (all veterinary surgeons should be ambidextrous) is better able to sustain this fatigue than one who can only employ the right or left arm in achieving this task, as he can remove the right hand for the left ovary, and *vice versâ*. Patience and tact are needed when the animal is restless, and when the fingers are so incommoded by the intestines that it is very difficult to pass the ecraseur chain over the ovary; in such cases it is sometimes easier to pass the ovary through the loop sideways than from above. It should also be remembered that in very exceptional cases the broad ligaments are sufficiently lax in the Mare to allow the ovaries to be drawn through the wound

into the vagina, where they can be much more easily removed than when they are in the abdominal cavity.

Should the ovaries chance to be adherent to adjoining organs or textures, the adhesions must be broken down by the fingers; if they are voluminous, owing to the presence of a tumour or a cyst, attempts should still be made to excise them, though a longer time is required for the chain of the ecraseur to act; and if a cyst is of such a size as to preclude removal, it may be drained of its fluid by means of the aspirator acting through a long tube and hollow needle, and the ovary then amputated.

The removal of the ovaries having been effected, nothing more remains to be done, unless it be decided to close the vaginal wound by one or two sutures—a course which Degive thinks is safer than to leave it open. The sutures are not difficult to apply if the following directions are observed: A rather fine and short suture needle, furnished with a very long, well-waxed silk thread, is passed from the outside to the inside of the right lip of the wound, and carried in the opposite direction through the left lip. The needle is then taken off the thread, the two ends of which are brought from the vulva and formed into a simple knot; one end is held by an assistant, and the other end is retained by the operator, who pushes the loop of the knot forward into the vagina until it reaches the wound, where it is drawn to the proper degree of tightness by pulling both ends. The simple knot is made a double one in the same way, and firmly tied, when the thread is cut off close to the knot. In this manner as many stitches may be made as are deemed necessary to hold the sides of the wound together.

Cadiot, however, is not in favour of doing anything with the wound, which, he asserts, is spontaneously closed in twenty-four hours after the operation, and is completely cicatrised in ten days.

It is necessary to free the vagina from blood by cleansing it well, and sponging its surface with some mild antiseptic fluid. The vulva and adjacent parts should also be cleansed and dried. The Mare must then be placed in a comfortable well-ventilated stable or loose-box, kept, if possible, at an equable temperature, and well littered. If the weather is changeable or inclement, the body should be warmly clothed. Tepid water may be allowed as drink immediately after the operation.

After-Treatment.—Food should be given sparingly for the first twenty-four hours, and ought to be of a rather laxative kind. For a few days after the operation signs of suffering from abdominal pain are manifested, the temperature may rise to some extent, and the appetite is diminished or altogether in abeyance; but if all goes on well these symptoms subside, and the animal is fit for gentle exercise; indeed, when signs of pain appear, walking exercise often dispels them.

It has been stated that prolapse of the rectum sometimes occurs during the operation. Should it happen, Cadiot—who, however, has never observed it—recommends that the eversion

be reduced, and that a large pledget of tow or lint be applied to the anus, and maintained there until the operation is completed, by means of a folded towel, the ends of which are held by assistants.

Hæmorrhage may occur through wounding a branch of the vaginal artery if a slit is made in the wall of the vagina away from the mesial line, instead of a puncture in the middle. A wound of the posterior aorta or one of its branches would be irremediable, and quickly fatal, of course; but it should not occur if anything like ordinary care is observed. The same may be said with regard to bleeding from the stump of the ovary; this can be avoided by constricting the pedicle slowly and steadily by the chain of the ecraseur until it is crushed through. Hernia of the intestines into the vagina through the wound in its wall might happen, but it must be extremely rare, as union takes place so rapidly. When it does take place, the loop of intestine should be cleansed, if soiled, returned into the abdominal cavity, and a tampon of lint or tow lodged in the vagina, or, better still, some sutures may be passed through the margin of the wound in the manner already described. If there is any apprehension of this accident, when the ovaries are removed the wound should be sutured.

If antiseptic precautions are carefully adopted during the operation, and even before, septic peritonitis ought not to ensue. The same remark applies, more or less, to pelvic abscess or formation of pus in the connective tissue in or about the vagina; the wound has either been improperly made, or infective matter has been introduced. Its presence is denoted by fever, stiffness in the hind-quarters, especially when the animal is backing or turning, with sometimes lameness in one of the hind-legs; micturition and defæcation are effected as if they caused pain. An exploration by the rectum and vagina will confirm the diagnosis. When the presence of pus is detected, the abscess must be punctured through the vagina by the bistoury caché, and its cavity washed out several times a day with a weak solution of carbolic acid (2 to 3 per cent.).

Ovariotomy in the Cow.

This operation has been extensively practised on the Cow, with the object of increasing the secretion of milk and favourably influencing fattening, apart from its adoption in cases of disease or disordered function of the ovaries. It is asserted that if it is practised when the Cow has been deprived of its calf and the milk secretion is at its maximum, the period of lactation, in young animals especially, may be prolonged to fifteen and eighteen months, sometimes even to two or three years, the quantity being rarely diminished, while the quality is usually improved, the milk being richer in fat and casein. There is also evidence that the castrated Cow fattens more easily and rapidly than the non-castrated animal, and it is generally admitted that its flesh is finer in the

fibre, as well as more tender and juicier. Much of this change is doubtless due to the modification the operation brings about in the character of the Cows operated upon, as they become much more docile and tranquil, particularly if they have been excitable and restless during œstrum, or affected with nymphomania.

When the operation is resorted to with the view of increasing the secretion of milk, it is recommended by some authorities that it should be undertaken at that time of life when the activity of the mammary gland begins to decline—about six to eight years of age—unless it is not intended to breed from them, when they may be castrated earlier. Young animals should not be submitted to it, and it should not be performed within a month nor beyond three months after parturition, the best period being an intermediate term—six weeks—as that is the time when the animals yield the largest quantity of milk. The operation should not be performed, of course, when the animal is pregnant, and the results of the castration are most favourable when it is undertaken before the return of œstrum, and everything connected with recovery goes on well; they are generally not so favourable when the Cows have suffered much from the sequelæ of the operation, or when old animals are submitted to it a considerable time after parturition.

Ovariotomy in the Cow is carried out in a similar manner to that operation in the Mare. The removal of the ovaries through the upper wall of the vagina in the manner already described, is the method most approved of; while of the two procedures, Charlier's and Colin's, the latter is the simplest, safest, most expeditious, and generally most satisfactory in its results, especially if the ecraseur be employed. This is the procedure which will be briefly described here, as its principal features have been dealt with at some length in treating of ovariotomy in the Mare.

The surgical anatomy of the Cow's ovaries, as we have seen, does not differ to any considerable degree from that of the Mare, though their arrangement in the Cow, and that of the other parts related to them, as well as the less irritable character of the animal, is more favourable for the performance of the operation. It has to be remembered that the ovaries are smaller than those of the Mare, that they are situated near the anterior border of the broad ligament, and are about two inches only above the cornua; they are much less forward in the abdomen, and so loosely attached are they that the fingers can readily draw them into the vagina, through the incision made in its wall; they also hang lower than those of the Mare, and are often below, or rarely slightly above, the level of the vaginal wound.

Instruments and Appliances.—These are the same as for the Mare—a suitable knife and an ecraseur of sufficient length and strength.

Position.—This also is the same as for the Mare, though the operation may be performed in the stable or shed, one assistant

firmly holding the head moderately raised; the bull-holder may be applied to the *septum nasi* if the animal is very irritable or unsteady; two other assistants, one at each flank, prevent the animal moving sideways, and if provided with a broom-handle they can make such pressure on the loins as will prevent straining; one of them can also hold up the tail; while a fourth assistant will aid the operator.

Operation.—The antiseptic precautions taken before and during, as well as after the operation on the Mare, should be observed, so that they need not be repeated here. The rectum must be emptied, as well as the bladder if full.

Technic.—The vaginal wall is punctured, and the perforation is extended by means of the fingers, in the same manner as in the Mare; the ovaries are generally in such close proximity to the wound, being near the body of the uterus, on the inner surface of the lower part of the broad ligaments, that the index-finger and thumb can readily discover them in the peritoneal cavity; their size, shape, consistence, and relations, should serve to prevent mistake. The pedicle of the right ovary is seized by the thumb and middle fingers, the organ itself being in the palm of the hand, and slowly drawn into the vagina, exercising as little traction as possible on the broad ligament. The ecraseur is passed into the vagina by the left hand, its chain forming a loop at the end; when it reaches the ovary the thumb of the right hand opens the loop, the organ is put through it, the chain is placed around the pedicle, and the assistant turns the lever of the instrument (the operator's right hand holding the ovary and steadying the end of the ecraseur) very slowly, making a turn every twenty or thirty seconds, until the tissues are cut through. If the remaining stump or any shreds of its tissue are fixed in the ecraseur, they must be gently disengaged from it before it is withdrawn. The same procedure is followed for the excision of the left ovary; it may be carried out by the same or the other hand.

In very exceptional cases the ovaries are too far from the wound to be reached by the fingers, and then the opening must be enlarged, as with the Mare, the entire hand pushed into the abdominal cavity, and search made until they are found, using the body of the uterus, the cornua, and the border of the broad ligaments as guides; even in such cases the ovaries can generally be drawn into the vagina, and it rarely happens that they have to be amputated in the peritoneal cavity.

The different manœuvres having been accomplished, the vagina is swabbed out antiseptically and the external parts cleansed. The vaginal wound may be sutured, but as a rule this is not necessary.

After-Treatment. — Cleanliness and attention to diet are usually all that is necessary. Soon after the operation the animal is uneasy, but it becomes tranquil in a short time; the secretion of milk is diminished for two or three days, but when the surgical fever subsides it again becomes augmented in

quantity. The wound in the vagina usually heals rapidly by first intention.

The same remarks that have been made with regard to accidents and bad results occurring in the Mare, are applicable to the Cow.

Laparo-Ovariotomy.

In the Mare and Cow removal of the ovaries through an incision in the abdominal wall is not to be recommended, unless the animal is so small that the necessary manipulations cannot be effected in the vagina, or for some other important reason.

The preliminary preparations already alluded to should be observed, except the disinfection of the vagina.

Mare.

The abdominal wall is incised on the left or right side, the animal being placed recumbent on the opposite side. An anæsthetic should be administered.

The skin having been shaved, washed, and disinfected in the region of the flank, as described for laparotomy (p. 363), the abdominal cavity is opened as in that operation, the wound being about four inches in length, or sufficiently long to admit the hand, and passing obliquely downwards and forwards; care must be taken that it does not extend so far as to endanger the anterior branch of the circumflex artery of the ilium.

The hand, well asepticised, is passed into the abdomen, downwards and backwards, towards the pelvic cavity, but below the rectum, until the body and cornua of the uterus can be felt. Search is then made for the ovaries, and when one is found it is brought as near the wound as possible without straining the broad ligament much; the ecraseur, also well asepticised, is then passed along the arm into the cavity, and the loop of its chain is carried over the gland and around its ligament; the lever is then turned slowly, and the same performance enacted as in ovariotomy through the vagina. The second ovary is excised in the same manner. The wound is then closed by sutures; one through the peritoneum may be of catgut, as should another through the muscles, and a third through the skin may be of whipcord or strong silk. The surface of the wound should be treated as directed in laparotomy.

Should an arterial branch be divided in excising the muscles, it must be ligatured or twisted, so as to stop hæmorrhage before the peritoneum is perforated.

The after-treatment is the same as for vaginal ovariotomy.

Cow.

In young cattle, in which the rumen is but little developed, the incision may be made in the left side; but in older ones the right side must be selected. The animal is usually propped up against

a wall, and the several steps of the operative procedure carried out in the manner just described. The wound also is treated in the same way.

Ovariotomy in the Sow.

The Sow is castrated in order to prevent œstrum and to hasten growth and fattening. Nearly all the animals not intended for breeding are so treated, the operation being performed at an early age—when six weeks to two months old, though it may be practised at any age; in older animals it is advisable not to operate during œstrum, and to feed sparingly for a day or two previously. At all ages mild weather is to be preferred, the spring and autumn being the most favourable seasons.

In operating, it is necessary to remember that the cornua of the uterus are long and flexuous, and that, in consequence of the great size of the broad ligaments, they float among the convolutions of the intestines; while the ovaries themselves are very small, and are attached to the inner side of these ligaments.

Fig. 500.—Viborg's Knife for Ovariotomy in the Sow.

Fig. 501.—Helper's Ovariotomy Knife.

Instruments.—These are few in number, and are usually a short-bladed knife with a convex edge—that introduced by Viborg (Fig. 500) has been largely employed on the Continent, though he considered that of Helper a better pattern (Fig. 501); nearly all the knives used for this purpose have more or less resembled this model. A pair of curved scissors, and a suture needle with a double silk thread, are also necessary. It is advisable in operating upon older Sows to be provided with a pair of torsion forceps.

Position.—Latericumbent, left side uppermost; a table or bench is convenient, especially with small animals. Two assistants are usually necessary; sometimes one has a fore-foot in each hand, the other assistant holding the hind-feet in a similar manner, the hind-limbs being drawn back and the front ones forward, with the head free; at other times one assistant holds the head while the other seizes the hind-legs, and holds them back in order to make the flank tense. It is advantageous to cross the hind-limbs, so that the relation between the skin of the flank and the parts it covers will be so changed that the

borders of the wound will not be parallel when the animal is released; accidents may in this way be averted. The same object is achieved in carrying the left hind-leg well back. The operator places himself behind the animal.

Operation.—The bristles are cut off and the skin of the flank cleansed. If the flank is hollow, it can be raised by placing a small bundle of hay or straw under the right flank.

Technic.—The incision in the flank may be horizontal, oblique, or vertical, according to the fancy of the operator. The vertical incision is generally preferred, as the ovaries are more easily reached; it begins immediately below the transverse process of the fifth lumbar vertebra, slightly in front of the haunch, and is best made by scissors in a small fold of raised skin; it should be from one and a half to two inches long, or a little more, according to circumstances. Then the connective tissue and muscles are cut through, and the peritoneum exposed; this is perforated in raising it by forceps or the finger and thumb, and passing the knife through it; or the muscles and peritoneum are sometimes divided by the long sharp nail of the index-finger. The abdominal cavity being now opened, the index-finger of the right hand, well cleaned and asepticised, is passed into it, back towards the lumbar region, and between the vertebræ and intestines, bringing the finger forward so as to catch the ovary, which is small and hard; this is brought against the inner surface of the abdomen to the wound, through which it is drawn along with its attached cornu, which also brings with it the right cornu and its ovary. Both ovaries being now brought outside the wound, the cornua are held in the left-hand fingers, while those of the right hand tear away the glands or scrape through their attachments by means of the finger-nail, care being taken to completely remove the ovaries. To prevent the bowels escaping through the wound during the operation, the fingers not in the abdomen press down against the wound, and should the animal strain manipulation must only be effected in the quiet intervals. The ovaries having been amputated, the cornua are gently returned to the abdominal cavity and the wound closed by continuous suture, separate points of suture, or a crossed (X-formed) suture, great care being taken not to include the intestine in it.

With older animals it is advisable to withdraw only one ovary at a time, and excise it, before attempting to remove the other; and as the blood-supply to these organs is greater than in young Sows, their excision should be effected by torsion or scraping of the vessels.

In old animals the presence of cysts in the ovaries, or certain pathological changes in their structure, may render their removal somewhat difficult; cysts can be punctured and their volume so reduced as to permit extraction through the ordinary-sized wound, otherwise the opening must be extended. If the Sow should happen to be pregnant, removal of the ovaries must be deferred until after parturition.

After-Treatment.—Beyond cleanliness and spare diet for a few days, it rarely happens that anything more is necessary.

Ovariotomy in the Bitch.

Sometimes, though rarely, Bitches undergo ovariotomy, either because of diseased ovaries or with the view of extinguishing the sexual function and its attendant inconveniences.

The peculiar arrangement of the broad ligaments renders the operation more troublesome than in the animals just alluded to, and modifies the procedure so far, that in one method an incision has to be made in each flank for the removal of its corresponding ovary, and in another both ovaries are taken away by an opening made at the linea alba.

Instruments.—These are the same as for the Sow.

Position.—Latericumbent or dorsicumbent, according as the operation is to be at the flank or at the linea alba. The animal is placed on a table or bench.

Operation.—An anæsthetic should be administered, and the skin at the seat of operation well cleansed and disinfected, after the hair has been removed, if the flanks are the seat of incision.

Technic.—In the flank operation the incision is made in the same manner as in the Sow, but slightly lower and nearer the last rib; the other steps are also similar, only one ovary being sought for and removed on one side. The cornu is very small in young bitches, but it must be found, as it is a guide to the ovary. This is excised in the manner indicated for the Sow, and when this has been accomplished the wound is closed by suture, the animal turned over, and the second ovary removed in the same way at the other flank.

In operating by way of the linea alba, the incision is made in the abdominal wall, between the two last teats, as far as the next two teats, or even a little beyond The two forefingers are passed into the abdominal cavity, where they act as forceps, and all the other fingers are closed, the backs and knuckles making the necessary pressure and keeping the bowels from escaping. The uterus is found near the loins, above the bladder; when discovered, the right fore-finger is passed forward along it until the ovary is reached; this is torn away gently with the finger-nail from the broad ligament, and lifted up to the incision, where it can be removed a short distance off by scraping or torsion. The same procedure is followed in the removal of the other ovary. The wound in the peritoneum and other tissues is closed by suture, cleansed, and dressed with antiseptic fluid or powder; an antiseptic pad is placed over it, and retained by a bandage round the body and between the thighs.

After-Treatment. — Very little food should be given for twenty-four hours, and the animal must be kept quiet. A muzzle ought to be worn until the wound is healed.

Ovariotomy in Fowls.

The operation is practised on fowls with the view to hasten fattening and improve the quality of the flesh, and in this way to render the birds more valuable for food. The situation of the ovaries in the lumbar region of the fowl has been referred to, and it was remarked that in early life the right ovary becomes atrophied, so that there is only the left ovary to remove; this is situated in the left side of the sublumbar region, a little beneath and in front of the corresponding kidney (Fig. 482, 1), behind the diaphragm, but above the liver and intestines, and is largely composed of a mass of vesicles or granules. The fowls should be operated on, if possible, when young—at three or four months.

Instruments.—A short-bladed bistoury is all that is required by some operators, but others use instruments which they consider facilitate the operation. For instance, an implement named a 'spreader' is employed to keep the wound open while the finger is in search of the ovary (Fig. 502, *c*), and another, the 'gripper,'

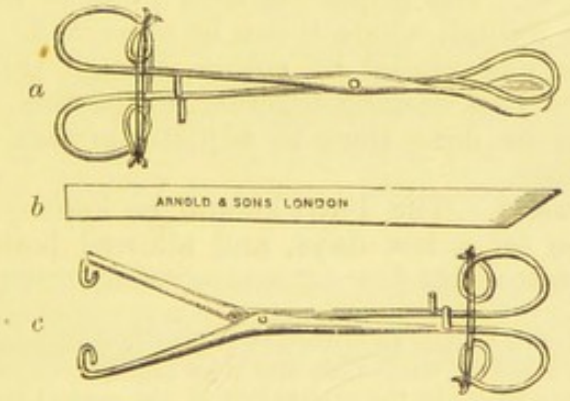


Fig. 502.—Instruments for castrating Poultry.
a, Gripper; *b*, knife; *c*, spreader.

seizes that organ (Fig. 502, *a*). By employing these an assistant may be dispensed with.

Position.—The Fowl is placed on the right side on a small table, and an assistant holds the legs and wings; but it is better to adopt the following plan for securing the bird, as directed by an expert: Take two pieces of moderately thick string, three feet long, and tie half a brick, or any other weight, to the end of each piece; the other end of one string is tied round the feet, and the weight is dropped over the right end of the table; the second string is tied around the wings, close to the back, and the weight at the extremity is suspended over the left end of the table. In this way the creature is made fast, and if the table measures three feet by two feet the operation can be more easily performed.

Operation.—This should be undertaken, if possible, in dry and moderately warm weather, and the Fowl must have fasted for a day at least. A good light is also necessary, so that a bright, sunny day should be selected. The Fowl having been placed

on the left side and tied, the feathers are plucked from the skin between the last rib and hip, and those around this denuded space are wetted with very cold water, which not only keeps them better out of the way, but also helps to deaden sensation.

Technic.—The operator, standing at the back of the Fowl, pushes the point of his knife to a depth of half an inch between the first and second ribs from the hip, and cuts downwards and forwards to their lower end, and upward to near the spine, so that there is plenty of room for the passage of the finger, the wound being about an inch in length. The operator now pushes his fore-finger into the abdomen until it meets the ovary, which he incises or scratches horizontally by a backward and forward movement of the finger-nail, until no vesicles can be felt; these fall into the abdomen, where they are gradually absorbed. Care must be taken not to scratch through any considerable bloodvessels.

If the 'spreader' is employed, this is put into the wound between the ribs, the amount of spread being controlled by the elastic band on it. The gripper is used to seize the ovary and bring it near the wound, where it can be extracted.

The wound may be closed by suture, though this is scarcely necessary, as the ribs coming together effect this, and nothing more remains to be done than to adjust the wet feathers and release the creature.

After-Treatment.—The Fowl should be kept quiet by itself in a warm place for a few days, and allowed boiled grain and plenty of cold fresh water.*

* In some localities in France an operation is practised on female Fowls which is said to render them sterile, while inducing more rapid development and fattening. This operation consists in the extirpation of the conical membraneous and glandular cavity which communicates with the posterior portion of the outer compartment of the cloaca, known as the *bursa Fabricii*, after its discoverer. It is found in male and female Birds, and is situated more posteriorly than the rectum; it opens into the upper part of the cloaca. The procedure is as follows: The legs are tied with a piece of hemp or ribbon, and the operator places the Fowl between his knees, the wings pressed against its body, and its head hanging between his legs, its belly being towards him. An assistant holds its tail down towards its back. The operator then carefully removes the feathers from the space between the croup and the anus, after which he incises the skin from right to left, about one-sixth of an inch above the anus, and parallel to the croup, completing this transverse incision by a short vertical incision at each end. This cutting is done by dressmakers' scissors. The skin is now dissected from these incisions towards the croup; then, with a strong pin or sewing needle, he tears through the connective tissue, and exposes the cylindrical organ subjacent to the cloaca, seizes it with forceps, draws it gently through the wound, and separates it from the parts to which it is attached by torsion. The skin is then replaced and maintained in position by a few sutures.

It is possible that the inflammation set up by the removal of this bursa extends to the oviducts, and leads to their obstruction and consequent loss of function of the ovary. As the operation is also practised on the male, the same result would happen with regard to the seminal canals. This extension of the inflammation from the upper part of the cloaca to these male and female passages has occurred experimentally, when the actual cautery has been substituted for the knife.

CHAPTER II.

OPERATIONS ON THE UTERUS AND VAGINA.

Operations on the uterus and vagina are rare in animals, when compared with those practised on the human female. Sometimes, though very infrequently, the interior of the organs has to be treated for disease or morbid growths, and the uterus itself has to be incised, or replaced when everted or extruded; it has also to undergo total excision in certain circumstances. The vagina is also sometimes the seat of disease and tumour, and it is occasionally prolapsed or ruptured. The clitoris has been excised in cases of nymphomania.

The condition of these parts can be ascertained by examination with the eye and hand, though vision is limited to the labia and cavity of the vulva, the vestibule and interior of the vagina, the meatus urinarius, and the cervix of the uterus when the vagina is dilated, in the larger animals. In order to inspect the interior of the vulva, vestibule, and vagina, the labia must be well separated by a hand placed inside each, after the tail has been raised or drawn to one side, and the light of the sun or reflected light allowed to enter. This inspection is, however,

Fig. 503.—Reflecting Vaginal Speculum.

greatly facilitated by the employment of one of the several forms of vaginal dilators or specula introduced into practice at different times. One of these has been already noticed (Fig. 377); two others may now be alluded to. One is merely a reflecting speculum (Fig. 503), which enables the explorer to obtain a view of the vaginal surface; the other speculum (Fig. 504), introduced by Meadows and improved by Polansky, is more useful, as it widely dilates the canal at the same time that it affords a view of the interior by means of its reflector. By a simple mechanism, its side-blades can be thrown considerably apart by means of handles which act upon them.

An exploration by the hand is also necessary when the condition of the mucous membrane of the vagina has to be ascertained, as when it is injured, torn, or its wall has been perforated, or when it is the seat of tumour; the condition of the uterine cervix can also be discovered by a manual examination, as when it is indurated, lacerated, spasmodically contracted, impervious, twisted, or diseased, or when the uterus is prolapsed through

the os ; sometimes the interior of the uterus can be examined by the hand when the os is suitably dilated ; in the same manner the urethra, and even the cavity of the bladder, is accessible to the fingers. In this examination, great assistance may often be obtained by palpation through the floor of the rectum. In the

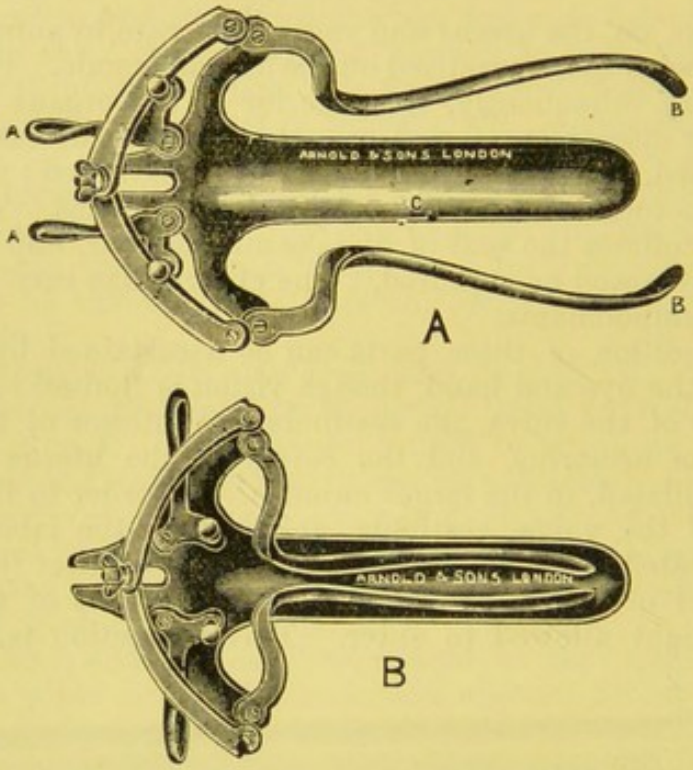


Fig. 504.—Polansky's Vaginal Speculum and Dilator.

A, The speculum extended : a, a, handle ; b, b, dilators ; c, reflector. B, Speculum closed.

smaller female animals palpation is limited to one or two fingers, but a small vaginal reflecting speculum (like Fig. 503) might become useful. Palpation of the lower abdominal wall, towards the inguinal region, may sometimes be of service in ascertaining the condition of the uterus.

Tumours in the Uterus.

Tumours in the uterus are of much rarer occurrence than in the human female, and they are more frequently observed in the Cow and Bitch than in the other domestic animals. Fibromata are the most common, though sarcomatous and carcinomatous tumours are found. Tuberculous deposits are often met with in the uterus of Cows, and occasionally they are of great extent.

Sometimes uterine tumours are so large as to simulate pregnancy, though animals which have them are generally sterile ; a manual examination by the genital canal or through the wall of the rectum, may lead to their detection if their presence is suspected.

Operative treatment for their removal will depend upon their situation and shape. The ecraseur will be found most advantageous in extirpating them; ligation is usually difficult, if not altogether impracticable.

Inversion, Eversion, or Prolapse of the Uterus.

This accident occurs most frequently in Ruminants and Swine, much more rarely in Mares and Bitches; it is usually observed soon after parturition, when the cervix and the uterine ligaments are much relaxed, and there has been great straining on the part of the animal, or severe force has been exercised in removing the fœtus, or its enveloping membranes after birth has taken place. As the accident is therefore included in the category of those incidental to parturition, and fully dealt with in works on veterinary obstetrics,* it will be only referred to briefly here.

The eversion is complete or incomplete, according as the organ is prolapsed beyond the vulva or has not got much beyond the os; it is also simple when the uterus is uninjured, and there is no extension or displacement of any other organ; or it is complicated when the organ is wounded or torn, or there is protrusion of other viscera.

The symptoms vary with the degree of inversion, but they are generally very distinctive. The chief one is protrusion of the organ beyond the vulva when the accident is complete, but when it is incomplete an examination in the vagina is required to discover it. If the uterus is not seriously injured, reposition should be effected as soon as possible, and measures adopted to prevent recurrence of the displacement, according to the directions given in text-books on obstetrics. If the organ is torn or wounded, this condition must be attended to before reduction is attempted; if the injuries are so serious, or the state of the organ itself is so bad, that it would be hopeless to expect the animal to recover, even if reduction were successful, amputation offers the only chance of saving its life.

Torsion of the Uterus.

This condition is also dealt with in books on veterinary obstetrics, and the several methods of detorsion are explained. In those cases in which reduction cannot be effected by simple measures, as through the vagina, laparo-hysterotomy has been more or less successfully resorted to.

Laceration and Rupture of the Uterus.

The uterus is exposed to laceration and rupture, more particularly during parturition, and these accidents are all the more serious because at that time the os uteri is dilated and the

* In my work on Veterinary Obstetrics (second edition, London, 1896), the accidents incidental to pregnancy and parturition in animals are fully described, and their treatment indicated.

external air can obtain admission to the interior of the organ. In some cases the lacerations only involve the mucous membrane; in others all the membranes are torn, and the uterus opens into the abdominal cavity. The uterus is sometimes ruptured during pregnancy, at parturition, or immediately afterwards, when it generally complicates inversion. Rupture during pregnancy is always most serious, as it is also during or after parturition, but it is not so grave when the uterus is completely inverted.

Rupture during pregnancy will, in the great majority of cases, necessitate recourse to laparotomy and hysterorraphy, and also very frequently to hysterotomy. The rupture, when accessible, can be sutured, but this is generally scarcely necessary, unless it is in the floor of the organ. Lacerations must be treated according to their indications, but, as a rule, little can be done except to keep the interior of the uterus clean, and frequently inject into its cavity chinosol or carbolic solution (1 to 500) or that of mercury bichloride (1 to 4,000).

(See works on veterinary obstetrics.)

Hysterotomy—Metrotomy.

There are occasions when it is imperatively necessary, in order to save an animal's life and restore it to usefulness, to amputate the uterus. When this organ is so diseased or injured that its restoration to a fairly sound condition is impossible, or when its reposition after inversion cannot be effected, then its excision is rendered imperative. The operation has been successfully performed on the Mare, Cow, Goat, Ewe, Sow, Bitch, and Cat. In the Mare the operation is more hazardous than in the Cow or smaller animals, and much of its success depends upon the state of the animal and the time that has elapsed since inversion or injury occurred.

Instruments and Appliances.—The selection of these will depend upon whether amputation is to be effected by means of the ecraseur, the inelastic or elastic ligature, simple or multiple ligature, or the clamp. If by the ecraseur, the instrument and the chain should be strong; if by the inelastic ligature, there is nothing better than strong antiseptic whipcord; by simple ligature whipcord only is necessary; but by elastic ligature a long piece of india-rubber tubing is required; for the multiple ligature a strong needle—a saddler's or sacking needle answers well—five or six inches long, and a piece of whipcord, are needed; if by clamp, one similar to those recommended for umbilical hernia will suffice. If amputation is to be made by Esmarch's method, a very long and strong elastic band must be provided.

Position.—With the larger animals amputation of the uterus can be accomplished in the standing position, but they must be safely secured. The hind-limbs of the Mare should be fixed by hopples or side-lines, but it is best to put the animal in the stocks if this position is preferred. The animal may also be placed

latericumbent, though this position is not so convenient for operating.

For small animals the latericumbent position is the best.

Operation.—Before doing anything, the operator must assure himself by careful examination of the prolapsed uterus that there is no intestine within it; if there is, it must be withdrawn by rectal taxis and external manipulation. This inclusion of intestine in the inverted uterus may occur in all animals, but it is most likely to happen with the Mare. If there is any doubt, it would be most advisable to make an exploratory incision in the body of the uterus in order to ascertain whether intestine is present, before amputation is attempted. Before commencing to operate on large animals, it is a good plan to wrap the uterus in a large towel or sheet, so that it can be more readily moved about by the operator or his assistants; this also makes the operation cleaner and less repulsive-looking; but before this is done, the uterus must be freed from all foreign matters adhering to it. It may be well to administer a narcotic immediately before commencing. It should be observed that, in applying constriction to the pedicle of the tumour formed by the uterus, every care must be taken to keep the meatus urinarius clear of it.

Technic—Amputation by the Ecraseur.—The chain of the ecraseur is passed around the pedicle, the uterus being held horizontal if the animal is standing, and the handle or lever turned very slowly when constriction begins to be noticed; a number of turns are to be made, then a brief pause, and so on until the mass comes away; the amputation will require some minutes, and the more slowly the chain is tightened the less chance there is of hæmorrhage. The stump is to be gently returned into the vagina, and the parts around the vulva cleansed. The ecraseur has been employed successfully with small animals, but its safety with the Mare or Cow is doubtful, as the peritoneal cavity is opened, and discharges may find their way into it and give rise to septic peritonitis.

Amputation by the Inelastic Ligature.—When the pedicle is not much swollen, amputation may be effected by the whipcord ligature. The cord doubled, is placed around the pedicle, one end is passed twice through the loop formed, so as to make a running loop, and each end is tied in the middle of a piece of stick, in order to afford a good grip for the hands. When the loop is evenly placed near the vulva, it is gradually but firmly tightened by pulling at each end of the cord; short intervals should be allowed in this tightening process, until at length the constriction has completely stopped the circulation of blood in the organ, when the cord is to be tied in a knot. The uterus can then be cut away a short distance from the cord—an inch to three inches, according to circumstances—and the ligatured stump carried into the vagina.

Amputation by Elastic Ligature.—The procedure in this method is similar to the foregoing. A long piece of india-rubber tubing is applied around the pedicle, and firmly tied there. The tissues

are cut through by the continuous pressure, which causes obliteration of the bloodvessels.

Amputation by Multiple Ligature.—The procedure is the same as in excision of prolapsed rectum by this means, and is resorted to when the tumefaction at the pedicle of the tumour is so great that the simple ligature might not exert sufficient compression to produce complete effacement of the bloodvessels. A stout needle armed with a double piece of whipcord is passed through the middle of the pedicle from above to below, or *vice versâ*, and the twine cut off close to the eye; there are now two pieces of cord, and one of these is tied firmly round one half of the pedicle, the second piece being tied around the other half. Then the uterus is cut away, and the stump returned to the vagina.

Amputation by Clamp.—The clamp is applied to the pedicle as for umbilical hernia, and the uterus is removed. The clamp must be left on the stump outside the vulva for at least twenty-four hours, when it is to be taken away and the stump put into the vagina.

Amputation by Esmarch's Method.—This is effected by winding around the uterus, commencing at the distal end and proceeding as high as the pedicle, an elastic band, so as to press the blood back into the body; above the band around the pedicle is firmly tied a piece of india-rubber tubing, so as to prevent a reflux of blood. The elastic band is then removed, a piece of whipcord is tied tightly around the pedicle, the tubing is dispensed with, the bloodless uterus is excised, and the stump is pushed well into the vagina.

If after excision of the uterus by any of these methods there is hæmorrhage, injection of cold water into the vagina will check it; the canal may be tamponed with fine tow or lint steeped in cold and slightly astringent water.

After-Treatment.—In some cases the animals do not appear to be much disturbed after the operation, but in others they are very restless. Light diet must be allowed for a few days, and the animals made comfortable. The vagina should be washed out at least once a day, and antiseptic fluid—dilute chinosol or Condy's fluid by preference—injected. If micturition is difficult the urine must be withdrawn by catheter.

It is advantageous to have the animal standing, with the hind-quarters considerably raised, if there is straining and danger of the vagina becoming prolapsed.

(For fuller details see text-books on veterinary obstetrics.)

Laparo-Hysterotomy.

Laparo-hysterotomy, gastro-hysterotomy, and abdominal hysterotomy, are terms usually employed to denote opening the uterus through the abdominal wall, for the extraction of the fœtus or fœtuses when they cannot be removed by the natural channel. The uterus is rarely extirpated under such circum-

stances, unless it is seriously injured or diseased. If it is not, and the parent is to be permitted to live, the incision in the wall of the uterus is closed by suture (hysterorraphy), and the organ is allowed to remain in the abdomen, the abdominal wound being likewise closed. Or, instead of for a fœtus, the uterus may be opened by this way for the removal of a tumour from its interior, or in case of rupture, displacement, or disease; but this need not necessitate complete excision of the organ. Perhaps it would be advantageous to distinguish abdominal incision of the uterus from its entire removal by employing the term 'laparo-metrotomy.'

In the larger animals incision or excision of the uterus through the abdominal wall is one of the longest, most fatiguing, and most difficult operations in veterinary surgery; while for the animal itself it is one of the most serious, because of the great extent of the two wounds, especially in the gravid uterus, the hæmorrhage, and the escape of blood and other fluids into the peritoneal cavity. Besides, the animal may be in a very prostrate condition before the operation is begun, and if it rallies from it the difficulties attending after-treatment are most formidable, owing to the quadrupedal position of the patient; for after section of the abdominal parietes the mass of intestines presses heavily on that part of the abdominal wall which has been incised; so that it needs much careful management and supervision to effect cicatrisation, and to procure such a solid adhesion of the margins of the wound that enterocele will not occur.

Notwithstanding the seriousness of the operation, and the obstacles and disadvantages the operator has to encounter, a fair measure of success has been met with, the mortality averaging from 50 to 71 per cent. This certainly shows a very heavy loss, but it is possible that with as much care in the application of antiseptic principles as the veterinary operator may be able to exercise, the fatality might be very considerably reduced. We are not dealing with the fatality among the young creatures removed from the uterus in this way, as that is treated of in obstetrical works. The Sow appears to withstand the operation better than other animals, and shows a very much larger proportion of recoveries. The Bitch and Cow come next, and the Mare last, the operation in this animal being nearly always unsuccessful in its results.

Death is usually due, when not immediate, to septic peritonitis or metro-peritonitis—showing that if antiseptic measures could be well carried out a fatal termination to such cases would be less frequent, and animals now allowed to die because of the evident hopelessness of successful operation, might be more often operated upon with better hope of their recovery.*

Instruments and Appliances.—These have been already detailed in describing the operation of laparotomy. They consist chiefly of a scalpel, probe-pointed bistoury, scissors, forceps, broad

* I have given all the *pros* and *cons* for the operation in the work on Veterinary Obstetrics already mentioned.

retractors, suture needles, and suture material of aseptic silk or catgut. The appliances are those for laparotomy. Antisepsis should be carried out in every particular, if circumstances will permit.

Position.—This will depend upon the species of animal to be operated upon. With the Mare and the Cow the operation is sometimes attempted in the standing position, but there is danger, as well as some amount of inconvenience, in this; besides, it is such a painful and formidable operation that general anæsthesia should be produced, and this cannot be effected in the standing position. It is advisable, therefore, to place the animals on the left side, the right side being uppermost. The Bitch and Sow are often operated upon in the dorsicumbent position.

Operation.—If the animal is narcotised and completely insensible, there is no need to secure the limbs.

Technic.—The wound in the flank is made in the same manner and with the same precautions as already described; for the Mare and Cow it may be from twelve to fourteen inches in length. The opening in the peritoneum is to be of the same extent as that in the skin and muscles, and in making it the greatest care has to be taken to avoid injuring the abdominal viscera. The right hand and arm are pushed through the opening into the abdominal cavity, and the uterus is found and brought opposite the incision. Two assistants (hands cleansed and asepticised) press the sides of the wound against the uterus, which the operator incises slowly and deliberately, membrane after membrane, until he can introduce two of his fingers through the aperture he finally makes in the mucous membrane. If the uterus is in a gravid condition, care must be taken not to wound it until the peritoneal opening is made of the same length as that in the abdominal wall, and passing in the same direction. The fœtal membranes can then be punctured, and the fluids they contain allowed to escape outside the abdomen, if possible; then the fœtus can be extracted as rapidly as circumstances will permit, the umbilical cord being torn or tied, the membranes cleared out of the uterus, which is to be sponged out with warm water, and the interior swabbed with a solution of chinosol or of potassium iodide (1 to 500 or 700). If the necessity for opening the uterus is a tumour or the removal of a diseased portion, this can be done in the same way. The opening in the uterus, as a rule, need not be closed, though in some cases it may be well to apply a few sutures, which can be passed through all its membranes. Ruptured uterus can be sutured through this abdominal opening, when deemed advisable. The uterus can also be amputated through the abdominal parietes, employing either the ecraseur or catgut ligature.

After the uterus has been dealt with, and when it can possibly be done, the peritoneal cavity should be freed from blood and other fluids, and sponged out gently with warm water slightly impregnated with common salt.

The abdominal wound is dealt with in the manner described for laparotomy, and the after-treatment of the patient is the same.

Laparo-Hysterorraphy or Ventrifixation of the Uterus.

Hysterorraphy is a term sometimes employed to designate the operation of fixing the uterus to the abdominal wall in cases of chronic inversion, when that organ cannot be kept in its normal position, though ventrifixation of the uterus would be a better designation. It has been successfully performed on woman, but it has rarely been attempted on animals, so far as I am aware, and then only on the Bitch.

Instruments and Appliances.—A scalpel or bistoury; suture needles and ligatures of catgut and silk; antiseptic powder and fluid; aseptic lint or gauze; an abdominal bandage.

Position.—Dorsicumbent.

Operation.—The animal should have had a dose of laxative medicine a short time before operation. The under surface of the abdomen has the hair shaved off, is well washed with soap and water, dried, then sponged with antiseptic fluid. An anæsthetic should be administered.

Technic.—If the uterus is protruded, it is cleansed and returned to the abdomen. An incision, about four to six inches in length, according to the size of the animal, is made parallel with the linea alba, between the posterior teats, through the textures, and the abdominal cavity is opened in the manner described for inferior laparotomy. The hand is passed into the cavity, the uterus is seized and gently drawn forward to its usual position and close to the wound; the suture needle, armed with catgut, is carried through the muscles of the floor of the abdomen, through the lower surface of the uterus, and back again through the abdominal muscles; the needle is now removed from the catgut, which is tied in a firm knot, so as to bring the uterine and abdominal peritoneal surfaces in apposition. Three or four sutures will suffice. The cavity is gently sponged with warm salt water; the muscles are sutured with catgut, and the skin wound with silk thread; the surface of the belly is dried, the wound is dusted with chinosol or boric powder, a pad of aseptic lint or gauze placed over it, and a wide abdominal bandage applied moderately firmly around the body and between the hind-legs up to the loins.

After-Treatment.—The bandage and dressing may be removed in the course of three or four days, and the wound dressed with chinosol or boric powder; in two or three days more the skin sutures can be removed. If there is any offensive discharge from the vagina, the uterus should be irrigated with warm antiseptic or astringent fluid.

Tumours and Cysts in the Vagina.

These are not infrequent in the Mare, Cow, and Bitch; the tumours may be fibromatous, sarcomatous, carcinomatous, or lipomatous (the latter, perhaps, oftenest met with in the Bitch). They sometimes attain a very large size Cysts are not at all

uncommon in the Mare and Cow, especially the latter, and are usually located in the vestibule; those in front of the meatus urinarius are usually retention cysts, formed by occlusion of the ducts of Bartholin's glands, while those behind that orifice are said to arise from obstruction in the Wolffian duct.

In some cases the tumours or cysts only cause inconvenience during parturition; in others they interfere with micturition; and in others, again, they are accompanied by discharge of pus, blood, and mucus from the vagina, often complicated by straining, and even prolapse. Sometimes they become visible externally, when they are near the vulva; but when nearer the uterus they can only be discovered and examined by the hand, though the dilating speculum may also make them visible. The cysts can readily be distinguished by palpation, being soft and elastic, and when they protrude beyond the vulva they resemble bladders distended with more or less turbid fluid.

The operative treatment will depend on the nature and form, and, to some extent, on the location of the tumours or cysts. If the tumours have their attachment to the vaginal wall by a neck or pedicle, they may be removed by ligature, by the ecraseur, or by the galvano-cautery. The same means may be adopted for the extirpation of other tumours. When there is a wide base, excision leaves a large wound in the mucous membrane; this may be dealt with by sutures, and if carefully treated the wound frequently heals by primary intention.

Cysts can be dispersed by puncture and expressing the contents, or even by squeezing them in the hand.

Thrombus or hæmatoma of the vagina and vulva is sometimes observed in the Mare and Cow after parturition, and is due to infiltration of blood into the connective tissue of these parts. The mucous membrane is raised into one or more irregular swellings, and the membrane itself is discoloured. Deep and long scarifications are required to get rid of the blood, after which swabbing out with cold water and dressing with antiseptic fluid will effect a cure.

Prolapse or Inversion of the Vagina.

Inversion of the vagina may take place with or without that of the uterus. When occurring alone, it is a much less serious accident than prolapse of the uterus, and Mares, Cows, Swine, and Bitches may often suffer from it for some time without showing much inconvenience. It very often follows abortion and parturition, and is fully dealt with in my book on Veterinary Obstetrics. It sometimes occurs during pregnancy, and in that case generally disappears spontaneously after parturition. In the Bitch it not infrequently happens immediately after copulation.

When inversion occurs without that of the uterus, the latter is pushed back by contraction of the abdominal walls on a distended abdomen, and is especially exaggerated by the animal standing or lying on ground sloping considerably to the rear. The upper

portion of the wall is most involved, though in severe cases the whole of the vagina is implicated, the uterus itself having taken the situation of the vagina in the pelvic cavity; the connective tissue attaching the vagina to neighbouring parts and organs is then, as a rule, more or less lacerated, whereas in simple cases it is only more or less stretched; it then has no tendency to spontaneous reduction.

The chief symptom is the presence of a tumour protruding from between the labia, for a more or less considerable distance; in the majority of cases it is most voluminous when the animal is recumbent, and can then be best examined. It is circular in outline, varies in size, being in the larger animals from that of an apple to a large melon, and in shape it is something like a sausage; the surface is smooth, of a deep-red colour streaked with darker patches, and covered by a thick white mucus or a fibrinous exudate; though in some instances it is inflamed, excoriated by the tail or litter, and soiled by foreign matters. On its under surface is seen a longitudinal opening or furrow that leads to the urethra, while at its end is a round opening marking the entrance to the os uteri, which is either closed or partially open. At the vulva the tumour is narrow, and shows longitudinal folds or ridges, due to the constriction caused by the vulva; between the vulva and the tumour is a depression or *cul-de-sac* formed by direct continuity of the mucous membrane of both. In certain cases the cervix uteri can be discerned in the middle of the tumour. Not infrequently the tumour, if it is not large, is invisible when the animal is standing.

Inversion of the vagina may be mistaken for a real tumour, cyst, or inversion of the bladder, and *vice versâ*, and a very careful examination is necessary to avoid a mistake.

Operation.—The operative treatment is similar to that for inversion of the uterus. The surface of the tumour must be cleansed, and if the mucous membrane is much swollen, an astringent fluid (acetate of lead or tannin solution) may be sponged over it; or if it is wounded, the wounds may be sutured. Reduction is effected by pressing the tumour into the vulva by the closed fist placed in its centre; or if too large for this to be done, the mucous membrane nearest the vulva is first to be gradually and gently returned until the whole is in the passage, when this membrane should be carefully smoothed down, leaving no folds or inequalities as far as the cervix uteri. Reduction is rendered more easy if the bladder is previously emptied, by introducing the finger or a catheter into the urethra.

If there is straining or inflammation, local astringents and anodynes must be employed. The animal's hind-quarters should be raised, and if there is likelihood of recurrence a vulvar truss must be worn, or wires or similar devices passed through the labia of the vulva.*

* These trusses, labial pins, and bands and rings are described in my work on Veterinary Obstetrics.

In cases in which the tumour is in such a condition that it cannot be reduced with safety, or retention is impossible, it will be found necessary to amputate it. This can be done by ligating the mass close to the vulva by single or multiple ligatures, in the same manner as in amputation of the rectum. The after-treatment is the same.

Wounds and Rupture of the Vagina.

The vagina is most liable to be wounded or perforated during parturition, particularly in the larger animals, the hoofs of the young creatures often inflicting the damage. The Mare suffers most frequently from lesions of the vagina during parturition. Such injuries may also occur during coition, or as the result of causes operating externally. Wounds occurring during parturition are more serious than at any other time, from the liability to septic infection. When much lacerated, the torn shreds that have lost or are likely to lose their vitality should be removed, and, if necessary, the wounds sutured; the vaginal canal must be kept clean, and frequently dressed with chinosol solution (1 : 1,000).

Rupture or perforation of the vagina is a serious accident, and all the more so if it is in the floor of the canal, opening into either the abdominal cavity or the loose connective tissue around the posterior part of that canal in the Mare. In these cases the bowel or bladder may be prolapsed through the rent, and blood and other fluids may pass through it, and give rise to septic peritonitis or cellulitis; even the fœtus may fall through it into the peritoneal cavity. In the roof of the vagina the danger is very much less.

When rupture takes place near the cervix uteri it is nearly always transversal, and the vagina may in such cases be completely separated from the uterus; longitudinal rents often extend from the vagina to the cervix, and even the body, of the uterus.

The symptoms and gravity of rupture of the vagina vary considerably, according to its seat and complexity, and also to some extent upon the species of animal; in the Mare it is usually very grave, and in the Bitch and Cat the most trifling rupture, even if there is no prolapse of bowel or bladder, nearly always causes death.

The treatment of ruptured vagina will depend upon various circumstances. When it is recognised during parturition, delivery should be effected as rapidly as possible. If there is serious hæmorrhage, it may be suppressed by ice or injections of cold water when the rent is in the roof or sides of the vagina; when inferior, a bundle of tow, a sponge, or cloth damped with cold water, to which iron perchloride has been added, may be placed in the canal. If there is hernia of the bladder or bowel, this must be reduced at once. When the wound is near the vulva, an attempt should be made to suture it, as described in

ovariotomy, and too much care cannot be taken to keep the vagina clean and disinfected.

Vaginal fistula sometimes occurs as a result of injury or perforation, the opening being usually in the floor or side of the wall, and the canal runs obliquely, but does not communicate with the bladder or rectum; it contains a quantity of pus that flows intermittently from the vulva. It is readily cured by tearing the superficial wall by the finger, so as to convert the fistula into a simple wound, which only requires cleanliness and dressing with an antiseptic to heal quickly.

Recto-vaginal fistula, one of the more formidable complications, is not always satisfactory to treat. Sutures have been employed to close the wound in the rectum, when accessible, and employed with success; they were applied in the manner first alluded to, and a pessary or tampon placed in the vagina below to support them.

Rupture of the perinæum, another complication, usually happening during parturition, is sometimes very extensive, and involves the sphincter ani and rectum, thus forming a grave surgical case.

The lacerated margins of the wound, if much torn, must be freed from shreds, and then brought together by sutures, either of metal, silk, or catgut. Cold-water dressings may then be applied, but it is generally preferable to dress with styptic colloid, collodion, or chinosoled glycerine. The sutures should be supported from the vagina by a tampon placed therein; this will tend to prevent the passage of fæces tearing away the sutures in the floor of the rectum.

Another complication is *vesico-vaginal fistula*, which very often can only be palliated by treatment, not cured. When the bladder is in its place, an attempt might be made to close the fistulous opening by suture, after making its margin raw, and then removing the urine at frequent intervals by the catheter.

Occlusion of the Vagina.

This sometimes occurs after parturition, as a result of injury to the mucous membrane, and may take place at any part of the canal, but always beyond the meatus urinarius. If recent, the new cicatricial tissue can generally be broken down by the finger, finger-nail, or finger-knife; but if it has become firm and unyielding, careful dissection will be necessary to separate the sides of the canal. Should the adhesion be situated at an inconvenient distance from the vulva, a vaginal dilator will be required.

Constriction or atresia of the vagina and vulva is sometimes met with in animals, being either congenital or acquired as the result of disease, and demanding surgical interference. The character of this will, of course, vary with the nature and situation of the stenosis or atresia, but it will chiefly consist in making incisions to a depth commensurate with the exigencies of each case, and modified according to the anatomy of the part involved.

Lateral incisions, when they can be practised, are preferable to those made above or below, especially at the vulva, as the textures at the sides of that aperture have more vitality, and therefore cicatrise more rapidly, than at the superior commissure.

Clitoridectomy.

Excision of the clitoris has been performed in a few cases of nymphomania in Mares, but the result has not been satisfactory, and ovariotomy is always preferable. This organ is so rarely the seat of disease that it seldom, if ever, requires surgical treatment; but its excision by the ecraseur or by ligature is such a simple matter, should removal be necessary, that it would be superfluous to describe the operation when the anatomy and relations of the clitoris are considered.

CHAPTER III.

OPERATIONS ON THE MAMMÆ.

The mammæ of the domestic animals are exposed to injury, and are also liable to functional disturbance and organic disease, which very often necessitates surgical intervention. The greatly developed pendulous udder of the Cow is most exposed to external damage, while its exalted vascularity when its milk-secreting function is most active, predisposes it to the different forms of inflammation due to its structure and the causes which give rise to that condition. The mammæ are also sometimes the seat of new formations and specific diseases; while their appendages, the teats, sometimes alone require operative treatment, without the glands or gland being interfered with.

Wounds and other injuries of the mammæ must be treated on general surgical principles. Sutures and antiseptic treatment are necessary if the wounds are extensive, in order to prevent suppuration and the occurrence of purulent or milk fistulæ. Superficial wounds, and even deep wounds, after they are closed should be covered with some impermeable material, as collodion, and chinosol dusting-powder (chinosol, 1 part; starch, 4 parts) may be employed if that material is not at hand. Deep-seated bruises require much attention, as they are likely to involve the milk-ducts and secreting structures, which is usually indicated by the milk being tinged with blood or the presence of an ichorous fluid flowing from the teat. Here the use of antiseptics must be resorted to, not only on the surface of the gland, where it is injured, but also in the form of injection through the teat, if there is reason to suspect infection. The best agent for this purpose is chinosol (1 : 300 to 1,800).

In nearly all injuries and diseases of the mammæ, especially of the Cow, it is very essential to have the glandular mass

suspended by a wide bandage or other means, so as to diminish the strain on the affected tissues, and favour the blood circulation (Fig. 505). Such a suspensory apparatus is also most valuable for retaining warm, humid material, such as lint, cotton-wool, spongio-piline, etc., saturated with chinosol solution, in the different forms of inflammation affecting the mammæ.

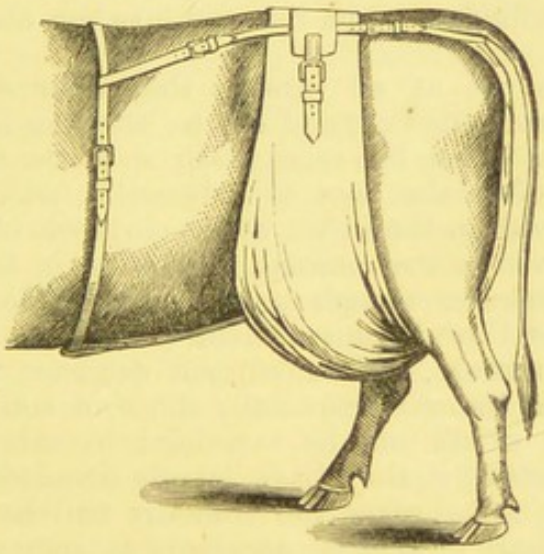


FIG. 505.—SUSPENSORY APPARATUS FOR THE COW'S UDDER.

FIG. 506.—MILKING CATHETER OR TUBE, WITH RINGS FOR ATTACHMENT OF A TAPE PASSING ROUND THE LOINS, AND SO RETAINING THE TUBE IN THE TEAT.

FIG. 507.—MILKING-TUBE PROVIDED WITH A SHIELD.

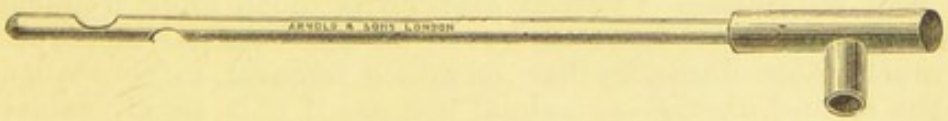


FIG. 508.—MILKING-SYPHON WITH LATERAL EXTERNAL OPENING.

In injecting fluids into the milk-ducts, unless they are antiseptic, care should be taken to have the syringe perfectly clean and the fluids themselves free from active disease-producing germs,

In order to withdraw the milk from the glands in the larger animals, and even in Sheep and Goats, milking tubes or catheters, and syphons, are most usefully employed (Figs. 506, 507, 508); it is most essential that these are kept clean, and thoroughly

disinfected immediately before they are introduced into the milk-ducts. The same remark applies to probes and other instruments employed in diseases of the udder or teats.

Abscesses in the udder must be treated according to indications and the prescribed principles of surgery. As a rule, they should be freely laid open without injuring the proper gland tissue, and, if necessary, drainage-tubes ought to be inserted; through these tubes antiseptic fluids may be injected into the abscess cavity in some cases.

Tumours are not at all rare in the udder of animals, and especially in that of the Cow and Bitch; they are not infrequently malignant in the Bitch, but more rarely so in the Cow and Mare. The udder is often the seat of tubercular and actinomycotic deposit and growth in the Cow; bothryomycosis of the udder has also been observed in that animal, as well as in the Mare. The removal of tumours, though generally possible, is not often attempted in the Cow, because of the permanent injury inflicted on the gland structure, and consequent decrease in its secretory function. Some tumours, especially those of actinomycosis and tuberculosis, it would not be expedient to submit to surgical treatment, especially if they have largely invaded the texture of the gland. In some cases the tumours can be extirpated by excision; in others it may be necessary to remove a portion or the whole of a quarter, or even the entire gland.

Extirpation of the Mammæ.

Amputation of a portion or the whole of the mammary gland is sometimes necessitated when it is affected to a more or less considerable extent with gangrene which threatens to extend, and nothing but extirpation of the dead portion will check it and save the animal; when the gland is invaded by malignant disease, is the seat of tumour or cyst, or in any other circumstances in which the organ is seriously involved, and it is advisable in order to prolong the animal's usefulness and relieve its sufferings.

Amputation of one or more divisions of the mammæ, and also of the entire mass, has been effected on Mares, Cows, and Ewes, as well as Bitches. Partial excision is much more frequently required than total removal, but in all cases partial amputation is much more desirable than complete removal, in consequence of the serious damage an animal sustains if it is chiefly valuable for milk production; and when the amputation is limited to a portion of the organ, the operator should always endeavour to spare the healthy texture as much as possible, especially if its normal secretion is likely to enter the milk-ducts of the teat belonging to the affected division, though only too frequently these ducts and the teat itself are involved.

Instruments and Appliances.—A scalpel or bistoury; dissecting, torsion, and bulldog forceps; ligature silk; aseptic lint and jute; wool and gauze; chinosol powder; tepid water; sponges; antiseptic fluid; suspensory bandage.

Position.—It is generally necessary to place the animal in a recumbent position—the Mare and Bitch dorsicumbent; the Cow latericumbent, the side of the gland to be operated upon being uppermost; the Ewe and Goat may be placed dorsicumbent or latericumbent, according to circumstances. The hind-limbs must be drawn well away from the mammary region.

Operation.—It is generally advisable to administer an anæsthetic or give a strong narcotic. The skin of the gland in the vicinity of the portion to be removed should be well cleansed, and the hair, if there be any, removed.

In cases of gangrene, partial excision is effected by enlarging the opening by which pus escapes, and separating the mortified tissues still adhering to the living parts of the gland by means of the fingers and handle of the scalpel, keeping clear as much as possible of the arteries, which must be tied if injured. When the separation is completed, ligatures must be placed round the principal vessels, the material being narrow ribbon or tape, as their walls are usually very friable, and easily torn or divided. If hæmorrhage occurs, the actual cautery or a powerful styptic can be employed to subdue it. The surface of the wound is to be dressed with antiseptic powder, the application of which is to be continued until it ceases to emit a bad odour and a crust has formed over it. The animal's strength must be sustained by good food, and by stimulants and tonics if necessary.

Technic.—When amputation is necessary under other conditions than gangrene, the skin over and around the part is washed with tepid water and soap; if there are hairs they are clipped or shaved off; the surface is then sponged over with antiseptic fluid. A longitudinal incision is made through the skin, so as to expose the gland without wounding it; or the part to be removed is enclosed in two semi-elliptical cutaneous incisions joining each other at their extremities, so as to remove the intervening portion of skin with the diseased mass; in this way less dissection is required, and there is no superfluous integument to be got rid of when the amputation is accomplished, while a more regular and even cicatrix is ensured. If the tissues are largely infiltrated and the skin is adherent to them, of course it must be removed along with them under any circumstances.

The lips of the skin wound are separated and dissected from the subjacent tissues, the handle of the scalpel assisting in this, and the part to be extirpated is fully exposed; this is seized by hooks, and if not too heavy or voluminous, the operator himself can manipulate it with the left hand while he dissects with the right; but if he cannot handle it this task must be confided to an assistant. The mass is carefully incised around its circumference while it is carefully lifted away.

If one quarter, one half, or the whole of the organ is to be removed, the procedure is the same; the mass is detached from the abdominal surface by breaking through the loose connective tissue by means of the fingers or by free incision with the knife,

taking care not to injure the abdominal muscles or tunic, especially towards the inguinal region, and ligating the more important bloodvessels that must be divided as the dissection proceeds; smaller vessels may be twisted or temporarily secured by the bulldog forceps.

If the gland is excised in mass from the abdominal surface, it is only necessary to bring the borders of the skin together by means of interrupted sutures, and over it place pledgets of aseptic lint or other material; but when the amputation has been limited to a portion of the mammæ, pledgets of lint are usually packed into the wound, and the skin is drawn over them to some extent by means of the continuous suture. In both instances, after sufficient dressing has been applied, the suspensory bandage is placed over all. Drainage scarcely requires to be considered, as the position of the wound ensures that.

The dressings are removed in one or two days, the surface of the wound is cleansed and dressed with antiseptic powder (chinosol by preference), and it is protected from rubbing or injury by covering with lint or jute and the suspensory bandage. Dry dressings should be employed, and a crust allowed to form over the wound, beneath which healing generally takes place rapidly.

Injuries to the Teats.

The injuries to the teats are wounds, which are most frequently produced in the Cow, rarely in the Mare, during the period of lactation, by the powerful traction of the offspring when the duct is empty, the milk scant, and the skin covering this part is fine and thin. Then the wound appears as a more or less deep, narrow, and sinuous ulcer, running around the teat, and having indurated and thickened margins. The indications are: prevent suckling, withdraw the milk by the teat syphon, keep the sore clean and dress it with chinosol ointment (chinosol 20 parts, vaseline 110 parts, distilled water 20 parts); it may also be lightly touched with nitrate of silver. The teat may be covered with an india-rubber capsule or ring.

Sometimes this ulcer penetrates so deeply through neglect, or an ordinary accidental wound of the teat so incompletely heals, that the milk sinus is opened at the side, and a fistula results, through which the milk escapes instead of by the end of the teat, and the flow is nearly constant. This is a great annoyance, and a cause of loss in the case of milch Cows; it is so difficult to remedy during the lactation period, that it is often necessary to wait until this ceases, when the fistula is readily cured. The ring teat syphon (Fig. 506) may be employed with advantage to withdraw the milk by the natural channel, if it is decided to attempt a cure during lactation, the syphon being allowed to remain in the teat for some time, by securing it there by a tape passing round the body, and treating the fistula with nitrate of silver and collodion.

Stenosis of the Milk-Duct.

Closure of the milk-duct in the teats of the Cow, in which it most frequently occurs, may be due to fissures, disease or injuries of the skin at the end of the teat, and growths of various kinds; it may also be congenital. The occlusion may be partial or complete. When due to disease, the symptoms gradually appear, but when congenital they are suddenly manifested immediately before or after parturition, when the gland becomes active; then the udder is distended, but no milk issues from the teat, and the distention increasing, inflammation may result. In such a case, on examining the extremity of the teat under pressure from above, if the skin is alone the obstacle there will be a slight prominence where the opening of the duct should be; if the obstacle is higher, this prominence will not be seen.

Treatment.—When the occlusion is only due to the skin, a small crucial incision through it at the prominence, by the bistoury or lancet, is generally all that is necessary. To prevent the wound closing, a disinfected probe should be passed into the

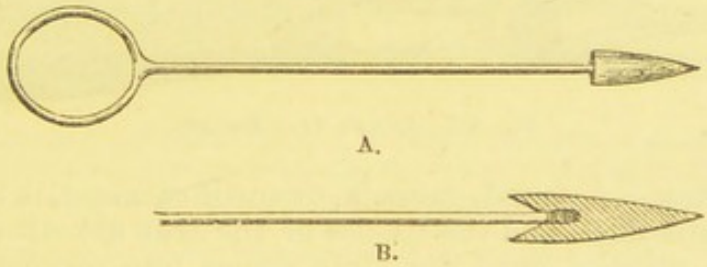


Fig. 509.—Morier's Teat Perforator.

A, The entire instrument, half the usual size; B, section of the cone, usual size.

duct very frequently, or, better still, the ring syphon may be left in until the wound is healed.

When the obstacle is higher up, attempts should be made to dilate the stenosed duct by passing probes or bougies of different sizes beyond the obstruction, and leaving them there for some hours, after being secured by a tape round the body; or small-sized ring syphons may be employed. Great care must be taken to keep these probes, bougies, or other articles passed into the teat, well cleansed and disinfected.

If the obstruction cannot be passed by any of these, a fine trocar and cannula may be thrust up the duct until a suitable channel is made; the trocar is then removed, and the cannula allowed to remain for some time, an easy matter if it is provided with rings at its lower end. A small plug of wood or cork will prevent the milk escaping from the cannula.

In other cases where the atresia is due to tumour, adhesion, or thickening, it may be necessary to enlarge the duct by a perforating sound, such as that of Morier (Fig. 509); this is an iron wire about eight millimetres long and two in diameter, with

a ring at one end, and at the other a steel cone screwed on to it; the cone has a very sharp point, and both sides have cutting edges at the widest part or base. This perforator is passed into the opening of the teat, pushed through the obstruction, and then gently turned round from side to side until no resistance is felt, when it is withdrawn, and a bougie or ring syphon introduced and kept there for some time.

Amputation of the Teat.

Amputation of the teat is nearly always performed on the Cow, in those cases in which obstruction of the milk-duct cannot be removed or overcome.

The operation is best performed in the latericumbent position, though in some animals it may be attempted in the standing attitude, the hind-limbs being secured and the bull-holder applied to the nose. Amputation may be made at any part of the teat, according to the seat of obstruction.

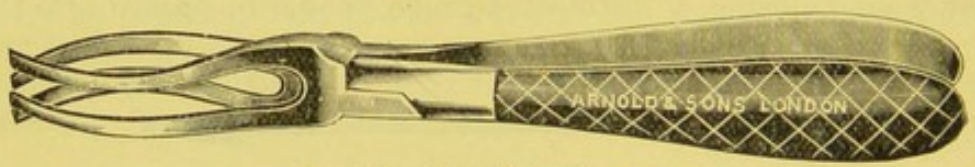


Fig. 510.—Kühn's Teat Forceps.

Operation.—A sound, cannula, or small catheter, is introduced into the milk-duct, and the tissues of the teat are cut through in a circular manner, until the knife comes into contact with the catheter. When the latter cannot be passed sufficiently high, the portion of teat to be removed may be cut off with sharp strong scissors. A still better plan, perhaps, is to employ Kühn's teat forceps (Fig. 510), which seizes the teat transversely, and holds it so firmly that amputation can be easily effected between the blades.

The hæmorrhage is usually insignificant, and when the wound is kept dressed with a dry antiseptic (chinosol), a scab soon forms under which the healing process goes on rapidly. To prevent infection and to keep the wound clean, it is advisable to protect it by the suspensory bandage. If there is much discharge of milk, this may be checked by putting a flat or circular india-rubber ring around the stump of the teat. When the wound has healed the milk flows as usual.*

* The diseases, injuries, and defects of the mammæ, and their treatment, are fully described in my work on Veterinary Obstetrics.

CHAPTER IV.

OPERATIONS ON THE MALE GENERATIVE ORGANS.

Operations on the male generative organs are much more frequent than those on the female sexual organs, and are practised with the same objects—to render the animals operated on more tractable and useful to man, by modifying the temper and disposition, to induce precocity in development, to improve their flesh in quantity and quality when it is intended for human food, as well as to cure disease, rectify defects and deformities, and to facilitate the repair of injuries.

Of all these operations, emasculation holds the foremost place with regard to frequency, a very large proportion of Horses and Cattle, as well as Sheep and Pigs, less frequently Dogs and Cats, having the semeniferous glands usually removed at an early period of life; even fowls are not exempt.

Otherwise the male sexual organs (excluding, of course, the penis, which we have dealt with in the Surgery of the Urinary Apparatus) do not often come under the attention of the veterinary surgeon.

Surgical Anatomy—Horse (Fig. 444, p. 444).—The seminal glands, testicles, or *testes*, two in number, are situated in the abdominal cavity, in proximity to the upper rings of the inguinal canals, or they are lodged in these canals themselves, previous to or at birth, soon after which they are usually found externally in the scrotum.* This sac is placed between the thighs, in the inguinal region, and the testes have found their way into it through the inguinal canals, each having passed through its own channel, and is suspended there, one on each side of the penis, by means of its vessels, but they are completely separated by a partition in the scrotum (*septum scroti*).

The *scrotum* itself is a single pouch or sac, and is lined by several membranes. It is merely the portion of skin covering this part of the body, but it is thin, covered by very short fine hairs, and provided with numerous sweat glands, as well as sebaceous follicles, which render it soft to the touch, keep it pliable, and modify the effects of friction during progression. On the middle of its surface it shows a longitudinal seam (*raphe*), which corresponds to the internal median septum that separates the testes.

The scrotum is closely lined by a rosy-tinted membrane, the *dartos*, composed of elastic tissue and non-striped muscular fibres, which forms a contractile pouch that reaches the lower (inguinal) ring of the inguinal canal, from the margin of which it spreads to the neighbouring parts, adhering closely to them, and, gradually becoming thinner, it is prolonged into the prepuce, and even on to the penis itself; it also passes between the thighs, and merges into the abdominal tunic. This contractile tunic forms two pouches, a right and left, and is in

* Anomalies sometimes occur, not only in the situation, but also in the number of the testes; they have even been reported as altogether absent, very rudimentary, or very defective in structure. In the domestic Mammals they are sometimes retained in the abdominal cavity (in the Elephant always so) or inguinal canals in adults. In other recorded instances they have been discovered adhering to the diaphragm, or lying in the sublumbar region; while external to the body they have been met with beneath the skin of the flank, beneath the abdomen and away from the scrotum; even beneath the chest, and in the crural canal. Three and four testicles are stated to have been found in the Equine species.

reality a double membrane, the inner sides of which ascend in the middle to constitute the partition between the testes, though they (the inner leaves) are kept apart superiorly for the passage of the penis between them. This septum corresponds to the raphé on the external surface of the scrotum. The dartos is related to two other internal tunics, but is separated from them by an abundance of lamellar connective tissue, which at a particular point becomes very dense, and forms a cord that strongly connects one of these tunics with the dartos. This tissue has to be torn through in what is called the 'covered operation' in castration.

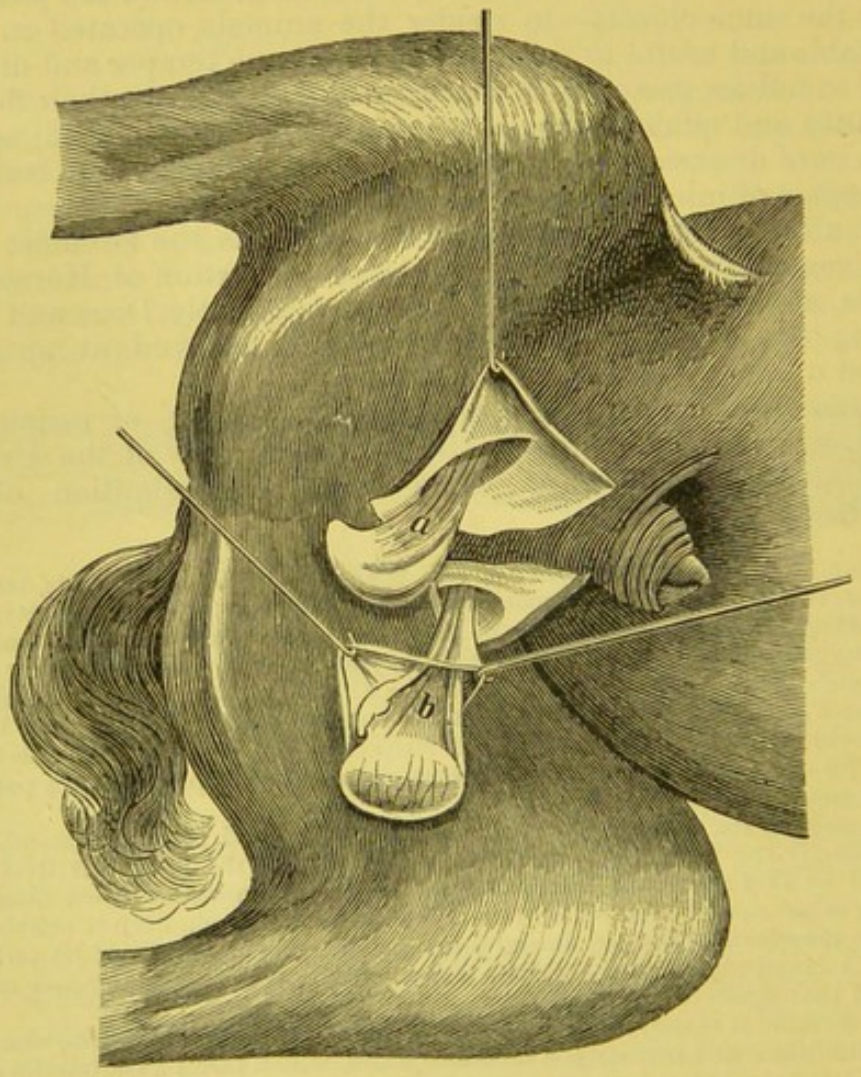


FIG. 511.—THE TESTES AND SPERMATIC CORDS. (After Cadiot.)

a, Testis in its tunica vaginalis communis; *b*, testis exposed.

It is the contraction of the dartos which causes the peculiar vermicular-like movements sometimes observed in the scrotum, the skin of which it also corrugates, and in this way aids the cremaster muscle in raising the testes. When it is not in a state of contraction the skin of the scrotum is smooth and even, and the testes pendulous.

The *cremaster muscle*, *cremasteric fascia*, or *tunica erythroïdes*, is an incomplete tunic, a dependency of the internal oblique muscle of the abdomen, in the form of a bright red band of muscle that arises from the inner or peritoneal surface of the ileo-lumbar aponeurosis, and descends through the inguinal canal into the scrotal sac, covering outwardly the tunica vaginalis at its middle part, and terminating in a number of small tendons, which are inserted into the next tunic

(*infundibuliform fascia*), to which this (the cremaster) is otherwise united by an abundance of connective tissue. It is the contraction of this muscle that causes the sudden ascent of the testes.

The fibrous tunic known as the *infundibuliform fascia* is very thin, and is really a continuation of the transversalis fascia of the abdominal wall. It is related externally to the cremaster and dartos, and internally to the tunica vaginalis, to which it forms a complete covering, and to which it is intimately adherent, thereby strengthening it.

The *tunica vaginalis*, the innermost layer of the sac in which the testis is suspended, and which is only a diverticulum of the abdominal cavity, is merely a continuation of the serous membrane lining that cavity—the peritoneum—which

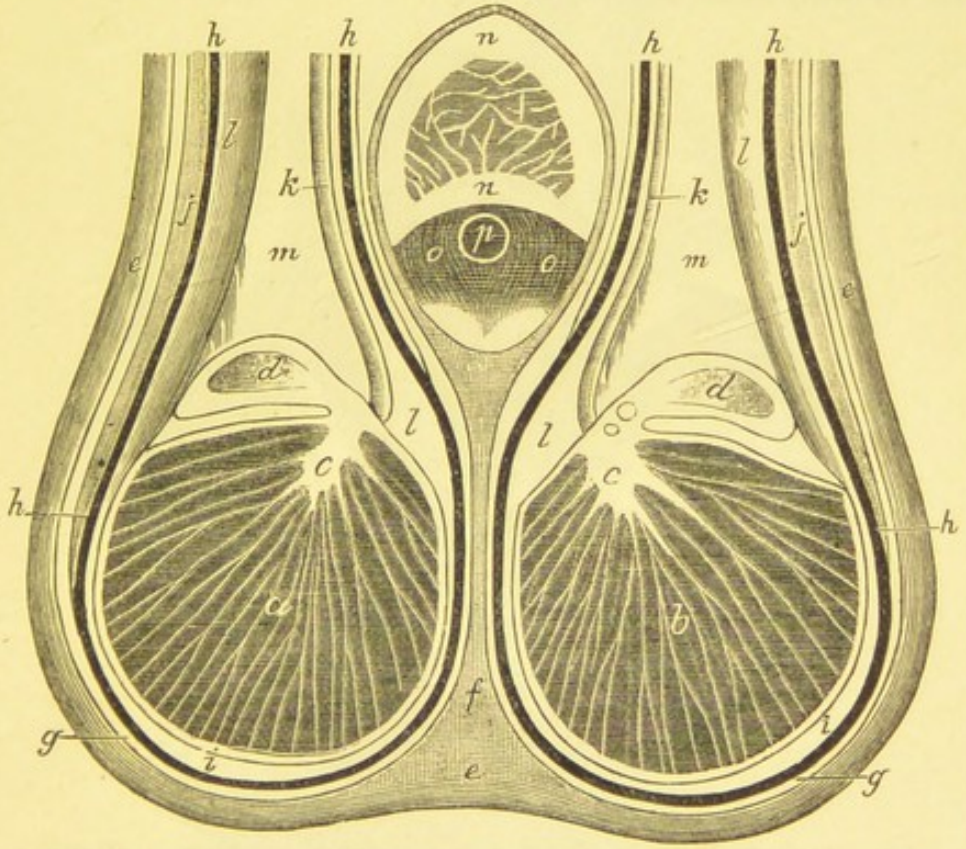


FIG. 512.—VERTICO-TRANSVERSE SECTION OF THE GENERATIVE ORGANS OF A HORSE. FROM A FROZEN SPECIMEN. (After Schmalz.)

a, Right testis; *b*, left testis; *c*, *c*, mediastinum testis; *d*, *d*, epididymi; *e*, *e*, *e*, scrotum; *f*, septum scroti; *g*, *g*, *g*, *g*, dartos; *h*, *h*, *h*, *h*, tunica vaginalis communis; *i*, *i*, tunica vaginalis propria; *j*, *j*, *j*, *j*, cremaster muscle; *k*, *k*, vas deferens; *l*, *l*, *l*, *l*, scrotal cavity; *m*, *m*, tunica vaginalis propria enveloping the vessels and nerves of the testes; *n*, *n*, corpus cavernosum of the penis; *o*, *o*, corpus spongiosum; *p*, urethra.

has been carried by the testis during its descent through the inguinal canal and beyond the inguinal ring, where it is covered by the tunics just described, and to which the collective term 'scrotum' is usually applied. This serous pouch is vertically elongated, slightly inclined downwards, inwards, and backwards; the bottom is pyriform, and contains the testis and its epididymis; the middle portion is narrow, and through it passes the spermatic cord, while the upper part or opening maintains communication with the abdominal cavity, and affords a passage for the spermatic bloodvessels and vas deferens. When the opening is abnormally wide a loop of intestine may enter it and lie alongside the testis in the sac, giving rise to inguinal or scrotal hernia. As in the abdomen, this tunic is divisible into two portions—a *parietal* and *visceral*. The former, usually desig-

nated the *tunica vaginalis communis* or *reflexa*, lines the scrotal pouch just described, while the latter is named the *tunica vaginalis propria*, and covers the testes and spermatic cords. These two layers are made continuous by a serous connection, or frænum, analogous to the mesentery which sustains the floating colon, and, like it, is formed by the junction of the two layers. This band is flat, elongated from above to below, extends from top to bottom of the sac, and is attached by its upper border to the posterior side of the spermatic cord, while its lower end passes over the epididymis, and is fixed to the testicle ; above, it is continued into the abdominal cavity in accompanying the different vessels composing the cord. A small quantity of serous fluid is usually present in the tunica vaginalis, which when in excess constitutes hydrocele. Such are the different membranes or tunics composing the external pouch containing the *testes*, commonly termed the scrotum.

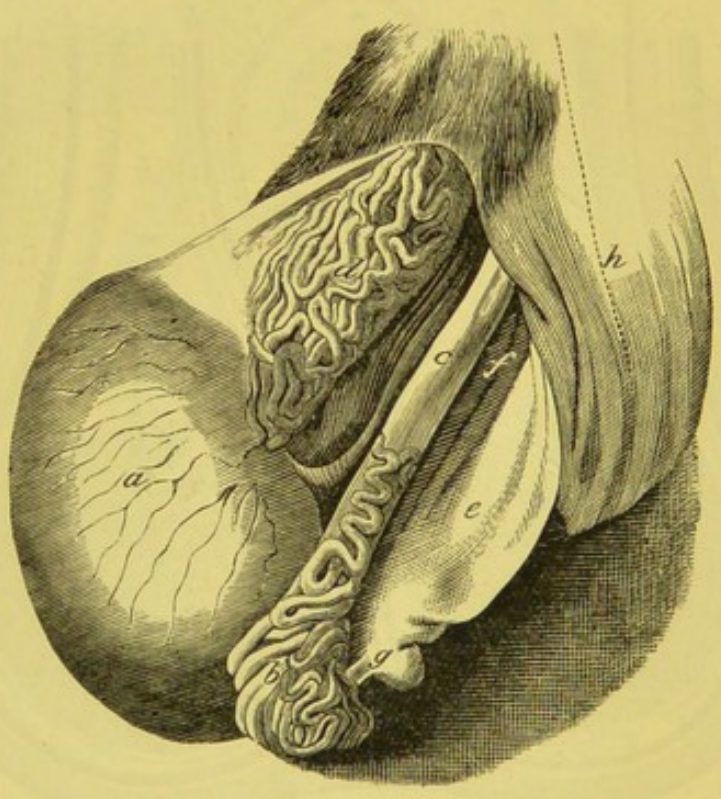


FIG. 513.—RIGHT TESTIS EXPOSED BY CUTTING THROUGH THE SCROTUM, DARTOS, AND TUNICA VAGINALIS. (After Hering.)

a, Testis ; *b*, epididymis ; *c*, continuation of the epididymis in the spermatic cord ; *d*, spermatic bloodvessels passing to and from the testis ; *e*, tunica vaginalis propria thrown back ; *f*, *f*, posterior band attaching the tunica vaginalis to the spermatic cord ; *g*, ligament of the epididymis ; *h*, scrotal raphé.

As has been said, each testis is lodged in a separate division of the scrotum, in which it is suspended horizontally and longitudinally by a cord that passes from the abdominal cavity through the inguinal canal ; the left testis is usually heavier and larger than the right, and in consequence hangs lower. For instance, in a two-year-old foal the right testis may weigh from six to eight ounces, and the left will be one to two ounces more. The testis is somewhat ovoid in shape, slightly flattened on both sides, its inferior border being much more convex than the upper, which is almost straight, and has the spermatic cord attached to it, as well as the *epididymis*. The latter is the excretory canal of the gland, and is formed by the union of its efferent ducts ; it is an elongated body situated at the upper margin, though rather to the outer side ; its middle portion is attached to the testis by a very short ligament—a continuation of the tunica vaginalis propria and commun s, while the extremities are enlarged and adhere closely to the gland ; the

largest of these (*globus major*) is commonly termed the 'head,' and contains nearly all the efferent ducts ; it is situated anteriorly. The smaller end of the epididymis (*globus minor*), or 'tail,' is situated posteriorly, is more detached, and is curved upwards to become continuous with the vas deferens ; there is seldom more than one efferent duct near it, and this is more voluminous and less flexuous than the ducts in the head. All the ducts converge to form the vas deferens, a canal about the thickness of a goose-quill, which is at first flexuous, then becomes straight, and passing upwards joins the bloodvessels of the testis to constitute the spermatic cord (testicular portion), accompanying them, however, only as far

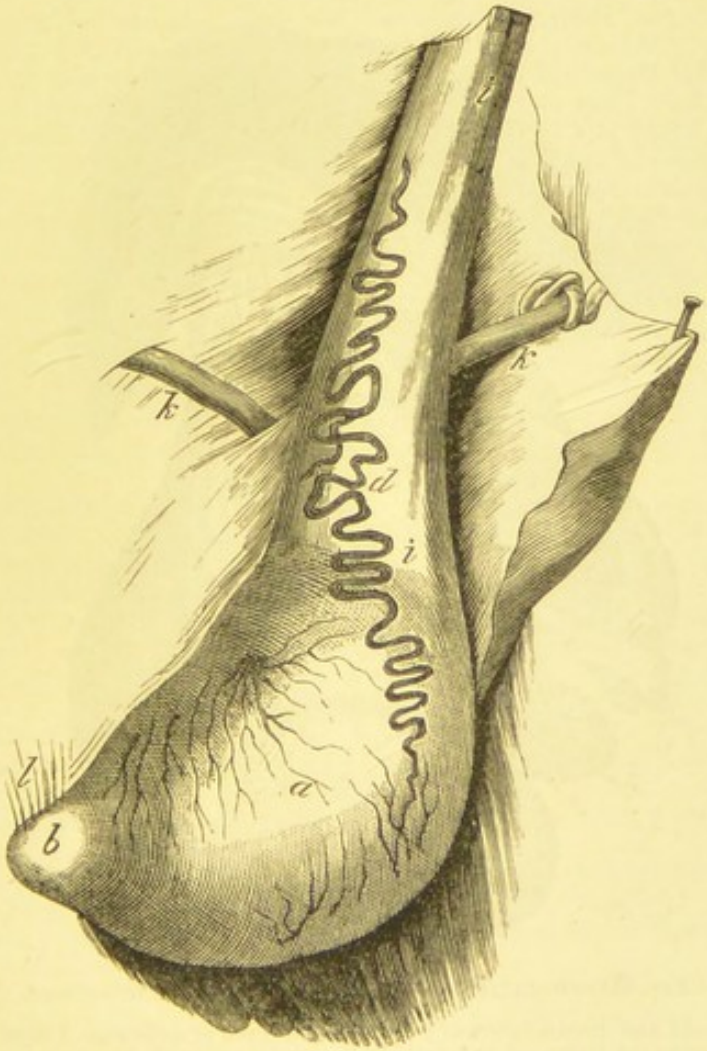


FIG. 514.—LEFT TESTIS ENCLOSED IN THE TUNICA VAGINALIS COMMUNIS, THROUGH WHICH ITS POSTERIOR PORTION IS APPARENT. (After Hering.)

a, *b*, *d*, as in Fig. 513 ; *i*, *i*, cremaster muscle ; *k*, *k*, vein of the prepuce ; *l*, dense connective tissue which must be incised in castration by the 'covered operation.'

as the abdominal ring, where it leaves them on entering the pelvic cavity and crosses obliquely the ureter and remains of the umbilical artery to become inflected backwards above the bladder, where it suddenly dilates (bulbous portion) and is prolonged as far as the neck of that viscus ; here it terminates, after passing beneath the prostate gland by a sudden constriction, where the vesicula seminalis commences, and is continued by the ejaculatory ducts. The vas deferens is sustained in the vaginal sac by a very short serous fold, a dependency of the tunica reflexa, the two layers of which envelop it and the spermatic bloodvessels to constitute the spermatic cord ; externally the duct is composed of a

fibrous tunic, and a muscular coat having three layers of non-striped fibres passing in different directions ; it is owing to the thickness of these that the vas deferens appears as a hard rigid cord.

What is termed the *spermatic cord* is composed of the vas deferens and the testicular bloodvessels and nerves. The bloodvessels are the spermatic artery and veins, which are placed in front and to the outer side of the duct. The artery is very long, and describes a great number of very remarkable flexions and convolutions before it enters the upper border of the testis, a little behind the head of the epididymis ; while the radicles of the spermatic veins, issuing from the same

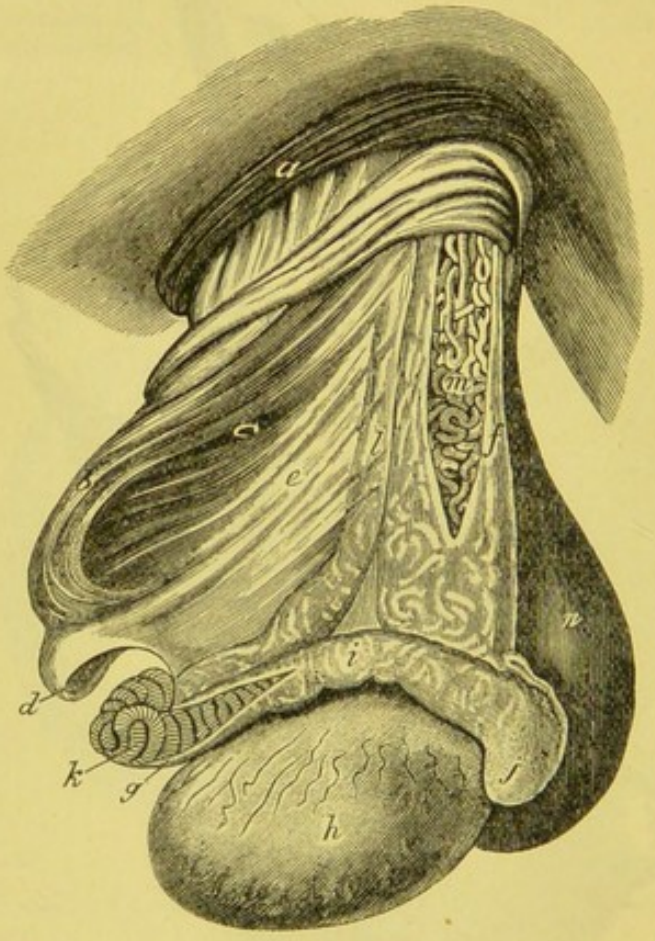


FIG. 515.—RIGHT TESTIS OF THE HORSE. (After Leisering.)

a, Scrotum opened and drawn upwards ; *b*, tunica vaginalis propria pulled back ; *c*, cremaster muscle crossing the latter ; *d*, concavity in the tunica vaginalis which surrounds the tail of the epididymis ; *e*, *f*, *g*, tunica vaginalis propria ; *h*, testis ; *i*, middle of the epididymis covered by the tunica vaginalis propria ; *j*, head of the epididymis (globus major) ; *k*, tail of the epididymis (globus minor) ; *l*, vas deferens ; *m*, bloodvessels of the testis—pampiniform plexus ; *n*, intact scrotum of left side.

point, present a wonderful flexiform and very complicated arrangement—enlacing, turning, and inflecting themselves in a thousand ways around the convolutions of the spermatic artery, ascending in this manner, with frequent varicose dilatations, as an elongated mass, which, with the flexuosities of the artery, constitute the pampiniform plexus, towards the abdominal ring, where they unite to form two venous trunks. The spermatic cord itself is supplied with blood by a special artery—the cremasteric—a slender vessel that also gives off several ramuscules to the peritoneum, iliac glands, and vas deferens.

There are numerous lymphatic vessels which accompany the veins, and are, with them, attached to the spermatic cord by loose connective tissue.

The nerves are derived from the sympathetic system, the bloodvessels forming a small particular plexus around the artery.

On the serous covering of the cord, or, rather, between the peritoneal layers that form the posterior septum and connect the parietal and visceral membranes, is a band of non-striped muscular tissue passing from the tail of the epididymis, the tunica albuginea of the testis, and the pampiniform plexus to the abdominal ring; this is the 'internal cremaster,' which, like the external, is capable of drawing the testis upwards.

Related to the testes are the *vesiculæ seminales*, the *prostate gland*, and *Cowper's glands*, but these very rarely require operative treatment in animals. The vesiculæ seminales are two oval pouches, with a smaller supplementary one between, lodged in the pelvic cavity, above the bladder and the vasa deferentia. Each vesicula has an ejaculatory duct that conveys the semen into the urethra, and not only in entire Horses but also in Geldings this canal sometimes becomes obliterated, and the accumulation of the secretion in the pouch then distends this until it attains large dimensions. The prostate gland is also situated in the pelvic cavity, at the commencement of the urethra, and lying across the neck of the bladder, with a lobe on each side of that part to which they are closely attached; it also covers the terminal extremities of the vasa deferentia and ejaculatory ducts, as well as the neck of the vesiculæ seminales. Its viscid secretion is ejected into the urethra, and in certain cases it becomes so enlarged that it may check the flow of urine from the bladder. Cowper's glands are likewise placed one on each side of the urethra in the perineal region, but above the ischial arch. They are globular bodies, denser in structure than the prostate, and are enveloped in the fibres of the compressor muscle; their mucous secretion is thrown into the urethra immediately before the semen, by several rows of openings.

RUMINANTS—BULL (Fig. 447, p. 448).—In this animal the scrotum is always of a pale colour, but the internal layers are similar to those of the Horse. The testes are very voluminous, oval in shape, but vertically elongated, the tail of the epididymis being a small free appendage inflected inwards at the upper end of the gland to become continuous with the vas deferens; while the head is wide and flat, and partly covers the anterior border of the testis, the middle portion of the epididymis being merely a narrow cord lying on the outside. The spermatic cord is composed as in the Horse, and passes into the abdominal cavity in the same manner; it may be observed that the abdominal ring is much smaller than that of the Horse, and is situated nearly at the junction of the two branches of the sartorius muscle.

The testes with their envelopes form a pendent mass, with a constricted neck, and occupy the inguinal region.

Cowper's glands are absent, while the prostate gland is comparatively small, and is prolonged on the membranous portion of the urethra. The vesiculæ seminales are somewhat different in appearance to those of the Horse, and, besides being less in size, are only two lobes.

In the RAM the disposition of the testes and vasa deferentia is similar to that of the Bull. There is no prostate gland, but there are two small Cowper's glands.

BOAR.—In this animal the testes are round, and are situated in the perineal region; the scrotum is narrow, and not detached from the body as in Equines and Ruminants, the two pouches containing the testes appearing merely as two prominences on the surface of the perinæum. The tail of the epididymis is very voluminous, and the vas deferens has no pelvic dilatation. The vesiculæ seminales are comparatively very large, and with regard to disposition are intermediate between those of the Horse and Bull. There are two prostates, one disposed as in the Horse, the other as in the Bull.

CARNIVORA—DOG.—The testes of this animal are situated in the perinæum, and are distinctly detached from the body; they are oval in shape. There are no vesiculæ seminales nor Cowper's glands, and the prostate gland, consisting of two lobes, surrounds the neck of the bladder.

CAT.—The testes are formed like, and placed in the same region as, those of the Boar. There are no vesiculæ seminales or prostate gland, but Cowper's glands are present, though they are very small.

Poultry.—In the male Fowl the testes are found throughout life in the sub-lumbar region of the abdominal cavity, behind the lungs, and below the anterior extremity of the kidneys, in front of the three last ribs, where they are held in position by the parietal peritoneum. They are close together, and in contact with the bloodvessels. Their form is usually oval, and their size varies with the different species of bird, as well as at different times; at the breeding-season they are greatly developed. There is no proper epididymis, the vas deferens passing from within the posterior extremity of the testis, and continuing in a flexuous manner backwards, it approaches the ureter on its own side when both

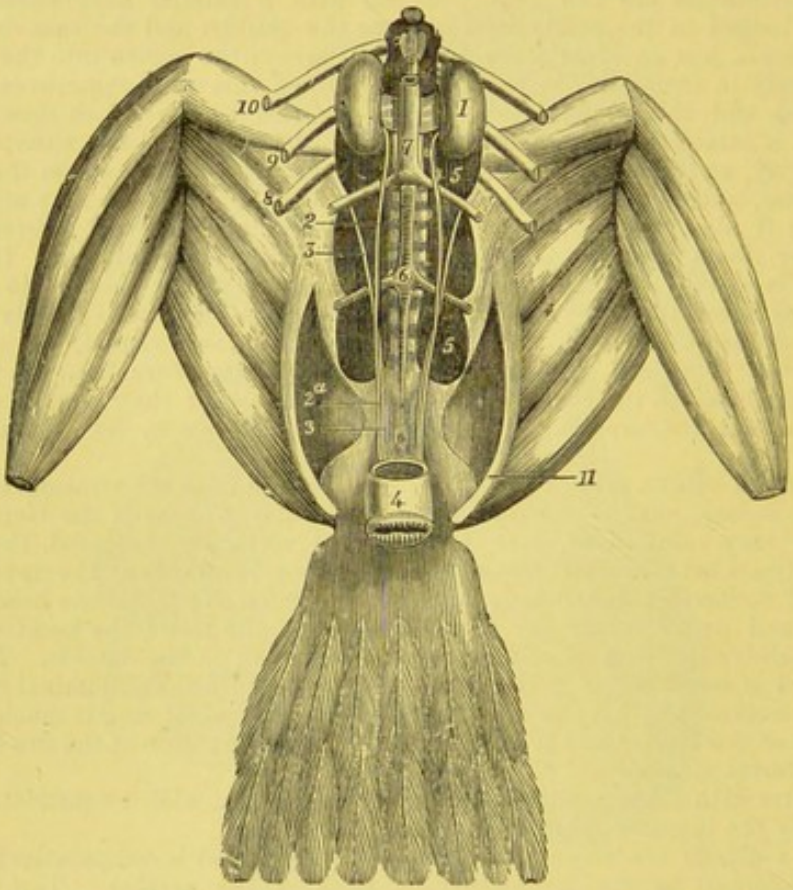


Fig. 516.—Genital Organs of a Male Fowl. (After Peuch and Toussaint.)

1, Testis; 2, 2*a*, vas deferens of each side; 3, 3, ureters; 4, cloaca; 5, 5, kidneys; 6, posterior aorta; 7, posterior vena cava; 8, 9, 10, three last ribs; 11, pelvic bones.

go alongside the kidney, the vas deferens opening into the cloaca by a particular orifice. In the duck there is, near the termination of this canal, a small oval vesicle which is always full of spermatic fluid.

Operations on the Prostate.

The prostate in animals is very rarely involved in those conditions that so frequently require operative interference in Man, and the Dog is more often the subject of prostatic derangement than any other of the domestic creatures, probably because it is large in Carnivora.

Acute and chronic prostatitis have seldom been met with in the Horse and Ox, but frequently in Dogs. It may be due to

traumatic injury, or arise from cystitis or urethritis, or other irritation of the urinary passages. This condition is denoted by difficulty in micturition and defæcation, which are generally accompanied by pain, and sometimes febrile symptoms. On exploration of the rectum, the prostate is found to be greatly enlarged, tense, and very painful on pressure.

Soothing applications to the perinæal region, hypodermic injections of morphia, cathartics, and removing the urine by catheter, or, if this is not possible, by ante-pubic puncture, is the medical and surgical treatment. When the inflammation passes on to suppuration, the abscess may open into the urethra or rectum, or at the perinæum ; fistulæ will probably form.

When medical treatment does not check the tendency to suppuration, and abscess is present, this should be opened at the most favourable point, which may be at the perinæum or in the rectum, by a covered bistoury. If in the latter, the fæces are cleared away by enema, followed by irrigation with chinosol or boric solution.

Hypertrophy of the prostate is not at all uncommon in old Dogs, and may be so great as to obstruct the flow of urine. This is the chief symptom, and an examination *per rectum* will discover the gland enlarged, dense, and painless on pressure. In this condition medical treatment is of little avail, and castration offers the only chance of relief, this operation being generally followed by considerable decrease in size of the prostate. Until this diminution has taken place to a sufficient extent, the urine may be withdrawn by catheter, or, if that be impossible, by ante-pubic puncture, in which the aspirator will be found most useful.

Operations on the Scrotum.

The scrotum is sometimes injured externally, this accident being more common in the Dog than in other animals, because of the exposed position of this part. Contusions and wounds are the most frequent injuries, and they may be more or less serious according to circumstances, and are to be treated on corresponding surgical principles, with antiseptic precautions. The scrotum may be so deeply wounded that the testicle is exposed, and if it is not injured it ought to be cleansed, returned, and the wound closed by sutures. The strain on these can be much diminished by a suspensory bandage ; indeed, this bandage will be found of the greatest advantage in treating several diseases and injuries in this region, especially in the Horse and other animals. It is made of strong cotton cloth, or even of canvas for large animals, and is triangular in shape ; to each angle at the base is attached a long piece of tape, and to the apex two pieces, on each side ; the base is placed forwards, and the tapes at each angle tied over the loins, while the apex is brought back between the hind-legs, its tapes being carried upwards on each side of the tail and fastened to the others across the back. A special testicle-suspender for

the Horse has been made of india-rubber, and is particularly useful and convenient (Fig. 517).

If the testicle is so seriously damaged that it is likely to lose its function, or if, owing to lapse of time, it has become inflamed and adherent to its envelopes, then it will be necessary to remove it in the manner hereafter to be described.

The same remarks may be applied to severe contusions of the scrotum, involving the testicle, in which not only is there hæmorrhage into the connective tissue of the scrotum, constituting *parietal hæmatocele*, but effusion of blood may be more or less extensive into the scrotal sac, *vaginal hæmatocele*, and also into

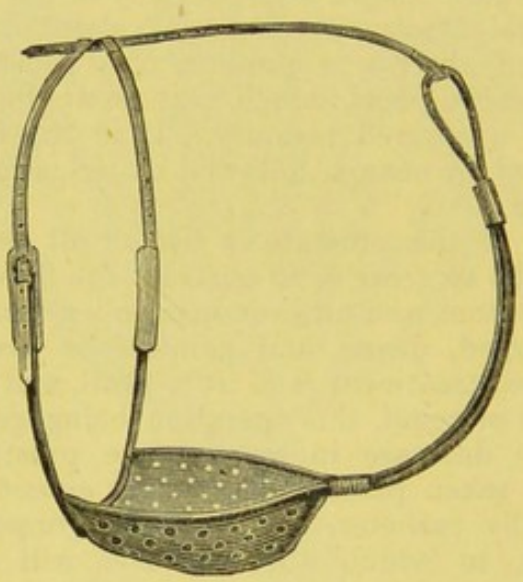


Fig. 517.—India-rubber Testicle-Suspender for the Horse.

the testicle itself, in which case it may be only slight, or the glandular tissue may be transformed into a mass of bloody pulp. When such accidents have taken place, the swelling is rapid, and sometimes very considerable, the skin is tense and shining, and crepitation may be detected; gangrene may set in, and then there can be no doubt as to the nature and seriousness of the case.

In slight contusions, warm fomentations and the use of the suspensory bandage are usually all that is necessary to promote recovery; but in the more serious case, and particularly in testicular hæmatocele, castration should be resorted to as soon as possible, and antiseptic treatment scrupulously carried out.

Hydrocele.

Effusion of fluid into the sac in which the testicle is suspended, has been observed in the Horse, Bull, Ram, and Goat. It is generally the result of vaginalitis, and not infrequently coexists with ascites, inguinal hernia of some duration, or disease of the spermatic cord. It may also be due to external injury. The

fluid is nearly always situated between the visceral and parietal layers of the tunica vaginalis communis (scrotal hydrocele); in rare cases it is contained in the duplicatures of this tunic which surround the spermatic cord (hydrocele of the spermatic cord). In scrotal hydrocele the quantity of fluid varies in the Horse from a few ounces to several pints. When the hydrocele is due to inflammation, accompanied by the formation of false membranes, the fluid may be found in multilocular sacs.

In scrotal hydrocele the scrotum is more or less enlarged at its lower portion, sometimes to a very great degree—being from the size of a cocoanut to that of a man's head—and is pyriform in shape. It is soft, elastic, fluctuating, and painless, and the fluid can be readily moved about, unless it is divided into cavities by false membranes. The testicle always occupies the postero-inferior part of the tumour, and can be easily felt. This, together with the shape of the swelling, the absence of heat and pain from the scrotum, its smooth, even surface, and the elastic, fluctuating feel, suffice to distinguish this condition from inguinal hernia, and also from sarcocele; but the diagnosis is rendered more assured by an exploration of the abdominal ring *per rectum*.

Hydrocele is sometimes treated by local remedies, such as repeated mild vesicants, but they are generally ineffective. The fluid can be removed by means of a fine trocar and cannula, or by the aspirator; but it nearly always reaccumulates, and repeated punctures may do harm by inducing septic infection. After the fluid has been withdrawn in this way, tincture of iodine (freshly prepared) has been injected into the cavity, and in some instances with favourable results. But, as a rule, the only satisfactory surgical treatment is castration, when retention of the testicle is not essential to the usefulness of the animal; and in this operation, if the spermatic cord is involved, the clamp should be employed. If there is any doubt as to the existence of hernia, the procedure in exposing the testicle is the same as in the covered operation, a small incision being made through the tunica vaginalis communis, above the epididymis, and parallel with the cord. Through this opening the interior can be explored, and if neither intestine nor omentum be found, torsion may be applied to the cord (one or two turns), and the curved clamp placed as high on it as possible. If intestine or omentum is found, however, the 'covered operation' is to be resorted to.

Varicocele.—Sarcocele.

Varicose dilatation of the veins of the spermatic cord is somewhat rare in animals, and has only been observed in the Horse and Bull, and then usually in old subjects. In some cases the spermatic arteries were involved, and opened into the veins. The cord was greatly enlarged, forming an elongated, irregular, soft tumour, which, from the appearance and size of the scrotum, might have given rise to the notion that hernia was present. A

careful examination, however, in most of such cases will prevent any mistake, and especially if pulsation is felt in the tumour. In rare cases the pampiniform plexus is enormously dilated and elongated, and when associated with varicocele is somewhat puzzling to distinguish, but with care and patience this can be done.

Tumours of the epididymis and of the testicle (sarcocele) are not infrequent in the Horse, Ass, and Bull, as well as the Boar, and sometimes attain a great size. When the testicle is involved, its surface may be quite smooth, or it may be lobulated or nodulated, this depending greatly upon the nature of the disease that produces the enlargement. Sometimes this may be carcinoma, which in many cases extends to the spermatic cord, and also affects the sublumbar lymph glands.

For varicocele and sarcocele, the operation of castration is usually the only remedy. This operation will be described immediately, but in the meantime it should be remarked that, in performing it for the cure of these morbid conditions, certain things have to be noted. When possible, the 'covered operation' should be preferred if the testicle and epididymis are only involved, a convex clamp (or clam), or a ligature being placed as high above them, and as near to the inguinal ring, as possible. This being firmly secured, the testicle may be removed by the ecraseur. In cases of varicocele the covered operation may not be possible, so that it will be necessary to open the vaginal sac, and apply the clamp or ligature high above the enlargement, great care being taken not to tear the bloodvessels, the coats of which are usually very friable. In all cases, if the clamp or ligature is firmly fixed on the sound part of the cord, the testicle and portion of the cord it is desired to remove can be taken away at once. If there is effusion into the scrotal cavity, it may be advisable, before throwing the animal down for operation, to evacuate it by means of the trocar and cannula, or the aspirator.

EMASCULATION, OR CASTRATION; ORCHEOTOMIA; ORCHIDECTOMY.

Excision of the testicles of animals has been practised from the very earliest times, the Horse, Ass, and Mule being most frequently operated upon, with the object of rendering them more tractable and serviceable, and probably in war-time less likely to reveal their presence to the enemy, because of their silence; as castrated horses have not the same tendency to neigh that entire ones have. Though Horses were emasculated from time immemorial in England, yet it is noteworthy that it was not until the reign of Henry VIII. that Mares were deprived of their ovaries (spayed).[1] Removal of the testicles is now undertaken in

[1] In addition to being one of the commonest operations to which animals are subjected, castration is perhaps the most ancient. Moses is supposed to refer to it (Lev. xxii. 24), but it is very doubtful if the Hebrews ever resorted to it; and

the domestic animals generally on economical grounds. Their excision may be necessary in consequence of disease, defect, or deformity; or it may be to render the animals more amenable to management. Thus, Horses, Asses, and Mules, as well as Oxen, when deprived of their testicles, can associate with or be safely employed along with Mares or Cows, and even with each other; while to man they are much less dangerous, and are greatly more tractable and useful. The operation also renders the flesh of those animals used for food much less unpleasant, more palatable and succulent, and of better quality. Indeed, it brings about a wonderful alteration, not only in the physical condition of the animals subjected to it, but in their disposition. Their appearance is more or less changed; their form and voice are modified; they are more inclined to fatten quickly; they are much less aggressive, and are more docile and tranquil, ceasing more especially to seek the female. The Sheep grows more wool, and that of a better quality. In fine, from many points of view, castration is an operation of great economical importance, and is therefore most extensively practised wherever animals are reared and utilised by man. It is also resorted to for the relief

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the term 'Ox,' when mentioned in the Bible, may be accepted as only meaning a young Bull fit for ploughing. Nevertheless, it has been asserted that the Israelites practised it, and that they learnt it from the Egyptians, that nation having acquired it from the Assyrians and Ethiopians. According to Hesiod, the operation was already known to the Greeks for centuries. Xenophon also gives us to understand that the Persians knew of it. These authorities speak, as Homer does, of emasculated Horses, Oxen, and Dogs. Aristotle refers to the castration, or rather spaying, of female Camels, Sows, and even Birds. The Romans extended the operation to all the domesticated animals, even, it is said, to Fishes. Mago, the Carthaginian, is the first to mention clamps as employed in its performance, and Varro and Pliny mention the most favourable age for having recourse to it. Apsyrtus alludes to cauterisation for it, and Vegetius about the same period mentions tetanus as a consequence of it; while Rusius at a later time speaks of hernia, and Estienne (A.D. 1565) of amputation. Rusius considered castration by means of the knife as dangerous, and recommended beating the testes, or, in the case of Cattle, twisting them off.

In England the operation was known to the Celts, and Geldings are frequently referred to in the Welsh laws. The English, says Polydore Vergil, were wont to keep herds of Horses in their pastures and common fields, wherefore castration became necessary; but the animals operated upon were used only by the lower people. In Germany it was also well known from a very early period, and, according to Vogel, certainly before the word 'Wallache' came into use—a word now employed to designate a Gelding or castrated Horse, but which was derived from the long-time custom of importing such animals from Wallachia. It may be noted that Berenger thought the fashion of using Geldings was Turkish or Hungarian in its origin; and it is probable that in France the name given to such Horses—*cheval hongre*—may have had this derivation.

Geldings were probably much more employed in classical times than in the Middle Ages, when noblemen considered it undignified to ride them. But then the wearing of heavy armour by horsemen necessitated the use of the heaviest breeds of Stallions. Grimestone, in his 'Generale Historie of Spaine,' speaks with great contempt of cavalry mounted upon Geldings or Mares. With the fall of the feudal system and the introduction of gunpowder, light castrated Horses and Mares were taken into favour for riding purposes. Nowadays Stallions are rarely utilised except for breeding purposes.

or cure of some abnormal conditions, such as disease of the testicles themselves or their appendages, scrotal or inguinal hernia, etc.

Perhaps no operation to which animals are subjected is more diversely practised, and it is carried out in the most primitive and painful, as well as in the most scientific and humane manner. The most brutal mode of abolishing the procreative faculty by destroying the testicles, especially in Bovines, is that known in the East as 'mulling,' in which the glands are destroyed, *in situ*, by beating or crushing them with a wooden mallet; and beating the spermatic cord with a mallet against a block of wood was practised at one time, and is perhaps now, in the North of Scotland, and in some parts of France.[1] Another very painful method of removing them is sometimes practised, by applying a clamp or tight ligature over the skin and high up around the neck of the scrotum, leaving it there until the entire mass sloughs away. In exceptional cases such a course may be necessary, but they must be very rare, and to obviate at least some of the suffering, an endeavour should always be made to exempt the skin from constriction, even though this exclusion might render the operation a little more protracted and difficult.

Oftentimes, also, the operation is performed by those who are destitute of anatomical, surgical, and pathological knowledge, and work in a merely mechanical fashion; consequently, it not infrequently happens that the animals submitted to them suffer unduly, while the mortality is occasionally great.

To describe all of the many methods of performing the operation of castration would be as useless as it might be considered tedious; so that only those which are recognised to be the best, and are therefore usually adopted, will be dealt with.

CASTRATION OF SOLIPEDS.

Horses, Asses, and Mules may be operated upon in the standing or recumbent position. The age at which the operation may be performed is not limited, from a few months to twenty years being often noted. When it is required to prevent procreation, however, the earlier it is adopted the better; as then the animal suffers less, and, as a rule, recovers more rapidly than when it has reached adult life.

Much, however, will depend upon circumstances, such as the health of the Colt, its development, spirit, etc. Large numbers are emasculated when three months old, and with uniform success. It has been remarked that with them the tumefaction and inflammation consequent on the operation are less, the danger of injury to the animal during the operation is not so great, hernia is not

[1] A similar and as cruel a mode of destroying the function of the testicles is practised on the Reindeer in Lapland, according to Bayard Taylor: 'The male Deer used for draft are always castrated, which operation the old Lapp women perform by slowly chewing the glands between their teeth until they are reduced to a pulp, without wounding the hide' ('Northern Travel,' London, 1858, p. 124).

so frequent, excessive hæmorrhage does not occur, the dejection and indications of pain are less apparent, and they thrive better afterwards. The usual age is, however, from three months to two years. Of course, if resorted to because of disease, accident, or vice, age cannot be considered, and the operation has been quite successful, so far as the castration is concerned, in old animals.

The season of the year and the weather prevailing has doubtless an influence on the result, spring or autumn and mild, dry weather being generally preferred; a cold east wind is very adverse.[1] If possible, the animals should be sheltered until they have recovered from the effects of the operation. For a day or two previously the diet should be restricted and laxative; on the day of operation no food or water ought to allowed, and for two or three days afterwards it may be limited in quantity and easy of digestion. Scrupulous cleanliness in the surroundings, and also in the performance of the operation, should be observed, and antiseptic precautions cannot be too carefully attended to. The animal should be in good health, and there ought to be no infectious diseases about.

Before operating a careful examination should be made as to the condition of the scrotum, prepuce, and adjacent parts, and especially with regard to the absence or presence of scrotal or inguinal hernia, and also as to whether the testes are descended.

When both testes are accessible and in the scrotum, which is commonly the case, the animal is said to be *phanerorchid* (*φανερος*, *manifest*, *ὄρχις*, *testis*); when only one gland can be felt, it is then a *cryptorchid* (*κρυπτός*, *hidden*, *ὄρχις*, *testis*); and when both are absent externally the horse is designated *anorchid* (*ἀν*, *without*, *ὄρχις*, *testis*). Cryptorchid Colts are not so rare as anorchids, but

[1] The notions prevailing in England with regard to the castration of Horses some centuries ago were a mixture of common-sense, ignorance, and superstition. For instance, Thomas Blundeville, of Newton Flotman, Norfolk, in his book on the 'Breeding of Horses,' published about 1565, writes, in the chapter on the 'Guelding of Colts': 'Yea, to be guelt (castrated), as some authores say, is such a cooler, as it tameth both man and beast in their greatest madness, and clean healeth them of that disease when nothing else will. Moreover, Gueldings do not neigh so often nor so loud as stoned (entire) Horses do. . . . Wherefore, I think it good here to show you the age and at what time of the year and hour it is best to gueld such Colts. And, first, as touching the age, it is best done when the Colt is almost two years old, for to gueld him younger will hinder his growth very much. Again, if he be much older, his neck will wax great, and the strings of his stones (testicles) will be so hard and strong as they will not be broken, but must needs be cut, which, as Russius sayeth, is very dangerous. Albeit our guelders here in England be so cunning and expert in that facultie as they make no matter thereof; for they will cut (emasculate) both old and young at what age soever they be, and warrant them to do well enough. And some, I assure you, do evil enough, and specially if the best time for that purpose, as well of the year as of the moon, be not duly observed. Wherefore, I would wish you to suffer none of the guelders to take your Colts in hand, unless it be in the spring, as in May or June, or else about the fall of the leaf, as also when the moon is on the wane, for these two seasons are most temperate—that is to say, neither too hot nor too cold, the excess of either of which qualities is very noysome to those that be newly guelt, and causeth many to peake out.'

though both are comparatively infrequent, yet the operator must be prepared to encounter them, and remove the non-descended organs, whether they be located in the inguinal canal or in the abdominal cavity.

The position in which the operation is performed may be the standing, latericumbent, or dorsicumbent, according to circumstances, or the fancy or convenience of the operator. The standing operation is only resorted to in the case of phanerorchid horses, the latericumbent and dorsicumbent positions being those most frequently chosen for phanerorchid, cryptorchid, and anorchid animals, and particularly if there are indications or risks of hernia, scrotal or inguinal.

The function of the testis may be destroyed by (1) ligating and excising the vas deferens (vasectomy); (2) the gland may be removed by ligating the bloodvessels of the spermatic cord; (3) by crushing and dividing the bloodvessels of the cord by the ecraseur or castrator, and cutting through the vas deferens; (4) by torsion of the bloodvessels after division of the vas deferens; (5) by division of the bloodvessels by the actual cautery; (6) by the application of a clamp on the bloodvessels; (7) by scraping through the bloodvessels after dividing the vas deferens.

Phanerorchid Castration.

Standing Position.—Many operators prefer the standing to the recumbent position, and for several reasons, among which may be mentioned the belief that the serious accidents that sometimes occur in throwing the animal down are avoided; that time is saved, and fewer assistants are required; the animal struggles much less; if there chances to be hæmorrhage, the blood does not get into the abdomen. The disadvantages are said to be: the difficulty in getting the testes sufficiently low, when the cremaster muscle is short or acts powerfully, to allow the clamp, chain of the ecraseur, or blades of the emasculator to act on the cord; the danger of the Colt throwing itself down; and the necessity for alacrity and expertness on the part of the operator.

But the advantages more than counterbalance these apprehended drawbacks, and numberless animals have been emasculated in this way without any mishap whatever occurring, and without accident to the operators. Animals of all ages have also been castrated in this manner, and it has been noted that the older they are the less they appear to feel the operation, and also the less they are restrained the steadier they stand. The seizure of the testes and incision of the scrotum, with the application of the twitch to the upper lip, seem to produce a benumbing sensation that almost deprives the animal of the power of movement.

Instruments and Appliances.—The instruments and appliances are wholly or to some extent those employed in the recumbent position in the other modes of castration. The instruments are

not many, and the operator uses those he is most accustomed to or has most reliance on.

The scrotum may be opened by an ordinary scalpel, but a castrating knife is usually preferred; this may be convex or straight on its cutting edge (Fig. 518). The spermatic cord may

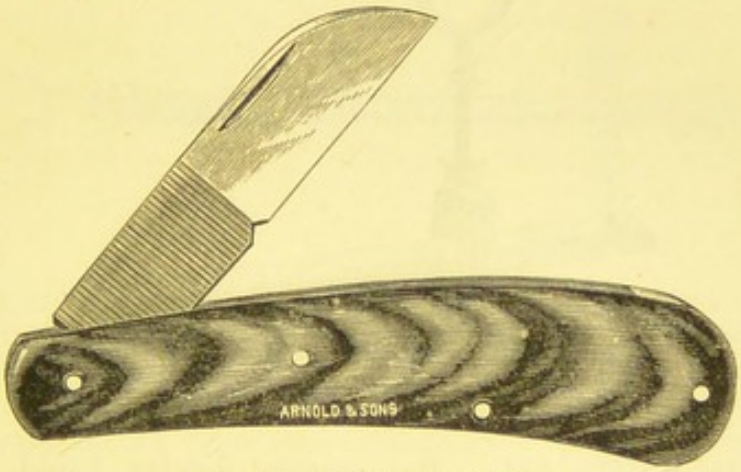

Fig. 518.—Castrating Knife.

be enclosed in a clamp, of which there are many patterns—the ordinary clamp with a longitudinal groove in each half (Fig. 519), or that with indiarubber rings at each end (Fig. 520); for greater ease in tying the two portions a screw clamp is sometimes

Fig. 519.—Ordinary Clamp.

employed to bring them together (Fig. 521). An improvement on these has been introduced by Mr. Wilkinson (Fig. 522), as a clamp for the standing operation, it being lighter and more easily manipulated; it is worked by means of a screw nut, which

Fig. 520.—Clamp with India-rubber Rings.

obviates the need for an accessory clamp, indiarubber bands, ferrule, or string; so that when the fibrous tissues are cut through, the clamp applied to the spermatic bloodvessels, and the testis is removed, there is no danger of hæmorrhage; while on the day after the operation it may be readily removed. Or

the ecraseur may be employed to cut through the bloodvessels at once, and so complete the operation. An ecraseur much used for this purpose is that of the Miles pattern (Fig. 523), and also that

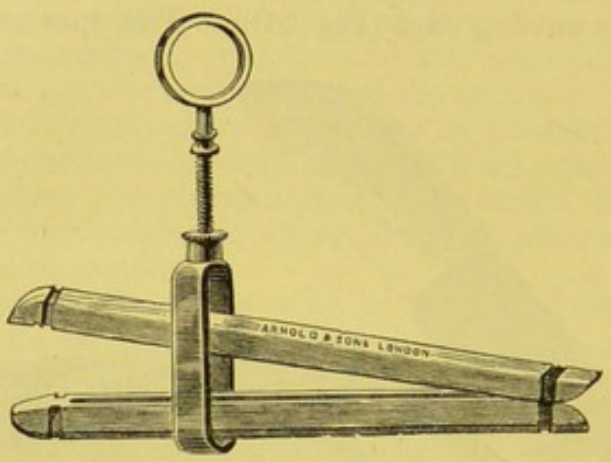

Fig. 521.—Clamp with Accessory Screw Clamp to close it.

of Robertson (Fig. 524). But certain defects found in these, when employed for the standing operation, have led to the production of an improved ecraseur (Fig. 525), which, while retaining the slow, steady action of the screw, by pushing forward the

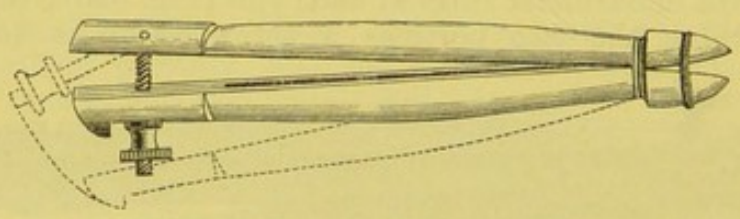

Fig. 522.—Wilkinson's Castration Clamp.

thumb-plate allows the slack of the chain to be easily pulled in, and by pulling it back again the screw movement is at once pulled into gear. The shaft is sufficiently long to make it available for the castration of Mares and Cows *per vaginam*, and is

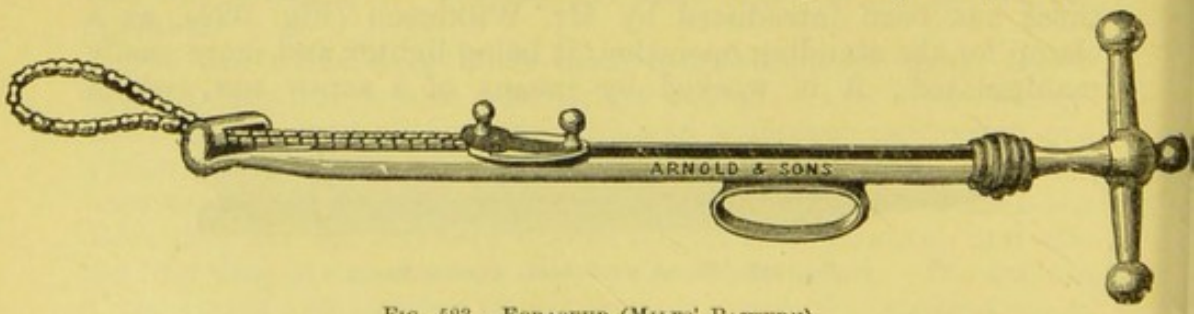

Fig. 523.—Ecraseur (Miles' Pattern).

more convenient for the castration of Horses in the standing position. The chain is bevelled on one edge, so that it crushes but does not cut, a great advantage in castration; while it can be reversed and the angular edge used when more fibrous tissue

requires to be divided. The slot through which the chain passes is also slightly blunted on the edges, to prevent the sharp cutting action which so often leads to hæmorrhage after using the ecraseur.

It is most important that the edge or border of the chain of all

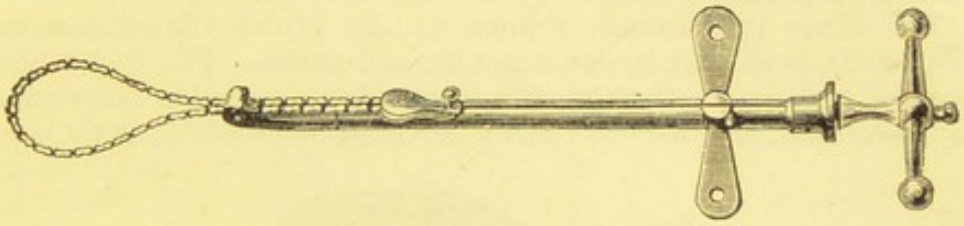

Fig. 524.—Ecraseur (Robertson's Pattern).

ecraseurs should be blunt, and that in using the instrument, when cutting or crushing through the vessels, the lever be turned slowly and steadily. The chain should be placed directly across them, not obliquely.

At a more recent date two instruments, somewhat similar in

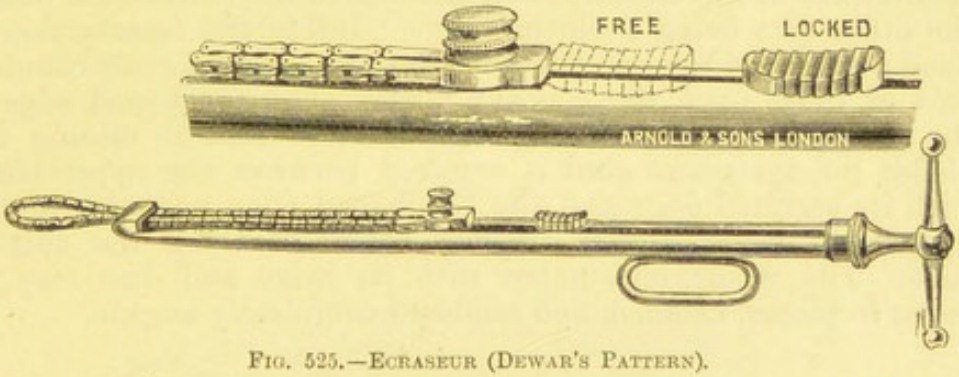

Fig. 525.—Ecraseur (Dewar's Pattern).

construction, have been introduced, which by many operators are preferred to the ecraseur or any other implement for this purpose. Acting on the same principle as the ecraseur, the 'reliance' castrator (Figs. 526, 527), as it has been named, is a kind of shears, the upper and lower blades of which are curved, with longitudinal

Fig. 526.—Reliance Castrator.

grooves on each; these blades have a series of small sharp teeth, which, when the blades are closed, fit closely between each other, and so squeeze the spermatic bloodvessels sufficiently tight to prevent hæmorrhage, at the same time holding the cord so firm as to hinder it from slipping; so that the cord is cut and clamped

at the same time. By a simple arrangement equable pressure can be obtained throughout the entire length of the blades, which confers a great advantage. It is fitted with a thumb-screw, and, being nickel-plated, it can readily be taken to pieces and cleaned. This instrument has been highly spoken of as simple and efficient for the purpose.

The other instrument, known as the Huish-Blake castrator (Fig. 528), is similar in construction and action. The upper blade is solid, and passes through the lower blade, which is fenestrated. It is serrated, and to it is fixed a serrated ledge which is the exact

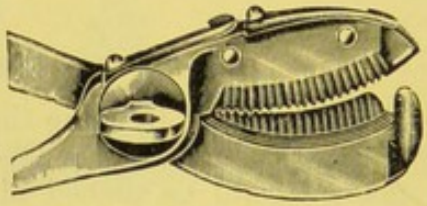

FIG. 527.—RELIANCE CASTRATOR.

counterpart of the serrations on one side of the fenestrated blade, the other side being a cutting edge. Inside the fenestration is fixed a convex disc of metal, the serrations being an exact counterpart of those upon the concave blade. The roughened edge of the fenestrated blade is slightly raised, so that in closing the blades the spermatic cord is engaged between the upper blade with its serrated edge and the roughened edge and disc of the fenestrated blade, and is crushed before reaching the cutting edge. The whole instrument with its ledge and disc may be taken to pieces, cleaned, and rendered completely aseptic.

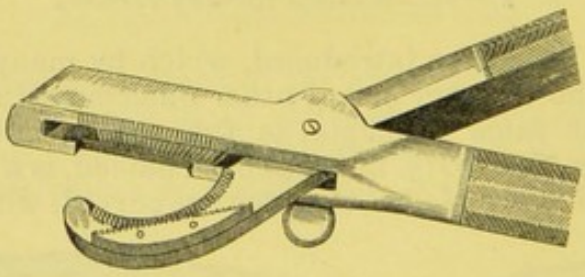

FIG. 528.—THE HUISH-BLAKE CASTRATOR.

The appliances are those articles required to render the wounds aseptic, and a long twitch to fix on the upper lip, as well as a pair of blunt-pointed scissors. Some operators employ a rope with which to fasten the Horse against a wall provided with iron rings, from two to five feet from the ground. Some, again, blindfold the animal by means of blinds or a hood.

OPERATION.—The operation may be performed out of doors, the animal being placed with its right side against a wall, the hind-quarters in a corner. Many operators employ only a long-handled twitch on the upper lip; this twitch is held by a man, who also holds

the rope of the head-collar, and perhaps an assistant, who stands at the animal's shoulder to prevent it from lying down. Others, in addition, secure the Horse by a rope passed round the neck and through the ring in the wall (Fig. 529); but experience proves that the less restraint imposed the better. The animal should be handled gently, and stroked and patted about the hind-quarter and left flank.

Some operators prefer a stall, with the tail pulled round the heel-post on the right side, and the twitch on the lip. Others, again, like a well-lighted loose-box. Sometimes the animal is completely blindfolded.

Technic.—The skin of the scrotum and the adjacent parts having been, if possible, cleansed, asepticised, and dried, the operator stands facing the animal's left hind-quarter, passes his left hand round the stifle and seizes the testes, moving the hand gently above them so as to grasp the spermatic cords between the

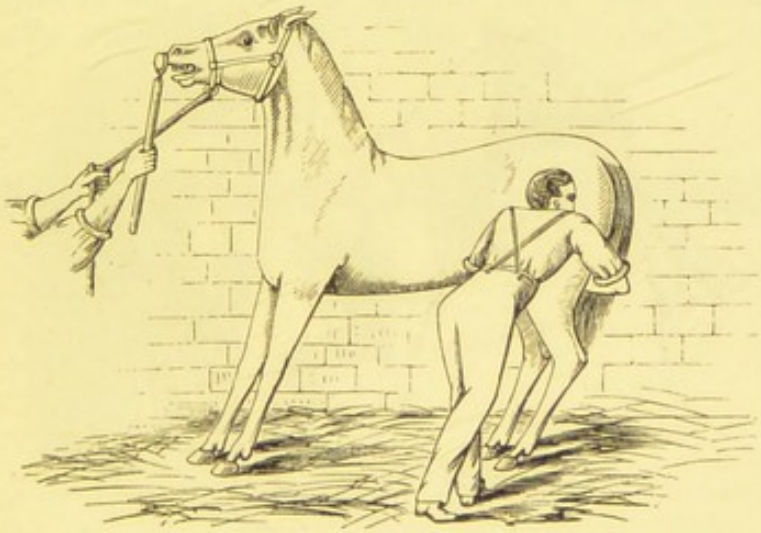

FIG. 529.—FIRST POSITION OF OPERATOR IN THE STANDING OPERATION.

two middle fingers, pressing the testes downwards and slightly backwards, so as to render the skin on the lower surface tense; then the right hand, holding the castrating knife, is passed behind the thigh (as in Fig. 529) towards the inguinal region, and makes a long and rapid longitudinal incision through the scrotum for the entire length of the right testis, so as to completely expose the gland; the same procedure is to be adopted with the left testis. The skin of the scrotum is pushed upwards, so as to expose the cords, the vas deferens of which, as well as the membranes intervening between these ducts and the bloodvessels, are to be divided by the knife or blunt pointed scissors. The testes are now hanging suspended by their anterior extremity, and the clamp may be put on the vessels and firmly secured, or the ecraseur or castrator employed. In order to do this, it is convenient to have both hands in front of the limb (as in Fig. 530).

In working about the animal, the operator should not lean or

press against it, as the probability is that it will lean against him and so fall down. The greatest risk is incurred when seizing the testes and incising the scrotum ; after that is effected the animal seems stupefied. In applying the clams, the ecraseur, or the castrator, care must be taken not to include the skin. If the testes are strongly retracted, so that they cannot be slowly and carefully drawn downwards after the scrotum is excised and the skin pushed upwards, the animal should be walked for some yards.

When the loop of the chain of the ecraseur is put over the testis and directly across the bloodvessels, it should be tightened up and the lever slowly turned. Neither with this instrument nor any others should the vessels be dragged upon. The vessels of both testes may be included in the chain of the ecraseur and divided at the same time, and the same may be done with the castrator if the jaws are sufficiently wide. It may be noted that,

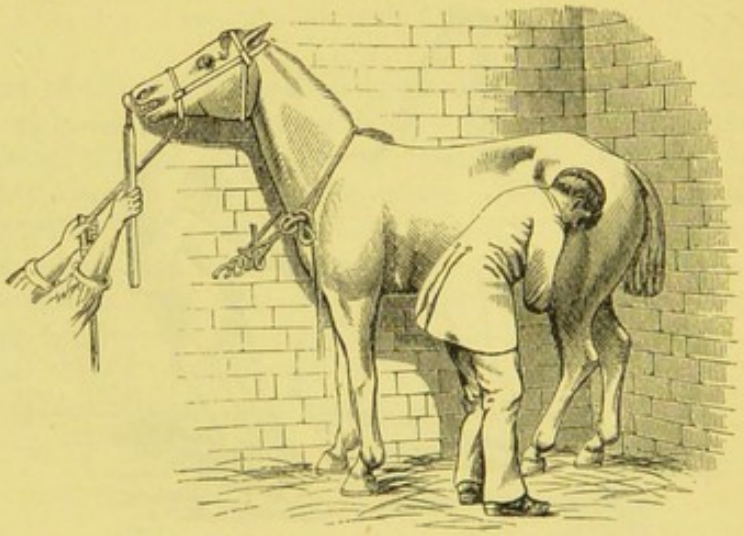

FIG. 530.—SECOND POSITION OF OPERATOR.

whether the vessels of one or both are included, it is found to be a good plan to twist the vessels round one, two, or three times. They are then placed in the jaws of the instrument, the handles of which are firmly closed and pressed ; the vessels are by this means divided, the testes are taken away, and after the lapse of about a minute the jaws are slowly opened and the remainder of the vessels allowed to escape or are pushed upwards.

Such is the standing operation, which is sufficiently simple in itself, and in the hands of many operators perfectly successful. Some operators do not divide the vas deferens, but include it and the fibrous frænum in the instrument. This, however, adds to the pain and the amount of tissue to be cut through, increases the risk of hæmorrhage, and is otherwise quite unnecessary unless the animals be rather old.

The operation appears to cause very little pain or discomfort, and the horses generally begin to eat immediately. The wounds are

washed with an antiseptic, and closed, but not sutured ; the animal is kept quiet for an hour or two, then if the weather is fine it may be depastured, but brought under shelter at night for eight or ten days.

Should there be any serious hæmorrhage after the operation, which is seldom, the scrotum may be plugged, or a blanket steeped in cold water put across the loins. If symptoms of pain are exhibited, the animal should be walked about.

When the wooden clamp is employed, and the testes are not at once removed, the instrument may be taken off after the second day, and the wound dressed with antiseptic lotion.

Recumbent Position.—This position is preferred by many operators, and in certain conditions—in scrotal or inguinal hernia, when one or both testes have not descended to the scrotum, or some other cause exists—its adoption is imperative. The dorsi-cumbent attitude has its advantages, as has also the latericumbent. With regard to the latter, it is claimed for it that the animal is more easily secured ; that it is less likely to injure itself, the

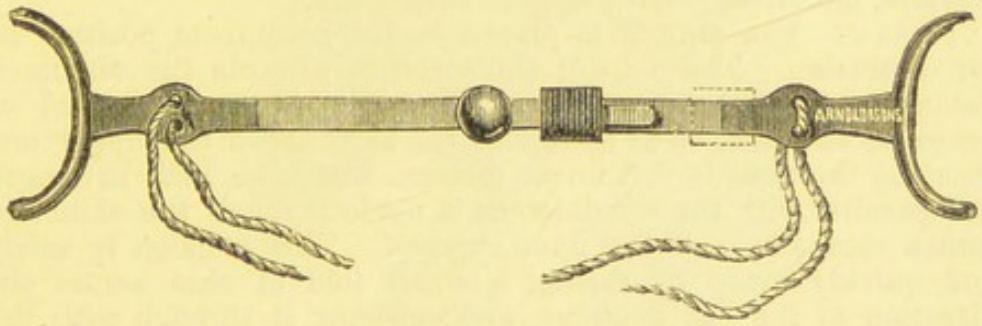

Fig. 531.—Spreader.

operator, or his assistants ; that the testes are more readily accessible ; that blood, etc., are less likely to find their way into the abdominal cavity. When the animal is latericumbent, the upper hind-limb must be drawn well forward towards the shoulder, so as to expose the inguinal region on both sides. When it is dorsi-cumbent, both hind-legs should be carried forwards, and even then there is in some cases scarcely sufficient room for manipulation in this region. In such cases use may be advantageously made of an article called a spreader (Fig. 531), which, fixed between and tied to the hind-legs, keeps them well apart. The manner of securing Horses for castration in these positions has been already described in the earlier part of this work (Chapter I.).

An anæsthetic is administered by some operators before commencing the operation ; but as a rule, unless there is hernia (when the struggles of the animal might render matters worse), or the procedure is likely to be long and painful, anæsthesia is not to be recommended. It is usually the restraint that causes the animal to struggle and perspire, not the pain.

Vasectomy.

This mode of rendering male animals infertile has not to my knowledge been practised, though it has been resorted to in mankind for the abolition of function of the testes in cases of hypertrophy of the prostate gland. Yet there are cases met with in the practice of the veterinary operator in which it might prove very useful, and might even be equivalent in its results to castration, though leaving the testes intact.

Operation. — The operation consists in exposing the vas deferens of each testis by a small opening through the skin a few inches above the gland, and removing a portion of that duct. The operation is a very simple and almost a bloodless one, and, if successful, will obviate the risks that attend removal of the testes without mutilating the animal. At any rate, it is worthy of a trial, and judging from its success in the hands of the surgeon of mankind, there is reason to anticipate similar success with animals.

Instruments.—Scalpel, dissection forceps, pair of blunt-pointed scissors, aneurism needle, aseptic suture silk.

Technic.—The animal is placed in the recumbent position as for castration. The skin of the scrotum towards the abdomen having been cleansed and asepticised, the testes are raised or drawn to one side, so as to render the skin above the upper one tense on the outside. A linear incision about an inch in length and parallel with the vas deferens is made through the skin and tunica vaginalis, and the duct exposed. This incision is safely and quickly made by raising a small fold of skin across the direction of the vas deferens, and snipping it through with the scissors. Pass the aneurism needle under the vas deferens and withdraw it outside the wound; then pass a silk ligature around it and tie firmly. Cut through the duct above the ligature and twist its upper end, snip off a small portion immediately below the ligature, close the skin wound by suture, dress with iodoform or boric powder, and carry out the same procedure on the opposite side for the other testis.

Little, if any, after-treatment should be necessary, a few days' rest with gentle exercise being sufficient.

Castration by Ligation of the Spermatic Bloodvessels.

This method of castration, strange as it may seem, has never been popular, though it is simple and more scientific, perhaps, than any of the others; indeed, it has fallen into disrepute, and probably there are few, if any, operators who now attempt it. This is in all likelihood due to the want of success attending the operation before the advent of antiseptic surgery, when a non-asepticised ligature was employed and none other of the modern precautions observed. It might now, however, be advantageously adopted, especially with adult or aged animals. The bloodvessels

might be ligatured subcutaneously, as in the operation just described (vasectomy); but as in nearly all cases the scrotum would require to be opened for the removal of the testes, it will be permissible to devote a few words to that matter, as the procedure is required in all the other modes of operating yet to be described.

The animal is placed dorsicumbent or latericumbent in the manner already alluded to; the scrotal region is well cleansed with soap and warm water, and it may also be advisable to clean out the interior of the prepuce, especially if the Horse is aged. It is premised that the hands and finger-nails of the operator are scrupulously clean also, as well as his instruments. The washed skin is now to be sponged over with an antiseptic solution.

The testes are to be seized gently and slowly, the fingers being extended below them, the palms directed upwards, and the inner or ulnar side of the hands towards the spermatic cords (Fig. 532).

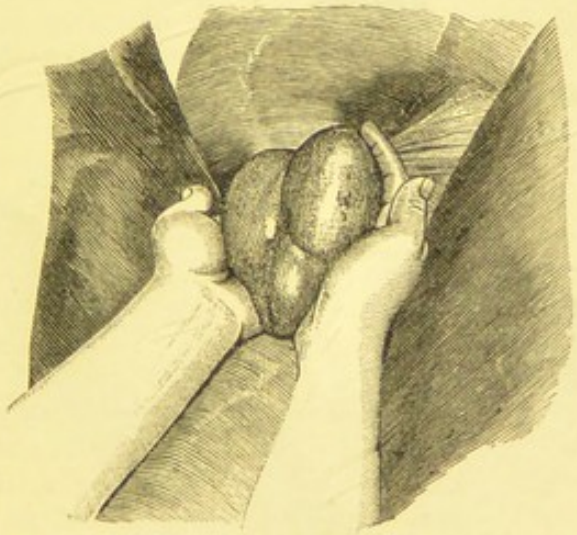

FIG. 532.—MANNER OF SEIZING THE TESTICLES PREVIOUS TO OPENING THE SCROTUM. (After Bayer.)

The fingers are gradually pushed forward and insinuated beneath the organs and slightly bent, so as to grasp them softly; at the same time the operator lifts the testes up towards himself, and the thumbs also aid in this seizure by being turned over towards them, so as to hold them fixed. This act not only soothes the animal, but it affords an opportunity for assuring one's self that both testicles are present, that they are free from adhesions, and that there is no hernia; it also allows any resistance offered by the cremastor muscle to be overcome. The left hand is now quickly removed and passed forward beneath the left testis, the ulnar border next the abdomen and the thumb upwards; the cords are seized close to the testes, the right hand is taken away, and the skin covering the organs made tense, with the scrotal raphé straight between (Fig. 533).

The testes may also be seized by passing the left hand in front of them, the fingers extended, the thumb separated from the index,

and the palm against the skin; the right hand, with the fingers disposed in the same manner, is placed behind the organs. The two hands are brought towards each other below the testes; the left hand seizes the cords near the testes, which is readily done if these are well down. The glands should be parallel with the long axis of the body. In those cases in which the scrotum is so swollen that the testes cannot be grasped, the skin of the scrotum can be rendered tense between the index-finger and thumb of the left hand, and so incised.

When castration is to be effected by what is termed the 'covered operation'—*i.e.*, the tunica vaginalis left intact, as in operating for scrotal or inguinal hernia—the tense skin covering one testis is to be carefully incised in the middle, parallel with the raphé, from the anterior to the posterior extremity of the

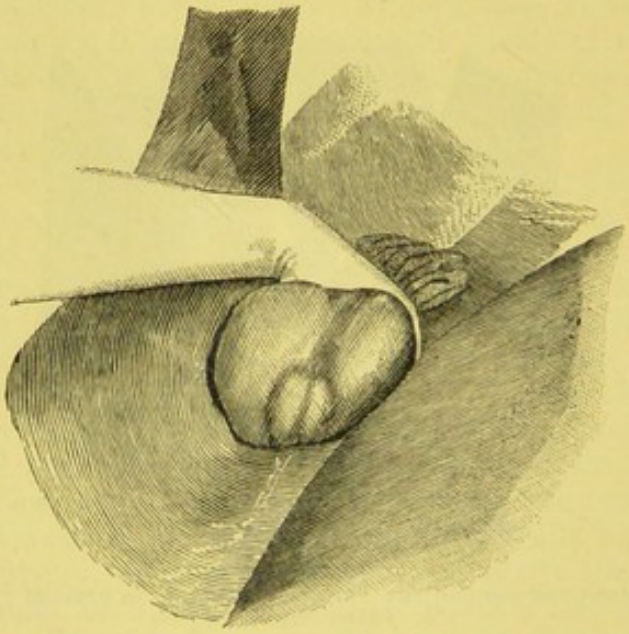

FIG. 533.—LEFT HAND GRASPING THE TESTES AND MAKING THE SCROTUM ON THEIR SURFACE TENSE BEFORE INCISING IT.

inferior border of the gland, dividing at one sweep the skin and dartos. The skin being still kept tense by the left hand, the testis—covered by the deeper layers of the scrotum—projects beyond the wound, and the connective tissue covering the cremaster is incised with the greatest care. Then the knife is dispensed with, and the fingers of the right hand—by pressing and tearing—are pushed up in the dartoic connective tissue and the cremaster and fibrous tunic of the scrotum. This being done, the right hand now seizes the testis in its remaining coverings—the thumb on its upper, the other fingers on its lower surface—and pulls it gently outwards or upwards; then the thumb and index fingers of the left hand push the divided coverings up the cord. Finally, the cord is firmly held in the fingers of the left hand—the thumb on the cremaster—while the thumb and index of the right

tear through the dense connective tissue that closely unites the dartos and the globus minor posteriorly. When the operation is the 'uncovered' one—*i.e.*, the testis completely exposed—the incision includes the tunica vaginalis, and the pressure required to render the skin tense often extrudes the gland; if this does not occur, the fingers of the right hand introduced into the wound will enlarge the latter, and by pressure force it out, when gentle traction exercised by the left hand while the right pushes away the envelopes, exposes the spermatic cord—the bloodvessels in front, the vas deferens behind. It will now be necessary, in order to have more freedom, especially when the ecraseur or castrator, clamp or torsion, is to be employed, to tear or cut through the connective tissue that binds the dartos to the tail of the epididymis.

But it should be remembered that in these operations there is no necessity to include the vas deferens or its intervening membrane in the crushing or squeezing portion of the procedure; on the contrary, in order to spare the animal pain, to shorten the operation, and make recovery more rapid, these should be cut through by the bistoury or sharp scissors, so that the testicle is only retained in front by its bloodvessels. In aged animals, however, the cremasteric artery may be so large as to render the inclusion of the vas deferens with the bloodvessels necessary.

In them, also, the tunica vaginalis communis is not infrequently found adherent to the testis, and cannot be separated from it, except, perhaps, after long and difficult dissection. In such instances it is generally advisable not to attempt separation, but to include the membrane in the removal of the testis.

A most important point to be remembered, in exposing and seizing the testis, is not to make strong traction on the cord, and especially jerking pulls, when the cremaster muscle is exerting its force, but rather to draw the testis steadily and gently downward or upward, according to the position of the animal, until the resistance is overcome, which often occurs quite suddenly; sometimes a smart slap on the loins will bring this about. Of course, when the animal is under the influence of an anæsthetic such opposition is not encountered, as all the muscles are more or less relaxed.

Instruments.—Having exposed the testis and spermatic cord, and divided (if it can be safely done) the vas deferens, nothing more is necessary in ligating the vascular portion of the cord than aseptic ligature silk, which should be strong—if plaited in a flat band, all the better—and, if the vas deferens must be tied also, a straight suture needle for the silk.

Operation.—It must be remembered that, in all operations of this kind, it is most desirable to obtain healing by the first intention, and if the rules of antisepsis are carefully observed—and their observance is not so very onerous—this in many, if not in all, cases may be secured.

Technic.—In some instances, as in hernia, it may be necessary to leave the tunica vaginalis communis intact. Then the skin

and dartos are carefully incised, the fibrous tissue (*infundibuliform fascia*) and the cremaster divided with the knife or torn asunder by the fingers. Rarely in some cases this fascia is diseased, thickened, and so closely adherent to the dartos and the tunica vaginalis that it has to be skilfully dissected away from them. But this is exceptional, and, as a rule, the testis contained in the tunica vaginalis is readily enucleated. Then the scrotum and dartos are pushed well up towards the abdomen, so as to leave plenty of room for the application of the ligature. An assistant holds the testis up, so as to keep the spermatic cord somewhat tense, while the operator ties the ligature firmly and securely around this and the tunica vaginalis, about an inch or two above the epididymis. The testis, with its covering, is cut away about half an inch or so from the distal side of the ligature. To prevent the ligature slipping, it may be advisable to pass it double, by means of a suture needle, through the tunica vaginalis, between the bloodvessels and vas deferens, cutting away the thread close to the needle, and tying one of the threads firmly round the anterior portion, the other being similarly secured around the posterior part. The ends of the ligatures are to be cut short, and the stump pushed well up towards the inguinal ring. When the testicle is uncovered, a similar procedure is to be adopted. If there is any bleeding from small vessels, torsion of these will stop it. The scrotal wound is to be closed by sutures of finer silk than that of the ligatures, the wounded surface dusted well with boric powder, chinosol, or iodoform, or painted over with asepticised collodion.[1]

Covered Operation.

This term is applied to the operation of castration when the testes are removed without opening the tunica vaginalis communis; it is resorted to in cases of accident, disease, or hernia—scrotal or inguinal—occurring in entire Horses, though there can be no doubt that it is the safest course to adopt in ordinary castration by means of the clamp, as there is much less risk of septic peritonitis, and especially of that troublesome sequel of castration by opening the vaginal sac—"champignon" or "schirrhous cord." It has already been described in the preceding notice; it consists in incising the scrotum, dartos, and infundibuliform fascia in the manner just alluded to, so as to expose the tunica vaginalis as high as possible, to allow of its being included

[1] Whenever possible, an attempt should be made to secure immediate union of the wound; and though the veterinary surgeon labours under several disadvantages in obtaining this result, yet aseptic castration has been rigidly practised, and with most gratifying consequences. Plosz reports that, of forty-eight operations, forty-seven healed without suppuration; while another practitioner, Jacoulet, was equally fortunate with 135. In these cases the wounds were cicatrised in from seven to eleven days. But it is to be apprehended that such a desirable termination cannot be always attained, though it may always be attempted, and castration by the covered method holds out the best prospect of success.

in a ligature or clamp applied above the testis (see Fig. 534, *a*). This, of course, implies that the hernia has been reduced, and that nothing is to be included in the sac except the spermatic cord.

In the majority of cases the clamp is found to be the best and most reliable instrument for rendering the operation successful, and when it is necessary to obliterate the sac and the spermatic cord as high as possible, as when dealing with hernia, carcinoma or varicocele. The most effective form of clamp is that which is

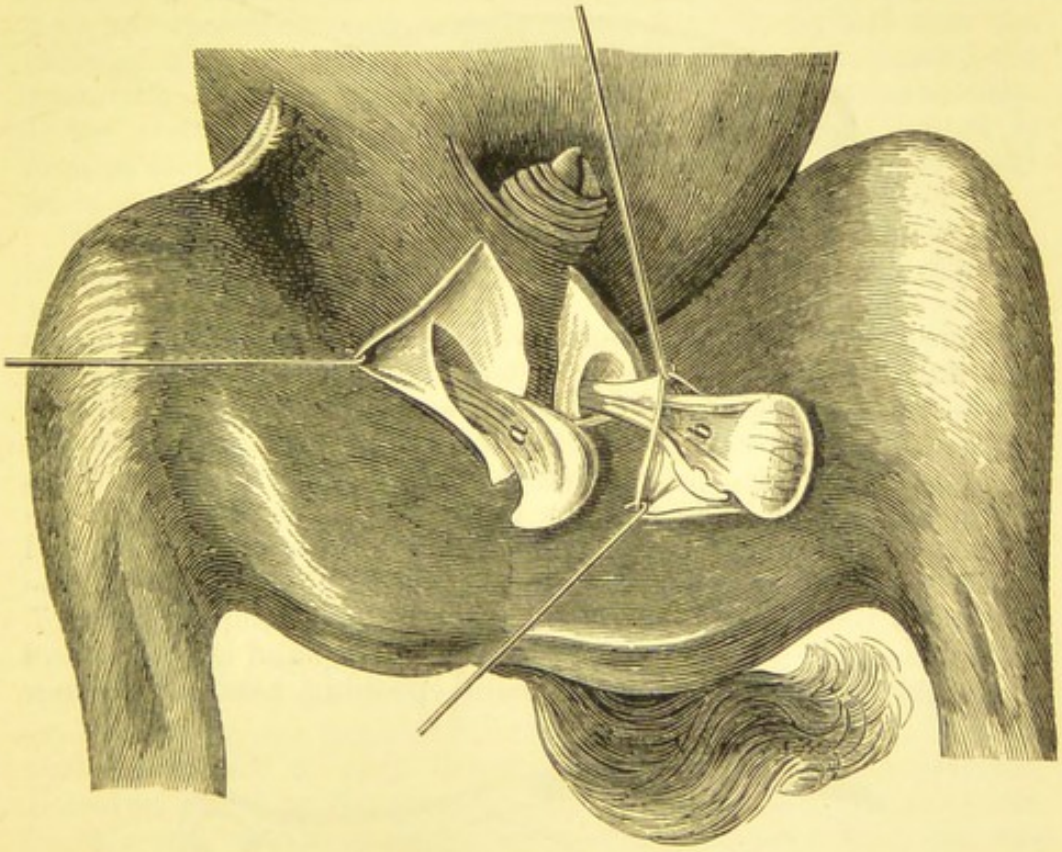

FIG. 534.—CASTRATION BY THE COVERED AND UNCOVERED OPERATIONS.

a, *b*, Immediately above these letters is the situation where the clamp, ecraseur, castrator, or cautery should be applied.

convex laterally (Fig. 535), as the convexity allows of its being fixed higher up towards the inguinal ring than can be effected with the straight clamp. When the clamp forceps (Fig. 536) is used to close the clamp, the latter can be very firmly tied—indeed, so firmly that everything may be immediately cut away a short distance from the clamp, or at any rate within two or three days, when the clamp itself may be removed, if considered desirable. Then the end of the stump is pushed well above the scrotal wound, the lips of which are to be brought together, but not sutured.

In view of the fact that septic peritonitis is more likely to

follow the uncovered than the covered operation, a modification of the former has been proposed, which might be applicable to all castrations, and particularly to those cases in which there is any reason to apprehend the occurrence of hernia. This is to make the operation partly covered and partly uncovered, the cord being allowed to remain in the vaginal sac, the testis only being exposed. The procedure is as follows: Incise the scrotum and dartos in the middle third of the testis, and the other coverings not quite so much. Then press both sides of the gland with the fingers of the left hand, so as to enucleate it, the skin and other coverings

FIG. 535.—CURVED CLAMP.

ascending towards the abdomen. Or if it is impossible to seize and hold the testis in order to make this incision, a transverse fold of skin is to be raised on the surface of the organ, and this is snipped through by scissors or the bistoury; through this opening the other coverings are divided, so as to draw or press forth the testis, seizing the globus minor to aid in this, during which the posterior part of the fibrous membrane is reversed on itself and forms a glove-finger-like fold that serves to afford a hold of the gland and the tunica vaginalis while fixing the clamp on the cord. Into this cul-de-sac the index-finger of the left hand is passed, and the right grasps the covered cord, pushing away the other

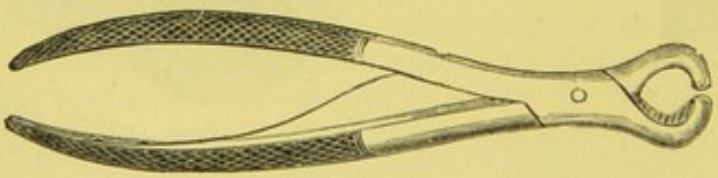

FIG. 536.—CLAMP FORCEPS.

envelopes, and then with both hands spread the tunic down and over the cord as far as the testis. The clamp is then applied over it, close to the gland, regularly and completely enclosing the vessels, where it is securely fixed. The testicle is removed about three-fourths of an inch from the clamp, the wound cleansed from blood and washed with an appropriate antiseptic solution.

CASTRATION BY THE ECRASEUR OR CASTRATOR.

This is a great improvement on the older methods, though it requires more skill. The scrotum is opened in the usual way,

and the testis may either be covered or uncovered. When it is diseased, it is perhaps best removed in the vaginal sac; otherwise the gland is usually uncovered. When covered, a little longer time is required, from five to ten minutes for the division of each cord; indeed, the only safeguard against hæmorrhage when using the ecraseur is not to be in a hurry in cutting through the cord, as many as twenty seconds being advised for each turn of the lever when the chain is drawn tight. Another important matter to attend to is having the chain directly, not obliquely, across the bloodvessels.

To save time in this somewhat tedious procedure, both testes may be exposed at once, and if covered in their vaginal sacs the chain of the instrument can be placed over both and around the spermatic cords, so as to crush through them simultaneously. If the testes are uncovered, the vas deferens of each cord is divided and the bloodvessels only are included in the chain, about an inch and a half above the epididymis.

The same remarks apply to the use of the castrator, the scissor-like action of which must be regulated, like that of the chain of the ecraseur. The testis is to be pulled well away from the body, turned round three or four times (after division of the vas deferens); then the castrator (the grooves in which should be previously smeared with vaseline) is applied, the blades being closed steadily and held firmly closed for about a minute. The testis is now removed, and the instrument carefully relaxed.

Castration by Torsion.

Castration by twisting the vessels of the spermatic cord is one of the oldest and most primitive methods, and almost the only one adopted for the smaller animals, with which it could easily be effected by the fingers without requiring instruments, beyond, perhaps, a knife to open the scrotum. With the larger animals, however, owing to the greater and tougher vessels, their rupture in this way could not be so easily achieved, even when the vas deferens and frænum were previously divided by the knife. So that unless the operator had very strong hands and fingers the twisting through of the bloodvessels alone was a serious task, and, as the twisting movement was likely to extend much higher up the cord than the operator's left hand, grave injury was likely to be inflicted. Therefore certain instruments were needed for this purpose in the case of the larger animals, and the introduction of these is only of a comparatively recent date; since then the method has become very popular, as it has been found to be simple, rapid, and safe, when properly carried out, though it requires some skill and expertness.

Some operators use only one instrument, a kind of forceps, to firmly grasp and steadily hold the vessels of the spermatic cord, while the testis is being twisted round until the cord between it and the instrument is torn through. This is what might be

termed "unlimited torsion";[1] but other operators employ, in addition, another forceps which is made to seize the cord a short distance from the other one; the former being turned round, the portion of cord between them is twisted until it is severed. This limited torsion is the easiest, and perhaps the most satisfactory.

Instruments.—There are various patterns of torsion instruments, all of which are more or less effective. For unlimited torsion, in

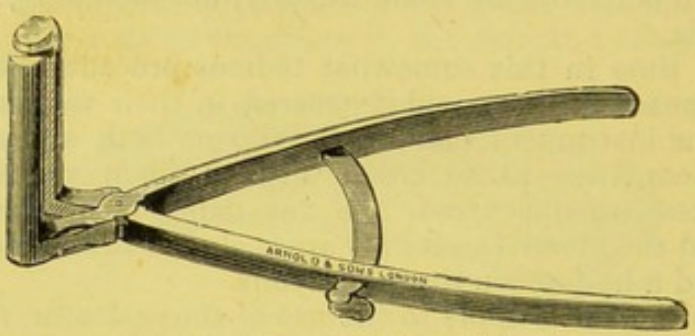

FIG. 537.—ROBERTSON'S TORSION FORCEPS.

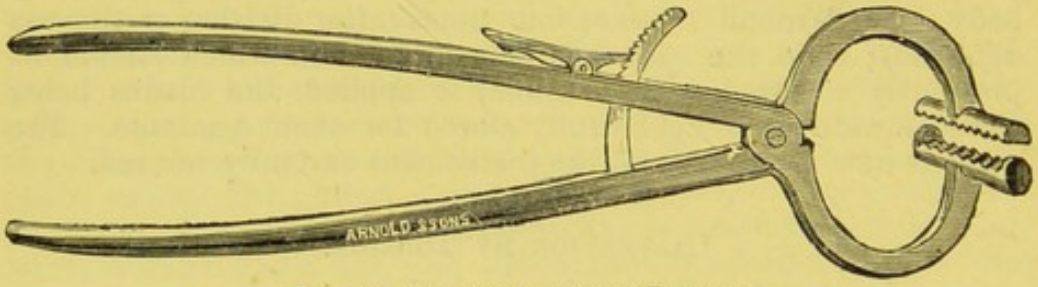

FIG. 538.—WILLIAMS'S TORSION FORCEPS.

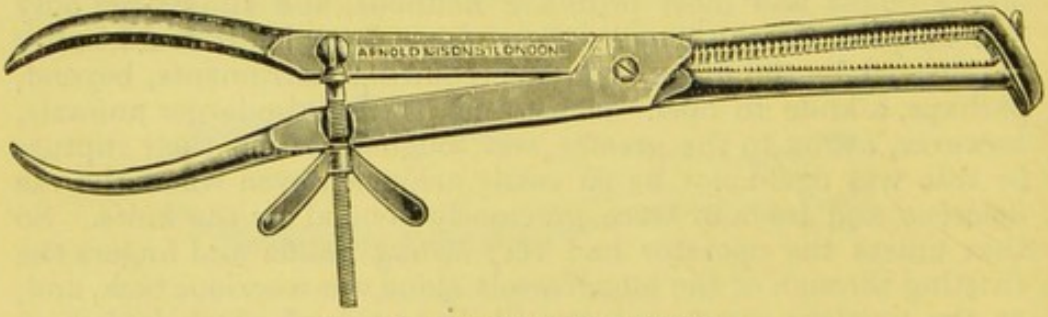

FIG. 539.—BAYER'S TORSION FORCEPS.

which only one forceps is used, one pattern is that of Robertson (Fig. 537), which is provided with a rack and screw to relieve the strain on the hand; Williams's pattern is also a useful one, being

[1] This term has been employed for twisting of the cord alone, as was done in early times, and is even carried out now with the smaller animals, the fingers of one hand holding the cord firmly some distance from the testis, and the other hand rotating this rapidly and steadily. But while we would be inclined to call this free torsion, we think the above designation should be adopted to distinguish it from limited torsion, in which two forceps are employed, and the portion of cord involved can be limited to a small extent.

furnished with a spring rack (Fig. 538). Bayer's torsion forceps is much used on the Continent, and is provided with a thumb-screw easy to work (Fig. 539).

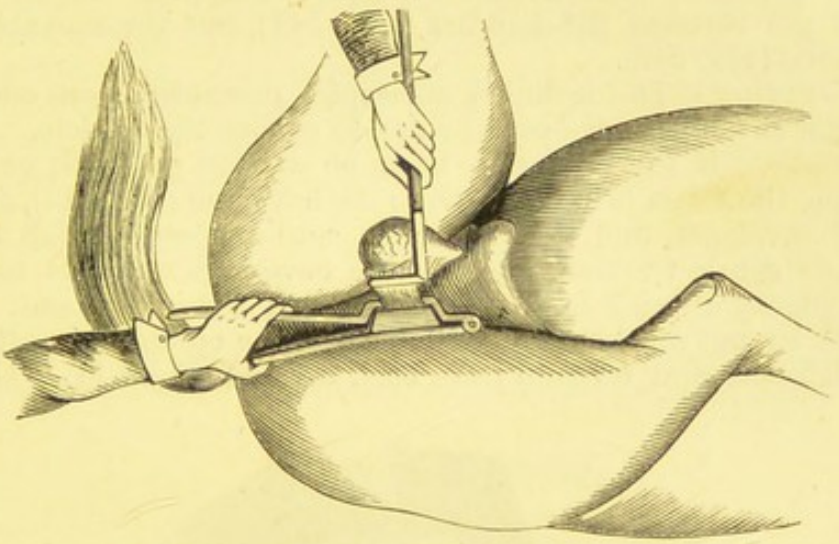

FIG. 540.—TORSION BY RENAULT AND DELAFOND'S FORCEPS.
(After Peuch and Toussaint.)

In 1883 Renault and Delafond introduced limited torsion, in which two forceps were used—one to hold the spermatic cord firm and fixed, so as to prevent this from being strained higher

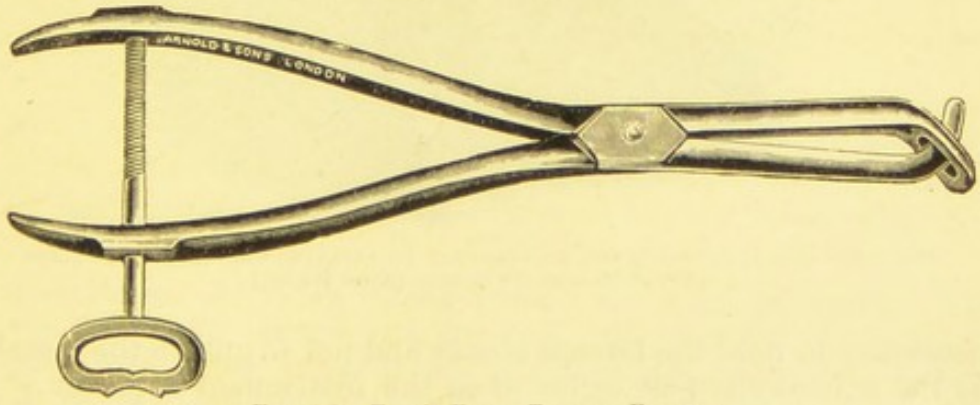

FIG. 541.—TÖGL'S FIXED TORSION FORCEPS.

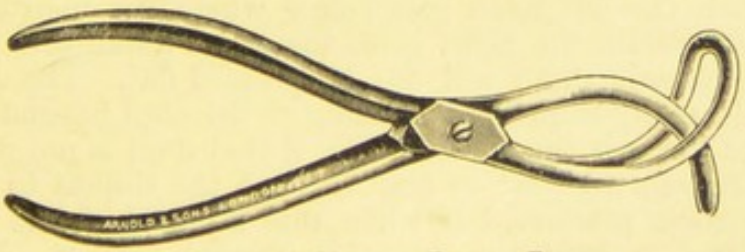

FIG. 542.—TÖGL'S MOVABLE TORSION FORCEPS.

up, and another forceps to be applied to the cord, nearer the testis, and to rotate the latter. They are similar to Robertson's and Williams's in principle (Fig. 540). Reynal improved upon

these, and the two patterns are those chiefly used in France; both have racks on the fixed and movable instruments.

Torsion forceps, much favoured in Germany, are those of Tögl, which appear to answer their purpose, the fixed one having a screw pin through the handles (Fig. 541), but the movable one has none (Fig. 542).

Operation.—The ordinary antiseptic precautions are adopted, and the envelopes are opened so as to expose the testicle.

Technic.—If the operation is to be carried out with only one forceps, the testis is to be seized in the left hand (Fig. 543), cleared of its envelopes, and the spermatic cord exposed as high as possible by gentle traction, pushing the coverings upwards so as to leave plenty of room for the application of the instrument. This should be put on the cord, well beyond the epididymis, after the vas deferens and frænum have been divided (Fig. 544). Care is

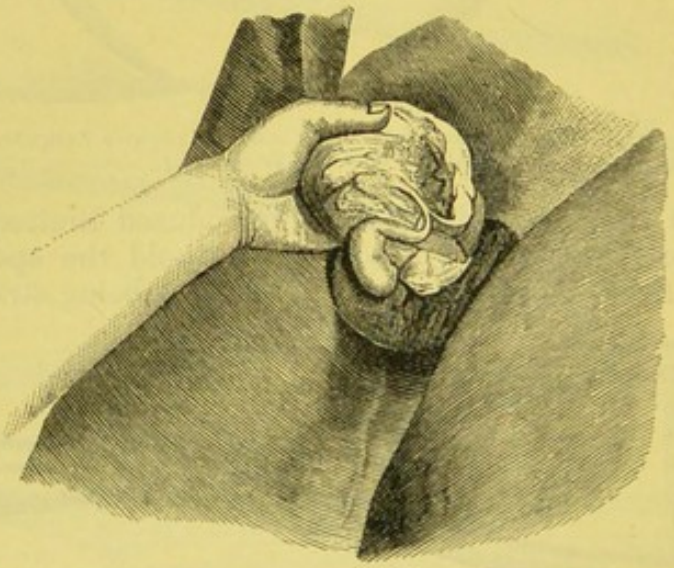

Fig. 543.—Grasping the Testis preparatory to applying the Torsion Forceps on the Spermatic Cord. (After Bayer.)

necessary to hold the forceps steady and not to pull on the vessels, as the animal often struggles when the instrument is put on. It is a good plan, before the forceps is closed, to seize the vessels firmly with the left hand just below where the instrument will hold them, while the right gives the testis a half-turn round, so that the vessels there will not be pressed flat. The use of the forceps is really to prevent twisting of the cord beyond where it is held or towards the vas deferens, if that duct is not divided.

It is recognised that to tear through the tissues in this way requires some practice, but when this is acquired the testis can be removed without the use of a second forceps. Beginners usually make the mistake of letting go the testicle, when rotating it, the instant the hand can turn no more round; the consequence is that there is a reversion of the twisting, and the operator has to begin again. Therefore the hand should on no account be

removed from the testis. The right hand seizes the spermatic cord in such a way that the thumb faces right, and the fingers are in the opposite direction, while the cord and testis lie in the palm of the hand. Now the half-turn is completed, so that the thumb faces left and the long axis of the testis corresponds to that of the body. The palmar surface of the thumbs now remain on the side of the testis, and press it against the forceps until the fingers have taken their place, whereupon it is at last on the right side of the vas deferens. Only at the commencement, and for as long as the tissue of the cord is intact, must force be employed; afterwards the torsion goes on rapidly until the whole is torn through. About twenty turns or twists usually suffice to tear the cord. Then the cord is held by the thumb and middle finger (palm of hand upwards against the forceps) below the forceps, which are now opened to ascertain whether there is any

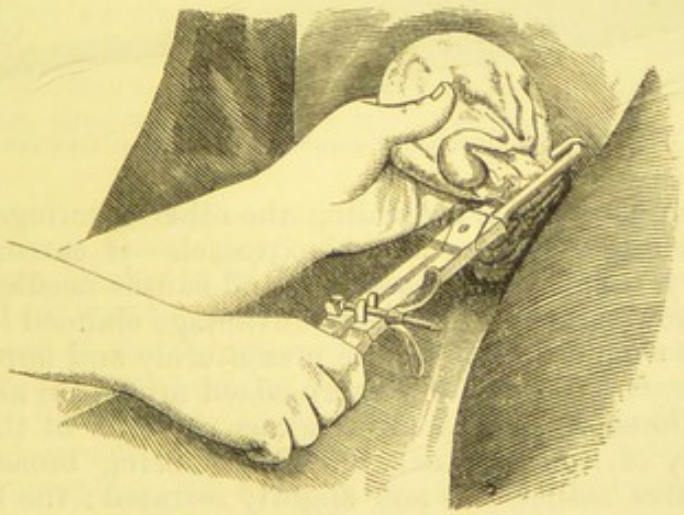

FIG. 544.—THE TORSION FORCEPS APPLIED TO THE SPERMATIC BLOODVESSELS. (After Bayer.)

hæmorrhage. If there is, the vessels must be ligatured. The parts are finally dusted with chinosol, boric powder, or iodoform, pushed gently up towards the inguinal ring, and the divided skin of the scrotum drawn together and powdered with the same antiseptic material.

The procedure, though lengthily detailed here, does not occupy much time, and the removal of the second testis completes an operation which is comparatively painless, simple, and safe.

When two forceps are employed, the fixed one holds the cord firmly at some distance from the testis—about an inch and a half. It is given to an assistant, who keeps it steady against the abdomen, and does not drag on the cord. The operator places the other forceps on the cord near and above the testis, so that there is a small clear space of cord—about one-third of an inch—between the two instruments, and it is here the torsion occurs and division takes place. The operator twists from left to right, using both hands, one to keep the forceps in place, and the other to rotate

the instrument (Fig. 540); about ten to fifteen revolutions are required, the artery being the last to tear. Then the stump and scrotal wound are dealt with, as already described.

Castration by the Actual Cautery.

Division of the spermatic cord by the actual cautery is a very ancient procedure, Vegetius and Apsyrtus mentioning it as common in their time; and the results are generally so satisfactory that it is even now, notwithstanding its apparent barbarity, very popular in some countries. But often the entire operation—

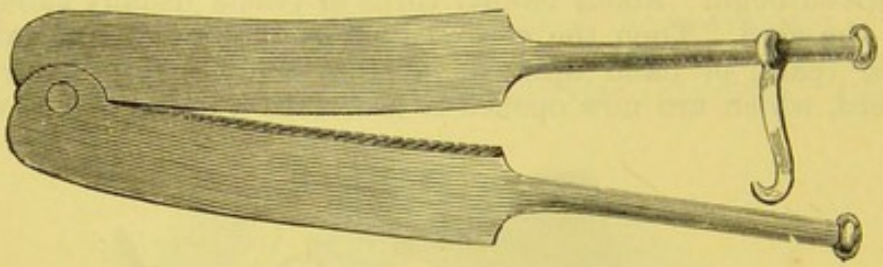

Fig. 545.—Clamp for Castration by the Actual Cautery.

opening the scrotum and dividing the other coverings, as well as the vas deferens, septum and bloodvessels—is carried out with the cautery. This is unnecessary, and causes needless pain and a wound slow to heal. The only advantage claimed for it is that the scrotal wound does not close prematurely and imprison pus.

Instruments.—These are a sharp-edged firing-iron and a special clamp or forceps. There are various patterns of these. They are usually of iron or steel, the blades being broad and their inner borders rather thin and slightly serrated; the handles are held together by a cord, hook, screw, ratchet, or spring (Fig. 545).

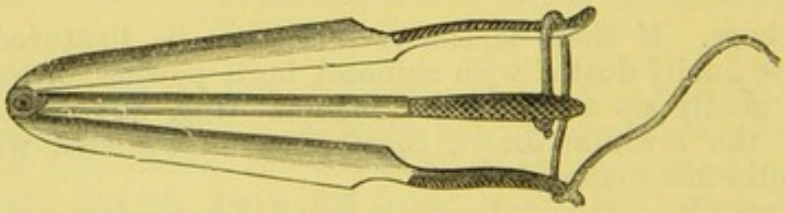

Fig. 546.—Double Clamp for Castration by the Actual Cautery.

To expedite the operation, both testes are sometimes exposed at the same time, and a double clamp is then employed (Fig. 546), so that the two glands can be seared off at once. This is a matter of some moment, as it is not always convenient to have the cautery heated twice, and there is always the risk of having the eschar formed by the burnt tissue rubbed off the divided end of the cauterized vessels. This is less likely to happen when they are all done at once. Of course, the instruments required to incise the scrotum and other coverings are needed.

OPERATION.—The spermatic bloodvessels of one or both testes are exposed, the single or double clamp is firmly fixed on them about an inch or so above the epididymis, taking care that the skin and other membranes are not enclosed in it, and held steadily, by an assistant if necessary; the operator then, with the bistoury, cuts off the testes one by one a short distance from the clamp, and with the *red-hot cautery* sears the ends of the vessels well. A better way, perhaps, is to slowly cut through the vessels with the hot iron close to the clamp, by a sawing motion. On slightly relaxing the clamp, if any oozing of blood is observed, it is again tightened and the cautery re-applied to the stump. When there is no danger of hæmorrhage the clamp is removed, the stump is pushed into the cavity, which is then dusted with boric powder, chinosol, or iodoform, and the edges of the scrotal wound are approximated. Sometimes cold water is poured over the parts, with the object of forming a clot, should there be any bleeding; but as this may wash off the eschar and prevent the action of the antiseptic, it cannot be recommended unless hæmorrhage really occurs. If there is any chance of burning the adjacent parts, they may be protected by damp cloths.

CASTRATION BY THE CLAMP.

Castration by means of the clamp has already been more or less described, and the various kinds of clamps have been referred to. It is one of the old methods that has stood the test of time, and experience has testified to its value, as it is still largely employed. There is no danger of hæmorrhage from the spermatic vessels, and the clamp can be employed either in the covered or uncovered operation, the compression being exercised over a wide surface.

OPERATION.—The uncovered operation has been already described, and there is no need to refer to it further than to emphasise the need for including the tunica vaginalis communis in the clamp—which is placed a short distance above the epididymis—and excluding the scrotum and dartos. The tunica vaginalis, too, should be spread evenly within the branches of the clamp before they are fastened firmly together. The ordinary clamp, either straight (Fig. 547) or curved laterally, may be employed, according to circumstances, and the pressure should be as firm as possible.

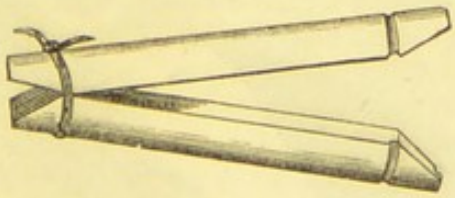

FIG. 547.—THE ORDINARY CASTRATION CLAMP.

This is insured by using the clamp forceps at the open extremity, which is slipped from before to behind the testis and tied (Fig. 548).

In the uncovered operation the testis is exposed, the vas deferens and septum divided (if this can possibly be done without risk of

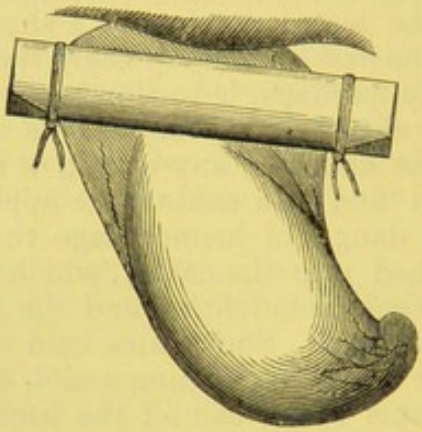

Fig. 548.—The Ordinary Clamp in the Covered Operation.

hæmorrhage from the cremasteric artery), and the clamp put on the cord from before to behind, a little higher up than in the covered operation. An assistant firmly closes the clamp by means of the clamp forceps (Fig. 549), and the operator then has both

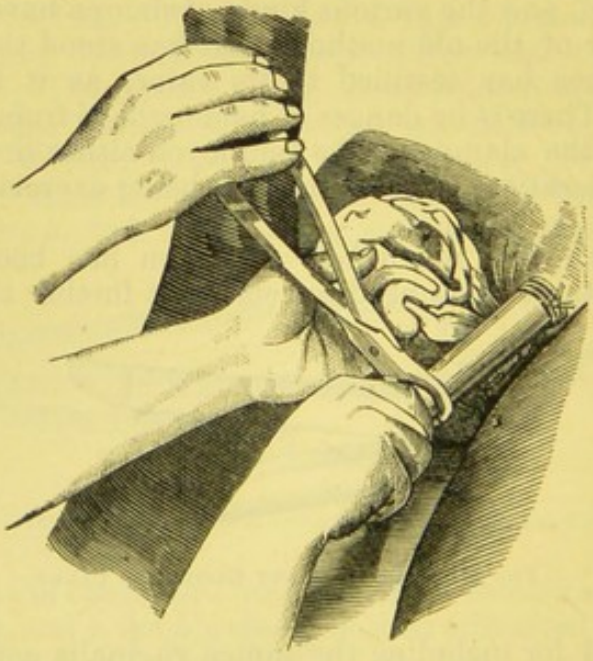

Fig. 549.—Applying the Clamp in the Uncovered Operation.

hands at liberty to fasten the clamp. Care must be taken that there is no undue strain on the cord while the clamp is being closed and tied, as the animal often struggles at this time. If the whole of the cord is included in the clamp (Fig. 550) this

must be longer and stronger than when the spermatic bloodvessels alone are compressed.

If the clamp has been properly fastened, so that there is no danger of it slipping off the cord, the testes may be cut away at once from close to the clamp. But in the covered and uncovered operations they are often allowed to remain until they fall

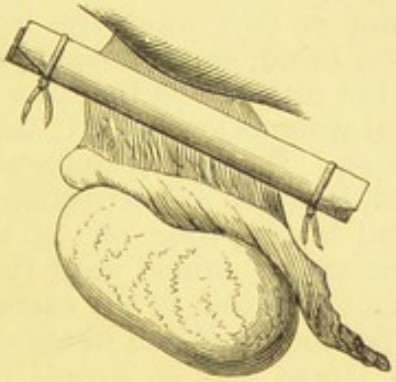

FIG. 550.—THE CLAMP APPLIED IN THE UNCOVERED OPERATION.

off, or until from thirty-six hours to four, five, or six days have elapsed, according to circumstances or the fancy of the operator. When, however, there is no hernia or reason to fear its occurrence, nor any other cause in operation, the testes are best removed at the time the clamps are applied; these may be removed a few days afterwards.

CASTRATION BY SCRAPING THROUGH THE SPERMATIC BLOODVESSELS.

This is a method originally practised in India, and is in principle allied to torsion and crushing of the spermatic cord. It has been very successfully practised on Horses of all ages.

Instruments.—These are only those required to expose the testis and the bloodvessels, and divide the vas deferens and the frænum, and a jagged or serrated-edged knife. An old table-knife with a ragged edge has been sometimes employed.

OPERATION.—The Horse is placed dorsicumbent or latericumbent; the testis and spermatic cord are uncovered in the usual way.

Technic.—The vas deferens and frænum are divided, the spermatic bloodvessels extended on a small piece of flat board laid on the inside of the Horse's thigh, the thumb and first finger of the left hand holding them there, leaving an inch or so of the vessels held tense between them. This portion is then rubbed up and down with the jagged edge of the knife until the vessels are frayed through, which is easily and quickly done, and the testis removed. The remains of the cord are dusted with antiseptic powder, pressed up toward the inguinal canal, the lips of the scrotal wound sponged clean, brought together, and dressed with the same powder. The other testis is removed in the same manner, and the operation is completed.

After-treatment of Castrated Horses.

If the animal is in a healthy, vigorous condition, the operation properly performed, and the surroundings favourable, recovery is usually rapid, though more so with some modes of operating than others.

After the operation the animal should be kept quiet for some time, even for an hour or two, when the legs and lower part of the body, if soiled with blood, can be cleansed. It is well also to have the hair of the tail plaited and tied to a surcingle round the body, until the scrotal wounds are healed; this is more necessary when clamps are left on. When the clamps are allowed to remain on the spermatic cord, the pain and irritation are sometimes provocative of biting and tearing them off; so that it is generally a wise precaution to tie up the animal until there is no longer any danger of this accident; indeed, in all cases where clamps are left on this should be done. If the weather is mild and fine in the early spring, the Horse may be turned out to graze during the day, and brought into the stable at night; but if later in the season he may remain out day and night. If the weather is unfavourable he must be housed and receive good, easily-digested food, but exercise night and morning must be allowed; and if there is considerable swelling, with stiffness of the limbs, walking exercise must be more frequent or longer continued, and even gentle trotting for a portion of the time may be advantageous.

If the weather is very severe, it may be necessary to have the animal blanketed; exposure to extreme changes is to be avoided.

It is not usually necessary to lay the Horse down to remove the clamps. A twitch on the upper lip, and, if the animal is very refractory, a side-line to raise one of the hind-feet, are sufficient. The fastening of the clamps is undone by passing the hand between the posterior limbs from behind.

The wounds should require no treatment beyond dressing, if need be, with antiseptic powder. If the clamps have been left on, these require to be removed in the course of two or more days, according to circumstances; when taken off, it is important that the remaining stump be pushed well up beyond the scrotal wound. If suppuration takes place, this wound will require to be kept sufficiently open to permit the escape of the pus, and antiseptic lotions applied. Suppuration is rare and trifling in well-bred Horses, but sometimes profuse in common ones.

Accidents occurring during or after the Operation.

The most frequent accident occurring during or immediately after castration is hæmorrhage when certain methods are practised; but this is really infrequent and rarely alarming, unless something unusual has happened or there has been carelessness. If the bleeding occurs during the operation, it may be from some small vessel which can be twisted, but before the animal is

allowed to go the operator ought to assure himself that there is no further risk. If the Horse is still recumbent and the bleeding profuse, it is generally necessary to find and tie or twist the vessels ; and if it occurs after the operation he must be laid down for that purpose. Some operators plug the scrotum with tow or lint, but this is not advisable. In the great majority of cases the bleeding, if trifling, ceases spontaneously, or if more serious it will be checked by applying a blanket saturated with cold water across the loins, by giving an enema of cold water, or throwing antiseptic cold fluid into the wound. In all cases the animal should not be moved about.

Not infrequently the animal gives evidence of suffering from colicky pains soon after the operation, but this soon disappears after a little gentle exercise.

Prolapse of the large omentum or the intestine is an accident that is always liable to happen either during or after the operation—within a few hours or as many days ; or hernia of these may exist before the operation, and only become markedly manifest during its performance. It nearly always occurs during or after castration by the uncovered operation, though it may also happen after the covered operation, when the clamp is removed ; for in both cases the vaginal sac is opened. When it takes place during the operation it is owing to the abdominal ring being more or less relaxed or unusually dilated, and the struggles of the animal forcing the intestine or omentum into it, when the straining will propel it more and more into and beyond the inguinal canal. This protrusion is all the more rapid as the pain produced by the constricted viscus increases the straining, until in some cases a mass of omentum or intestine hangs from the scrotal opening for a considerable distance. In other instances, however, when the abdominal ring is narrower, only a small piece of omentum or knuckle of intestine passes through it and remains fixed in the inguinal canal, or only slightly projects beyond the lips of the scrotal wound, notwithstanding the severe expulsive efforts of the animal, and becomes strangulated. The small intestine is most frequently prolapsed, and is recognised by its small surface and nacreous tint when quite recently extruded ; when it is the large intestine, the floating colon is involved, and this is known by its sacculated appearance and longitudinal bands. The prolapsed intestine, however, soon becomes altered in aspect, its tint passing to red and then to dark brown, while its temperature is diminished. The animal suffers intense pain, which seems to come on in starts, during which its movements are most disordered and violent ; after some hours this condition is succeeded by prostration and all the signs of collapse, and death usually ensues within twenty-four hours after strangulation of the intestine has taken place.

Prolapse of the omentum can easily be differentiated from that of the intestine by the shape and general appearance of the viscus, which, when it has been protruded for a short time, becomes tumefied and infiltrated. If it cannot be returned before it is

much altered, then it must be amputated above the altered portion, ligatured, and the stump pushed into the inguinal canal, a clamp being placed on the tunica vaginalis communis to prevent a re-descent.

Hernia of the intestine is a much more serious affair, and requires prompt attention. The animal should receive an anæsthetic in order to avert the straining and struggling, be placed dorsicumbent, and reduction of the viscus effected under all possible antiseptic precautions. This being achieved, a laterally-convex clamp (Fig. 535)—convex border upwards—should be placed on the deeper coverings, so as to occlude the opening into the inguinal canal, or, if the clamp cannot be employed, deep sutures must take its place. The subsequent treatment must be that already mentioned for this kind of hernia.

Tumefaction of the Spermatic Cord.—In somewhat rare cases inflammation, usually moderate in intensity, occurs at the wounded extremity of the spermatic cord immediately after the operation, but becoming quite appreciable in one or two days; indeed, in some instances the consequent swelling develops so rapidly as to simulate hernia of the intestine, from its protruding beyond the lips of the wound as a reddish, smooth, and glistening tumour, looking somewhat like a knuckle of intestine. But a careful examination will quickly prove that it is only an inflamed and swollen spermatic cord, in which may be detected its two constituent portions, the vas deferens and fibro-vascular cord, the latter forming the major portion of the swelling, at other times the former. But as it is related to the wound in the skin and serous tissue, generally the swelling subsides as these cicatrise. When the inflammation is more intense, however, extends to a larger portion of the cord, and is continued for some time, the tumefaction assumes pathological characters of a special kind. The absence of restlessness, excitement, and distress, should distinguish this accident from intestinal hernia; for the animal does not appear to be much, if at all, disturbed, and there may be only trifling stiffness in its gait, while the swelling may move up and down to a slight extent, thus coinciding with the movements of the animal itself; whereas the prolapsed and strangulated intestine is immovable.

This accident has followed operation by torsion, by the clamp, and even by the covered method, when the clamp has not been properly closed and the compression exercised by it has not been uniform and complete. The greatest care in operating, however, does not always prevent this swelling, which may have been due to excessive length of the spermatic cord, the lacerated end of which has protruded beyond the wound, where it becomes congested and inflamed, and perhaps even semi-strangulated—this being most likely to occur if the scrotal wound is small, or if tumefaction of the inguinal canal has decreased its width.

As the tumefaction of the part will not subside spontaneously, but will become an indurated tumour, if the cord cannot be pushed

up into the inguinal canal and maintained there, it will be necessary to remove the swollen portion by excision. The animal is laid on the side opposite to that on which the tumour is, the upper hind-limb is drawn well back, and the inguinal region is thoroughly cleansed. The operator grasps the tumour and pulls it gently towards him, while an assistant draws the lips of the scrotal wound away from it; it will be found somewhat cylindrical in shape, rather solid in consistence, rosy-pink in colour, and its volume gradually decreasing as it ascends, or it may be pyriform. It is slowly withdrawn from the wound, and the chain of an ecraseur or the jaws of the castrator—though the former is preferable, as the chain can be carried higher up—applied to the cord above the swelling; then excision is slowly and steadily effected. The end of the cord should be well up in the inguinal canal after the enlarged portion has been removed; the wound is then dressed antiseptically, and the animal allowed to get up.

When serious hæmorrhage is apprehended, instead of excision by means of the ecraseur, a double ligature of strong silk thread is applied on a healthy part of the cord, and the tumour cut away from below it. If the cord cannot be pressed into the inguinal canal because of the narrowness of the wound, this should be enlarged.

Scirrhous cord, chronic funiculitis, and botryomycosis are the terms applied to a more advanced stage of the condition just described. It is an indurated or suppurating tumour, generally both, formed on what remains of the spermatic cord, and is due, in the first instance, to inflammation, as we have just seen; but in many cases the tumefaction is complicated by secondary infection with specific germs, which, according to their pathological significance, cause the tumour to be designated 'botryomycotic,' 'streptococcytic,' etc. Indeed, it has been asserted that every case is due to infection, and that all the causes hitherto assigned for its production—dragging on the spermatic cord; leaving the cord too long, so that it protrudes beyond the scrotal wound; faulty adjustment of the clamps, etc., are ineffective. But it will oftentimes occur without any of these supposed causes being in operation, and it is certain that in the large majority of instances a microscopical examination of the pus will lead to the discovery of immense quantities of botryomyces and streptococci, though these are not special to this region, but are found elsewhere in wounds and tumours. It is very probable that they are acquired either from the hands, instruments, or appliances of the operator or his assistants, or are derived from the litter upon which the animal has been laid for the operation, or that of the stall or loose-box which it has subsequently occupied before the wounds were healed. Certain methods of castrating are certainly frequently followed by this accident; the clamps and actual cautery in the uncovered operation appear to furnish the largest number of cases, and the use of the ecraseur or castrator, and the covered operation, seldom, if ever, have such a result, especially if careful

asepsis is attended to. Its occurrence demonstrates the necessity for the adoption of asepsis, and either keeping the animal standing until the wounds are healed, or, if the locality is one in which this accident is frequent or common, to use pinewood sawdust instead of straw in the stall. Raw, inflamed, and suppurating surfaces are those which the germ more especially favours. The end of the cord is perhaps most frequently affected, but any part is liable to attack, and the adhesions between the cord and adjacent tissues are often extensive, the infiltration invading even the prepuce and the walls of the inguinal canal. Sometimes the growth of the enlargement is very slow, and almost nil; but in other cases it is rapid, and may attain formidable dimensions, instances having been recorded in which the tumours weighed 107, 134, and 170 pounds, while their density is often quite extraordinary.[1] They seldom cause much pain, though they may more or less interfere with movement; in all cases the constant suppuration is unpleasant and annoying; while the tumour, when apparent, is very unsightly, being sometimes as large as a man's head.

All kinds of treatment by astringents, caustics, actual cautery, etc., have been tried, but in nearly all cases the disease has resisted them. The internal administration of large doses of potassium iodide has also been tried, with injections of the same drug into the tumour; but though it sometimes appeared to have a beneficial effect in recent cases, in many chronic instances it completely failed to produce any diminution of the growth; so that it is now pretty generally recognised that operative procedure is the only certain way to insure a cure. But this is not possible in all cases, especially those in which complete excision cannot be effected owing to the extension of the morbid process to the abdominal cavity, and the infiltration of inaccessible tissues.

The gravity of the operation will depend on the extent of the disease. When only the end of the cord is involved, the adhesion between it and the skin of the scrotum is slight, with very little infiltration into the surrounding tissues, the operation is not of much moment; but when the tumour is large and dense, adhesions many, and the adjoining textures much involved, then the operator has often a serious task before him.

Instruments.—Dissecting instruments; ecraseur with chain and steel wire; bulldog forceps; suture needles and silk; antiseptic materials; probes of different lengths; a blunt seton needle.

Operation.—The animal must be placed dorsicumbent or latericumbent, with one or both hind-limbs drawn well forward, so as to leave the operator as much room as possible. One or two assistants will be necessary. The skin at the seat of operation is to be well cleansed and washed with an antiseptic. If the operation is likely to be prolonged, an anæsthetic should be administered.

[1] In one case on which I operated the chain of the ecraseur broke, as did also a steel wire that replaced it, and a wire had to be specially made before I could cut through the tumour.

Technic.—The tumour is carefully examined, and the fistulæ explored by the probe. If it protrudes beyond the scrotum and does not extend any distance upwards, it should be released from the adhesions it has formed by cutting through the skin on its sides, and dissecting this and the connective tissue away until the tunica vaginalis communis is exposed and the upper end of the tumour is reached. The finger, blunt seton needle, or handle of the dissecting knife, will be most useful in effecting this liberation. The tumour should now be removed by placing the chain of the ecraseur around the healthy cord above the growth, embracing also the tunica vaginalis, as in the covered operation, turning the lever only two or three times per minute. Or the ligature or clamp may be employed, but the ecraseur is generally preferable.

When the tumour is large and involves much of the skin, it is a good plan to isolate an elliptical piece of this on the surface, proportionate to the size of the growth, including the castration cicatrice, by passing a band of tape through the mass by a seton needle; this tape is to form a loop, by which an assistant can raise the tumour and aid the operator as the dissection proceeds. Skin adhering to the tumour elsewhere is also to be cut away, and the tissues pushed from the tumour until the tunica vaginalis is reached. Knife, dissecting scissors, and fingers perform this

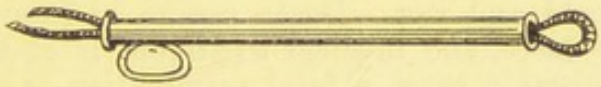

FIG. 551.—LIGATURE-CARRIER.

task, and bleeding must be stopped by ligation of vessels, torsion, or bulldog forceps. Not infrequently the tissues are very vascular, and the hæmorrhage is rather copious. The connective tissue becomes looser the nearer the inguinal canal is approached, so that the finger can easily tear through it. Then the ecraseur is employed, care being taken to place the chain round a healthy part. In some cases the tumour extends so high into the inguinal canal that it is difficult, if not impossible, to get the chain above it; then it may be necessary to resort to a strong aseptic ligature, and even this may be very troublesome to carry high enough. To assist in this, use may be made of a simple contrivance in the form of a small tube of wood or metal, eight or ten inches in length (Fig. 551), into which the double ligature is passed, so as to make a loop at the end. This loop is pushed high up over the tumour until the portion of healthy cord is reached, when it is tightened to the necessary degree by pulling the ends of the cord at the other extremity of the tube, where they are secured by tying them on a small piece of wood placed across this extremity. Every second or third day the tube may receive a twist or two, which will tighten the ligature and hasten the process of separation, which is necessarily slow. If the tumour is very dense, the ligature may be of pliable wire.

In employing the ecraseur, and for the same reason, it may be requisite to use a steel wire instead of the chain.

In order to render the ecraseur more effective, and to diminish the risk of hæmorrhage, Degive recommends passing a skewer through the tumour, and when the chain of the instrument begins to tighten, to rotate the mass by this means during the intervals of turning the lever, so that there is crushing and torsion of the cord alternately.

In other cases, the tumour extends to the abdominal ring, and even into the abdominal cavity, occupying the whole of the inguinal canal, so that it is necessary, if the ecraseur is to be employed, to dilate the latter by incision, so as to allow the chain of the instrument to be carried sufficiently far.

Growths extending into the tissues beyond the spermatic cord may be removed by the knife or the curette.

The wound is to be dressed with antiseptic lotions or powders. Some cases may require the wound to be plugged with gauze or lint.

Peritonitis is a not infrequent, serious, and often fatal result of castration, occurring about two or three days after the operation in many cases in which it is acute. In the great majority of cases it is due to septic infection, which should so often be preventable; in a small percentage of cases it may be caused by exposure to cold and wet. Death occurs in from two to four days in acute cases, and medical treatment is of little avail in them. In non-septic cases a fatal termination is not so rapid, and prognosis is more favourable. The prominent symptoms are loss of appetite, disinclination to move, dulness and drooping head, temperature 106° or 107° Fahr., pulse 70 or 80 per minute, respiration short and hurried, conjunctivæ of a dead, reddish-yellow tint, etc.

Tetanus is another most fatal sequel; in fact, it is looked upon as invariably fatal. Like the malady just described, it is due to specific infection, but is often ascribed to the use of the clamp in the old-fashioned method of castration. It is more prevalent in some regions than others, and in some seasons it is unusually frequent. It may appear in an animal soon after the operation, or it may not become manifest for a number of days.

Abscesses in the scrotum are often owing to the scrotal wound being too small, or to premature closure of the wound when suppuration has taken place in the inner tissues. Opening the wound freely, and washing out the cavity with aseptic lotion, will soon bring about recovery. Not so with abscesses due to pyæmia. These may appear almost anywhere, and are often very troublesome; they may even have fatal results.

Amaurosis.—This condition has been sometimes observed to follow castration, but it has always been produced by excessive hæmorrhage, and recovery has usually ensued with appropriate treatment.

The Castration of Cryptorchid and Anorchid Solipeds.

Allusion has already been made (note, p. 537) to anomalies, not only in the number of the testes, but also in their situation. *Polyorchidism* appears to be exceedingly rare, as very few instances of animals having more than their normal number have been recorded, and even in some of these it is possible a mistake has been made, the globus minor being taken for a testis. The absence of the testes—*anorchidism*—is also most unusual, though unilateral or bilateral defects in, or absence of, their constituent parts are not so uncommon. The junction, or coalescence, of the two testes—*synorchidism*, as it has been termed—is likewise described, and though it has been distinguished as intra- and extra-abdominal, yet it has been remarked that the former seems the only possible form.

Hypertrophy of one testis is generally compensatory for atrophy in the other, and is the consequence of disease having checked the development of one of them, the volume of the hypertrophied one being due to increase in the length and calibre of the seminiferous ducts. A testis retained in the abdomen or inguinal canal is usually undeveloped; therefore the term *atrophy* should, according to Cadiot and Almy, be applied more particularly to the testis lodged in the scrotum.

Similar remarks may be made with regard to the position of the testes. The authorities just quoted state that all abnormal positions of these glands in the scrotum are *inversions;* normally the greater axis of the testis is inclined obliquely downward and forward, its supero-posterior border being covered by the epididymis; so that if this axis is modified inversion exists. *Ectopia* is also said to exist when the gland is arrested in its normal migration from the abdominal cavity to the scrotum, or when it has taken a wrong direction; and there is distinguished a *retention* or *incomplete migration*, and a *defective migration*. *Cryptorchidism* belongs to the first, and is most frequent, the anomaly resulting from the incomplete migration of the testes. It is termed *abdominal* when the gland is retained in the abdominal cavity, and *inguinal* when, having passed through the abdominal ring, it does not traverse the inguinal ring. It is also said to be *simple* when only one testis is so situated (*monorchidism*), and double (*anorchidism*) if both are ectopic, which constitutes true cryptorchidism. In this way we may have abdominal cryptorchidism on one side of the body and inguinal cryptorchidism on the other; but in the majority of cases it is only unilateral, and some writers have declared that it occurs more frequently on one side than the other—the right side according to some, the left side according to others; but the most experienced assert that more than two-thirds are left-sided.

The ectopic testis is rudimentary, as in the fœtus, being usually small, flaccid, and not at all like the normal gland, and in time

frequently undergoes degeneration, when it may become transformed into one or more large cysts (Fig. 552); it may contain hairs, teeth, or patches of osseous or cartilaginous tissue; or it may attain enormous dimensions from having become sarcomatous or carcinomatous. Some even contain sclerostomes.

In the abdominal form the epididymis is generally unrolled in the shape of a flexuous cord extending behind, so that the globus minor is some distance from the testis itself (sometimes four to

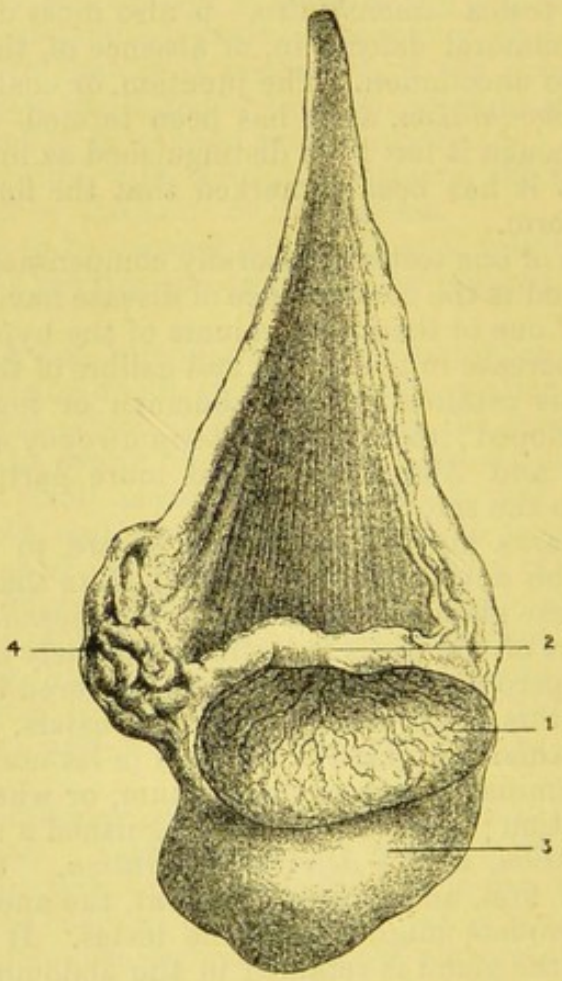

FIG. 552.—TESTIS OF A CRYPTORCHID HORSE WITH A SEROUS CYST ATTACHED TO IT. (After Hendrickx.)

1, Testis; 2, epididymis; 3, serous cyst; 4, globus major.

six inches), which is nearly always lying free and movable on the floor of the abdomen, near the flank and a little in front of the pubis, towards the middle line, and it may be among the intestines. More seldom it is near the lumbar region or in the vicinity of the bladder; and in rare cases it is adherent to the wall of the abdomen or some of the organs therein. It is attached to a wide triangular band, or frænum, that acts as a suspensory ligament, and which extends, parallel to the middle line, from the sublumbar region to the bladder. The anterior border of this band carries

the testicular bloodvessels, while the posterior lodges the vas deferens; from its external surface a narrow layer is detached, which is fixed outwardly into the corresponding lateral margin of the pelvis, while its inferior free border passes from the abdominal ring, or the fossette there, to the globus minor and the testicle, where it is joined by the abdominal portion of the gubernaculum.

The inguinal canal is entirely absent in the complete form of abdominal cryptorchidism, only a slight depression being sometimes observable at the place where it should be. In the incom-

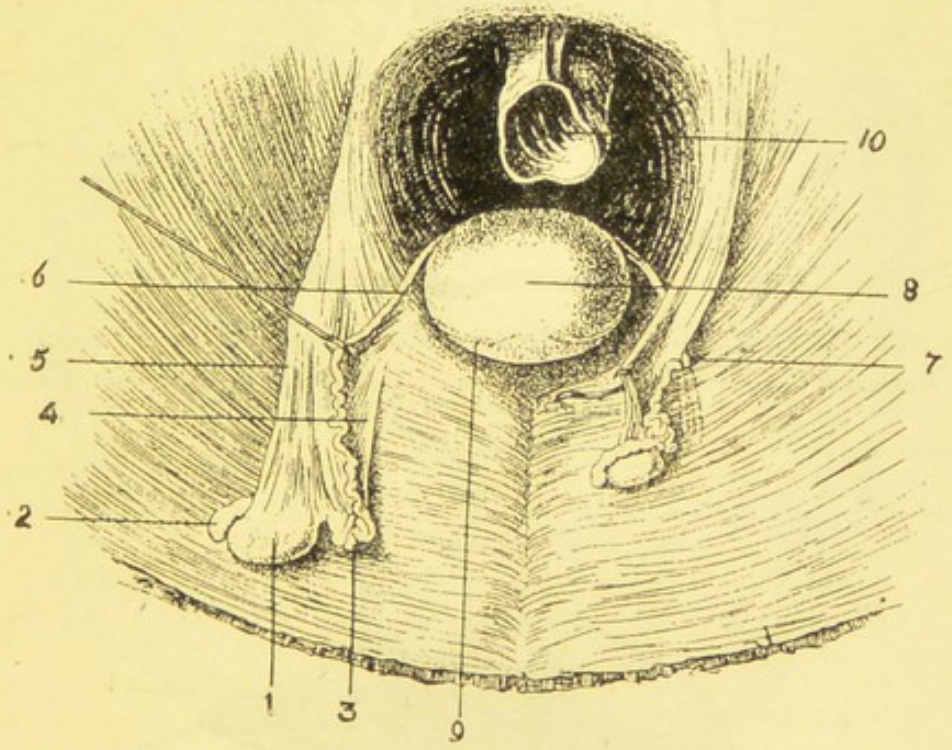

FIG. 553.—SEMI-DIAGRAMMATIC FIGURE OF THE UPPER SURFACE OF THE PREPUBIC REGION, SHOWING THE POSITION OF THE TESTES IN ABDOMINAL CRYPTORCHIDISM. (After Cadiot.)

On the right side (left looking at the figure) the cryptorchidism is complete; on the left side it is incomplete: a double portion of the vas deferens has entered a partly-formed inguinal canal. The suspensory ligaments should be a little nearer the middle line than the figure indicates; in the living animal they are usually in plaits, and the testes are near the pelvic entrance. 1, Testis; 2, globus major; 3, globus minor with the vas deferens proceeding from it; 4, gubernaculum; 5, suspensory ligament (tunica vaginalis propria) spread out; 6, vas deferens; 7, abdominal ring; 8, bladder; 9, lateral ligaments of the bladder; 10, rectum.

plete form, however, there has been described a rudimentary canal—a sort of peritoneal cul-de-sac—that lodges either the globus major or minor or a portion of the vas deferens; but in some cases this canal has been larger, and yet contained nothing. In inguinal cryptorchidism the canal exists, though to a variable extent, and has its three tunics; sometimes it extends to the inguinal ring, and it always contains the testis.

The existence of cryptorchidism may be suspected by the appearance and behaviour of the Horse, especially if it has reached, or is approaching, adult age. The scrotum is unde-

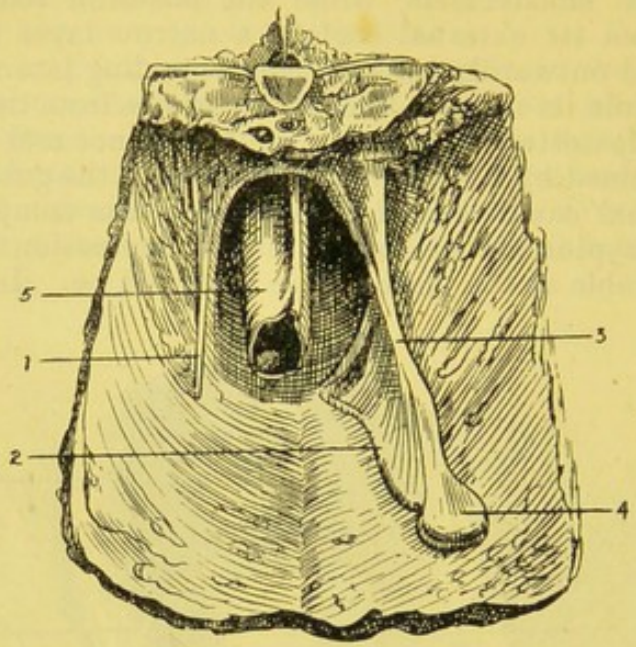

FIG. 554.—UNILATERAL ABDOMINAL CRYPTORCHIDISM. (After Cadiot and Almy.)

1, Suspensory ligament of the descended testis ; 2, vas deferens ; 3, suspensory ligament of (4) the ectopic testis ; 5, rectum.

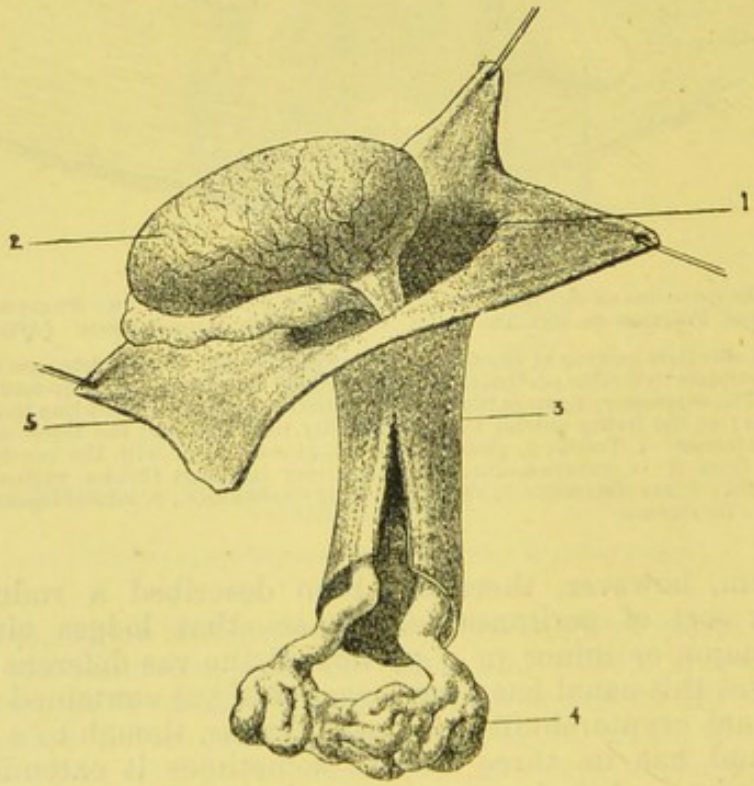

FIG. 555.—INCOMPLETE ABDOMINAL CRYPTORCHIDISM. (After Hendrickx.)

1, Abdominal ring ; 2, testis in the abdominal cavity ; 3, inguinal canal ; 4, enormously developed epididymis in the inguinal canal ; 5, abdominal wall.

veloped if castration has not taken place, or if it has been attempted there may be cicatrices apparent on the skin, and the absence of one or both of the testes is evident to the eye, and still more to the touch ; the animal neighs like an entire Horse, and only too often behaves like one, being unsteady, more or less uncontrol-

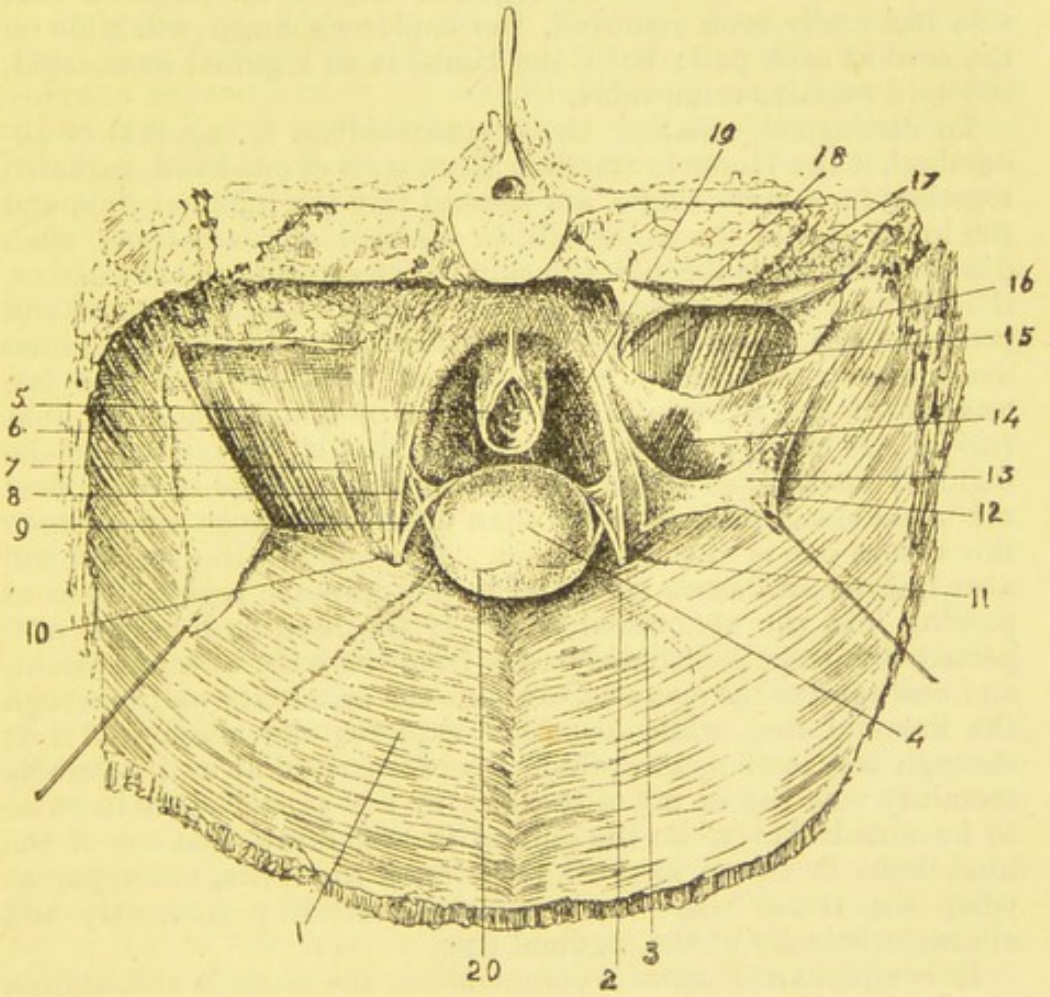

FIG. 556.—VERTICAL AND TRANSVERSE SECTION OF THE POSTERIOR ABDOMINAL REGION, SHOWING A PORTION OF THE SUBLUMBAR, ILIAC, AND PREPUBIC REGIONS OF A HORSE, WITH THE TESTES IN THE SCROTUM. (After Cadiot.)

1, Peritoneum ; 2, posterior abdominal vein ; 3, posterior abdominal artery ; 4, bladder ; 5, rectum ; 6, internal oblique muscle ; 7, cremaster muscle ; 8, 11, spermatic cord ; 9, vas deferens ; 10, abdominal ring ; 12, layer comprising the upper border of the crural arch, posterior border of the internal oblique, cremaster, subperitoneal layer, and peritoneum ; 13, crural arch turned down, showing its deep surface ; 14, sartorius muscle ; 15, iliacus muscle ; 16, lumbo-iliac aponeurosis ; 17, psoas magnus muscle ; 18, tendon of the small psoas muscle ; 19, pelvic cavity ; 20, lateral ligaments of the bladder, margined by the obliterated umbilical arteries.

lable, especially when in the presence of Mares, and frequently vicious. There may be scars on the skin, as if castration had been attempted and had failed ; but these differ from real castration cicatrices in being, as a rule, level with the surface of the skin, and not depressed and puckered as in the latter, while the stump of the cord cannot be felt in passing the fingers over them or

making pressure towards the inguinal ring. If there is still any doubt, an exploration can be made by passing the hand into the rectum and carrying it towards the abdominal ring of the suspected side; on reaching the opening, slight pressure is made on it with the first finger, while an assistant pulls at the cicatrix or skin of the scrotum below the inguinal ring; if the testis on that side has really been removed, the explorer's finger will glide on the cord at each pull; but if the Horse is an inguinal monorchid, the cord remains immovable.

To distinguish whether the cryptorchidism is inguinal or abdominal, if the Horse is standing the fingers of one hand, gathered together in a cone shape, are pressed into the inguinal ring, and the lower part of the canal will, in *inguinal cryptorchidism*, often discover the testis through the skin of the scrotum and the dartos, if it is near the inguinal ring; but if it is high in the canal and near the abdominal ring, it is not possible to feel it by external manipulation, especially if the animal is coarse-bred and fat, because of the latter and the number of lymph glands in that region. It may be observed, however, that if one testis is in the inguinal canal, that which has descended into the scrotum is of the usual size; but it is larger than usual, and hangs lower, when the absent one is in the abdomen. The hand in the rectum will also find on the same side, and in the prepubic region, the cord passing into the abdominal ring. If the hind-limb on the suspected side be pulled slightly away from the body by an assistant, and one hand of the operator examine the canal externally through the inguinal ring, while his other explores the abdominal ring through the rectum, an opinion may be arrived at with tolerable certainty whether or not a testis is in the canal. It is likewise to be noted that when the animal is laid down, and one of the hind-limbs is drawn forward, sometimes the testis, not apparent when the Horse was standing, reveals itself prominently and characteristically at the inguinal ring.

In complete *abdominal cryptorchidism*, the testis is absent from the inguinal canal—indeed, there is no canal, the abdominal ring is extremely small or imperceptible, and the testis may be felt in the abdomen; though owing to its extremely variable situation there, and its oftentimes small size, it may evade detection in many cases. Indeed, the difficulty in these cases is not so much in recognising the testis as in finding it. In these it has been recommended to explore the lateral parietes of the abdomen on the ectopic side, through the coats of the rectum, in passing the hand from the lumbar region toward the floor of the abdomen; or, beginning at the anterior border of the pubis and the middle line, to carry the hand thence forward and laterally about four or five inches from the linea alba, the fingers outspread, and the palm placed against the abdominal wall. The testis may then be encountered; it feels like a small, movable, ovoid, soft body. It has also been pointed out that the missing testis may be discovered by following up the vas deferens from the bladder to the

epididymis; but it is to be confessed that these attempts at discovery are not always successful.

In very young animals the descent of the testes into the scrotum may be retarded owing to debility or other cause, but if they are not present when an animal is a year old, or at most two years, their descent is very problematical. It is to be noted that in some exceptional instances of inguinal cryptorchidism, the abdominal ring[1] is sufficiently developed to allow the testis to fall through into the abdomen when the animal is placed on its back; so that when the Horse is standing it is an inguinal cryptorchid, and when dorsicumbent it is an abdominal one. In such a case, therefore, a Horse may be phanerorchid when standing, and monorchid, or even anorchid, when cast.

In some cases of abdominal cryptorchidism, also, there exists a rudimentary inguinal canal—a peritoneal cul-de-sac of variable depth, which may contain only the gubernaculum, the globus minor, or the vas deferens.

A monorchid Horse—one testis in the scrotum, the other concealed—may be quite fertile, but an abdominal cryptorchid is very rarely, if ever, capable of propagating its species,[2] though it may display a more vicious and unmanageable disposition than the ordinary Stallion.[3]

It may be observed that cumulative evidence goes to prove cryptorchidism to be a hereditary defect.

It is somewhat remarkable that operation for the emasculation of cryptorchid Horses is of comparatively recent introduction, notwithstanding that such animals are usually more vicious and intractable than properly-developed Stallions. It appears to have been practised by itinerant castrators in Denmark, who were expert and fairly successful operators, for a long time before Professor Stockfleth, of the Copenhagen Veterinary School, brought it prominently before the Veterinary Society of that city in 1856; for a few of the veterinarians then present had performed the operation either by the flank or the inguinal canal. Stockfleth, the following year, had an experienced travelling castrator brought to the school to give a demonstration as to the manner of performing the operation. It was practised at an early date by Marrel

[1] As will be observed, I have persistently designated the upper margin or orifice of the inguinal canal the *abdominal ring*, to distinguish it from the lower or *inguinal ring*. Much confusion prevails in designating these orifices, but in the course I have adopted I am only following Stockfleth.

[2] Cadiot mentions the case of the French double cryptorchid Horse *La Cloture*, which was remarkable for his shape and swiftness, and won his races for two consecutive years. Purchased by the Government as a stud Horse, he was put to forty Mares at Pompadour, not one of which proved in foal.

[3] The reason for this persistence of virile tendency when the power of procreation is absent, even when spermatozoa are present in the secretion of the testes, may be due to the latter maintaining their intensely stimulating influence; but owing to sclerosis, or some other change in the vesiculæ seminales or seminal ducts, the fluid cannot be taken away, and is a continual source of aggravated stimulation.

in France, and by Van Seymortier and Van Haelst in Belgium.[1] It had been performed mostly by the flank up to the time Van Seymortier first described the inguinal procedure, and showed how much easier and superior it was; this was also demonstrated by Brogniez in 1845. Dieriex popularised the operation in Belgium in 1864, and taught many how it should be performed.

In 1866 Stockfleth did much to render it popular by publishing a treatise on the anatomical relations of cryptorchids, in which he pointed out that the situation of the hidden testis may be very different in a number of cases; so that discovering it in the abdomen may be very difficult, sometimes necessitating the introduction of the entire hand; but the position of the vas deferens being always the same in all animals, this is much easier found, and leads to the detection of the gland. This explanation removed the apprehension that prevailed in the minds of many as to being unable to seize the hidden testis, and gave would-be operators confidence.

Since then several writers in Denmark, among them C. Jensen (1867), H. Jensen (1869), Petersen (1872), R. Jensen and Stockfleth (1878), and Nielsen (1884), have contributed useful articles on it; in Belgium, Degive (1875) has furnished an excellent description; in Germany, Hering, Hertwig, Schmidt (1885), Möller (1888), Ostermann, Peters, and others; in France, Capon (1878), Jacoulet (1886), Cadiot (1893), and Zabat (1897), have largely added to our knowledge of it. In England it would appear that nothing was known of the operation, and that it had never been attempted, even in the inguinal form of cryptorchidism, before the advent there (1888) of a very expert and successful American castrator, who seems to have been self-taught—Mr. Miles; but unfortunately his method was secret, except upon payment of a considerable sum, while he bound over those he instructed also to secrecy. But the operation began to be practised on a very gradually increasing scale from that time, and several useful papers have appeared on it in professional journals. In the United States it has received considerable attention; a book on it has been published by Miles (1891), and Liautard and others have dealt with it in an instructive manner.

But yet to many veterinary surgeons it appears to be a formidable and a difficult operation, and it certainly is a delicate and difficult operation, and demands tact, skill, patience, and a certain amount of dexterity and physical strength, as well as small hands and sensitive fingers. There is no reason whatever why everything connected with the operation cannot be understood by

[1] These Danish castrators frequently insured the animals they were about to operate upon, in case of death from the operation, by receiving a larger fee when they had recovered. This guarantee, however, was of little value, as they were poor men and came from another district to operate; they therefore expected their fees as soon as the operation was terminated, in order that they might return home, and it not infrequently happened that the animals remained Stallions after the operation, though this may have been conscientiously carried out.

every practitioner, nor why the operation itself could be undertaken by all or nearly all of them ; for one form of cryptorchidism —the inguinal—is not much more difficult than phanerorchid castration, and it is by far the most frequent, while confidence and skill should allow the abdominal form to be undertaken with much prospect of success.[1]

Operation.—Before operating there are certain things to be considered by the operator. The first of these are as to whether the animal is really cryptorchid, and if so, what form of the defect it is, and whether it is bilateral or unilateral ; whether operative attempts have already been made ; whether the animal is in a fit state for operation ; and the season of the year.

Between two and four years are generally considered the most favourable age for the operation, though it is performed on animals much older. Under two years the dangers attending it are much greater than over that age, and the testes may descend even after that period ; three or four years are certainly more favourable than two years, as the animal is more developed ; three years I would consider the lower limit. Horses have been operated upon when nine and ten years old, and made good recoveries. Younger animals, however, are more easily operated upon, as their tissues are not so hard. Animals in lean condition, too, are more favourable than fat ones, so long as they are not weakly nor their muscles too soft. Fat in the inguinal region is a disadvantage, as it makes the abdominal walls thicker, and the fingers cannot be passed into the canal so easily or so far ; while a fatty mesentery or omentum often makes it difficult to find the testis or cord.

As in castration, cold winds and wet weather are not favourable, and late spring and autumn are generally considered the best seasons for operating—between April and September, in fact. Needless to say, the animal should be in good health and in healthy surroundings.

For some days before operating food should be sparingly given, and then chiefly in the form of mashes, with frequent small doses of sodæ suph., the object being to empty the bowels as much as possible, so as to render detection and seizure of the testis more easy. On the evening preceding, and on the day of operation, no food should be allowed, and not much water ; and a few hours before one or two warm-water enemas should be administered, and brief exercise may be given.

Castration in abdominal cryptorchidism may be performed (1) through the inguinal canal, (2) through the inguinal canal and

[1] Danish veterinarians understand a 'cryptorchid' to be an animal that has one or both testes in the abdominal cavity, the walls of which must be perforated to reach them. When they are in the inguinal canal, the term 'false cryptorchid' (*falsche spitzhengste*) is used ; it is not then necessary to break through the abdominal parietes in order to remove the testes, as they can always be seized and withdrawn, though sometimes with difficulty, from the canals and inguinal rings, and there is no more danger in operating upon such animals than upon normal Stallions ; whereas the castration of true cryptorchids is always a serious operation.

floor of the abdomen, or (3) by the flank. Then there is the operation for (4) inguinal cryptorchidism.

1. Operation through the Inguinal Canal.—This is perhaps the most popular, as it is certainly the most advantageous, method of operating for the removal of the testes in cases of cryptorchidism, as the abdominal cavity may be reached through it, with the chance of meeting with the testis in some portion of the interspace, or the floor of the abdomen may be perforated from it if it is not desired to go right up through the canal. It is the

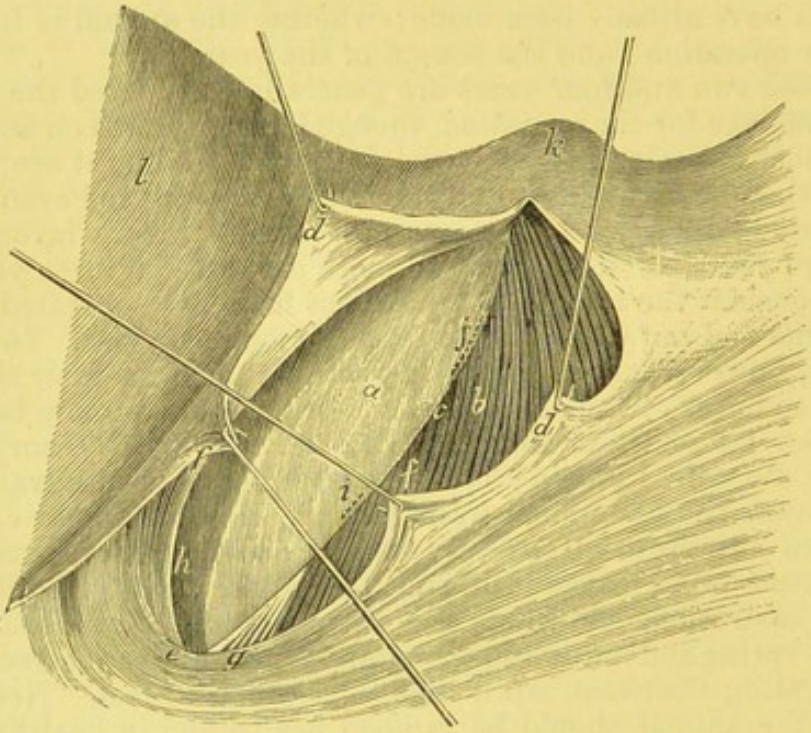

Fig. 557.—Inguinal Canal seen from the Flank, the Ring being divided. (After Cadiot.)

The aponeurosis of the external oblique is also divided in front of the line where it is inflected. The internal oblique is reflected from the crural arch to near the internal commissure of the canal. *a*, crural arch; *b*, internal oblique muscle; *c*, internal commissure of the inguinal canal; *d*, aponeurosis of the external oblique muscle divided; *e*, internal commissure of the inguinal ring; *f*, *f*, external commissure divided: *g*, anterior border; *h*, posterior border; *i*, dotted line indicating the situation of the abdominal ring; *j*, dotted line showing the place where the perforation in the commissure should be made in the operation for abdominal cryptorchidism; *k*, angle of the haunch; *l*, posterior limb abducted.

method adopted by many of the most successful operators, and owing to its zealous advocacy by Professor Degive, of the Brussels Veterinary School, it is known on the Continent by his name, or as the Belgian Method.

Surgical Anatomy.—At page 380 the surgical anatomy of the inguinal region has been dealt with in a more or less comprehensive manner, so that only a brief reference need now be made to it, in view of the requirements of this particular operation. We will borrow our description from Stockfleth's 'Handbook of Veterinary Surgery,' as it is at once concise and clear, and is given in connection with the operation:

'Near the place where the limb comes in contact with the body, the abdominal wall is pierced by the inguinal canal (*canalis inguinalis*), which lies between the

abdominal muscles and the ligament (*ligamentum Poupartii, s. inguinalis*) formed by them. This ligament divides into two parts, a limb portion and a pubic portion. The limb portion is the thinnest, and unites with the sheath of the muscles of the limb; the pubic bone portion, on the other hand, forms a strong tendon, which becomes attached to the anterior border of the pubic. The inguinal canal serves for the passage of the testicle and spermatic cord, etc., into the scrotum during fœtal life. Both are covered by the general serous tunic (*tunica vaginalis communis*). This canal is not merely a straight hole bored through the abdominal wall, but is an oblique canal, three to four inches long. The internal opening into the abdominal cavity (*annulus abdominalis, s. inguinalis*) is smaller than the external, and slantingly situated, about six inches from the middle line (*linea alba*). The peritoneum passes through it to the

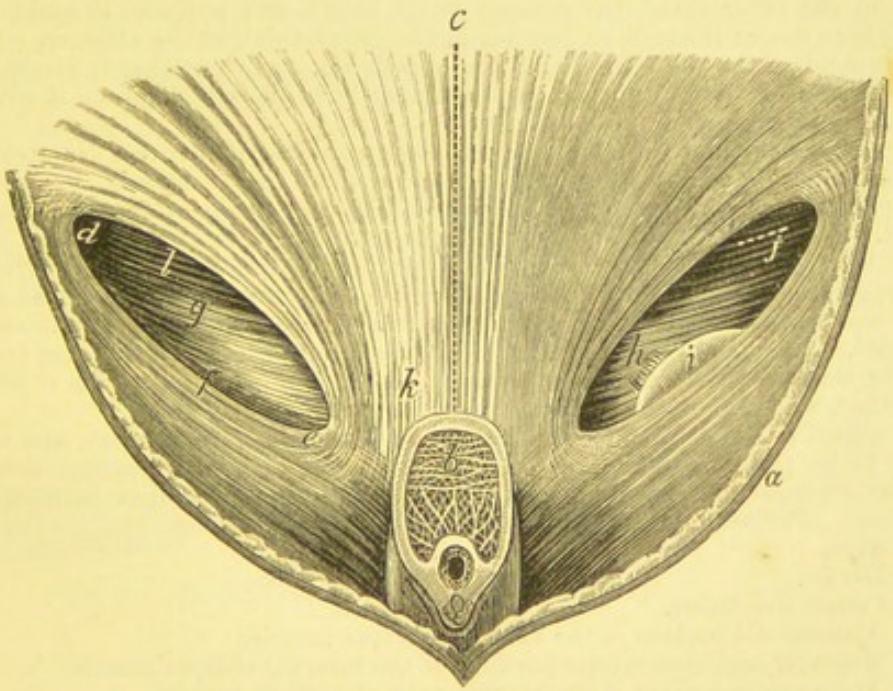

FIG. 558.—PREPUBIC AND INGUINAL REGIONS SEEN FROM BELOW, AND SHOWING ON EACH SIDE OF THE MIDDLE LINE THE INGUINAL RING AND ENTRANCE TO THE INGUINAL INTERSPACES OR CANALS. (After Cadiot.)

a, skin; *b*, section of the penis; *c*, dotted line marking the linea alba; *d*, external commissure of the inguinal ring; *e*, internal commissure of same; *f*, external border or lip of same; *g*, internal oblique muscle; *h*, divided fibrous band, the remains of the gubernaculum testis; *i*, testis covered by its tunica vaginalis, and lying close to the inguinal ring—*inguinal cryptorchidism*; *j*, dotted line indicating the situation and direction of the opening made in the internal oblique muscle in the Danish operation, as modified by Bang and Möller; *k*, common tendon of the abdominal muscles; *l*, internal margin or lip of the inguinal ring.

scrotum as a special membrane (*tunica vaginalis propria*), covering, on the one side, the testicle and its appendages, on the other in apposition with the common lining of the scrotum (*tunica vaginalis communis*). The canal is flattened from above to below, filled by loose connective tissue, and passes in a direction from before, backwards, and inwards towards the middle line of the body. The external opening (inguinal ring) is a cleft about four to five inches long, passing obliquely forwards and outwards in the strong Poupart ligament and the yellow abdominal tissue (*fascia superficialis*). It commences about an inch and a half in front of the border of the pubis, and the same distance from the linea alba, but is much nearer the latter than it is the abdominal. When the Horse stands normally on its legs, the inguinal canal forms an almost closed slit; but when the limb is held backwards and outwards, or when the animal is cast and fixed so that the limb is away from the body, then the inguinal canal is cylindrical,

because the limb portion of Poupart's ligament is drawn outwards and backwards. This is the reason why an inguinal hernia may take place during the operation of castrating a Stallion.'

In a cryptorchid that Stockfleth bought for post-mortem purposes, the left internal inguinal ring was normal, and the spermatic cord passed through it in the usual way outwards. The left vas deferens passed from the internal ring over the round ligament and the ureter, posteriorly over the wall of the bladder, through the portion of peritoneum (Douglas' fold) under the prostate gland, to the urethral canal. The right testis was in the abdominal cavity, hanging, with its vessels and vas deferens, in a fold of peritoneum about three inches broad, from the superior wall of the abdomen. Inferiorly, it was united to the right inguinal ring by a strong fold of membrane (a kind of gubernaculum). The vas deferens was tolerably long and tortuous, and had the same form and course as that on the other side. On account of its length and position, it could have easily been drawn through an opening in the inferior wall of the abdomen (operation wound). On the other hand, the vessels were so short that it would have been difficult to draw out the gland sufficiently to place a clamp on it without risk of rupturing them.

In another cryptorchid upon which Neilsen made a post-mortem examination, he found one of the testicles alongside the small psoas muscle, hanging in a duplicature of peritoneum, which formed a kind of ligament about four inches broad. The vessels and the vas deferens were so long, however, that they could have been easily reached through an opening in the floor of the abdomen, although the peritoneal duplicature must have been torn before the gland could have been seized. The main point to notice is, that the vas deferens was normally situated. In some cases he noticed that the internal inguinal ring was smaller on the side where the testicle remained in the abdominal cavity than it was on the other, whereas in other cases no difference could be detected.

In regard to the different layers which compose the inguinal region, and which have to be passed through in order to reach the abdominal cavity, they are similar to those of the abdominal wall, though their direction is somewhat different. Proceeding from without inwards, they are :

1. Skin.
2. Dartos.
3. Connective tissue.
4. Aponeurotic portion of the external oblique muscle.
5. Muscular and aponeurotic portions of the internal oblique muscle.
6. Aponeurotic portion of the transversalis abdominis muscle.
7. Subperitoneal connective tissue.
8. Peritoneum.

It is to be remembered that the anterior or antero-internal wall of the inguinal canal is formed by the internal oblique muscle, which gradually diminishes in thickness towards the middle line and the internal commissure, where it is very thin and aponeurotic. The posterior or postero-external wall is formed by the crural arch, which is rather thick in the inferior part and towards the external commissure of the canal, and thin at its upper border, which is joined with the lumbo-iliac aponeurosis. The external commissure, oblique downwards and backwards or outwards, is formed by the junction of the muscle with the arch. For its whole length these two parts adhere a little more intimately than in the canal, but this is not otherwise limited outwards ; the commissure may be pushed by the fingers so as to lay bare the internal oblique muscle and the aponeurosis covering it. The internal commissure is constituted by the same parts : towards the inguinal ring by the joining and the slender adhesion of the internal oblique to the arch, and higher by the union of the posterior border of the muscle to the arch. Inclining downwards and inwards, following a line extending from the iliac insertion of the internal oblique to the prepubic tendon, this commissure is less resisting than the external, and when the perforation, as in the operation, of the inguinal interspace is improperly made, and the fingers press on it, it is easily torn at any part.

It is also to be borne in mind that the inguinal ring is oval in shape, its larger diameter being directed obliquely backwards and inwards, and that it is chiefly formed by two fasciculi of fibres belonging to the external oblique muscle, which,

at first contiguous, separate from each other to constitute two incurved lips that circumscribe the opening. These lips show borders or pillars, and two angles or commissures. The antero-internal lip is deeply lined by the internal oblique, the fibres of which are inflected at this point to assume a more horizontal direction. The postero-external lip is entirely formed by a portion of the aponeurosis of the external oblique muscle, immediately continued above by the crural arch and below by the crural aponeurosis. The anterior or external commissure is more or less strong, according to the animals, and is formed by diverging fibres of the external oblique muscle, strengthened by some arciform fibres. The posterior commissure corresponds to the tendon of the abdominal muscles and to the anterior border of the pubis.

The bottom or summit of the inguinal canal is formed by the union of the two commissures, and it is limited by the line of insertion of the deeper fibres of the internal oblique on the iliac portion of the crural aponeurosis. The summit of the canal—the part where the peritoneum should be encountered in the operation through the canal—is situated much above the point where the abdominal ring usually is, as the latter may be only three or four inches from the middle line, while the summit of the canal may be six or eight inches from it.—CADIOT AND ALMY.

OPERATION.—Whether or not an anæsthetic should be administered has been much discussed, but there can be no doubt that if adopted it greatly facilitates the operation, especially if the

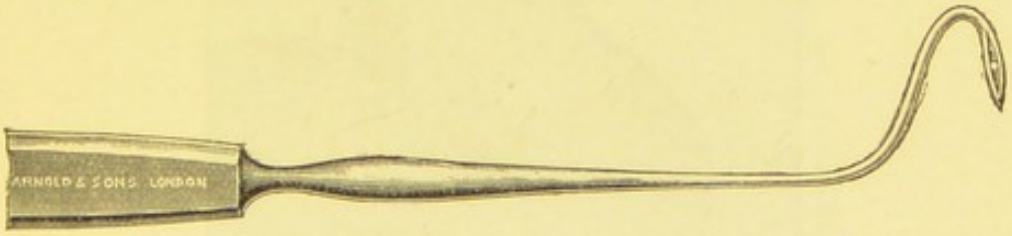

FIG. 559.—LIGATURE NEEDLE FOR CLOSING WOUND IN INGUINAL RING.

animal is nervous or irritable, if there is risk of hernia, or if the procedure is likely to be protracted. The muscular relaxation induced also greatly favours the operator, to say nothing of sparing the animal much pain.

The most careful asepsis possible should be observed ; the skin in the inguinal region, prepuce, and inside the thighs, ought to be washed with soap and water by an assistant, the shanks and feet of the hind-limbs should also be wrapped in a piece of cloth damped with disinfecting fluid, when the Horse is cast, and the skin of the prepuce, inguinal region, and inside the thighs, ought also to be sponged over with that fluid before the operation is begun. Needless to say that the hands and arms of the operator should also be scrupulously clean and aseptic.

Instruments and Appliances.—These are few in number, and may be limited to a scalpel, convex bistoury, or ordinary castrating knife, dissecting forceps, an ecraseur, a pair or two of artery forceps, a blunt seton needle, a curved suture needle in handle, ligature silk and wire, as well as aseptic lint and gauze.

Position.—The animal is to be placed in the latericumbent or dorsicumbent position, as for ordinary castration, or as for operation for schirrous cord. Some operators prefer the latericumbent

others the dorsicumbent, position. If latericumbent, the side to be operated upon should be uppermost, and the hind-limb of that side drawn well outwards and forwards, and kept there, the other three limbs being secured in the ordinary way. If dorsicumbent, the hind-limbs are well flexed at the hocks, and kept down and well apart by a strong leather strap or canvas band passing from the shank of one hind-leg, across the loins to the shank of the pposite hind-leg, and the spreader placed between them.

If possible, the bed on which the Horse is laid should be of pine sawdust, or be covered with a wide canvas sheeting or oil-skin covering, which should be damped with antiseptic fluid. The hind-quarters ought to be on a higher level than the front part of the body.

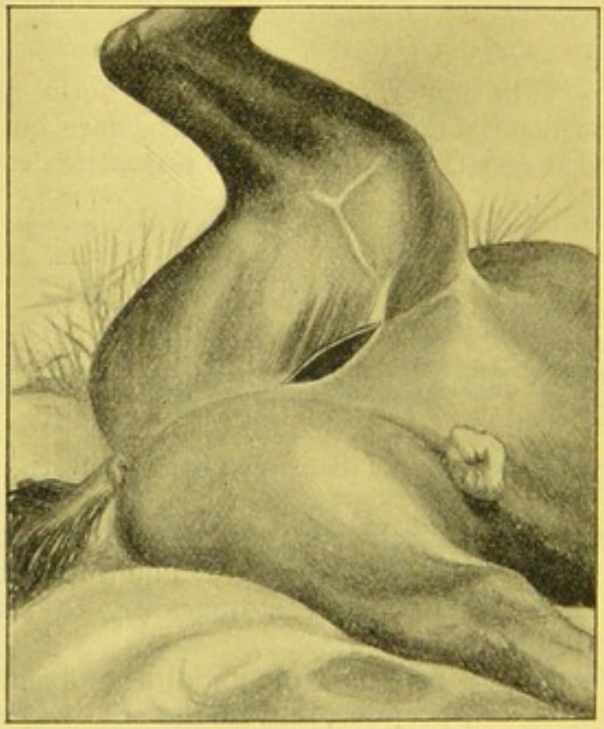

FIG. 560.—POSITION OF HORSE IN OPERATION FOR CRYPTORCHIDISM, SHOWING SITUATION OF INCISION IN THE SKIN OVER THE INGUINAL RING. (After Cadiot and Almy.)

Technic.—The skin is to be incised over the inguinal ring in the direction of its long axis, to the extent of about six inches; this incision may be effected by making the skin tense between the thumb and first finger of the left hand and cutting through it with the knife. But this entails risk of wounding veins and giving rise to troublesome bleeding. A safer and much more expeditious plan is to raise a large transverse fold of skin and divide this to a depth of three inches by one cut of the knife or one snip of sharp scissors. When released the wound will be six inches long, and there will scarcely be any hæmorrhage. If the dartos is not divided completely, this may be done by raising one lip of the wound, and with one or two light cuts of the knife, taking care

not to wound the veins that lie below it. The subjacent connective tissue is torn through by one or two of the fingers of each hand to an extent sufficiently great to allow the hand to pass through, or the knife may be used for this purpose ; the inguinal ring being exposed, and also the inguinal canal, the internal or prepubic commissure of the ring being easily felt. The index and middle fingers can now explore the lower part of the canal, but if nothing is found, all the fingers of the hand on the same side as the ectopic testis (right testis right hand, left testis left hand) are fully extended and gathered into a cone shape ; they are then

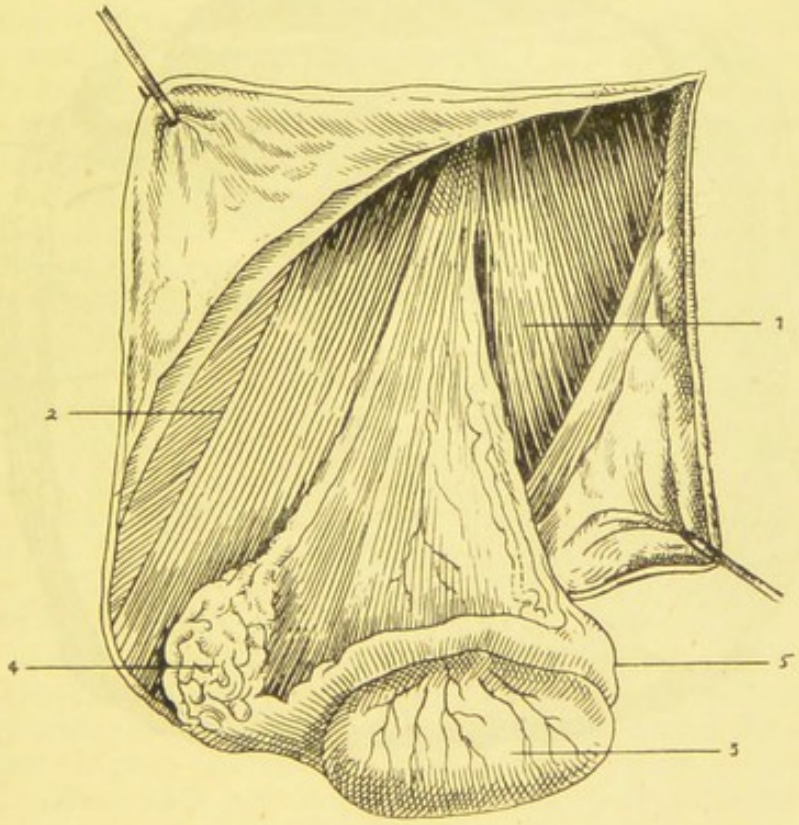

FIG. 561.—CRYPTORCHID CASTRATION. (After Cadiot and Almy.)

The inguinal canal opened, showing the testis therein. The inguinal ring has been widened by incising its external commissure. 1, internal oblique muscle ; 2, external commissure of the inguinal ring ; 3, testis ; 4, globus major ; 5, globus minor.

gently pushed into the canal, taking as a guide the internal or prepubic angle of the ring, in the direction of the angle of the haunch, resting against the crural arch, and advancing by a slight rotary or torsion movement, and separating the fingers now and again. This penetration is much easier effected if a little carbolised olive-oil is poured into the wound, so as to lubricate the passage. If the testis is in the canal, it will now be encountered (Figs. 553 *et seq.*). If it is found, gentle traction must be used to bring it down sufficiently near to get the ecraseur chain around the spermatic cord, above the epididymis, when it is to be removed slowly, as in phanerorchid castration.

But if the testis is not met with, exploration is to be slowly continued upwards in the direction indicated, taking care not to injure the internal commissure. In this way it is easy to detach the internal oblique muscle from the crural arch, from which the posterior border may be separated for a short distance; then the peritoneum can be felt, and through it the intestines. This mem-

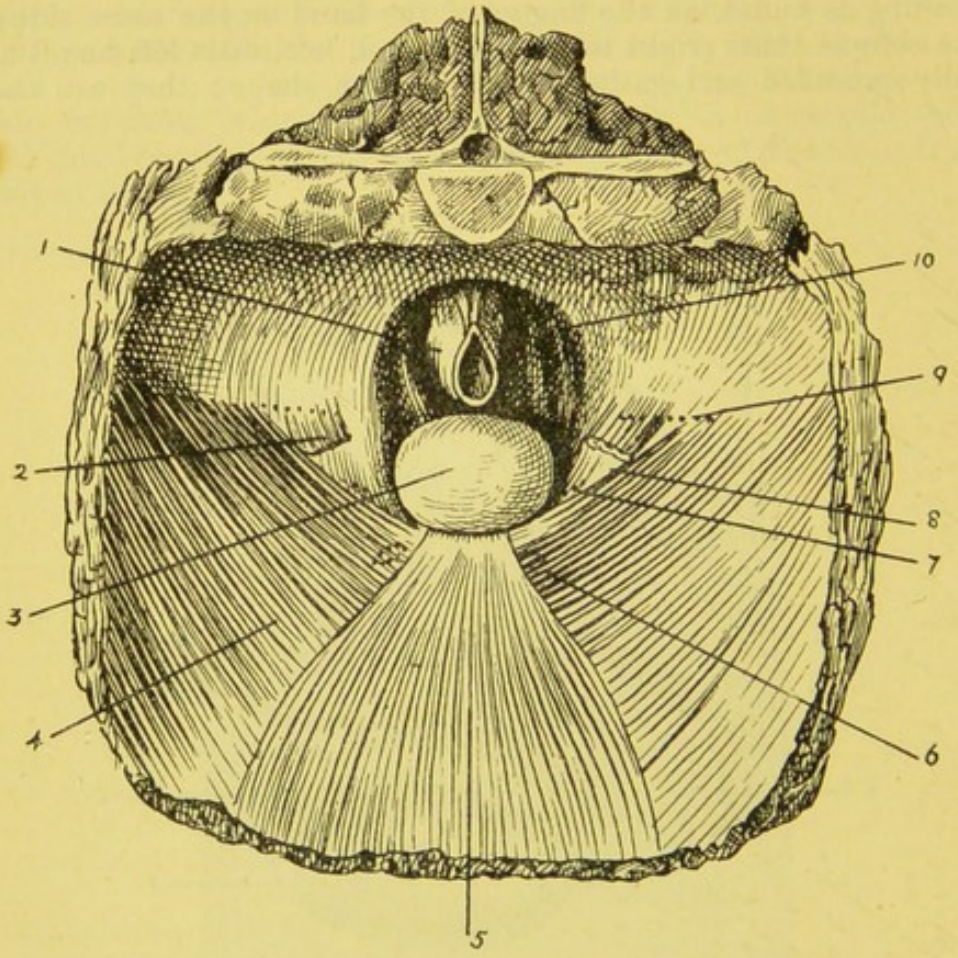

FIG. 562.—TRANSVERSE VERTICAL SECTION OF THE INTERNAL POSTERIOR ABDOMINAL REGION, SHOWING THE ORIGIN AND ARRANGEMENT OF THE INTERNAL OBLIQUE AND CREMASTER MUSCLES.

The peritoneum and transversalis abdominis muscles have been removed. 1, Rectum; 2, upper portion of the cremaster muscle, which has been divided near its origin; 3, bladder; 4, internal oblique muscle; 5, rectus abdominis muscle; 6, dotted line indicating the situation of the inguinal ring; 7, dotted line corresponding to the abdominal ring; 8, posterior border of the internal oblique muscle; 9, dotted line showing the point which the hand should reach at the peritoneum in the operation for abdominal cryptorchidism; 10, pelvis.

brane has now to be perforated by the end of a finger or by the finger-nail in seizing it between the thumb and first finger. It sometimes happens that the peritoneum, instead of tearing, becomes detached by the pressure of the finger, and then requires a strong push of the hand upwards to tear it. The blunt seton needle will usually be found more advantageous than the finger to effect this opening, which, once made, can readily be enlarged

by one or more fingers. It is to be noted that the passage of the hand up the canal can be much facilitated—especially if the position of the Horse is latericumbent—by flexing and abducting the hock of the limb of the same side as much as possible; and in taking the point of the haunch for guide, in pressing the hand rather outwards than inwards, and in penetrating as deeply as possible, the danger is averted of perforating the inguinal canal too low, which would in all probability lead to eventration. But if these directions are followed, the opening into the abdomen will be made sufficiently high to prevent such a mishap (Figs. 557, 558). The hand should, in fact, reach the peritoneum not far from the sublumbar region, near the terminal tendon of the small psoas muscle and the external iliac artery, or a little more outwards towards the middle of the external border of the iliacus muscle, or to near the superior insertion of the sartorius muscle in the lumbo-iliac aponeuroses close to the brim of the pelvis, and between the tendon of the small psoas muscle and the middle of the lower surface of the iliacus. An opening at this height leaves the intestines no tendency to escape, the effect of the pressure on the abdominal wall when the animal has risen being rather to bring the internal oblique muscle against the crural arch, and thus to hermetically close the peritoneal perforation.

The abdominal cavity being now open for exploration, the first, or the first and second fingers, are introduced through the opening in search of the testis or its appendages. In the majority of cases it is found in front of and below the opening, not far from the shaft of the ilium, though the fingers usually meet with the epididymis, or the lower border of the suspensory ligament. Whatever is found is drawn gently towards the inguinal canal.

But it is not always easy to detect the testis in this way, and the fingers may be moved about in every direction without meeting any trace of it. Then it is necessary to extend the perforation, and to pass the entire hand through it, so as to search around, taking care not to press the arm on its internal border, as the commissure is readily torn, and if the tear is extensive it might lead to lamentable results. The hand may now be passed to the bladder, where it will find the vas deferens; this is seized between the thumb and first finger, and followed until the epididymis is reached, when the testis is not far off. In this search the hand soon becomes fatigued, and frequent rests, without withdrawing it, are sometimes needed. In such fatiguing cases the hand of an assistant introduced into the rectum, when possible, will prove useful in exploring the prepubic region and bringing to the hand of the operator whatever organs his fingers may encounter.[1] In some cases this assistance may dispense with passing the whole hand into the abdomen. When found, if of

[1] Nielsen mentions two instances in which an expert assistant has passed his hand into the rectum, found the testis in the abdominal cavity, and brought to the abdominal ring, where the operator was able to seize it through the inguinal canal.

small size, there is generally no difficulty in bringing the testis into the inguinal canal and down to the ring. If the animal is not narcotised, it generally struggles when the testis or vas deferens is seized, and even when under the influence of an anæsthetic it has been noticed that flinching often occurs at that moment; though, even when conscious, other abdominal organs can be handled without any signs of uneasiness. If the epididymis or the spermatic cord is first found, by drawing it the testis will follow. But when the testis is very large it cannot be got into the canal without making such an extensive opening that the intestine might come through. In such a case Cadiot recommends that three-fourths of the hand should be in the abdominal cavity, the back slightly raising the internal oblique muscle, and the testis, having been previously brought to the margin of the opening, is drawn into it by flexion of the fingers, the hand preventing the intestines from following. The testis having been got into the canal, the fingers are slightly extended, carrying it with them slowly towards the crural arch; this allows the internal oblique muscle to come to this aponeurosis and close the opening. If, however, the large volume of the organ is due to a cyst, this must be punctured and its contents evacuated. This is done by passing a fine trocar and cannula up into it and puncturing it, the hand of an assistant being passed into the rectum to steady it, if need be.

In most cases the testis can be brought down to the inguinal ring, or even lower, if the spermatic cord is long, so that its excision by the ecraseur, castrator, or ligature can readily be accomplished. But if the cord is short, it will be necessary to employ the ecraseur in the canal.

Should it happen that both testes are in the abdominal cavity, they may be removed at the same time by the same wound, if the cord of the second testis is sufficiently long to allow it. If not, it may be advisable to defer removing the second one until the animal has recovered from the effects of the first operation, as opening the other inguinal canal on the same day might be followed by bad consequences.

It is to be observed that the operation may be more difficult when the Horse is placed dorsicumbent, as the testis, if in the abdomen, frequently falls among the intestines beneath it, and its situation may be rather different to what it is in the lateri-cumbent position, so that it is more troublesome to find, especially with two fingers only. But even then, if the Horse is not very fat or the intestines distended with ingesta, the vas deferens can usually be detected in the vicinity of the abdominal ring.

When certain that the opening in the peritoneum is sufficiently high, and the inguinal canal not too much dilated to allow the intestines to get through, nothing more is required than to cleanse the wound and dust it with antiseptic powder, and perhaps pass one or two sutures through the skin wound. But should there be any apprehension of hernia taking place, a plug of aseptic lint

or gauze should be passed into the lower part of the inguinal canal and kept there for one or two days by sutures through the skin wound.

2. Operation by opening the Inguinal Canal and Floor of the Abdomen.—This method of operating was practised for a long time in Denmark, and has consequently been termed the Danish operation, though it has recently been modified by several operators who are in favour of it. It is to be preferred for small Horses and Ponies in which the inguinal canal is too narrow for the passage of the hand.

The preparation and position of the animal, instruments, etc., as well as some of the details of the operation itself, are the same as for the method just described.

Technic.—The interspace in the internal ring is exposed as in the preceding operation. A small incision is made in the middle of this interspace, into which the two thumbs—back to back—are introduced, so as to enlarge it. The fascia may also be divided, layer after layer, by the knife, to make the lower end of the canal more apparent, tearing through the connective tissue in it, so as to pass in the first and second fingers and ascertain whether it contains the testis. If there is much hæmorrhage, this can be suppressed by the application of artery forceps on the divided vessels, or by twisting them. The anterior wall of the interspace is divided by incising the inguinal ring, outwardly, in its aponeurotic layer to the extent of two to four inches, so as to expose the internal oblique muscle (Fig. 557), where it forms a thick layer; here the abdominal wall is perforated, either by the first and second fingers, or by means of the blunt seton needle. This is done by pushing smartly through between the fibres of the muscle, aponeurosis, and peritoneum, which are all penetrated at the same time, if the puncture is made towards the termination of an inspiration; though sometimes a second push is required to perforate the peritoneum. The same fingers are passed through this buttonhole-like slit into the abdomen (Fig. 558), where they feel for the testis, epididymis or cord, which may be immediately met with. If not, the fingers passed backwards, and taking for guide the slight depression that exists at the abdominal ring and the serous layer that proceeds from it to the suspensory ligament of the testis, something of them should be felt. Still unsuccessful, the hand of an assistant in the rectum may prove as useful as in the operation through the canal. Of the organs pushed towards the wound, the one sought for is usually soon detected at it, and selecting the epididymis, this is seized and drawn through the opening, followed by the testis. In rare cases is it necessary to carry the hand into the abdomen, where the opening has to be enlarged sufficiently towards the haunch, in the direction of the muscular fibres, by separating these; the wound seldom allows the intestines to pass out if it has been allowed to keep its original disposition. The hand can be moved with impunity among the intestines, where the testis may be

found ; or it may be passed to the bladder, where it can seize the vas deferens between the finger and thumb and follow it from behind to before until the epididymis is reached, when the testis can be brought to the wound, and drawn outside, where it is excised by the chain of the ecraseur being slowly tightened on the cord above the epididymis. The stump is dusted with aseptic powder, and returned to the abdomen. The muscular wound need not be sutured if only a small opening has been made in the internal oblique, though it may be preferable to do so by means of the curved needle already referred to (Fig. 559). It should be cleansed, dressed with aseptic powder, and the skin wound closed by three sutures. If the animal has both testes in the abdomen they may be removed at the one operation, and possibly by the same wound. The muscular wound may be covered with aseptic gauze, which can be allowed to remain for one or two days, and a drainage-tube may be inserted at the lower angle of the skin wound.

3. Operation through the Floor of the Abdomen.—This method of removing the testes from the abdominal cavity has had its advocates, but is not much resorted to, and for obvious reasons. It consists in opening the floor of the abdomen in front of the pubis and inguinal ring, near the prepuce. In certain cases it might be adopted with advantage, when neither of the two preceding operations can be practised, but such cases must be rare.

Operation.—The preliminary attention to the animal already described for the other methods is to be observed in this. The hair is to be shaved off the skin where it is to be incised, and the part must be well cleansed and asepticised.

Instruments and Appliances.—A scalpel or convex bistoury, dissecting forceps, ecraseur, ligature silk, antiseptic fluids and powders.

Position.—The dorsicumbent position is the most favourable, and the animal secured as for ordinary castration. An anæsthetic should be administered.

Technic.—An incision about four inches in length is made in the skin about one and a half to two and a half inches from the middle line, alongside the prepuce in front of the pubis, and near the inguinal ring. Then the subcutaneous connective tissue is divided to the same extent, as are the abdominal tunic and the superficial layer of the rectus muscle. This done, the deeper layer of that muscle, the aponeuroses of the oblique and transverse muscle, the subjacent fascia, and the peritoneum, are perforated by the first and second fingers to a like extent. This makes an opening through which the fingers can explore the entrance to the pelvic cavity. If they do not come in contact with the ectopic gland, then the entire hand can be introduced, and in nearly every case the testis, epididymis, vas deferens, or suspensory ligament, can be found. If not, the hand is to be directed to the bladder, on which the vas deferens will be discovered ; this is traced forwards, and the epididymis will soon

be reached, and with it the testis. This is withdrawn through the wound, and removed above the epididymis by means of the ecraseur, the stump being returned to the abdomen after being disinfected. The wound is closed by sutures passed through the rectus muscle, then another row through the skin.

If both testes are in the abdomen, they can be excised through the one opening at the same time.

4. Operation through the Flank.—This method is simply laparotomy, and has been advocated and practised by some operators, though it has never become popular. The abdominal cavity is opened high up in the flank, at an equal distance from the angle of the haunch and the last rib, and the ectopic gland is searched for and removed through the opening.

Position.—Latericumbent, the animal being placed on the side opposite to that from which the missing organ is. The uppermost hind-limb may be held well back by assistants, to afford more room for the operator's hand and arm.

Instruments and Appliances.—These are the same as are mentioned for laparotomy (see p. 364).

Technic.—The animal should receive an anæsthetic. The precautions to be adopted and the procedure in opening the abdominal cavity are the same as those given for laparotomy (see p. 365). The opening in the flank may be made a hand's breadth below the point of the haunch, and between it and the last rib, so that when the hind-limb is released after the testis has been removed the opening in the muscles is spontaneously closed. The hand is passed into the abdomen and along the abdominal wall towards the entrance to the pelvis. When the testis is found, it is brought out through the wound and excised by the ecraseur, or the cord is ligated and the gland then cut away. The stump is then disinfected, returned into the abdomen, and the wound closed—the muscles by several catgut sutures, and the skin by as many silk sutures as may be necessary, and the surface dressed with boric or chinosol powder. If both testes are in the abdomen, they can be removed at the same operation and through the same wound.

The chief objection to this operation is the complex wound, and the difficulty in preventing the formation of intermuscular abscess, the pus gravitating to a lower level, no matter how carefully aseptic measures have been carried out. But it has its advantage in the impossibility of eventration happening, and also that in those cases in which the testis is in the abdomen, and cannot be discovered by the other methods, it can be by this. Also, when the testis is diseased or altered to such an extent that it cannot, without great trouble and risk, be removed through the abdominal ring or the floor of the abdomen, it can always be extracted through this flank opening. With rigid asepsis suppuration might be prevented.

5. Operation for Inguinal Cryptorchidism.—As has been remarked, a very large percentage of the cases of cryptor-

chidism are those in which the testis or one or more of its appendages are lodged in the inguinal canal; and in describing the operation for abdominal cryptorchidectomy, allusion was made to the possibility of finding the organ there instead of in the abdomen—a circumstance which greatly simplifies and abbreviates the operative procedure. Indeed, the operation in many of these cases is not much more difficult than ordinary castration, so that a brief description of the operation will suffice after what has been already stated.

The precautions, instruments, and position are the same as for abdominal cryptorchidectomy through the inguinal canal.

Technic.—The inguinal ring having been exposed in the manner already described, and the connective tissue in the canal having been torn through, the hand will come in contact with a small ovoid mass formed by the testis and its envelopes; this is to be isolated by the first, or first and second fingers, which tear away the connective tissue that holds it to the sides of the canal. This must be done with care, lest the mass escapes towards the internal oblique muscle and the internal commissure.

If the testis should chance to be lowermost, it must be seized in the hand, and its envelopes opened, as in ordinary castration, after it has been brought within easy reach outside the inguinal ring. In some instances considerable force has to be employed —when it is high in the canal—to bring it sufficiently low, and long forceps, like bitch obstetric forceps, may even be required.

In other cases it is the epididymis or the spermatic cord that the fingers first meet, and by traction on these it may be possible, if the testis is not too large, to bring it down through the abdominal ring, and then it can be excised. If, however, it cannot be carried into the canal, it will be necessary to dilate this throughout its length, and to enlarge the ring by incising it outwardly by means of a blunt-pointed bistoury or a bistoury cachée, or in the manner described in the inguinal operation.

The testis is then brought within reach of the ecraseur, and excised above the epididymis, or the cord can be ligated and the testis cut off below the ligature.

After-Treatment.—In these varied operations for the removal of ectopic testes, their success largely depends, not only upon the method adopted, but upon the skill and patience of the operator, and the care with which antiseptic measures have been carried out. If these have been satisfactory, the animal operated on does not, as a rule, require much attention. It should be comfortably housed until the wounds have healed, being kept tied up for two, three, or four days, and fed in the ordinary way of patients suffering from a serious traumatic injury. The tail-hair should be plaited and tied to the surcingle. If flies are annoying, the skin ought to be dressed with something that will drive them away. If there are no unfavourable signs, the animal may be given walking exercise in three or four days after the opera-

tion, or may receive sufficient in the loose-box in which it is domiciled. The wounds are generally cicatrised in about a month, before which time the animal should not be submitted to severe work, nor yet to very active exercise.

The wounds generally require no unusual treatment. If asepsis has been well carried out, the consequent inflammation is mild, and there is little traumatic fever. Suppuration is trifling if the wound is dressed with boric or chinosol powder; in some cases it does not occur at all, and cicatrisation is rapid.

Sequelæ.—The unfavourable sequelæ of the operations are septicæmia, septic peritonitis, and prolapse of the intestines or omentum, besides those accidents that may occur from all operations of this kind. Septicæmia can only be prevented by careful asepsis; when it does happen a fatal result may be predicted. The same may be said of septic peritonitis, which is due to infection during the operation, and is generally brought about by the operator himself, or neglect of the precautions so essential in dealing with the textures which this operation involves. Death usually sets in rapidly, though in rare cases it may not take place for several weeks.

Prolapse of the intestine—usually the small intestine, or rarely the small colon—and the omentum happens not infrequently when the operation is unskilfully performed. In the operation by the inguinal canal, which is perhaps the safest of all, the accident occurs when the perforation in the peritoneum is made too large or too low; and in that by the inguinal canal and the floor of the abdomen (known as the Danish method), it only takes place when the muscle has been more or less torn across. Passing the hand into the abdominal cavity does cause a large breach in the wall, and predisposes to the accident; therefore every care should be taken to keep the opening as small as possible. When the accident occurs during the operation, the intestine or omentum should be returned, and if the position is latericumbent it must be made nearly dorsicumbent; then the testis is to be removed, sutures fixed through the muscular layer, the wound plugged with aseptic lint or gauze, and the skin wound sutured. The inguinal ring can also be closed by two or three sutures. When eventration occurs after the operation the case is more serious. The animal must be placed in the dorsicumbent position, the viscus returned with every aseptic precaution, and retained in the abdomen by the means already described. Such cases are far from hopeless.

The mortality from these operations for cryptorchidism varies greatly according to circumstances. Before the introduction of antiseptic precautions the death-rate was heavy, and is now when these precautions are not observed. The deaths were probably more numerous than the survivals. By the flank operation the mortality has been estimated at 60 per cent. By the Danish method some operators have had 37 per cent., 35 per cent., and 40 per cent., while others have had only 3 per cent. and 1 per

cent. Bang, who operated on sixty-six cryptorchids (of which forty-nine were abdominal and four bilateral), only lost one; while Winter, who castrated about 100 cryptorchids every year, only lost 1 per cent., and in some years none at all. In the method by the inguinal canal the deaths recorded by one operator were 12 per cent., by another 22 per cent., by another 7 per cent. Degive has operated on 120 and 150 cases without losing one. Professor Hendrickx has had 300 operations and only two deaths; Labat one death in fifty-three; Donald one death in forty-six; while all those operated upon by Professors Mauri and Trasbot lived. Professor Cadiot, who has made this subject almost a speciality, and to whose writings we owe so much, does not give us the results of his operations, but we think they must be very favourable.

CASTRATION OF THE OTHER MALE DOMESTICATED ANIMALS.

Bovine Species.

Various methods are employed to emasculate the Bull. All those resorted to for the Horse can also be used for this animal. The clamp is largely employed, as is torsion, ligation of the spermatic bloodvessels, the actual cautery, etc. Very often the operation is conducted in a very crude manner, verging on the barbarous, such as crushing the testes or the vas deferens by squeezing or striking, passing red-hot needles or wires through the testes, tearing away the testes by force; and yet it is extraordinary how often these methods are successful, notwithstanding the torture the animals undergo, and the great risks of septic infection to which they are exposed. But yet the mortality is sometimes great. Aseptic precautions are seldom adopted, the comparatively low value of the animals being a barrier to employing such measures as would tend to avert infection, because of the expense and time attending them in cases in which there are large numbers to be dealt with. One circumstance which tends to render the operation much less fatal when performed by unskilful hands is the very early age at which it is practised, when sensation is far from acute, and the organs are only imperfectly developed. Calves are usually submitted to the operation when six weeks to two months old, though castration can be undertaken at any period after this. The principles upon which the operation is conducted are the same as in the equine species, the only differences, if any, being related to the difference in the anatomy of the generative organs. This difference has been dealt with elsewhere (see p. 543).

Calves are promptly dealt with by expert operators. The animal is seized by the right ear with the right hand, and the lower jaw with the left, and the head and neck receive a pull and a twist to the right in such a way as to make it fall on the

left side. An assistant places his left knee on the neck, and grasps the septum nasi by bulldog forceps, or with his fingers, raising the head slightly, while the other hand takes hold of the right hind-foot and pulls it forward towards the shoulder. If the animal is very strong, another assistant stands at its back and holds this leg firmly above the hock.

If the testes are to be exposed, one of them is grasped, pulled upwards, the skin made tense on its surface, as in the Horse, and a long incision made through it and the other coverings at one stroke of the knife, the incision being made, of course, in the direction of the long axis of the testis. Both testes may be exposed at the same time, and those operators desirous of sparing the animal needless pain and simplifying the operation will cut through the vas deferens and intervening membrane, leaving only the bloodvessels to be dealt with. The testes can then be excised above the epididymis by any of the modes described for the horse, the glands having been well cleared of the skin and subjacent membranes. The ecraseur, castrator, cautery, torsion, and clamp, as well as scraping and ligation, are all effective, but the first two will probably be found the most convenient in all cases, whether the animals be young or old.

If the place where the operation is performed is clean and free from draughts, the weather favourable, and asepsis attended to, there is no reason why the wounds should not heal by first intention.

Bulls can be castrated either when standing or latericumbent, they being secured in the same manner as the Horse. When cast, the long neck-rope round the hind-legs and brought up through the neck-loop again is quite sufficient. If standing, a side-line is necessary to pull a hind-leg forward. An assistant holds the animal by the bulldog forceps, and pulls the head round towards the operator, while an assistant on the other side holds the tail to steady the animal if it should prove troublesome. The testes are then removed in the manner just described.

Sometimes, to avoid making a wound, and so avoid the risks that attend exposing the peritoneum to infection, the bovine and ovine, and also the caprine species, are deprived of their testes by a ligature applied around the neck of the scrotum, the formation of which lends itself readily to this constriction. Two or three turns of a stout cord are made well above the testes, drawn as tight as possible, and securely tied. It is left on until the entire mass drops off, leaving only a small sore.

The elastic ligature has been somewhat largely employed on the continent of Europe, and also in Egypt. Piot Bey reported that in the latter country in 1885 he operated on 2,000 Bulls or Buffaloes by this procedure without any losses or complications of any kind. The ligature, as well as the scrotal region, was rendered aseptic; for some days after the operation there were antiseptic dressings; from the sixteenth day the mortified organs

were removed, and the stump dressed with tar that had been boiled. Nothing else was done, and the animals were usually put to work in from fifteen to twenty days.

A clamp has sometimes been employed instead of the cord, but this is a slow and a very painful procedure, and is not free from risk. The same object has been sought to be attained by temporary mechanical action upon the spermatic cord *in situ* when large herds and flocks of Sheep or Goats are concerned. For this purpose strong pressure has been made on the cord, through the skin, by means of a screw clamp. As a result of this compression, inflammation, and consequent exudation, are set up, and this is followed by obliteration of the spermatic blood-vessels. Nutrition of the testes is abolished, they gradually become atrophied, their function ceases, and the power of reproduction is lost. The clamp consists of two pieces of wood of oval shape about nine inches long and fifteen lines in diameter at their widest part for the smaller animals, larger and longer for bigger ones. Holes for the reception of screws are made near each end of the apparatus. The screws are fixed permanently in one blade of the clamp, and their projecting ends pass through the holes in the other, the blades being approximated when required by driving home a nut on the thread of the screw by means of a key furnished for the purpose. In performing the operation the scrotum and testicles are drawn forcibly downward, the wool or hair on the former is carefully removed, and the parts well smeared with grease. One blade of the clamp is then placed behind the neck, the other fitted upon its projecting screw in front, and the apparatus gradually screwed together, the tighter the better. In half an hour or forty minutes the screws may be loosened and the apparatus removed.

The screw clamp used by Seibold for castrating Oxen is otherwise constructed. It consists of two quadrangular rectilinear pieces of wood, two and a half centimetres thick and twenty or twenty-two centimetres long, perforated by iron screws in front and behind, and is applied to the spermatic cords lying in the neck of the scrotum in just the same manner as the oval clamp is used in the case of Rams or Goats, the blades being screwed together as tightly as possible by means of a suitable key. The clamp need not remain in position longer than a minute, the operation being effectually carried out by the end of that time.

In the course of six years Seibold has castrated 350 Bullocks and 100 He-goats by this method without any loss whatever, a degree of success hardly likely to be obtained by any other system of operation, and fully justifying his advocacy of its extended employment in lieu of the methods hitherto generally adopted. The effect of the pressure on the cord shows itself, according to Seibold's description, in some instances as early as the third week, and in others about the tenth, in the shrinking up of the testes, gradually followed by complete atrophy of the substance of the glands. Any objection that may be made to

this method on the score of its cruelty Seibold meets by reminding us that castration, however performed, must necessarily be painful to the subject of the operation, and he states that Bullocks treated by his method return to their food in the course of a few hours, and otherwise appear to be perfectly at their ease.

What may be termed subcutaneous torsion has long been practised on Bulls, in Southern France more especially, where it is known as *bistournage* (twisting or torsion), which has a similar effect to that of the temporary compression by the clamp just alluded to. It is a method of rendering the testis useless that is particularly adapted to the bovine species, in which the spermatic cord is so long, and the connective tissue between the dartos and the fibrous tunic is so loose, that the procedure can be far more easily carried out than it could be in the Horse species. The operation is particularly simple, though a certain amount of

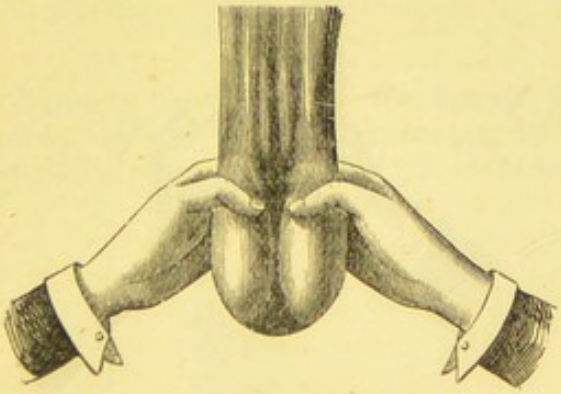

FIG. 563.—FIRST STAGE IN BISTOURNAGE OF THE BULL: DRAWING DOWN THE TESTES.

FIG. 564.—SECOND STAGE: DISPLACEMENT OF THE TESTES.

expertness is needed. No wound is made, and all that is necessary in the way of material is a strong piece of twine.

The animal to be operated on requires no preparation, nor does it require to be laid down, though an assistant or two may be required to hold the animal, and keep it steady, and the hind-legs may have to be secured. The operator places himself behind the hocks, one knee slightly flexed to enable him to seize the testes, which he grasps with both hands, and pulls them down into the scrotum (Fig. 563). Holding them there with one hand, with the other he raises the scrotum by the lower part, firmly pulling it downwards and backwards. The testes are then moved up towards the inguinal ring, and downwards several times in the sac, each movement being accompanied by a slight crackling sound, due to the laceration of the subdartoic connective tissue. In old animals this tissue is more resisting than in younger ones,

and the tearing requires a longer time to effect, but the adherence between the envelopes can be finally accomplished.

The next step is the displacement of the testes (Fig. 564). This is done by pushing both well up, and leaving one—say the right—there in the right hand; the other—the left—is pulled down to the bottom of the scrotum by the left hand, which grasps the spermatic cord above the epididymis, the thumb being on the outside, and the other fingers to the inside (Fig. 565); while the right hand, in pronation, acts in the reverse way on the envelopes, which it pulls downwards, so that the organ is displaced by the simultaneous action of both hands, the left pulling the cord downwards and backwards in such a way as to depress as much as possible the upper end of the gland (Fig. 566); the fingers of the right hand, the backs pressing against its posterior surface, push its lower end upwards (Fig. 567). Without losing

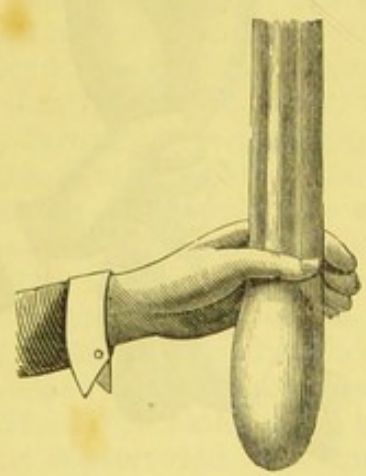

FIG. 565.—SECOND STAGE: POSITION OF LEFT HAND.

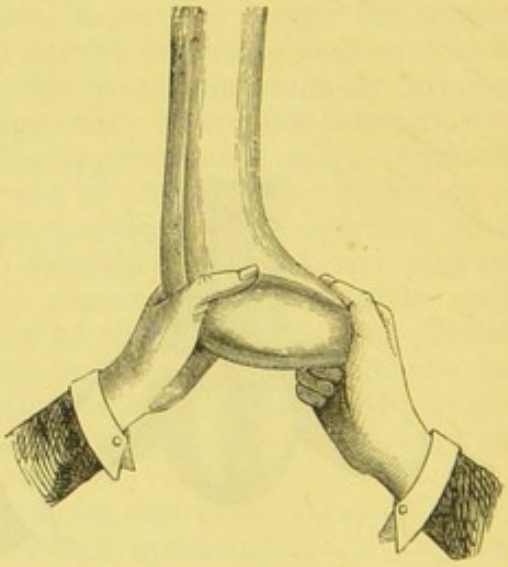

FIG. 566.—SECOND STAGE: POSITION OF BOTH HANDS.

hold of the envelopes, the left hand assists in lowering the upper end of the testis while the right is gradually raising the lower end, so that it is flexed upon the cord backwards and upwards. At the moment when it forms an acute angle with the cord the thumb of the left hand resting upon the cord aids in this displacement (Fig. 568), and soon the long axis of the gland is parallel with the cord itself (Fig. 569). The testis is now pushed up toward the inguinal ring, to rupture any chance fibres of connective tissue that may have escaped laceration. This completes the second stage of the operation.

In the third stage torsion of the cord is effected. This is done in the following manner: The testis is firmly held at the bottom of the envelopes, the left hand placed in front of the cord, the right behind it and on the testis, as in Fig. 568. The operator with his right hand gives the gland a twist or rotation from left

to right and inwards, while the left hand draws the cord in the opposite direction, so that the organ has made a half-turn round the cord, which, instead of being in front, is now behind (Fig. 570).

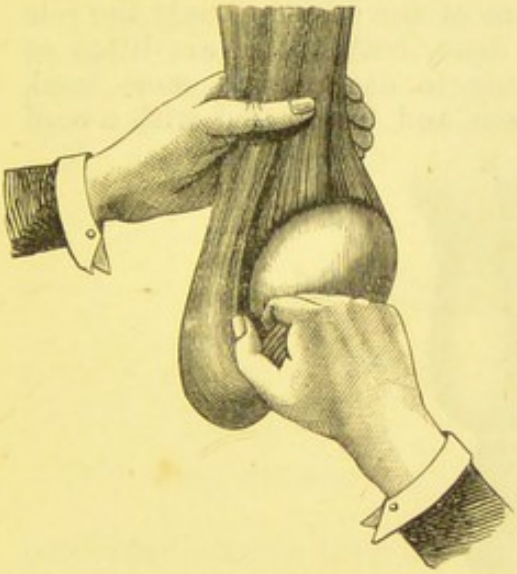

FIG. 567.—SECOND STAGE: DISPLACING THE TESTIS.

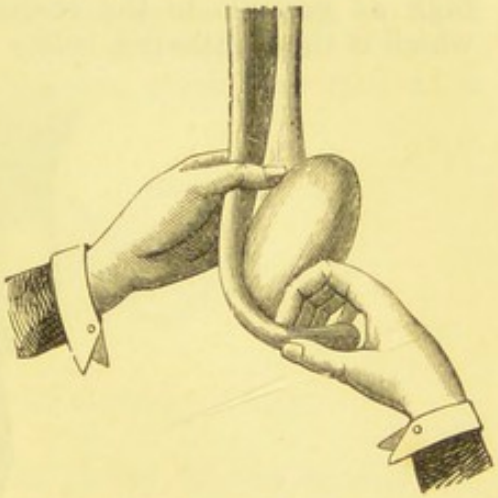

FIG. 568.—SECOND STAGE: THE TESTIS BEING TURNED UPSIDE DOWN.

Changing the action of the hands, but repeating the same movement, the right hand operates on the cord, while the left is applied to the testis, and the complete rotation of the latter and

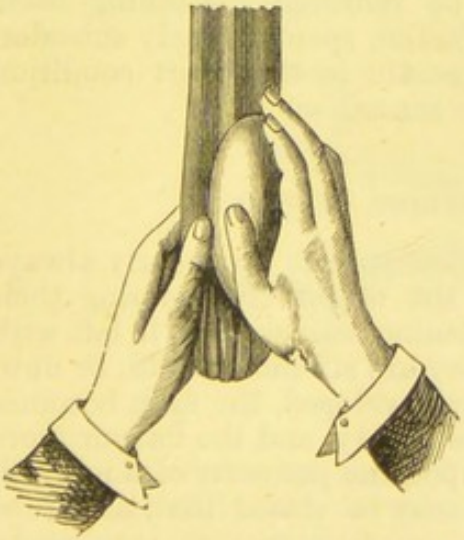

FIG. 569.—SECOND STAGE COMPLETED: POSITION OF THE HANDS AND TESTIS.

FIG. 570.—THIRD STAGE—TORSION OF THE SPERMATIC CORD: POSITION OF THE HANDS.

a whole twist of the cord is effected. It is generally found that two rotations are sufficient, but more can be given in the same way, never more than four or five being required, if the cord is

long enough for even that number. The first rotation is often difficult, but the others are easier.

Having finished with one testis, which is pushed up out of the way, the same manœuvre is gone through with the other, which is now brought down to the bottom of the scrotum, only the rôle of the hands is changed. This done, both testes are lifted as high as possible in the scrotal sac to exactly the same level, which is then gathered below them and firmly tied with a cord

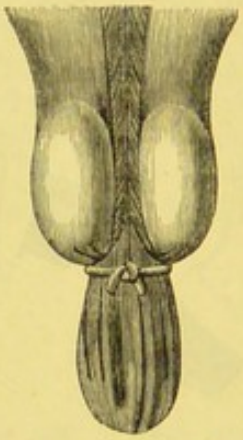

FIG. 571.—TERMINATION OF THE OPERATION: THE SCROTUM LIGATED, AND THE TESTES PUSHED UP TOWARDS THE INGUINAL RINGS.

passed round it three or four times (Fig. 571). If the operation has been properly carried out, the detorsion should not occur. The ligature should not slip, and it may be taken off after two or three days. The operation is followed by swelling of the scrotum, when the cord is to be removed. Nothing more requires to be done, as the tumefaction spontaneously subsides, the testes become atrophied, and remain in this inert condition where they were left high up in the scrotal sac.

THE OVINE AND CAPRINE SPECIES.

The males of the ovine and caprine species are nearly always castrated when very young, with the object of rendering their flesh more agreeable, and also fattening sooner than if left with their testes. If left entire until they are six months old, or until the sexual instinct has become fully developed, the flesh becomes coarse and hard, the adipose tissue scanty, and the flavour more or less repulsive. Much depends upon the precocity of the breed, however, as to this change, but it may be stated that, as a rule, castration is advisable when they are from two to four weeks old. Generally, Lambs are castrated and their tails shortened at the same time. The younger they are, the more simple and innocuous the operation.

The methods of castration are various, some of them being crude in the extreme, yet, on the whole, generally successful, though occasionally attended or followed by heavy loss. This is

usually, but often wrongly, ascribed to the weather. No doubt the weather has some influence on the result of the operation, the prevalence of rain or an east wind being regarded as unfavourable, as well as hot weather, a cloudy, damp day with a medium temperature being considered the most suitable. The place chosen for the castration of a large number should also be adapted for the purpose, the animals being so penned up that they can be seized without being chased and made hot.

To perform the operation, a ligature, sometimes tied in a

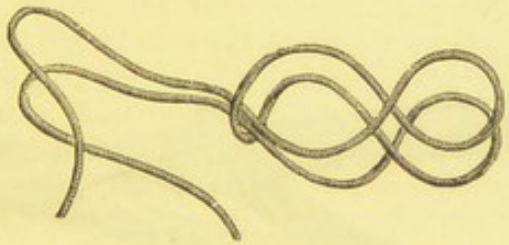

Fig. 572.—Form of Ligature for the Castration of Lambs.

particular manner (Fig. 572), may be placed on the neck of the scrotum, tied so tight that the mass sloughs off. A clamp may be employed instead of a ligature, or the testes can be exposed by incision, and torn away or excised. A common method practised by shepherds is to expose the glands and tear them away with their teeth. This method is known as 'drawing.' An assistant seizes the animal, holds fore- and hind-leg of the same side in each hand, resting the lamb's back in front of him and against his shoulder. The operators cut off the end or tip of the scrotum by means of a knife or sharp scissors; one after

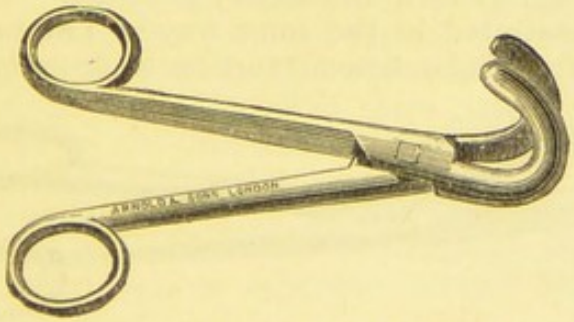

Fig. 573.—Torsion Forceps for the Castration of Lambs.

another the testes are pressed out, the tunica vaginalis communis is torn through, and the gland fully laid bare is seized by the operator's teeth, and drawn away until the spermatic cord is torn through; often both testes are torn away at once. Other shepherds draw out the organ, seize the cord by the finger and thumb of one hand, and twist it with the other hand until it breaks. This is certainly a less repulsive method. Sometimes the cord is simply drawn until it gives way. But this is a painful method. Scraping through the cord with the finger-nail or a

jagged edged knife is preferable. The actual cautery and clamp may be resorted to, but this is not always a convenient method. Torsion of the vascular portion of the cord is largely practised, a special forceps (Fig. 573) being employed. Another pattern of forceps is used in Australia for this purpose, and is provided with a spring between the handles, and a retaining catch (Fig. 574), or the castrator (Fig. 528), or the 'Reliance' pattern of the same (Fig. 526), but of a smaller size, may be recommended for this purpose. A very useful and efficient instrument, designated

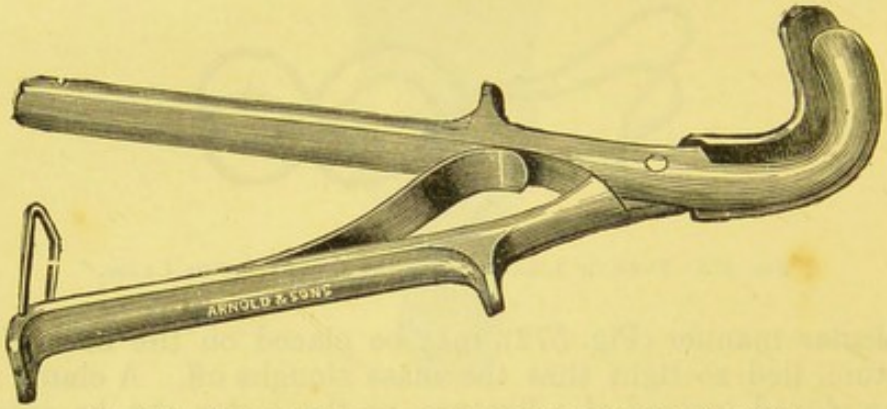

Fig. 574.—Torsion Forceps for Lambs (Australian Pattern).

castrating scissors' (Fig. 575), has been introduced, and should be preferred, perhaps, to everything else, as it is quick and certain in its action, while it is cheap and easily cleansed and disinfected. It is like an ordinary pair of scissors, but one of the blades is slightly angular, and both are serrated on their edges. They are used in the same way as the castrator, the cord being cut or squeezed through by slow and steady pressure.

Rams are castrated in the same way as Lambs, though more care is necessary. Subcutaneous torsion, as described for Bovines,

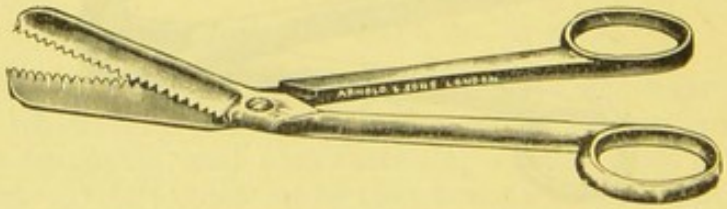

Fig. 575.—Castrating Scissors for Lambs.

should be well adapted for them; but the 'Reliance' castrator method, the actual cautery, or any other of the methods which are attended by little or no hæmorrhage, ought to be adopted if it cannot. Hæmorrhage is always to be avoided if possible; it is seldom dangerous in itself, but may be, because of the blood putrefying in the wool and in the wound, and setting up septicæmia in one of its fatal forms. If a wound is made for the removal of the testes, when the operation is completed, carbolised oil, or boric or chinosol powder, should be employed as a dressing,

not only to prevent sepsis, but to keep away the fly, and so hinder it depositing its ova in the wound.

Goats are castrated by the same methods as Sheep and Lambs, but Kids suffer much less severely than Lambs, as, owing to the natural brevity of their tails, this part does not require to be amputated, whereas Lambs are castrated and 'docked' at the same time; and this is not only a much severer trial, but the bleeding from the tail is often considerable, and leads to risk of septic poisoning. To avert this hæmorrhage, the end of the stump, an inch or so above the part of the tail that is about to be cut through, might be constricted by a bit of narrow tape firmly tied. This ligature could be removed the following day.

After the operation the animals should always, when possible, be kept dry, warm, and comfortable, and in a sheltered place, and, if very young, attention should be paid to their sucking. If there is much swelling and stiffness, fomentations, inspection of the wounds, and dressing of them with antiseptic lotion, is indicated.

The Porcine Species.

The Pig is castrated when young (from two to five weeks), and for the same reason as other animals whose flesh is used as food for mankind. The operation is a comparatively simple one when the animals are very young, and is well borne by them if ordinary care as to cleanliness is taken. The animals should receive very little food for some hours previously, and before operating an examination should be made for scrotal hernia.

The Pig is seized by an assistant, who holds it up by the hind-legs, its back being towards the operator, and its head and fore-part of its body held firmly between the man's legs, so that it cannot struggle. The operator then, with a sharp knife, opens the scrotum, which is in the perinæal region, the testis is pressed out, and the spermatic cord divided either by means of the knife or scissor castrator (Fig. 575). The same procedure is followed with the other testis, and the creature is liberated, and needs no further care as a rule. Should considerable swelling take place, however, the wounds should be dressed with an anodyne antiseptic while the animal is feeding. No attempt should be made to chase or catch Pigs, or otherwise disturb them, until the wounds are quite healed.

Scrotal hernia is not at all uncommon in young Pigs, and may prove troublesome if the operator is not on his guard; so it is customary with some practitioners, before opening the scrotum, to push the testis towards the anus, to obviate descent of the bowel, and fine suture needles and silk thread should be always at hand to close the wound when hernia is present. When the hernia is unilateral the testis on the sound side should be the first to be excised; the second one may then be removed from its compartment by a small opening in the septum, and extracted by the already existing wound. This gets rid of the necessity for

making a second incision in the scrotum. But if this cannot be done, the hernia must be reduced before the scrotum is opened, then the testis excised in the usual way, and two or three points of suture used to close the wound in the skin. Only a small quantity of food should be allowed for a few days. In older animals it will be requisite, probably, to lay them on their side for the operation, which is performed in the same way, only in them the testes can be seized and the skin made tense over them before it is incised. To remove them torsion, the castrator, clamp, actual cautery, or ligature, may be employed, according to the fancy or skill of the operator.

In castrating Pigs during the fly season, it is a wise precaution to dress the wounds, in order to prevent the development of maggots in them.

The Canine Species.

Circumstances sometimes require the Dog to be castrated. The operation is an easy and a simple one. After securing the animal and giving, if thought fit, an anæsthetic, an incision is made in the scrotum (which is also in the perinæum) over one testis. This is exposed, the vas deferens is divided, and the vascular portion of the cord cut through by means of the ecraseur, castrator, galvano-cautery, or, after ligating it, by the knife. It may also be divided by scraping through it with a blunt knife, or even the thumb-nail. The skin wound should be sutured.

The Feline Species.

Cats are frequently emasculated, to deprive them of their nocturnal wandering habits. The front part of their body and limbs must be wrapped in a large towel to prevent scratching, and an assistant should hold the creature firmly in this covering. The operation is so trifling that it is inadvisable to administer an anæsthetic. The assistant keeps the tail out of the way while the operator incises the scrotum over one testis, draws out this, seizes the cord firmly between the thumb-nail and fore-finger of the left hand above the epididymis, and tears away the gland with the right hand. The other testis is removed in the same way. During the operation the Cat usually ejects its urine with some force upwards, so that the operator must be on his guard against the unpleasant effects of this act.

Caponising Fowls.

Male poultry are now very much subjected to emasculation, or 'caponising,' in order to increase their weight, improve their flesh, and render them fit for the table sooner than they would be if not operated upon.

Reference has been made to the anatomy of the Fowl (p. 544), and it has been shown that the testes are intra-abdominal; it therefore is a somewhat difficult matter to remove them, and

demands skill, practice, and nimble fingers. The operation is performed when the Fowls are about three or four months old, and the instruments are the same as those used for ovariotomy in these creatures (see p. 515), and the position and securing are the same, as well as the preliminary steps of the operation and the search for the glands.

The first finger of the right hand, on being passed into the abdomen, is carried above the intestines towards the dorsal region, and to near the articulation of the two last ribs, where the testes are felt as two rather prominent bodies in the sub-lumbar region. Their attachments there are torn through with the finger, and they are brought outside, where they can be nipped off. If only one is removed at a time, it should be the lowermost first, as it is not so easy to get hold of as the upper one. The 'gripper' will be found useful for seizing them if the finger is too large to do this, but it must guide the instrument.

The wound need not be sutured if there are plenty of feathers and these are replaced over it. The birds do not appear to suffer much pain, and the mortality is trifling. Age not so much as maturity is to be considered in the operation, but it ought to be undertaken before the comb has grown.

In France, America, and China, Fowls are caponised in large numbers, and much attention has been given to the operation. The French method has been described as follows:

The time chosen is about the age of four months, when the weather is cool and moist; in the heat of summer it is attended with danger, and is rarely performed. The instruments are two —a small curved knife, kept very sharp, and a curved surgical needle, with some waxed thread. Two persons are required, one to operate while the other holds the bird. The operator sits down, and the assistant holds the bird in his lap, with its back towards him, and the right side downwards, the lowermost leg being held firmly along the body, and the left leg being drawn backwards towards the tail, so as to expose the left flank when the incision is made. A few feathers being plucked off to expose the skin, the latter is raised up with the needle, so as to avoid the intestines, and an incision large enough to admit the finger easily is made into the abdominal cavity just at the posterior edge of the last rib; in fact, the knife is kept close to the edge of the bone as a guide. Should any of the bowels protrude through the wound, they must be gently returned. The fore-finger is then introduced, and passed behind the intestines towards the spine, on each side of which the two testes are situated, being in a young bird of four months rather larger than a horse-bean. One of the testes being felt, it is to be gently torn by the finger away from its attachments to the spine, and removed through the wound, the other being afterwards sought for and removed in a similar manner. Care must be taken that the gland does not slip away among the intestines after it is detached, when its detection

and removal from the body may be difficult. Both testicles being safely removed, the edges of the wound are brought together, and kept in the proper position by two or three stitches with the waxed thread. These are made in the usual surgical mode, each stitch being detached and separately tied, not sewn as a seam. In making them, the chief thing to guard against is to avoid even pricking the intestines with the needle, much less including any portion of them in the stitch, which last would inevitably result in the death of the Fowl. The bird should be put under a coop in a quiet place, and given only soft food, such as sopped bread and water. After a few hours he may be put by himself in a run or yard, but, until perfectly healed, must not be allowed to perch, but obliged to sleep on straw. For three or four days the soft food alone must be continued, and when entirely recovered the bird may be set at liberty.

The Chinese operate somewhat differently to the French. The Chickens to be operated upon are fasted for at least twenty-four hours, as this is thought to diminish bleeding. The bird is then placed on its left side, with the wing folded back, and kept under one foot of the operator, who works without an assistant, while its legs are kept fast under the other foot; or sometimes an assistant is employed. The feathers are now plucked from the right side, near the hip-joint, and the incision is made between the two last ribs, going just deep enough to divide them, and the testicles removed with a loop of wire. In one respect their process is preferable, the wound not being stitched up, but the skin being forcibly drawn to one side before the incision is made, so that, when the whole operation is completed, it covers of itself the wound in the flesh, and avoids the irritation which the stitches sometimes produce.

The American plan is similar to the Chinese. By operating between the two last ribs, making an incision about two inches in length, and using a stretcher, the operator is enabled to see what he is doing. The covering of the gland is torn with a small hook, and the testis grasped in a pair of forceps, and as soon as the stretcher is removed the ribs come together.

Other modifications of the operation are adopted by different operators. The looped wire is probably the best and simplest way of removing the testicles from their attachments, as by twisting the wire and keeping the finger on the testicle till it is detached it can be extracted—held in the loop. Care should be taken to have the instruments and hands clean, and it is advisable to wash them with a weak carbolic lotion immediately before operating. The advantage of caponising is an increase of about one-fifth in weight over the same birds if fatted in their natural state; the flesh is also whiter and more delicate, and the development plumper upon the table. Hence the process becomes of considerable importance to all who consider poultry-keeping from a commercial point of view.

The utility of the operation depends a good deal on breed,

beyond the other circumstances referred to. In the United States of America, a series of observations was made in this direction, and the following conclusions were arrived at :

Birds thus changed grew larger in frame, matured later, became quiet and contented, did not crow or fight, and their flesh remained soft and tender.

Those weighing two pounds or less were most easily and safely caponised, but the larger the birds, provided they had not commenced to crow, and their combs had not developed, the more quickly they recovered.

The only birds that died under the operation were those that had developed combs.

The old Chinese tools, when their use was understood, were found most satisfactory of all.

Of the Brahma Cochin cross, it was seven months before the Capons equalled the uncastrated birds in weight, and they did not average one pound heavier in ten months.

The Langshan Rooster, although weighing but one-sixth of a pound more than the Langshan Capon at the commencement of the experiment, kept ahead in weight for seven months.

The Plymouth Rock Capon equalled the Roosters in weight in less than two months, and gained on them the rest of the season, but did not average more than three-quarters of a pound heavier at any time.

The Indian Game Capons were five months in catching up with the Roosters, and were not a quarter of a pound heavier eight months after the operation.

The Brahma Cochins gained the least during the first year, but made the largest and heaviest birds at eighteen months.

The Langshan was less affected by the operation, but was larger at the time it was performed.

The Plymouth Rocks recovered less readily, but they were operated upon when the weather was warmer, fifteen days later than the Langshan.

Indian Games and their crosses were harder to do, and should be taken when younger.

These experiments show less gain in weight as the result of caponising than we were led to expect by published accounts. The tender flesh, and the ability to quickly take on fat, seemed to be the only gain of importance.

During the exhibition of the R. I. Poultry Association, the ten Brahma Cochin Capons and the five Plymouth Rock Capons gained, while the Roosters of each lot lost in weight.

CRYPTORCHIDISM IN OTHER THAN THE EQUINE SPECIES.

This condition is so uncommon in other species than that of the Horse that only a brief reference will be made to it.

Cryptorchidism is not very rare in the asinine species, though much less common, from all accounts, than in the equine. Operation for it is the same as for the Horse.

In the bovine species it is very rare, and when it does occur, and operation is necessary, as it will generally be, the testis can be removed either by the flank incision or through the inguinal canal in the manner already described.

It is more frequent in the canine and porcine species. In the former, operation is not demanded, but in the Pig it is necessary if the flesh is to be utilised as food, and the rank, nauseous, and characteristic flavour of the Boar is to be avoided. Operation by the flank incision, as in spaying, is the only convenient method, and does not differ from spaying.

OPERATIONS ON THE EYE AND ITS APPENDAGES.

CHAPTER I.

THOUGH the eye and its appendages in the domestic animals are liable to various diseases and accidents, yet the operations performed upon them are comparatively few when those to which the eyes of mankind are subjected are considered. The reason for this is the immensely diminished value of animals, and the fact that those mechanical and optical appliances which can be brought into such remarkable use in man in improving or restoring vision cannot be resorted to in their case.

FIG. 576.—COCAINE BOTTLE AND DROP IMPLEMENT WITH INDIA-RUBBER CAP.

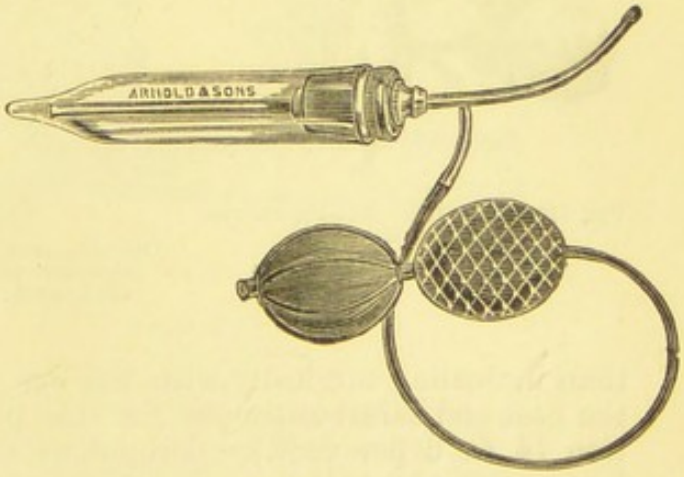

FIG. 577.—COCAINE SPRAYER.

Therefore it is that ocular surgery in animals is somewhat elementary; and though much has been done in recent years to promote its advancement, yet it can never have the same importance, or demand such skill and attention, in addition to serious study, as this section of human surgery.

The advantages conferred by the use of cocaine in operations on the eye of man are no less available for animals. This drug can be most beneficially employed to produce local anæsthesia in

2 to 5 per cent. of the hydrochlorate solution, and may be dropped into the eye from a special implement kept in the solution bottle (Fig. 576), or, better still, in some cases sprayed upon the eye by means of a special apparatus (Fig. 577). In five or ten minutes this will render the organ insensible to pain and pressure, as well as touch of the fingers or instruments, such as the fixation forceps, which may, indeed, be dispensed with; by its constricting the blood capillaries it also much reduces hæmorrhage, so that it permits the most delicate operation to be performed. In many cases the use of cocaine dispenses with the necessity for laying Horses down, and allows animals to be operated on in a more favourable position than the recumbent. In some operations in the interior of the eye mydriatics, such as sulphate of atropine, can also be used to produce dilatation of the pupil.

In no other part of the body, perhaps, is asepsis more necessary

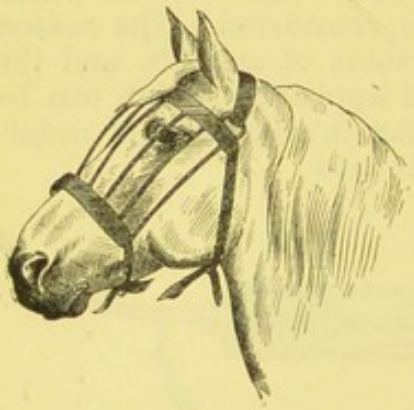

FIG. 578.—BROGNIEZ'S EYE-PROTECTOR FOR THE HORSE.

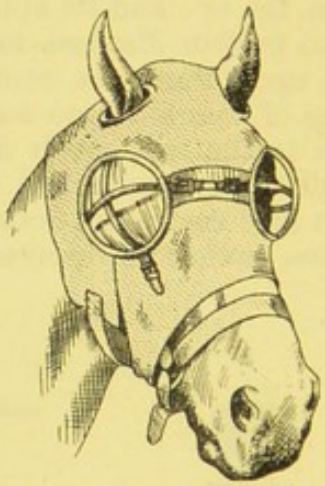

FIG. 579.—EYE-PROTECTOR.

One side has only the grating in the eye aperture; the other side (the right) has a dressing within the grating.

than in dealing surgically with the eye and its appendages, and the best and safest antiseptic for this purpose is boric acid solution (4 to 6 per cent.). Scrupulous cleanliness of hands and instruments, as well as of the parts surrounding the eye, has to be observed.

The eye has also to be protected, when wounded, from light and dust, and other foreign matters, as well as from the injury animals are liable to inflict upon it by rubbing. Bandages are most usually employed, and in Section VI., pp. 134, 135, some of these eye-bandages, as applied to the Horse, are shown (Figs. 171-174). In some cases a better protection is needed, one that may be applied over the calico bandage, if necessary. This may be of leather (like Fig. 7, p. 14), or be made up of a number of small iron curved rods, riveted at each end to a strap that fastens round the jaws, and a brow-band—a kind of head-collar

with the rods passing down from the brow-band to the nose-band, like that introduced by Brogniez (Fig. 578); or a still better one for some purposes is that made like a hood, the eye-holes being circles of iron, with two convex rods crossing their apertures (Fig. 579), forming a lattice or grating. For the Dog a calico

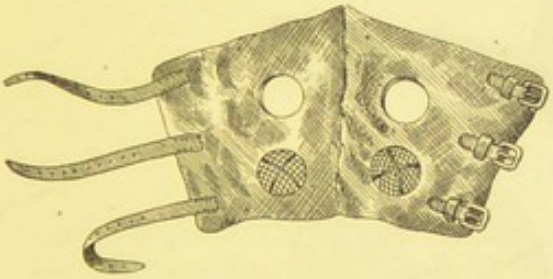

FIG. 580.—BRUSASCO'S EYE-PROTECTOR FOR THE DOG.

FIG. 581.—BRUSASCO'S EYE-PROTECTOR APPLIED.

bandage would suffice in some cases, but this animal is much disposed to rub the damaged eye with its paw, or rub it against the ground or any accessible object. Therefore, to guard the organ from danger it is necessary to have a similar protection to

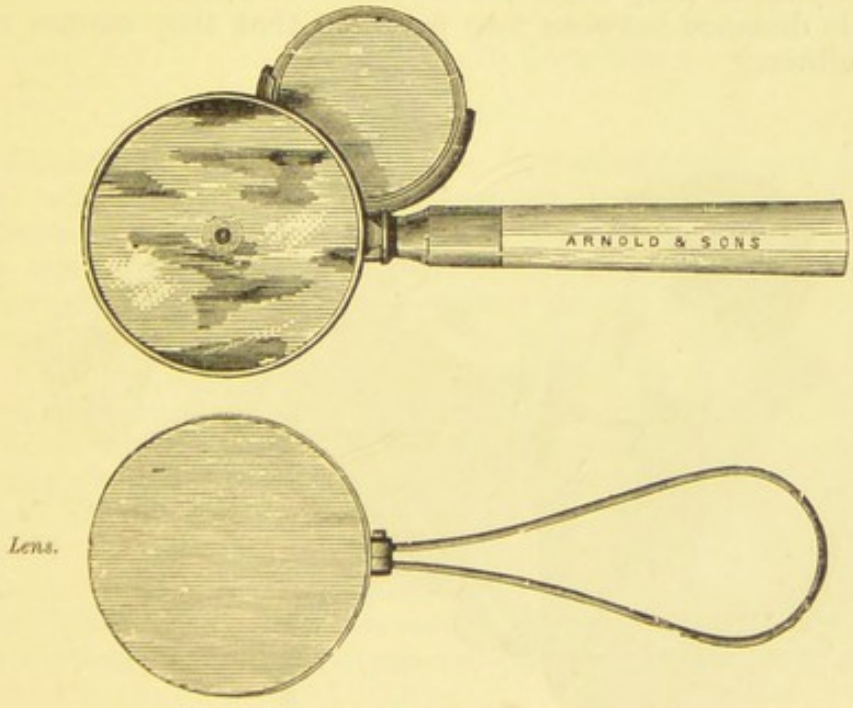

FIG. 582.—OPHTHALMOSCOPE WITH LENSES.

eye-guard. That introduced by Brusasco is convenient and effective. It is a sort of cap made of pliable leather, with two holes for the ears and two for the eyes. The latter are filled in with fine woven wire strengthened by two thin steel plates crossing each other (Fig. 580). These are hemispherical in shape and

completely protect the eyes, as well as retain dressings. The cap is fastened round the muzzle at one end, and to the collar-strap at the other.

It should be observed that with Horses which are very restless,

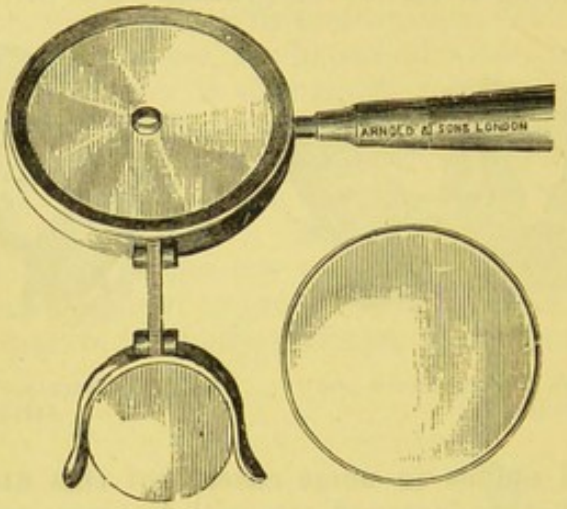

Fig. 583.—Liebrich's Ophthalmoscope and Lenses.

and are likely to displace any kind of eye protection, it is an excellent plan to keep them on the pillar-reins, or the head tied at a little distance between two posts, so that they cannot rub against either.

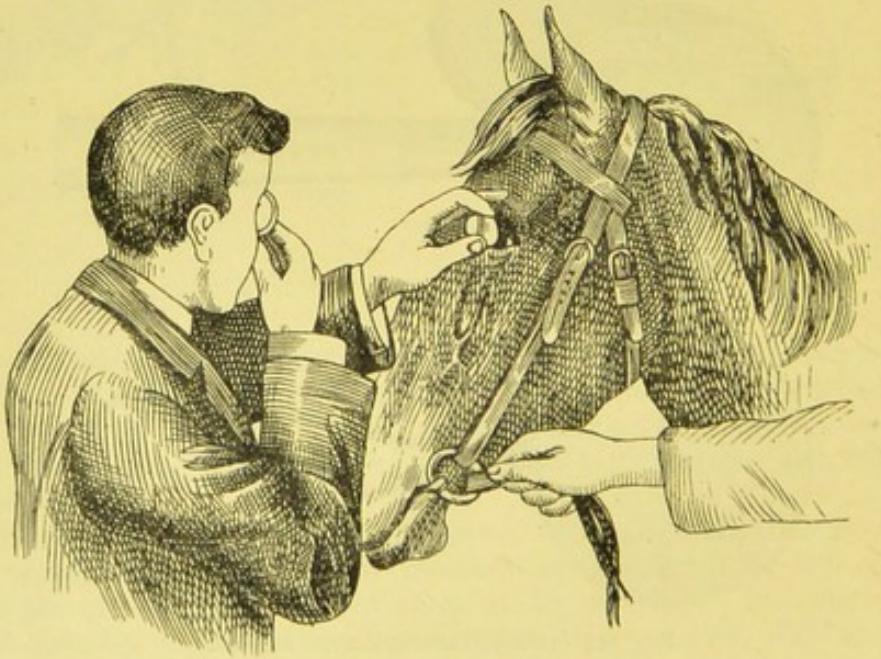

Fig. 584.—Manner of using the Ophthalmoscope.

An optical instrument of much utility in connection with ocular surgery is the ophthalmoscope, which is almost indispensable in examining the interior of the eye before some operations are undertaken, or while recovery from them is progressing (Figs. 582,

583). It consists of a reflector and a lens or lenses of different sizes. The reflector illuminates the interior of the eye by natural or artificial light, and the lens magnifies the objects to be examined (Fig. 584). To dilate the pupil, and so to obtain a better view behind the iris, and also to prevent adhesion between that curtain and the capsule of the crystalline lens, mydriatics are employed, such as the sulphate of atropine.

CHAPTER II.

OPERATIONS ON THE OCULAR GLOBE.

The globe of the eye is liable to accidents and injuries, as well as diseases and the result of diseased conditions, that demand surgical interference. The Horse and the Dog are the animals that most frequently require assistance, accidents and diseases of the eyes being most frequent with them.

The chief accidents and injuries are wounds, contusions, foreign bodies lodged in the eye, and dislocation and avulsion of the organ. There are also operations for the relief or cure of diseases, such as paracentesis of the cornea, iridectomy, sclerotomy, operations for cataract, and for tumours or growths.

Accidents and Injuries.

Wounds.

Wounds of the eyeball may be non-penetrating and penetrating, according as they are confined to the conjunctiva, the sclerotica, or the cornea; or they penetrate these, and, entering the cavity, wound the iris, choroid membrane, or other structures contained therein. According to the character of the wound must be the treatment, but a careful asepsis in all cases is of the greatest importance. Small wounds of the conjunctiva need no other attention than cleanliness, dressing with a collyrium of boric acid (2 to 4 per cent.) that should irrigate every part of its surface, and, if need be, covering the eye with aseptic lint or gauze and a bandage. When the wound is large and torn, it should be sutured, and every effort must be made to prevent adhesion between the ocular and the palpebral conjunctivæ (*symblepharon*). Corneal wounds heal rapidly if kept clean and asepticised, but bad consequences ensue on neglect of these precautions.

It is very rarely necessary to do anything to wounds of the sclerotica beyond cleanliness, as sutures are scarcely admissible.

Penetrating wounds of the eyeball are oftentimes serious, because they include injury to the delicate structures within. The cornea is usually the seat of these wounds, and we frequently have prolapse or hernia of the iris as a complication, if that curtain is not also damaged. This complication is manifested

by a round, dark-coloured protrusion on the cornea, which may increase in size and is generally accompanied by an escape of aqueous humour.

In such an accident treatment must be prompt, as the iris is readily damaged by the winking of the eyelids and the action of the air. The prolapsed part may be returned to the cavity by skilful manipulation with an aseptic sound or probe after the eye has been asepticised. When the hernia has been reduced, the eye is again dressed with the antiseptic collyrium, and if deemed necessary a few drops of eserine collyrium are instilled into the conjunctival commissure. When the reduction of the hernia cannot be effected in this way, the protruding part may be excised by scissors, and what remains between the margins of the wound put back into the anterior chamber; then antiseptic collyria as dressing and the use of eserine are to be employed. If scissors are not used, solid nitrate of silver will be found effective in destroying the displaced portion of iris. Fistula is not an infrequent result of penetrating wounds of the cornea, and is marked by escape of the aqueous humour, diminished convexity, and wrinkling of the cornea. Cauterising the fistula by means of the thermo-cautery, or pencilling it with nit. argent., instilling eserine, and covering the eye with a moderately-firm compress is the treatment that has been recommended.

Burns of the eyes are not uncommon among animals, and are produced by fire, hot bodies, or strong acids and alkalies. Cold water should be applied at once to wash over the surface, then compresses, steeped in boric solution, tied over the eye. When the eye has been burned by an acid, it has been recommended to inject a 1 per cent. solution of soda bicarbonate into the commissures. Quicklime is sometimes the injurious subject, and it has been suggested that in this case a saccharine fluid might be employed with advantage, as it would form with the lime a soluble saccharate. In all such accidents adhesion between the opposing conjunctival surface is to be guarded against by frequently smearing small quantities of vaseline or glycerine into the commissures of the eyelids.

Contusions of the Ocular Globe.

Contusions of the eyeball are much more frequent in the Horse than are wounds, and vary considerably in severity, from subconjunctival ecchymosis to erosions of the cornea, tearing of the iris and of the lens capsule, with dislocation of the lens, and rupture of the choroid and retina. The ocular globe itself may be ruptured, the tear taking place usually in the sclerotica, rarely in the cornea. This leads to the escape of the aqueous humour, crystalline lens, and vitreous body.

Cleanliness and asepsis are imperative in the treatment of these, as of other eye troubles in which there is abrasion of surface. Washings with boric solution and cold-water compresses are the chief means to be adopted in treatment. If there is much

effusion in the interior of the eye, causing damaging pressure, it will be necessary to afford relief by puncturing the cornea.

Foreign Bodies in the Eye.

Foreign bodies frequently obtain access to the eye, and may cause much irritation, and even disease, if not removed therefrom. They may be extremely various, from particles of dust, small insects,

FIG. 585.—DESMARRE'S EYELID RETRACTOR.

seeds, haulms, and hairs, to parasites and small shot. When the natural agencies for their removal fail, then their immediate expulsion is urgent before painful irritation and inflammation begin. Sometimes relief is afforded by holding the lower eyelid against the eyeball with one hand, while the other pulls the upper lid over it. Or the upper lid may readily be everted, and a feather or small camel-hair brush passed up beneath it. The inferior commis-

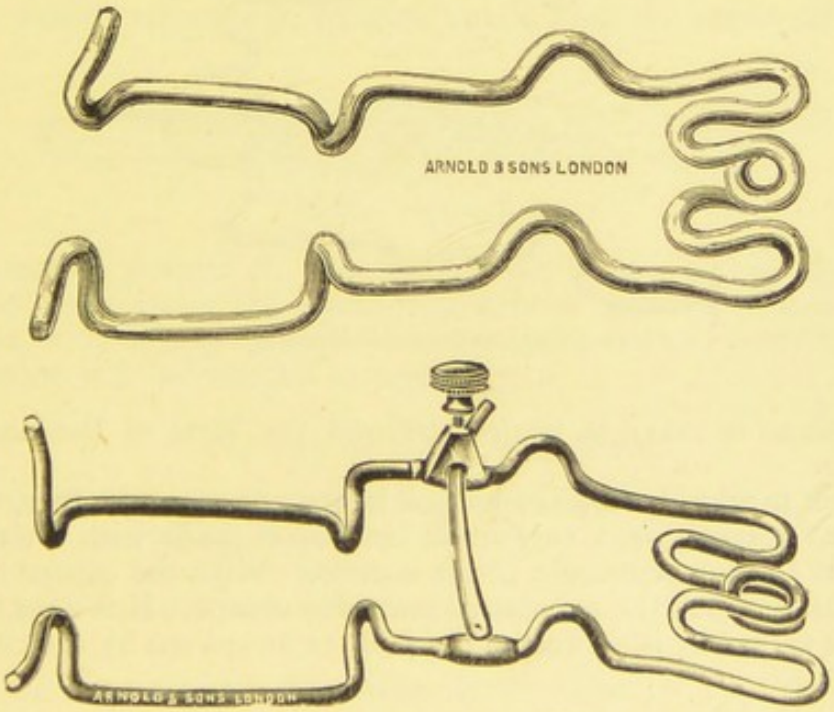

FIG. 586.—SPRING RETRACTORS FOR LARGE ANIMALS.

sure of the conjunctiva can be easily explored. Forceps may be required to remove some bodies which fix themselves in the soft conjunctiva. In some instances the eye is rendered so sensitive and painful by them that cocaine must be employed to render the animal tolerant of manipulation. An exploring curette may be employed to sweep to the bottom of the upper and lower commissures and behind the membrana nictitans.

Sharp angular bodies are liable to imbed themselves in the cornea, and are sometimes not easily discovered. The surface has to be examined obliquely in different directions by natural or artificial light, and a lens will often be useful. If they can be extracted by forceps when discovered, then the operation is easy, but not infrequently they become more deeply imbedded, and then it becomes imperative to resort to other measures. The animal must be secured, the eyelids kept apart by the retractors or blepharostat (Fig. 585), or by the spring retractor (Figs. 586, 587), cocaine instilled, and a fine knife or cataract needle (Fig. 588) employed to extract it. Sometimes so deeply imbedded is the substance that, in order to get hold of it, it is necessary to make a minute groove above and below it with Graefe's cataract knife (Fig. 589). Indeed, it has been found necessary in some cases to introduce the same knife into the anterior chamber of the eye, and with it make pressure on the posterior surface of the cornea immediately opposite the foreign

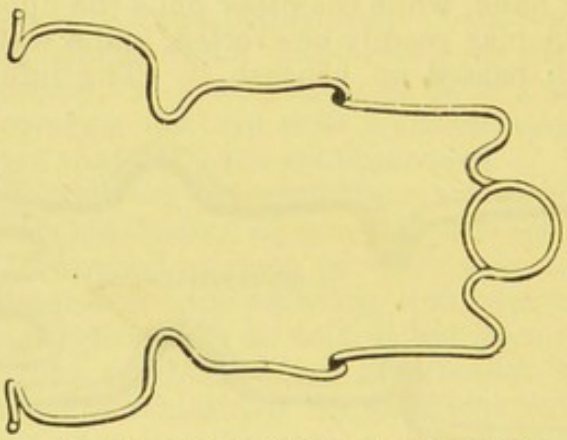

Fig. 587.—Spring Retractor for the Dog.

body, so as to make it project beyond the level of the anterior surface.

When foreign bodies are lodged in the anterior chamber, which happens sometimes, a very small incision is made with a Graefe's knife at the lower margin of the cornea. With the escape of the aqueous humour the substance may also escape. If it does not, it may be seized by iris forceps (Fig. 590), or swept out by the curette.

Fig. 588.—Cataract Needle.

It may be noted that dropping a little glycerine between the eyelids and the eyeball is sometimes very beneficial when objects are fixed in them, as it has a tendency to loosen and detach such particles.

Dislocation or Luxation of the Ocular Globe.

With the Dog more particularly, dislocation or luxation of the eyeball is not uncommon. It sometimes occurs when two dogs are

FIG. 589.—GRAEFE'S CATARACT KNIFE.

fighting, and the paw of one is pushed behind the eye of the other, driving the organ partially out of its bony receptacle. If the optic nerve is not ruptured, and prompt treatment is adopted, so that the eye has not become altered, successful reposition may be effected without serious permanent damage having been done to the organ. But the treatment must be very prompt and careful.

The dislocated eye must be gently cleansed and disinfected; then an endeavour must be made to return it to its orbital cavity. This is done by separating the eyelids, and if they cannot be got sufficiently apart to admit the eyeball, the external canthus may be incised a little by scissors; then gentle and methodical pressure is exercised on the globe, according to the axis of the orbit, until, with a slight suction sound, it fits into its place. Nothing more usually requires to be done but to keep the organ clean and

FIG. 590.—IRIS FORCEPS.

aseptic, and protect it. Sometimes the vision is not impaired, but in other cases the damage has been greater, inflammation ensues, and nearly always the eye must be enucleated. This operation will be referred to presently.

Avulsion of the Ocular Globe.

Avulsion of the ocular globe is a stage beyond luxation, in which the organ is forcibly torn from its cavity, and along with other attachments the optic nerve is torn. In such a case there is nothing to be done but to excise the eye.

OPERATIONS FOR DISEASED CONDITIONS OF THE EYE.

Paracentesis of the Cornea.

Paracentesis or puncture of the cornea has to be performed for various reasons, and is often most beneficial. Not only has it to be punctured for the extraction of foreign bodies and entozoa, but also when there is great and injurious tension of the eyeball, or effusions of blood or pus, or exudation of lymph. It has also been punctured with much advantage in cases of what is generally designated specific or recurrent ophthalmia.

The operation is simple, but demands care, in order to avoid accidents. Cocaine is advantageous in 5 per cent. solution, and in some cases it may be advisable to use a collyrium of atropia to contract the iris, and so prevent hernia of that membrane.

The animal is secured, the spring speculum or Desmarre's eyelid retractor is introduced between the eyelids, and a short Graefe's knife is inserted into the lower margin of the cornea, near its junction with the sclerotica, and midway between the inner and outer canthus. The puncturing is expedited by slightly pressing on the higher part of the cornea with a finger of the left hand, the finger having been previously smeared with glycerine or olive-oil. The blade of the knife must be pushed obliquely upward through the cornea, and not forwards, but parallel with the iris, and it need only penetrate for a short distance. The aqueous humour is allowed to flow gradually through the incision by leaving the point of the blade in it. A sudden and forcible flow is to be avoided, lest the iris or crystalline lens be torn or displaced. Sufficient fluid has drained away when the cornea assumes a slightly flattened appearance. Pus escapes readily, but exudates may require the introduction of iris forceps to seize and withdraw them. The same remark applies to entozoa, which may escape with the aqueous humour, or require the forceps. In making these seizures, great care is needed to avoid injuring the iris or the capsule of the lens.

In removing entozoa from the anterior chamber, especially *Filaria oculi*, the worm usually escapes with the aqueous humour, or gets between the edges of the wound and wriggles out. In some cases, if it does not escape with the fluid, and is even away from the puncture, it will travel to it, and pass through it without compulsion. It is well, therefore, when the worm does not make its exit immediately, to wait for a short time before extraction is attempted.

In performing corneal paracentesis for the removal of *Filaria oculi*, it is generally advisable to place the Horse latericumbent, the eye to be operated on being uppermost, and a general anæsthetic administered. The upper part of the head is raised, and the lower part depressed. The blepharostat is introduced between the eyelids, and a cataract knife is pushed into the cornea near the sclerotica, at its upper and outer margin, and parallel with the surface of the iris, care being taken not to wound that structure. The puncture should only be large enough to admit the iris forceps if they are needed. Indeed, in the majority of cases it is better to employ them to seize the entozoon than to make a larger opening to allow of its escape with the gush of aqueous fluid, as collapse of the cornea, displacement of the lens, and hernia of the iris, are averted, while the cicatrix is very small, if not imperceptible.

If occasion demands, the cornea may be repeatedly perforated.

Very little after-treatment is required. The humour, if lost,

s replaced in a few hours after a boric acid compress has been applied to the eye, and the wound soon cicatrises. In some cases it may be advantageous to instil a small quantity of the atropine solution into it, and it can be kept clean by dressing with the boric collyrium and a very weak solution of sodium chloride.[1]

Iridectomy.

Iridectomy, or partial excision of the iris, is performed with various objects in view, such as subduing inflammation in certain structures of the eye (*antiphlogistic iridectomy*), as in glaucoma, iritis, irido-choroiditis, to break up adhesions of the iris, or to form an artificial pupil (*optical iridectomy*), as in occlusion of the pupil, or in certain cases of cataract, as well as in opacities of the cornea. It has also been practised for hydrophthalmia.

The operation is performed in the same manner as paracentesis of the cornea, so far as the initial part of the task is concerned,

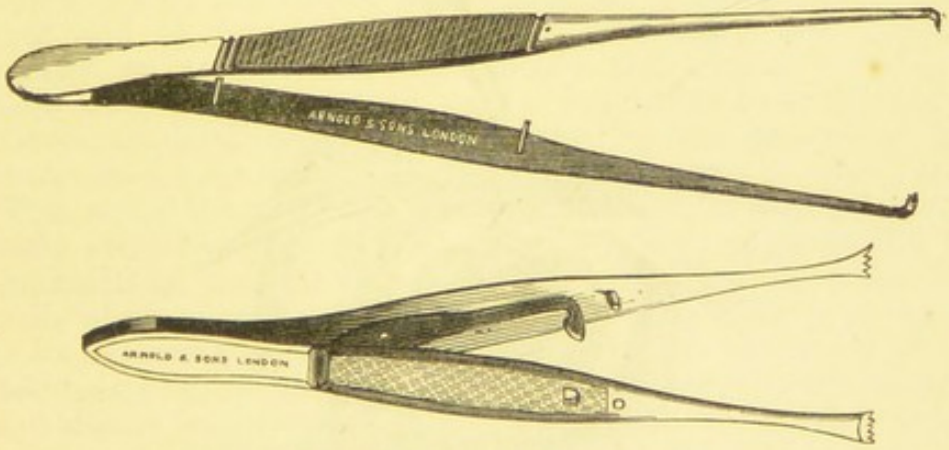

FIG. 591.—WALDON'S FIXATION FORCEPS.

except that the puncture is made in the upper part of the cornea, as then the gap left in the iris is more or less concealed by the upper eyelid; but if the operation is performed because of adhesions (*synechia*) between the cornea and iris, or the uvea and the capsule of the crystalline lens, then the situation of these governs the site of perforation, though the iris must be always excised at the upper or lower part of the pupil.

OPERATION.—The eye is asepticised and treated with cocaine, or the animal is placed in the recumbent position and anæsthetised. The eyelids are kept apart by the blepharostat, and it may be necessary to fix the eyeball by Waldon's fixation forceps (Fig. 591), which are made to seize the ocular conjunctiva at the

[1] Paracentesis of the anterior chamber of the eye has been practised with considerable advantage in cases of periodic, recurrent, or specific ophthalmia, and also in glaucoma. The operation is performed as described, but though only one eye be affected with the ophthalmia at the time, both eyes are usually treated, as the apparently sound eye is almost certain to be involved sooner or later, and the operation is said to avert the attack.

inner and lower side, and by slight pressure hold it immovable, at the same time keeping back the membrana nictitans. Graefe's knife is then pushed through the cornea near its union with the sclerotica, parallel with the surface of the retina: the knife is withdrawn, and the iridectomy forceps introduced through the incision into the anterior chamber, where a portion of the iris is carefully seized at a part adjacent to the opening, and brought gently outside, where it is cut off by curved scissors close to the cornea (Fig. 592), the part remaining between the lips of the wound being returned to the chamber by a probe.

To break up the adhesions just referred to, it has been proposed to puncture the cornea at a point immediately opposite to the synechia, and to introduce into the anterior chamber of the eye a small hook, like an iris hook, which, passed to the adhesion, is made to break it up.

The after-treatment of iridectomy is simple. The eye is to be

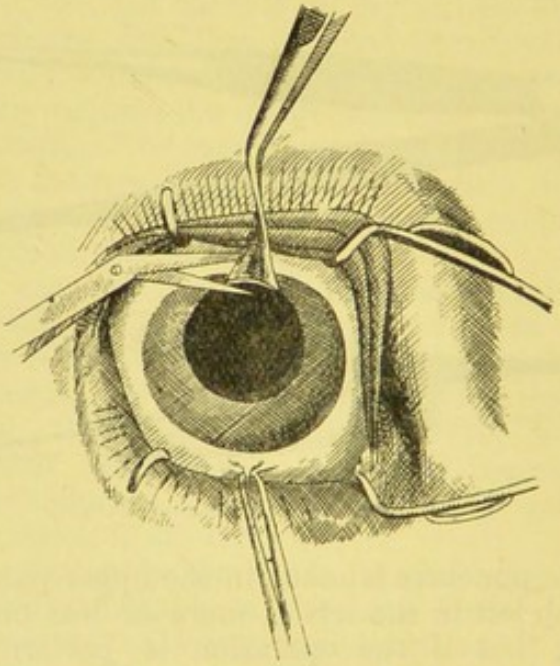

FIG. 592.—IRIDECTOMY IN THE HORSE. (After Cadiot and Almy.)

cleansed with boric solution, and covered with aseptic gauze or lint, an eye-protector being worn for two or three days. The eye itself is to be frequently sprayed with the boric collyrium, and to have instillations of atropine every second day.

Sclerotomy.

Puncture of the sclerotica has been practised chiefly for glaucoma, to relieve the intra-ocular distension that characterises that disease by affording an exit for the superabundant fluid through the wound in that dense inelastic membrane.

OPERATION.—The sclerotica is pierced either close to its junction with the cornea or a little farther away from it, a De Graefe's knife or a cataract needle being employed, after the eye has been

rendered insensible to pain by cocaine. The instrument should penetrate to a very slight depth—only through the sclerotica, in fact, so as not to damage the vitreous body. The after-treatment is the same as for iridectomy.

Operation for Cataract.

Operation for cataract, though conferring great benefit on man, does not possess the same value in the case of animals; indeed, so far as the Horse is concerned, and notwithstanding all modern advantages, the operation has been found useless, and only too often has been followed by serious complications.

Cataract in the Horse is usually capsular or mixed, and is generally accompanied by grave alterations in other parts of the organ. The eye, when deprived of its crystalline lens, not only loses its power of accommodation, but the rays of light entering it are not sufficiently refracted, so that the picture of objects is formed behind the retina, and things are presented in strange forms and of fantastic dimensions. Therefore, the animals operated on are alarmed and startled, and cannot be utilised unless altogether blindfolded, as it is impossible to fit them with suitable artificial lenses to compensate for the absence of the natural ones, even if there were no serious changes in other parts.

This is not the case with the Dog, however, in which cataract closely resembles that in Man, is very seldom accompanied by complications, such as adhesion of the iris, and in which the faculty of accommodation is quickly regained. This is probably due to the fact that cataract in this animal is extremely rarely inflammatory in its origin, whereas in the Horse it nearly always, if not always, appears after inflammation, and this involves other structures besides the lens and its capsule. The Dog is therefore the animal most frequently operated upon for cataract, and with which success is most certain.

There are three methods of operating for cataract—(1) *discission*, (2) *displacement*, (3) *extraction*.

1. *Discission.*

Discission, or splitting of the lens capsule, is the method that offers the best results in all cases of cataract in young animals, and in those of soft cataract in adult or aged ones. It consists in dividing or incising the anterior surface of the capsule or lens, so that it will be gradually imbibed by the aqueous humour and disappear. It is certainly the method most applicable to the Dog. A strong point in its favour is the great probability that from the capsule the lens fibres may be reproduced after the operation, though this reproduction would not account for Dogs recovering their vision more or less completely in the course of three or four weeks. It is the method that perhaps offers most likelihood of success in certain cases of cataract in the Horse.

In no operations is scrupulous asepsis more urgent than in those for cataract, and, in fact, in all those on the eye, instruments and hands being specially attended to. Cocaine, locally, may be employed, but it is found that general anæsthesia is more satisfactory.

Operation.—The animal is placed in a suitable latericumbent position, the affected eye being uppermost, the pupil well dilated by atropine, the eyelids kept apart by the blepharostat or two retractors; the eyeball is rendered immovable by the fixation forceps; the ordinary or Beer's cataract needle (Fig. 588), held like a writing pen, is passed through the upper part, or external side, of the cornea, a short distance from its border and parallel to the iris, its point being directed towards the upper border of the pupil. The anterior capsule of the lens is reached and incised to some extent—about two-thirds of its surface—care being taken

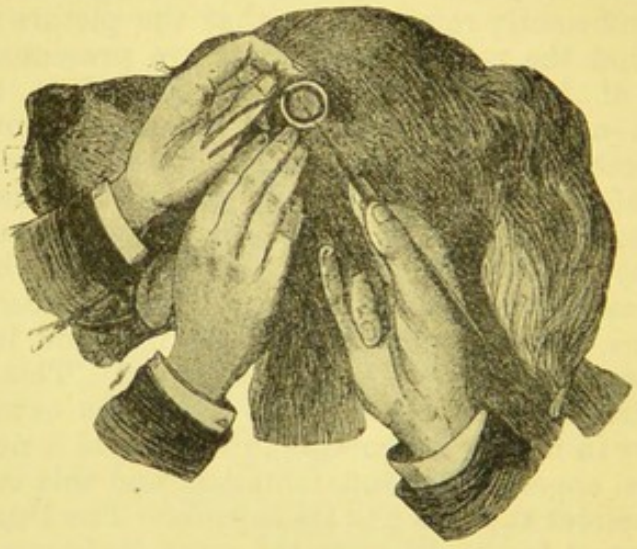

Fig. 593.—Operation of Discission for Cataract.

not to touch the lens itself, lest it become displaced; another incision is made across the first in a like manner, and then the needle is withdrawn gently, so as not to enlarge the corneal wound.

The operation is now completed, a fresh quantity of atropine is instilled, and the Dog is allowed to recover. The eye is dressed with boric solution, and it may be covered with an eye-protector. The animal must be kept confined, and for two or three weeks it will be necessary to drop atropine into the eye two or three times a day. On the day following the operation a mass of cortical-like substance will be observed protruding into the anterior chamber of the eye, but this gradually disappears, and in the course of three or four weeks there should be a perfectly clear pupil; perhaps only within the extreme ciliary margin will there be any remains of the capsule noticeable. At this time, if not before, the animal will be able to find its way through intricate

passages without any hesitation. If the other eye is to be operated upon it is advisable to allow an interval of two or three weeks between the operations.

In some cases the operation may require to be repeated at intervals of a few days; but this can always be done with impunity.

2. *Depression and Reclination.*

Displacement or dislocation of the lens is effected with the object of removing it from behind the pupil, where it is an obstacle to the passage of light, and to place it at the bottom of the chamber, behind the iris and clear of the pupillary opening.

The same preliminary steps are to be taken as in discission; the pupil is to be widely dilated by atropine, the eyeball rendered immovable by the fixation forceps, and the eyelids kept apart by the blepharostat.

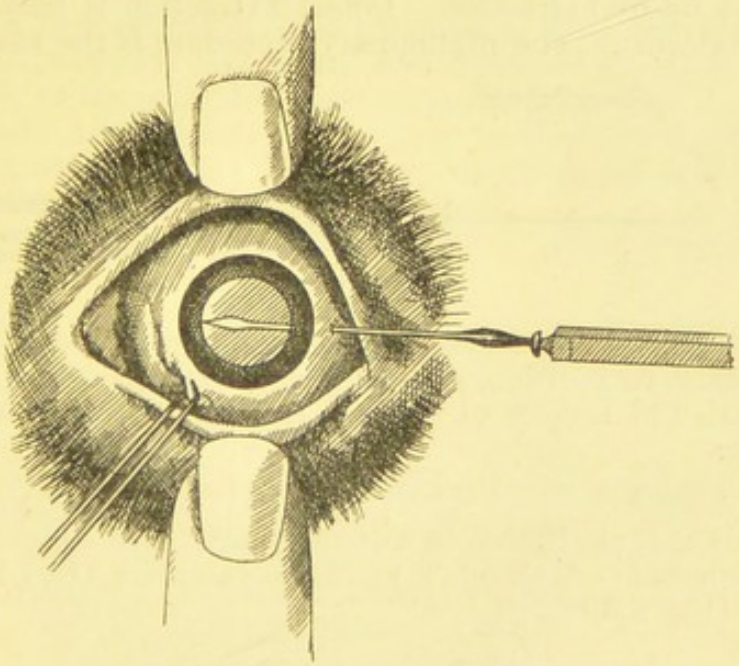

FIG. 594.—OPERATION FOR CATARACT BY DEPRESSION AND RECLINATION IN THE DOG.

OPERATION.—The cataract needle is held as in discission, and may be made to puncture the cornea (*keratonyxis*) or the sclerotica (*scleroticonyxis*), but we will suppose it to be the latter, which is to be preferred; the needle is pushed through the sclerotica about one-sixth to one-eighth of an inch from the cornea, a trifle below the transverse axis of the eye at the temporal side (Fig. 594); It should be passed a little obliquely upward and backward behind the iris and the crystalline lens, the convex side toward that membrane or upward. The point of the needle is now to be turned toward the upper part of the lens, and by a semicircular movement it is made to place its (capsule of the lens) concavity on the upper margin of that body and bring it down beneath the

vitreous humour and below the visual axis. Keeping it there for half a minute to prevent it ascending again, the needle is withdrawn in its former horizontal position. If the operation is properly performed, the anterior surface of the lens has now become the inferior.

In reclination the procedure is the same, except that the needle, instead of depressing the lens immediately downward, carries it back in the vitreous body and places it at the bottom of the chamber, so that its anterior surface becomes superior.

3. *Extraction.*

Extraction of the opaque lens from the eye is done with the same object as the two preceding operations, but that body is entirely removed from the eye instead of being left in it to undergo gradual absorption. This can be accomplished by *linear incision*, with or without iridectomy, and by *corneal flap* or modified linear extraction. Linear extraction is only applicable to soft cataract. The preliminary procedure is the same in both,

FIG. 595.—CYSTOTOME.

and analogous to that described for the two preceding operations with regard to position, general or local anæsthesia, dilatation of the pupil, and asepsis of the eye, instruments, and hands of the operator.

LINEAR EXTRACTION.

This is only applicable to soft cataracts.

Instruments.—A Graefe's knife, a cystotome (Fig. 595), and a curette (Fig. 596).

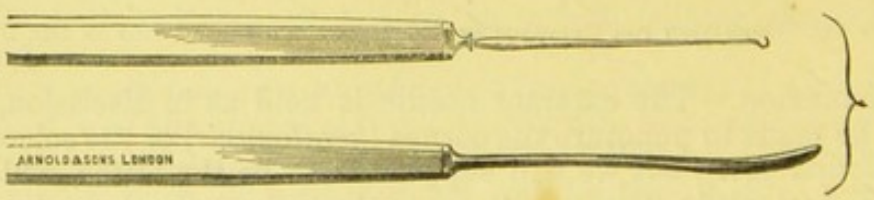

FIG. 596.—CURETTE.

OPERATION.—The knife is passed into the side or upper part of the cornea, a short distance from the sclerotica, and pushed into the anterior chamber parallel to the iris, the incision being about one-eighth of an inch long. The knife is then withdrawn, and the cystotome is introduced through the incision, and by means of this instrument the capsule of the lens is torn, as in discission. Gentle pressure is now exerted on the surface of the cornea

below by the curette, and on the upper surface of the eyeball by the finger, so as to expel the lens through the incision. A narrow curette introduced into the lens capsule removes any fragments of the lens that may have become detached, and which, if allowed to remain, might act as foreign matter and excite inflammation. If it is desired to extract hard cataracts by this crescentic linear incision, the opening must be made a little longer and the iris divided to the same extent.

FIG. 597.—BEER'S CATARACT KNIFE.

A dressing of aseptic lint must be applied to the eye after a few drops of atropine solution have been given to the conjunctiva, and an eye-protector worn for a short time. The dressing should be changed in twenty-four hours, and need not be renewed more than twice, as the wound in the cornea heals rapidly.

Extraction by Corneal Flap.—This method of extraction is adopted in cases of hard cataract, usually termed senile, and is a more delicate operation than the others.

The instruments are the same as in the last operation, except

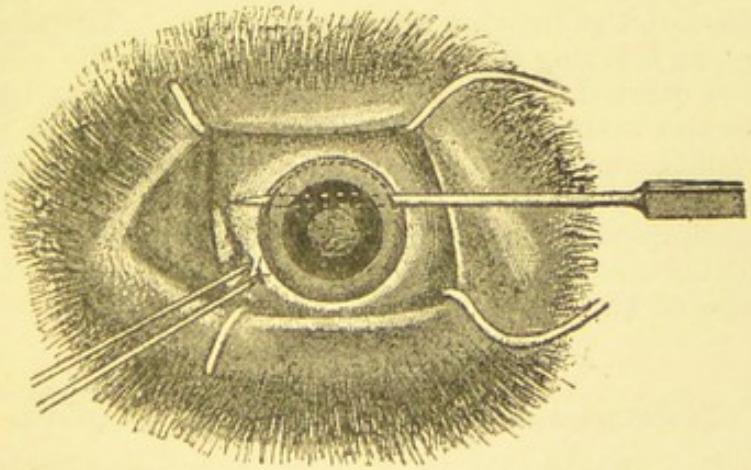

FIG. 598.—EXTRACTION OF HARD CATARACT BY FLAP OPERATION IN THE DOG. (After Cadiot and Almy.)

that a Beer's cataract knife (Fig. 597) may be substituted for Graefe's knife. The preliminary preparations are the same.

OPERATION.—The incision in the cornea is much more extensive than in the other operations on the eye, and makes a flap of a portion of the cornea.

The knife, edge upward, is passed through the cornea near the sclerotica, at the outside, and slightly above the transverse diameter of the eye, its point being directed into the anterior chamber parallel to the iris, and is worked across in a horizontal

direction by a slight sawing movement to the opposite side, where its point is pushed through, the opening being about the same distance from the sclerotica as the entrance (Fig. 598). It may be noted that puncture and section of the cornea is much facilitated by smearing a little olive-oil on the blade of the knife, as this prevents the cornea adhering to the instruments. If Beer's knife is employed, on pushing the blade through on the opposite side, the cutting edge being upward, the upper portion of the cornea is cut through and forms a flap; but if the Graefe's knife is used, this flap is made by cutting upwards in the same fine sawing movement. The incision should be at the same distance from the sclerotica throughout. The aqueous humour entirely escapes, and the iris may protrude through the wound. The cystotome is now carefully introduced into the anterior chamber, so as not to injure the iris or cornea, and divides the capsule of the lens from top to bottom, and slight pressure by the curette on the lower half of the cornea readily expels the lens if the corneal incision is sufficiently large. Sometimes the iris offers an obstacle to its extrusion, and then it becomes necessary to perform iridectomy.

In extraction of the lens, union of the corneal wound by adhesion should take place soon, in order to insure perfect success, and prevent what sometimes occurs after the operation —destruction of the organ. To this end, care should be taken that the flap lies even when the operation is completed, and that the borders of the incision are in coaptation. Therefore care is necessary, in bringing the eyelids together, that the edge of the flap is not everted by the upper eyelid, which may have to be lifted over the wound. An aseptic pad of lint should be placed on the eyelids, and bound there, to prevent their movement disturbing the cicatrization of the wound, which in favourable cases may be completed in two or three days. The greatest dangers to be apprehended from the operation are prolapse of the iris and escape of the vitreous body, so these have to be guarded against.

Tumours and Growths on or in the Eye.

The eye is not infrequently affected with tumours, which may be benign or malignant. The latter generally attack the deeper-situated membranes; the former are usually found in connection with the ocular conjunctiva.

The malignant tumours usually necessitate removal of the eye, but the benign ones can generally be dealt with surgically. Entozoa in the anterior chamber of the eye have been already dealt with.

The benign tumours are lipomata, cysts, melanomata, polypi, and dermoid growths. All these can be submitted to appropriate surgical treatment, which will depend upon their situation, their form, and their connections. Unless they cause

much inconvenience to the affected animals, or are likely to give rise to troublesome complications, they are not interfered with, and then they are removed by excision. When the sclerotic conjunctiva only is involved, their removal is not difficult; but when they are situated on the cornea, as is so often the case with the dermoid tumours, they need careful handling, lest the cornea be perforated. Local anæsthesia, by cocaine, or general anæsthesia will be necessary, and sharp, slightly curved scissors are best for cutting through the growth, which is to be held by strongly serrated forceps, and cut away by portions until the cornea is reached; but this should not be touched, even if the base of the growth should be implanted in it.

Boric collyrium and cleanliness are all that is needed afterwards.

Extirpation of the Eye.

Removal of the eyeball is necessitated for several reasons. The eye may be so seriously injured that its utility is destroyed, and its retention becomes a source of danger to the other eye, from panophthalmia setting in after the traumatism. Or the occurrence of disease in the eye itself, or in the orbital cavity, may render extirpation necessary, and especially if the disease be of a malignant character. Degeneration of the organ is also often a cause for its removal.

Evisceration is practised when it is desired to leave the sclerotica, muscles, and other immediate appendages of the eye to occupy the cavity. It is rarely had recourse to, and then only in cases in which there is no danger of disease progressing or the other eye becoming involved.

The eye is rendered insensible to pain, and is fixed, the eyelids being kept apart by the blepharostat. The conjunctiva is divided near the cornea in a circular manner, and parallel to the cornea, and reflected back for about one-third of an inch; then the sclerotica is incised in a similar manner about one-sixteenth of an inch from the cornea, so as to remove the latter. The interior of the globe is evacuated, and the curette employed to free the sclerotica from the tissues adhering to it. The cavity is dusted with boric powder, and filled with aseptic gauze or lint, and an eye-protector applied. The dressings are to be changed every second or third day, until the interior is firm and dry, and fit to sustain the pressure of an artificial eye.

Enucleation implies complete extirpation of the eye, and is the operation most frequently performed in cases in which the organ must be removed.

There are several ways of enucleating the eye, and the principal of these we will refer to. The animal should either be put under the influence of an anæsthetic, or the eye rendered fully insensible to pain by injections of cocaine around it. It is most convenient to have the animal placed on its side, the eye to be removed being uppermost.

First Method.—This is only applicable to large animals. The eyeball is seized and fixed by a tenaculum or the fixation forceps after the blepharostat has been applied to the eyelids. Then the eyeball is detached from its surroundings by incising the conjunctival folds and the oblique muscles. An incision about an inch in length is made through the skin over the temporal fossa by means of scissors, the index-finger is passed through it, and dissects away the adipose cushion at the back of the organ until the reflection of the ocular sheath is reached. After perforating this by means of a scalpel, the chain of a small ecraseur is passed through the opening (using if necessary a piece of twine or wire to serve as a guide) and round the recti muscles, the optic nerve, and the arteries. Carefully tighten the chain, and turn the lever slowly, when the parts will be cut through, and with very little, if any, hæmorrhage the eye will be freed from its attachments. The orbital cavity is well dusted with boric powder, and filled with aseptic lint. A bandage is applied over it, and if necessary an eye-protector. A suture closes the wound in the skin at the temporal fossa. The orbital cavity should be dressed every second or third day.

Second Method.—Also for large animals. The eye is fixed and eyelids kept apart; the membrana nictitans is excised; if necessary, the palpebral fissure can be extended at the external canthus (required when the eyeball is much enlarged); the conjunctival folds are cut through as well as the oblique muscles. The chain of an ecraseur is then passed over and as far behind the eyeball as possible, and tightened, the lever being slowly and intermittently turned. The organ is soon detached, and can be readily removed from the cavity, which is now dressed with boric powder, and filled with aseptic lint, which may be retained by a bandage or one or two sutures through the eyelids. If the palpebral fissure has been incised, the incision should be closed by a suture. The dressing should be renewed in a day or two.

Third Method.—The lids being held apart and the eye fixed, the ocular conjunctiva is seized with forceps on the outer side of the eye, near the cornea, and slit. The scissors are introduced into this opening and made to cut the conjunctiva quite around the margin of the cornea, also the connective tissue; the ocular muscles, commencing with the external rectus, are drawn out and divided. Curved scissors are passed behind the eyeball, after it has been pressed a little out of its cavity, and the parts behind still attaching it are cut through. The hæmorrhage is subdued by cold sterilised water, and the cavity dressed as in the preceding method, and the part protected in the same way. The dressings are repeated at the same intervals.

Fourth Method.—The preliminaries are the same as in the preceding methods. The conjunctiva is divided in a similar manner, as well as the muscles at the lower moiety of the eyeball; then the optic nerve is divided, and the muscles on the remaining portions of the eye. All this dividing is accomplished

with scissors curved on the flat. The after-treatment is the same as in the preceding methods.

Fifth Method.—This is very like the preceding. Close to the external border of the cornea the conjunctiva is seized by forceps, and by means of short curved scissors it is detached throughout its circumference as near the cornea as possible. Then a straight bistoury is passed between the eyeball and the orbit, at the inner angle of the eye, the cutting edge outwards, and pushed to the bottom of the cavity, detaching the lower part of the globe in cutting from within to without as far as the external angle; the knife is again carried to the inner angle, and the upper half of the globe is liberated in the same fashion. The eye is now retained only by the recti muscles and the optic nerve. These are cut through by curved scissors introduced to the bottom of the cavity along the external side of the orbit, their concave side toward the eye. Scissors may be used instead of a bistoury to detach the eyeball from the sides of the orbit.

The cavity is washed out with antiseptic fluid and filled with iodoform gauze, the eyelids being closed by one or two sutures. The following day the sutures and the gauze are removed, the cavity is carefully cleansed and dressed again; this is frequently repeated until the part has healed. Then it is often found that the eyelids are drawn into the cavity, rendering it difficult to employ an artificial eye. To obviate this, it has been proposed to use immediately after the operation a provisional artificial eye, provided with four holes: one superiorly covered by the upper eyelid, by which the interior of the cavity can be irrigated; two lateral, allowing the passage of an indiarubber drain-tube; and an inferior, larger than the others, to permit the introduction of small plugs of lint. In this way the eyelids are maintained in a good form, and by means of the holes it is easy to antisepticise the cavity until the inflammation has disappeared, when the proper artificial eye can be adopted.

Artificial Eyes.

Ocular prothesis or prosthesis is necessary if the unsightliness and depreciating effects of a vacant orbit are to be obviated; and this may be carried out so successfully that at a short distance an acute observer could not assert the animal had an artificial eye. This repulsive appearance of animals which had lost an eye has been modified by scarifying the palpebral conjunctiva near the margin of the eyelids, incising the skin covering them for about two-thirds of their length, and bringing the raw surfaces together by suturing the lids, with the result that union between them has taken place, and the unsightly cavity has been concealed by hair-covered skin.

But the artificial eyes as now made are much to be preferred. These are a convex hemispherical shell, slightly oval in outline, and of different sizes, not only for Horses, but also for Dogs.

They are best when made of thin metal, covered with celluloid, or entirely of celluloid, hard rubber, or gutta-percha. I have had them made of horn, and they answer perfectly ; but I found that the warmth and moisture of the eye was liable to distort them. Those made of metal and covered with celluloid are more durable in this respect. They are coloured exactly like the natural eye, and when a circular or oval ridge or furrow is made in the middle of the convex surface to represent the pupil, at a short distance from the animal the illusion is complete.

The eye should be of a proper size, neither too large nor too small ; for if too large it will cause irritation, and if too small it is liable to drop out. It should not be inserted if there is any inflammation or suppuration in the orbit, and it must be kept very clean, and polished on the convex side. It ought to be

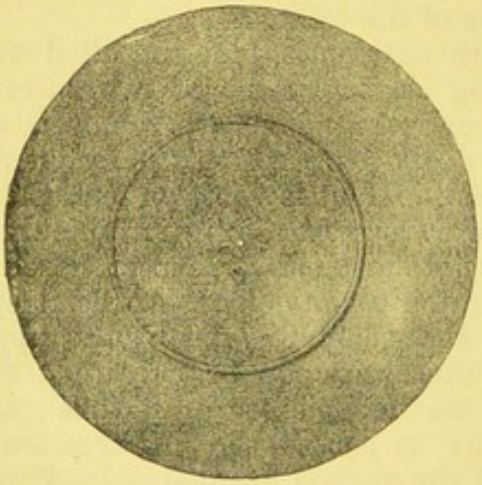

FIG. 699.—ARTIFICIAL EYE FOR HORSES. FULL SIZE; FRONT VIEW.

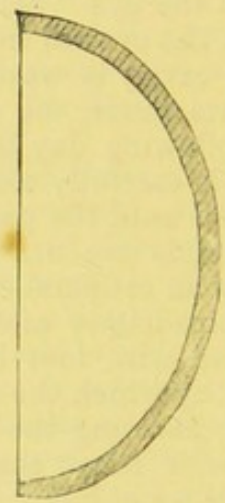

FIG. 600.—ARTIFICIAL EYE FOR HORSES. LATERAL VIEW, TO SHOW CONVEXITY.

removed every few days for this purpose, and if there are any indications of irritation in the vascular remains within the orbital cavity, this must be washed out with boric or alum solution. It is a good plan to have duplicates, so as to have one clean and ready to be introduced when the other is taken out.

To place the artificial eye in the orbit, the upper eyelid is pulled outwards and raised a little, and the border of the shell is glided upward beneath it ; the lower lid is drawn downward, and the other border placed within it ; the two lids are then adjusted and gently smoothed over it. To remove it, the lower lid is pulled down a little, and a blunt probe being passed underneath its lower border, toward the external side of the orbit, the shell is lifted out.

This artificial eye has the advantage also of keeping out flies, dirt, and dust from the orbital cavity.

CHAPTER III.

OPERATIONS ON THE APPENDAGES OF THE EYE.

The Eyelids.

The eyelids comprise the upper and lower and the third eyelid, or *membrana nictitans*. They are liable to accidents, traumatic and congenital, as well as diseases and deformities, which require operative interference. The Horse and Dog are the animals most frequently operated upon.

Contusions and Wounds.

Contusions and wounds of the eyelids are somewhat common in Horses and Dogs; wounds are most frequent.

Contusions cause subcutaneous or subconjunctival ecchymoses that need little treatment beyond astringent collyria, unless the hæmorrhage is so extensive as to produce hæmatomata; these will require opening with a lancet, cleaning out, and dressing with boric solution. In other cases palpebral emphysema is a result of injury to the lachrymal sac or canals, or fracture of the bones of the nose. It is of no importance, and usually subsides spontaneously.

Contused wounds are produced most frequently in the upper eyelid by hooks, nails, bites, etc., and are sometimes so severe that the eyelid is partially or wholly torn off; or the wounds divide the eyelid obliquely or perpendicularly to a great extent. When the eyelid is torn off the accident is a serious one, as the eye has lost its natural protection and suffers greatly. In such a case nothing can be done unless an attempt be made to form a substitute from the adjacent skin.

Wounds are best closed by interrupted or, better, twisted suture, the pins employed being fine and rather close to each other, and the tow or silk thread twisted spirally between them should lie close so as to make a covering to the wound. If one of the pins comes out before union occurs it should be immediately replaced. The points of the pins must be cut off short, and the eye ought to be shielded by an eye-protector; if a Horse, it may be advisable to have recourse to the pillar-reins. In the case of old wounds, the borders must be scraped and made raw before being sutured. Abscess may form as a result of contusions and wounds. It should be lanced and the pus evacuated, the incision being made parallel to the free margin of the lid.

Sometimes the membrana nictitans is much enlarged from chronic inflammation and tumour, and the cartilage may also become necrosed. In these cases it may be necessary to remove this third eyelid. This can be done without placing the Horse recumbent if the part is rendered insensible by cocaine. The

upper eyelid is kept out of the way by a retractor, the membrana nictitans seized by a tenaculum (its back or convexity towards the eye), drawn forwards and outwards, and amputated by scissors. Under boric solution dressings recovery is rapid.

Congenital or Acquired Deformities of the Eyelids.

Colomba.

Vertical fissure of the eyelid, designated colomba, is analogous to hare-lip, and involves the whole thickness of the lid. The remedy is simple. The borders of the fissure are made raw and brought together by the twisted suture in the manner described for wounds of the eyelids.

Ankyloblepharon.

Partial or total union between the upper and lower eyelids, either congenital or as a result of disease, is sometimes met with in animals, chiefly the Carnivora when congenital, but sometimes also in Foals.

Operation.—When the union is incomplete the operation for the disunion of the eyelids is not difficult. A director (Fig. 601)

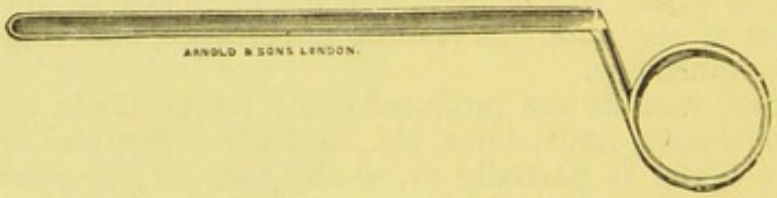

Fig. 601.—Director.

is carefully passed into the opening between them, and pushed along beneath them in the line of their junction as far as the external or internal canthus, as the case may be. Then, with the point of a bistoury placed in the groove of the director, the two lids are separated along the line of what would be their natural division. The separation may be effected with scissors.

When the lids are completely united, a fold of skin is to be raised transverse to the direction of the incision that is to be made for their separation. This fold is to be snipped through with scissors at the point where the separation is to commence; this will afford an opening for the director, when the same procedure as that adopted for incomplete ankyloblepharon is to be followed.

To prevent adhesion between the lids, a small piece of aseptic lint should be placed between their margins, and a bandage or eye-protector placed over the eye; this may be removed the following day, and the raw margins cleansed with tepid water, then dressed with boric ointment.

If the conjunctival mucous membrane shows a tendency to separate from the skin, it will be necessary to join them by a

suture in the margin at the middle of the lid, with two or more at each side of this, according to the extent of the separation.

The incision between the lids should be perfectly regular and even.

Symblepharon.

Adhesion between one or both eyelids to the ocular globe is sometimes observed in animals as a result of injury or disease, such as inflammation, ulceration, wounds, burns, or operations practised on the conjunctiva. The adhesion may take place between the cornea or sclerotica, or both, and the conjunctiva. It is most serious when the cornea is involved, as then there can scarcely fail to be opacity, no matter what is done.

Knowing the tendency to adhesion between the two opposing conjunctival surfaces under the conditions just mentioned, care should be taken to prevent it by frequently passing a probe between the inflamed surfaces in contact, and frequently inserting a little boric ointment or boric glycerine.

When adhesion has taken place, an operation will be required to divide it. This requires to be carefully done, the dissection being carried out by means of a scalpel, and an endeavour made

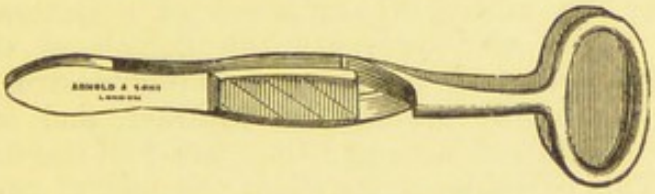

Fig. 602.—Entropium Forceps.

to save the ocular conjunctiva as much as possible rather than the palpebral. The disunion having been accomplished, attention has to be directed to prevent re-adhesion by adoption of the measures just described.

Trichiasis.

The deviation of the eyelashes inwards, so that they come in contact with the front of the eye, is not at all uncommon in animals, especially Horses and Dogs, and is the result of wounds of the eyelid, chronic inflammation of the palpebral conjunctiva, and sometimes of atrophy of the eyeball. If not quickly remedied, it will give rise to conjunctivitis and keratitis; it certainly causes much pain.

The remedy is to extract the offending eyelashes, or, to insure a radical cure, to pare away the skin from which the hairs grow (tarsorrhaphie). This is done by seizing the lid by means of the entropium forceps (Fig. 602), the fenestrated blade outwards, and pressing out the part of the skin by means of a small ivory paper-knife, to pare the outer margin of the lid through the opening in the blade. No more skin need be removed than that containing the hair bulbs. The wound is allowed to heal by granulation.

Entropium.

Entropium is a condition in which the eyelid is itself inverted, and its outer surface, as well as the cilia, is in contact with the eye. It is not at all uncommon in Dogs. It may be congenital or acquired. In Solipeds it is sometimes congenital. There is described a spasmodic entropium, due to inflammation of the conjunctiva or cornea, and an organic entropium associated with chronic disease of the skin, the orbicularis muscle, and the tarsal cartilages; the upper and lower lids may be involved. It may be partial or total, single or double, but it is frequently bilateral.

In some cases of spasmodic entropium occurring in Foals, astringent lotions have been successfully employed: but in organic entropium surgical interference is required to insure a cure. This interference comprises cauterisation, suture, or excision.

Cauterisation.—This is seldom resorted to, though it may sometimes be followed by benefit. One or two lines by the actual cautery are made through the skin parallel to the border of the eyelid and near to it. The resulting wounds should be regular and only through the skin, and to insure this the animal should either be under the influence of a general or local anæsthetic. This also prevents the danger of the cautery damaging the eye itself during the animal's struggles. The wounds in healing by granulation contract, and in doing so diminish the breadth of skin, and therefore pull the lid outwards.

Suture.—This is similar in its result. A fold of palpebral skin is raised parallel to the free border of the lid, and a continuous suture is passed through its base from the end, so that the included skin mortifies and sloughs away.

Another method is to pass a piece of aseptic silk through the eyelid, about a quarter of an inch from its margin, securing this thread to the skin of the forehead (if it be an upper eyelid—to the side of the face if it be a lower one) by passing it through a fold of skin there, and tying it to the other end of the thread sufficiently short to bring the lid to its normal position; there it is left for six, eight, or twelve days. Two or three sutures of this kind may be required, according to the size of the eyelid.

Excision.—This is the speediest and most satisfactory operation. The skin is excised in different ways, the amount of this being in proportion to the extent of the entropium. The animal should have an anæsthetic administered, after being placed on its side with the affected eye uppermost.

The first method of excision is to seize, by means of the entropium forceps, a fold of skin parallel to and near the free border of the affected eyelid; this fold is cut away at the bottom by means of curved scissors. The depth of the fold must be regulated by the degree of inversion of the lid; the edges of the resulting wound are brought together by fine sutures. The fold of skin may be sutured before it is excised, or three or four pins may be passed

through its base, and silk or fine tow wound around these as in twisted suture, and then the fold cut away by scissors or scalpel, taking care not to cut too deeply.

Another method is to cut through the skin only parallel to the margin of the lid, and about four lines from it; then on the intermarginal border the lid is split between the cartilage and muscle as deep as the skin incision, thus forming a band containing the cilia and their roots. Another incision is made parallel to the first and of equal length, about two lines below it, leaving a riband of skin between the two; this is dissected up, but is left attached at both ends. The top band of skin is now drawn down over the riband and fastened by silk thread sutures to the lower border of the lowest incision, the riband being drawn up beneath and sutured to the intermarginal edge. The sutures are to be removed in a week, when the wounds will be probably united by first intention, the cure being in all likelihood completed in two weeks.

Berlin's method is simple, but though it was originally intended

FIG. 603.—BERLIN'S ENTROPIUM OPERATION.

to apply to both eyelids when both were involved in entropium, it has been found effective only with one lid. This method is carried out as follows: The Dog having been placed on its side, the eye to be operated upon being the upper one, the incurved eyelid is gently drawn outwards, and an elliptical piece of skin raised by the forceps is cut out by the knife at the outer angle of the eye, a short distance from the external commissure (Fig. 603). The amount of skin removed depends upon the size of the animal and the degree of entropium. This may be ascertained before the operation by raising a fold of the skin at the part where it is proposed to operate, and sufficiently large to bring the eyelid or lids level and straight. It is better to err on the safe side by taking too little rather than too much, as if it is not sufficient the operation can be repeated. There is no need for alarm if the orbicularis muscle is involved in this excision. The bleeding is slight, and there is no need for sutures. The following day the wound is smaller, and there may be slight ectropium with limited conjunctivitis between the eye and the lid. In fourteen days the wound

is healed, and only a small cicatrix remains; the eyelid has resumed its normal position, and the inflammation has subsided, or nearly so.

Schleich has improved on this method, by which both lids, if affected, can be put right. Aided by the hand of an assistant, after the animal has been anæsthetised, at a point about 604, millimetres from the outer angle of the affected eye, at *a*, Fig. five and parallel with that angle, an incision is made through the skin from *a* to *b*, and another from *a* to *c*; these two lines are to be parallel with the margins of the eyelids and a fewer millimetres from them than *a* is. From the points *b* and *c* two converging incisions are made, which may be either straight or curved from *b* to *d* and *c* to *d*, so that the wound is like an arrow-head when the intervening skin is removed. The degree of concavity of the last incision must be in proportion to the degree of entropium. Interference with the orbicularis muscle in making these incisions and the dissection is not of much moment. Healing by primary

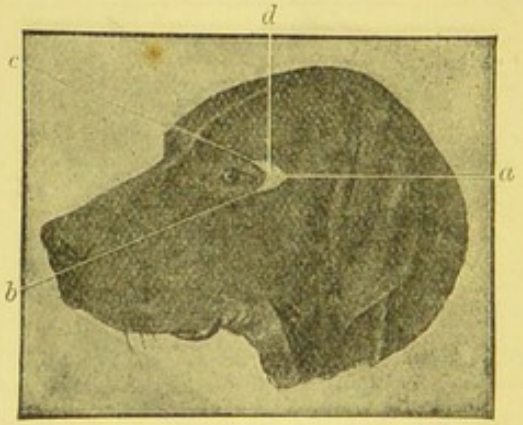

FIG. 604.—SCHLEICH'S OPERATION FOR ENTROPIUM.

intention is to be attempted by placing sutures at *a d*, at the wound borders *a c* and *c d*, then *a b* with *b d*, the part being covered with iodoform collodion, a bandage applied over the eye, and a cap over that. These must be worn for eight days, when the wound should be healed, and only a very small scar remaining at the end of fourteen days.

In those cases in which the entropium is due to abnormal construction of the orbicularis muscle, Stellway divides it at the outer commissure by passing a pair of closed scissors between the lid and the eyeball at this part, then opening them wide and making an oblique snip through the eyelid. This at once remedies the entropium, which does not recur on the healing of the wound. This method has been successfully combined with Berlin's method.

Fröhner operates as follows: After shaving and disinfecting the skin of the lid to be operated upon, a fold is raised by the fingers or forceps sufficient to efface the entropium, taking care

not to include the conjunctiva by passing a finger to the bottom of the sac. With scissors the skin held by the forceps is cut away, so that between the upper border of the resulting wound and the margin of the eyelid there will remain at least half a

Fig. 605.—Fröhner's Operation for Entropium.

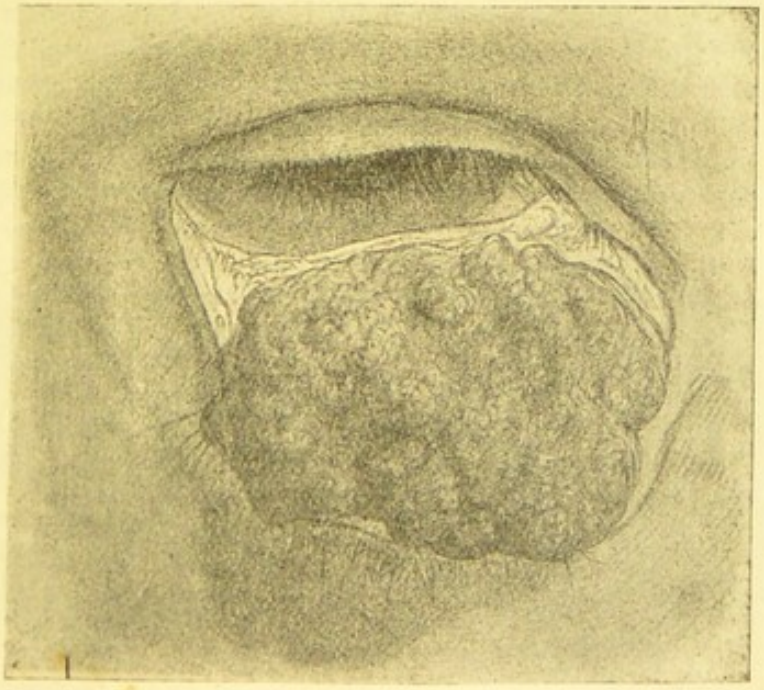

Fig. 606.—Ectropium of the Lower Eyelid of a Horse, due to Tumour of the Conjunctiva. (After Bayer.)

centimetre of skin. After bleeding has been suppressed, the wound is closed by button suture (Fig. 605).

Ectropium.

This is the reverse condition of entropium, the eyelid being everted. It may affect the upper or lower lids, one or both eyes,

and be general or partial. The under lid is most frequently involved. It is, perhaps, not so common as entropium, and requires similar operative treatment. It is induced by tumefaction of the palpebral conjunctiva, by inflammation, lesion, or loss of skin of the eyelid, burns in that region, tumour (Fig. 606), etc.

When the reversion is due to conjunctival tumefaction, scarifi-

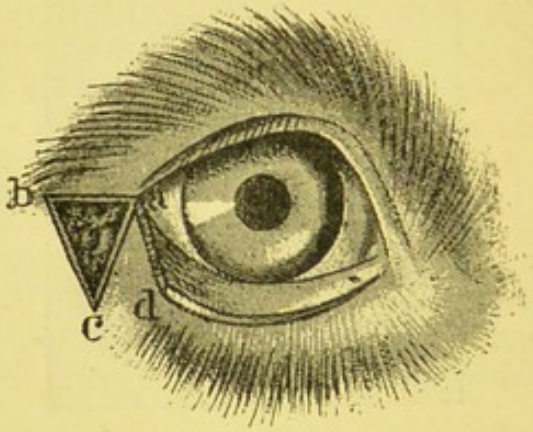

Fig. 607.—Dieffenbach's Operation for Ectropium.

cations will sometimes correct it, if a cold compress of boric solution be applied over the lid and eye; or snipping off a strip of the conjunctiva by means of scissors is still more effective.

If the ectropium is due to inflammatory retraction of the skin, the operation practised on Man, and favoured by Graefe and Dieffenbach, should be adopted; it is shown in Fig. 607. The

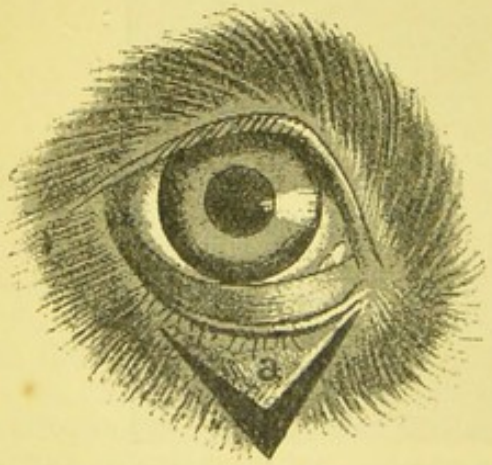

Fig. 608.—Wharton Jones's Operation for Ectropium: Incisions around Cicatrix.

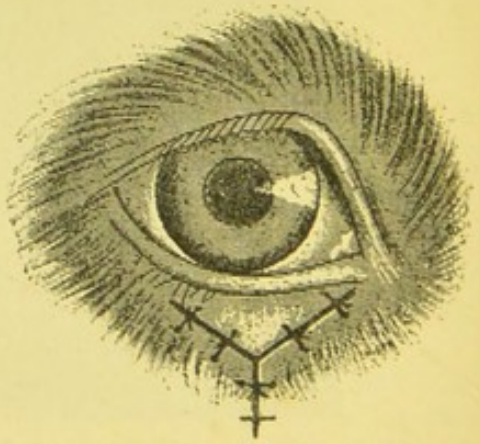

Fig. 609.—The same Operation: the Incisions sutured.

external commissure of the eyelids is incised from *a* to *b*; the everted lid is partially excised from *a* to *d*, and the triangular piece of skin removed from *b c a* (Fig. 607); the skin *c a d* is liberated, and a double suture unites the borders *a d* and *a b*, *a c*, and *b c*. A triangular shred of skin, the whole thickness of the eyelid, and the base of which corresponds with its margin, may

also be excised from near the external commissure, the two borders of the wound being afterwards sutured.

Cicatricial ectropium is dealt with by Wharton Jones's procedure, in which the cicatricial tissue is enclosed by two V-shaped incisions, and the triangular portion between (Fig. 608) dissected up as a flap from point to base; this flap then ascends, and the borders of the wound are united by suture in Y form (Fig. 609).

CHAPTER IV.

OPERATIONS ON THE LACHRYMAL APPARATUS.

The conditions which demand operative surgical interference on the lachrymal apparatus are very few in animals, and even these few rarely present themselves. The lachrymal gland is seldom diseased, though it may suffer from the effects of injuries which lead to inflammation (*dacroadenitis*), hypersecretion (*epiphora*), and perhaps fistula, which may be either conjunctival or cutaneous. Tumours may also affect it.

The cutaneous fistula is difficult to deal with, and should be converted into a conjunctival fistula, as then the secretion can find its way into the natural channel. If tumours involve the gland, their removal may necessitate its extirpation.

Encanthis is enlargement of the caruncula lachrymalis, and this may be the result of inflammation or new growth formation, such as papillary fibroma, angioma, melanosis, etc. It is most frequently observed in the Dog, though it occurs also in the Horse and Cow. When it does not yield to topical remedies, it is excised. This can readily be done by seizing it with a tenaculum or forceps—after applying cocaine to the eye—and cutting it away with scissors.

Inflammation of the lachrymal sac (*dacrocystitis*) is, when not primary, generally the result or accompaniment of inflammation in adjacent parts—conjunctivitis, nasal catarrh, or disease of the bones. It is sometimes followed by partial or total obliteration of the puncta, ducts, or the lachrymal canal, or all of these. The principal symptom of this obstruction is the flowing of the tears over the face. A close scrutiny of the puncta lachrymalis will detect whether these are at fault. When tepid water injected from a fine-pointed syringe is passed into the inferior of these two puncta, and escapes by the nostril, it is evidence that the passage is clear; but if it only escapes by the superior punctum, it shows that the lachrymal ducts are pervious, but that the lachrymal canal is obstructed; and if it flows back from the punctum into which it is injected, it is evident that the corresponding duct is obliterated. This atresia of the inferior punctum demands opening, if possible, by a fine silver or whalebone probe; if that does not succeed, then the punctum and its duct must be

opened throughout their length by a very fine knife (Weber's), and the frequent passage of a catheter will prevent their closing again.

When the two lachrymal ducts are obstructed, the lachrymal sac must be opened. This will necessitate the animal being placed on its side and narcotised. With a pair of forceps (Liston's artery forceps are very suitable) the operator seizes the conjunctiva

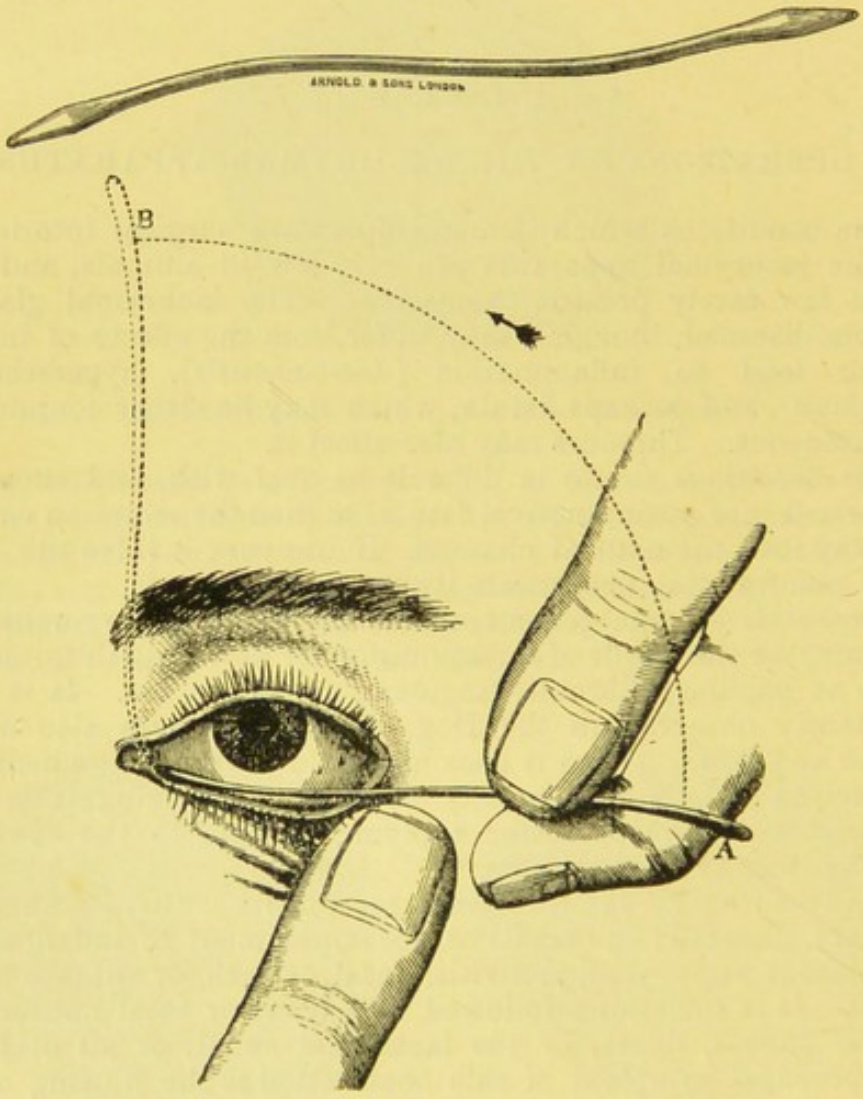

FIG. 610.—MANNER OF PASSING THE SOUND INTO THE LACHRYMAL SAC AND DUCT.

The arrow and dotted lines show the direction the sound must follow when it is being inserted at position A to enter the duct at position B.

at the internal canthus of the eye, and makes it as tense as possible where it covers the lachrymal sac, into which a very small and narrow-bladed knife is thrust. Then a whalebone stylet is pushed into the canal, and by it a narrow silk seton is passed down and left there to prevent renewed atresia. The seton should be moved every day until the artificial duct is large enough to allow the tears to flow through.

Inflammation of the lachrymal sac (*dacrocystitis*) is not infrequent in animals, and is generally a consequence of conjunctivitis or inflammation of the pituitary membrane, and is sometimes witnessed in strangles and glanders in the Horse and distemper in the Dog. It is indicated by a swelling or tumour in the internal angle of the eye, formed by the distension of the sac. When this tumour is compressed, its contents escape by the lachrymal ducts, if these are pervious. When the inflammation is acute, abscess may form in the sac, the pus burrows a channel by which it makes exit, and gives rise to a lachrymal fistula that is sometimes complicated with necrosis.

The treatment of this inflammation of the lachrymal sac re-

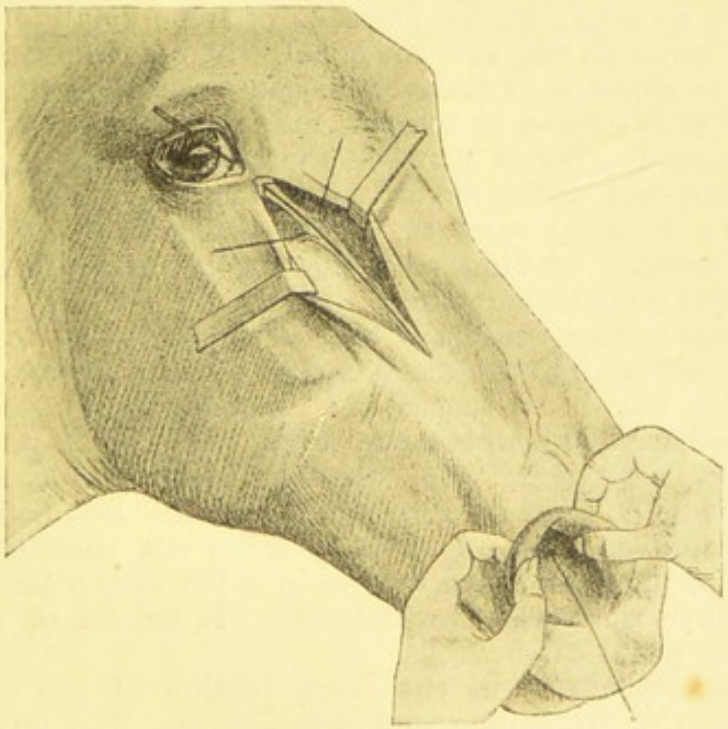

FIG. 611.—THE LACHRYMAL CANAL, SHOWING ITS COURSE FROM THE EYE TO ITS INFERIOR OPENING IN THE NOSTRIL.

quires the frequent passage of a flexible probe or sound during the early stages, with injections of tepid antiseptic or astringent solutions. When there is tumour, the same treatment must be continued and endeavours made to render the lachrymal passages permeable. Should abscess form, it must be opened by means of the narrow-bladed knife introduced through the upper puncta; but if this small canal cannot be found, then the pus must be evacuated through the skin. Should fistula have taken place, there is all the more reason why the natural channel for the tears should be re-established by catheterism. When this is impossible, it has been suggested that the lachrymal gland should be extirpated.

Obstruction of the lachrymal canal is occasionally met with in

animals, but chiefly in the equine species, with which it may be congenital or acquired. Congenital atresia is usually observed in Foals, the imperfection being observed at the lower part of the nostril, where the natural orifice of the inferior end of the duct should be. Instead of this, there is a small fluctuating swelling, and the tears from the eye of that side flow over the face, which they excoriate. On pressing the swelling, there is a sudden gush of tears from the nasal angle of the eye. The remedy for this is to make a small incision in the enlargement, which will be prevented from closing by the continual passing of the tears.

Acquired obstruction may be due to inflammation of the pituitary membrane or that lining the canal itself or it may be the result of injury to the face or the presence of a tumour. It may even have its origin in the presence of some small foreign body that has found its way into the canal. At the commencement, of course, the object is to discover the cause and the seat of obstruction. If it is caused by tumour, then the removal of this may prove a remedy; if it is owing to inflammation, frequent passing of a sound and antiseptic or astringent injections may prove sufficient. In some cases the introduction of a small blowpipe into the inferior opening, and blowing energetically through it, may effect an immediate cure.

But when these measures fail, it is necessary to make an artificial passage into the nasal cavity. The following method of doing this has been suggested: Introduce into the superior puncta lachrymalia a whalebone stylet, and pass it down until it encounters resistance; then, when its point is felt, a counter-opening is made there in order to extract it. But before this is done, a cord composed of two or three silk threads is passed through its upper end, and this seton is left in the canal and the wound when the stylet is withdrawn. It should be allowed to remain for about three weeks.

If the obstacle is in the bony portion of the canal, then catheterism or trephining must be adopted. The latter will be carried out through the lachrymal bone.

Strabismus.

Squinting has been reported in animals by a number of observers. It may be due to various causes, such as abnormal adhesions of the ocular globe, defective muscular equilibrium, or muscular paresis or paralysis, tumours in the orbit, etc. The strabismus may be convergent (inclining inwards of the eye), divergent (inclining outwards), and superior and inferior (upward and downward). Sometimes it is so developed that the cornea is nearly concealed.

The treatment consists in dividing the tendon of the muscle that pulls the eye inordinately to one side.

Operation.—The animal must be placed latericumbent, the defective eye uppermost, and placed under the influence of a

general or local anæsthetic. The eyelids are kept separate by the blepharostat, the ocular conjunctiva is seized at the part where the tendon of the muscle to be divided is inserted, close to

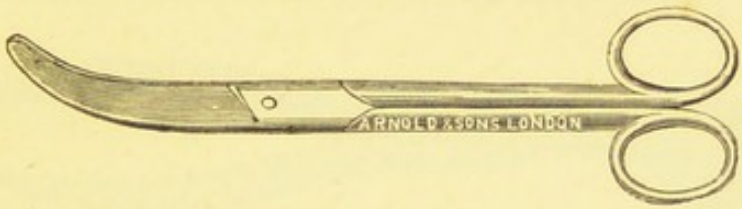

Fig. 612.—Strabismus Scissors.

the margin of the cornea, and cut through by curved scissors; an aneurism needle is passed underneath the tendon, which is divided by scissors. A bandage or compress may be worn for a day or two.

OPERATIONS ON THE AUDITORY APPARATUS.

With the domestic animals operations on the ear are comparatively few, and these are limited to the external ear, being chiefly for the relief or cure of traumatic affections or the removal of tumours. We know little of the affections of the middle ear in animals beyond traumatic lesions, which may give rise to suppu-

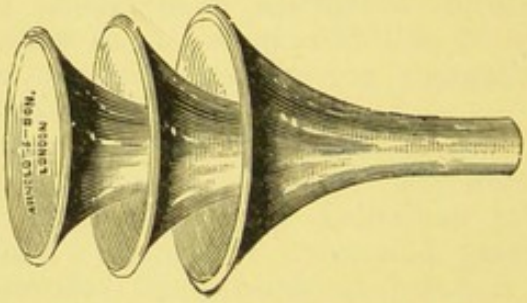

Fig. 613.—Otoscopes in Three Sizes.

rative otitis. The same may be said of the internal ear. Deafness is not at all uncommon in animals, and unless it is due to removable causes located in the external or middle ear, nothing can be done even to palliate this infirmity.

The hideous fashion of cropping Horses' ears that prevailed less

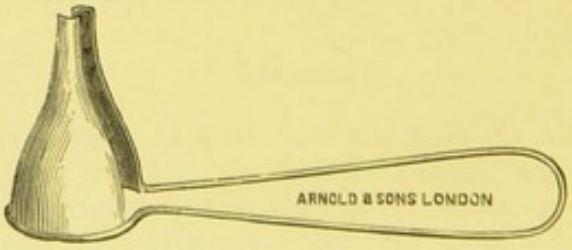

Fig. 614.—Stewart's Bivalve Otoscope.

than a century ago in this country, and of cropping Dogs' ears that still prevails, though to a diminishing extent, will not be expected to receive countenance in this work by a description of how the operation should be performed. Though this is done in nearly every other treatise on Operative Veterinary Surgery, especially those published on the Continent, yet as it is a perfectly useless

and disfiguring fashionable mutilation, belonging to the same category as the tail amputation of Horses and Dogs, lovers and admirers of these animals should refuse to recognise such displays of morbid taste, which are alike offensive to the eye of the fancier

Fig. 615.—Kramer's Bivalve Otoscope.

and injurious to the victims. Ear amputation has been a fertile cause of external and internal otitis, as well as deafness and even death.

The instruments required for the operative treatment of the ear

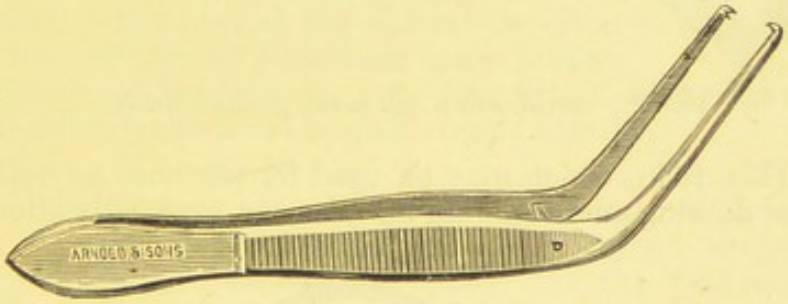

Fig. 616.—Angular Toothed Forceps for Dog's Ear.

are few. For the examination of the aural cavity a speculum (otoscope) may be employed, and especially in the Dog. This may be either a simple or a bivalve metallic speculum. The

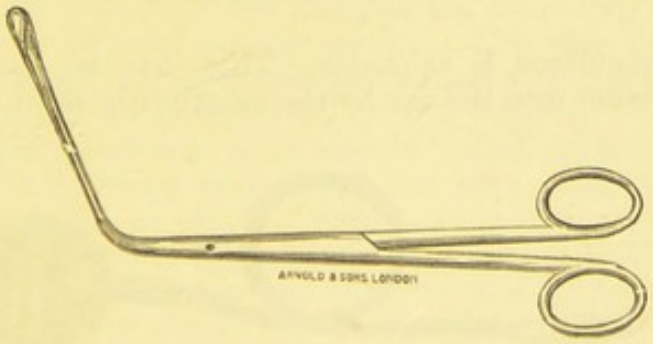

Fig. 617.—Angular Blunt Forceps for Dog's Ear.

former is a funnel-shaped tube, one end being widely expanded, the other being small for introduction into the ear. The other is a spring-handled (Fig. 614) or jointed instrument (Fig. 615) having a valve on each blade, and which can be widened or narrowed to

suit any ear; this expansibility obviates the need for several ordinary otoscopes. Forceps are also needed; these are, for Dogs, angular and toothed (Fig. 616) or angular and blunt (Fig. 617). An aural scoop is a most useful article (Fig. 618), and cannot well

Fig. 618.—Aural Scoop.

be dispensed with. For the removal of tumours and polypi nothing is so serviceable as a well-constructed snare, such as

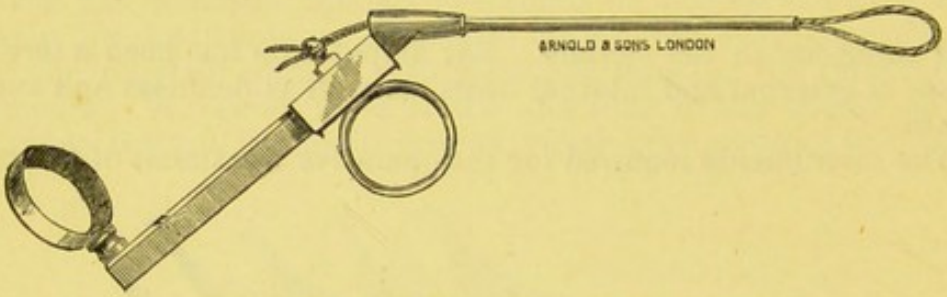

Fig. 619.—Aural and Nasal Snare (Blake's Model).

Blake's (Fig. 619), which may be used for the nose as well as the ear. For dusting medicaments into the ear, especially after opera-

Fig. 620.—Aural Insufflator.

tions, an insufflator is requisite. This may be constructed to blow the powder into the ear by the mouth (Fig. 620), or by means

Fig. 621.—Aural Insufflator with Indiarubber Tubing and Ball.

of an elastic ball (Fig. 621); for cleanliness the powder receptacle is made of glass. For washing out the ear a good syringe is likewise necessary; this is usually made of brass, with a bone or ivory nozzle (Fig. 622).

Wounds and Contusions of the External Ear.

The length of the ears in many animals, their situation and prominence, and their proximity to the bones of the cranium, predispose them to injuries of different kinds. Long-eared Dogs, especially water Dogs, are very liable to disease of the concha from the violent manner in which they shake their ears, and from

Fig. 622.—Aural Syringe.

the retention of moisture, dirt, and dust in them, which often gives rise to inflammation, suppuration, and ulceration. The concha and its muscles are also liable to be wounded and torn in fighting. The ears of the Horse are often wounded by nails, hooks, etc., or torn by bites from other horses.

Contusion of the concha may happen in several ways, and produce subcutaneous extravasation and abscess.

Wounds.

Wounds in this part do not differ much in their surgical treatment from wounds elsewhere, except for the presence of the conchal cartilage. When the skin only is involved, and rather extensively, so that there is a gaping wound, the hair should be removed and sutures employed. When the ear is torn through, as it frequently is, sutures are employed to bring the divided portions together. When the division has existed for some time and the edges of the wound have become hard, the same treatment can be successfully adopted if the margins are made raw and the skin on each side is brought into apposition. The skin on both sides should be sutured independently and pulled well over the cartilage, which ought not to be involved in the sutures. All wounds of the ear should be covered with aseptic collodion, and in the Dog, to prevent their being rubbed or the ears shaken, a securely fastened cap must be worn. Very often a net cap is preferable to one made of calico or canvas, as it is cooler, lighter, and less irritating. In the Horse an ear bandage may be worn (Figs. 175, 176), and the animal can be put on the pillar-reins.

Hæmatomata.

Blood tumours are very frequently met with on the concha of the Dog's ear, and are often troublesome to get rid of. They are produced usually by violent shaking when there is any irritation, or in getting rid of water in them when wet, as after swimming.

The tumour generally appears on the inner surface of the concha or flap of the ear; sometimes there is one on the outer or on both surfaces. The tumour is caused by rupture of small blood-vessels and extravasation of blood between the skin and cartilage. As the blood remains fluid the tumour is fluctuating, as if it contained water; it varies in size from the volume of a hazel-nut to that of a pigeon's or a hen's egg, and is situated at the most dependent part of the ear. It is at first hot, and is evidently painful, as the Dog objects to its being handled, and carries the head inclined to the same side. When the exciting cause is continued the condition is aggravated, and the inflammation may run on to suppuration. But this is not usually the case. If the contents are not evacuated the enlargement remains, for absorption is remarkably slow, and the tumour shows little sign of solidifying. When opened a quantity of dark red serum escapes, and there are clots of blood lying in the cyst.

The treatment consists in freely incising the tumour in the direction of its length, cleaning out all clots, and injecting into the cavity a 1 per cent. solution of chinosol; then adjusting, but not suturing, the lips of the wound, between which should be placed a small piece of aseptic wool or lint to prevent premature union. The ear must be reversed on the top of the head, so that the wound will be uppermost and outermost; on this surface must be placed some folds of aseptic gauze or lint, and a cap securely fixed over all to make gentle pressure, retain the dressing in position, and prevent the animal shaking, rubbing, or scratching the ear. The wound should be frequently dusted with boric acid or chinosol powder, and the easy pressure on the skin maintained, so as to insure its close relations with the perichondrium as soon as possible. If otitis coexists with the hæmorrhagic tumour, it ought also to be dealt with at the same time, as it is probably the cause of the Dog shaking its head. It must be remembered also that acariasis will cause this indication of irritation.

Abscess and Fistula.

Abscess of the pavilion of the ear is somewhat uncommon, and when it does occur it may appear on one or both surfaces. It is not without danger, the degree of this depending on the situation of the abscess. It should be opened as early as possible at its most dependent part, and the cavity kept well cleansed with antiseptic injections.

Fistulæ may be a result of abscess, or they may be due to the irritation set up by some foreign body. Not infrequently in the Horse, what is apparently a fistula is observed at the root of the ear, and is due to a dental cyst, which may contain two or more rudimentary teeth. But in other cases fistulæ may be caused by necrosis of the scutiform cartilage, and this, it appears, is more common in the Horse than in other animals. A careful examination can alone determine the cause, and then the cause must be removed.

The fistulous passages must be as freely opened as their situation will permit. If a dental cyst is the cause, then the contents of this must be removed, and the same in the case of fistulæ due to necrosed tissue. Plentiful injections of antiseptic fluids and cleanliness should complete the cure.

When the fistula depends upon the presence of necrosed scutiform cartilage and other means have failed, then the diseased portion is excised by making a V, a Y, or a cross-shaped incision over it, seizing it with denticulated forceps, cutting away the muscles that are inserted into it, and removing it. The wound is then sutured and treated as an ordinary wound.

Tumours.

Tumours in the external ear of animals are far from rare, and are found in Horses, Cattle, and Dogs in the form of warts, polypi, and sebaceous cysts; fibrous and sarcomatous tumours are, in addition, also found in this region. Polypi are most commonly met with in the ear of the Dog, and are generally the result of external chronic otitis. They are of variable size, and nearly always pediculated, which renders their removal easy. This is effected most readily by means of a snare (Fig. 619). Cleanliness and frequent syringing with warm water and antiseptic and astringent solutions complete the cure. Warts, if they have a very narrow base, may be removed in the same way, or they may be enucleated, cut off, or destroyed by escharotics. Other tumours must be excised by the knife or by scissors curved on the flat, though their total removal is not always possible.

Foreign Bodies in the Ear.

From its situation and formation the external ear affords ready admission to all kinds of foreign bodies, as well as to different species of insects and their ova. There are also often collections of the natural secretion of the ear, which form hard masses that act as foreign bodies and give rise to irritation, ofttimes to inflammation and other troublesome consequences. A careful examination generally discovers the offending bodies, and then the requisite steps are adopted to get rid of them. The aural forceps are most useful here, but it is generally advisable to employ injections of warm water and soap to wash out the ear; then the forceps, combined, if need be, with a curette, probe, and stylet, will effect the removal of most things from the auditory passage. Care, however, must be observed not to perforate the tympanum or invade the middle ear.

OPERATIONS ON THE FOOT.

Of all the domesticated animals the Horse is the one whose feet are by far the most interesting and important, not only from an anatomical and physiological, but also from a pathological and surgical point of view. In fact, the great and universally acknowledged utility of this animal largely depends upon the perfect construction, organisation, and soundness of its feet, for the demands made upon them are often severe and varied. To encounter these demands—which are generally so astonishingly met—the constituent parts of the foot are wonderfully and beautifully contrived and related to each other so as to combine a certain degree of rigidity with much elasticity, lightness with strength, and durability with the most delicate structure.

From the severe tests to which they are exposed and the heavy strain put upon their tissues and mechanism—tests and strains generally out of all proportion to their adaptability—the Horse's feet are, as might be expected, liable to more diseases and accidents of a more or less serious character than are those of all the other animals.

Domestication is doubtless responsible for many of the ills from which this animal's feet suffer, the artificial conditions of life it entails largely conducing to alterations in texture, structure and form that predispose to deformity and disease. To such an extent do these conditions operate that there is probably no exaggeration in the statement that of all the diseases and accidents to which Horses are liable, and which have to be medically or surgically treated, more than 50 per cent. of the animals affected with them are incapacitated by disorders and injuries to the feet.

Operations on the feet of the Horse are therefore numerous and frequent, and demand special skill and address for their successful performance and after-treatment, owing more particularly to the vascular and nervous tissues being enclosed in a more or less rigid envelope—the hoof. The extraordinary vascularity of the Horse's foot and the extreme sensitiveness of the vascular tissues entering into its composition render the surgery of this organ more important and exacting than that of perhaps

any other part of the body, mainly owing to the nature and shape of the hoof. The readiness with which septic infection takes place there is doubtless due to the highly vascular condition of the tissues—even the bones—contained in this comparatively unyielding capsule, and the severity of the inflammatory processes, as well as the agonising pain the animal suffers while these are going on, is as certainly due to the same cause. For this reason it also is generally imperative that judicious surgical intervention in diseases and injuries of the foot be prompt and effective if serious results are to be averted and the usefulness of the animal to remain unimpaired.

Anatomy.—A few remarks on the surgical anatomy of the Horse's foot will not be inappropriate before entering upon a description of the various operations practised upon it. These remarks will apply more particularly to the anterior or 'fore' foot, as the structure of the fore and hind feet is much the same, though the functions and shape of the two differ considerably, and this difference largely influences the production and course of disease in them. The fore foot is larger and more circular, the sole is less concave, and the frog is much more developed

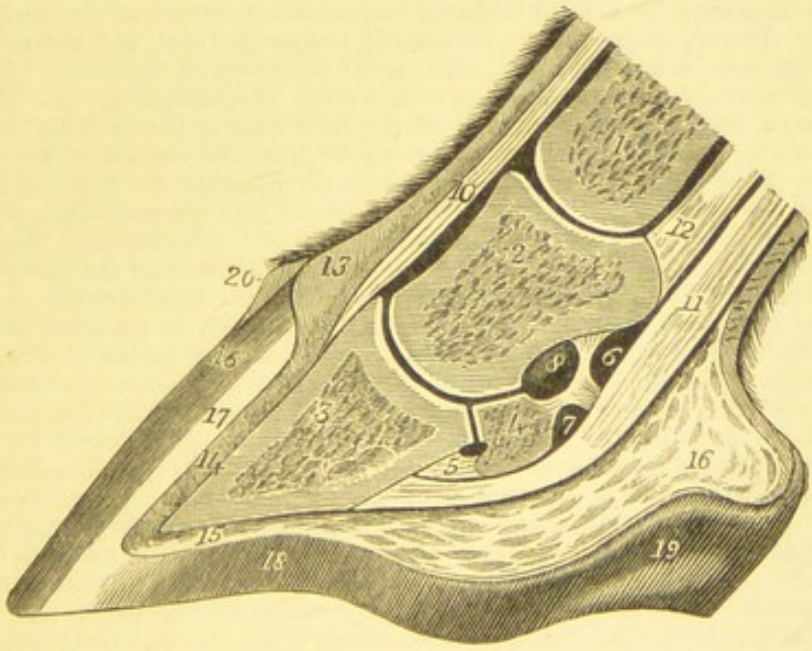

Fig. 623.—Median Antero-posterior Section of the Horse's Foot.

1, First phalanx; 2, second phalanx; 3, third phalanx; 4, navicular bone; 5, interosseous ligament; 6, inferior cul-de-sac of the great sesamoidean bursa; 7, superior cul-de-sac of the small sesamoidean bursa; 8, posterior cul-de-sac of the synovial articular capsule of the pedal-joint; 10, extensor tendon of the foot; 11, perforans tendon; 12, sesamoid ligament; 13, coronary cushion; 14, podophyllous or laminal tissue; 15, vascular sole or velvety tissue; 16, plantar cushion; 17, keraphyllous tissue; 18, horny sole; 19, horny frog; 20, periople.

than that of the hind foot, which is narrower and almost oval in outline. The wall of the fore foot is more oblique than that of the hind foot, which is nearly vertical, and the elastic apparatus of the former is greatly more developed than that of the latter. These differences are chiefly due to the difference in function of the fore and hind limbs and feet, the first being weight supporters and the latter weight propellors.

The foot of the Horse, then, is constituted by the thick and solid envelope just alluded to—the hoof, which contains a number of very dissimilar parts.

The hoof itself is described as composed of four portions : (1) The wall or crust which forms four-fifths of this horny envelope, and is prolonged backwards and inwards to constitute what is commonly termed the 'bars'; (2) the coronary frog-band or periople, a thin band of rather soft horn, in reality a continuation of the frog, and which extends around the upper part of the wall ; (3) the sole, which forms the floor of the horny box, and is enclosed in or circumscribed by the lower border of the wall ; and (4) the frog, disposed between the inflections of the extremities of the wall, and situated at the posterior part of the hoof, completing its floor and its circular outline. The structure of the hoof is fibrous, the fibres passing in the direction of the weight—more or less vertically, and the fibres themselves are composed of epidermic or horn cells, arranged concentrically around each fibre.

The parts contained within the hoof are: (1) The important tegumentary vasculo-nervous membrane that at the upper part of the foot covers an elastic ring or cornice—the coronary cushion, which is a continuation of the plantar cushion, and extends in a circle around the front and sides of the foot ; it is lodged in a corresponding concavity on the inner and upper part of the hoof-wall. The membrane is here covered with myriads of minute papillæ that form the horn fibres of the wall, its entire surface being keratogenous. From this prominence the membrane is continued downwards in the form of plates, laminæ, or, as they are more appropriately termed, 'podophyllæ,' numbering between 500 and 600, contiguous and parallel to each other, passing from the cornice above to the lower margin of the foot, and covering not only the front and sides of the latter, but also extending for a short distance on the inner surface of the wings of the os pedis. These podophyllæ are widest and longest in front, and decrease in size as they proceed backwards ; from their sides are given off numerous leaves that pass from above downwards and terminate with the parent leaves. The podophyllæ serve for the firm attachment of the hoof wall to the os pedis, while permitting of the growth of the wall downwards from the surface of the coronary cushion. They interleave with similar leaves (*keraphyllæ*) the cover of the inner surface of the wall. From the lower margin of the foot the membrane covers the sole and plantar cushion, where it is termed the 'velvet membrane,' and is here again studded with countless papillæ that originate the fibres of the horny sole and frog. Not only does this membrane serve to attach the hoof securely to the foot bone, but it secretes the horn, and serves as a matrix for the immense network of minute bloodvessels that give it a fleshy appearance by means of a stratum of fibrous tissue, sometimes designated the *reticulum processigerum* and the *plantar reticulum*. (2) The hoof also contains the elastic apparatus that compensates for the rigid box in which the foot is enclosed, and aids the guarding of the delicate sensitive structures from harm while rendering the Horse's footsteps springy and light. This apparatus is constituted by the plate of fibro-cartilage on each side of the foot, the plantar cushion placed immediately above the horny frog into which it fits, and composed of fibrous tissue with much adipose tissue in its interspaces, and the coronary cushion already mentioned, which is similar in structure to the plantar cushion. (3) The terminal portions of the flexor and extensor tendons of the foot. (4) The navicular bursa, which favours the gliding of the perforans tendon over the infero-posterior surface of the navicular bone, the tendon being here a rather wide expansion named the plantar aponeurosis. (5) The lower end of the os coronæ, the os pedis, and the navicular bone, these three forming the osseous basis of the foot. (6) The five ligaments that unite these bones. (7) The synovial capsules that complete the joints formed by these bones. (8) The terminal branches of the digital arteries, forming a rich and beautiful arterial network over the entire surface of the foot, after channelling the substance of the pedal bone. (9) Numerous venous plexuses, in relation with the fibrous layer or stratum vasculosum, which, converging to the upper margin of the foot in increasingly larger vessels, constitute the beautiful capillary networks and plexuses seen there, and more particularly towards the upper border of the lateral cartilages, where they ultimately form the digital veins. (10) What must be a very developed lymphatic organisation, though its arrangement has not yet been thoroughly elucidated ; the vessels are extraordinarily fine and tortuous in the stratum vasculosum, but as they penetrate the papillæ and even the secondary laminæ they become yet more attenuated. (11) The terminal divisions

of the plantar nerves, which are abundantly distributed in the stratum vasculosum and stratum mucosum, as well as in the stratum phyllodes and stratum papilla. Every papilla on the surface of the coronary cushion, on the plantar surface as well as on the plantar cushion, has at least one nerve-ending, while the laminæ are also well provided with them. Their great abundance everywhere in the stratum vasculosum explains the extreme sensitiveness of the Horse's foot and the intense pain the animal experiences when the vascular tissues are injured and inflamed, and more especially when they are much tumefied, as the inelastic box in which they are imprisoned does not permit increase in volume of its contents; consequently the nerve-endings are severely compressed. This compression also explains the rapidity with which gangrene occurs in injury and inflammation of this organ.

Mention must not be omitted of the presence of sudoriferous glands in the plantar cushion, in immediate proximity to the upper surface of the horny frog. They have not been discovered in any other part of the foot contained within the hoof.

The hoof itself is composed of four parts—wall, sole, frog and periople (sometimes designated the 'coronary frog-band'). The wall is, perhaps, the most important division of the hoof, as it sustains nearly all the weight when the foot is on hard ground, and the horn of which it is made up is very dense externally to sustain wear, but it becomes softer as it gets nearer the podophyllous tissue. Its growth is continuous from the coronary cushion, and the fibres of which it is composed proceed in an oblique direction downwards; it is related in the most intimate manner to the podophyllæ through the medium of the horny leaves (keraphyllæ) on its inner surface. At the heels it is reflected inwards to form the bars which continue the close connection of the wall with the os pedis. The horny sole is not so dense as the wall, and its fibres break off when they have attained a certain length, coming away in flakes. It is joined by its outer circumference to the inner side of the lower margin of the wall by a narrow band of lighter coloured and softer horn—the white line. The sole is thickest at its periphery and thinnest in the centre. The frog is constituted by the softest horn of the hoof, and fits into a triangular space in the posterior part of the sole, between the bar, from which it is separated by a space at each side of the lateral lacunæ or commissures. There is also a space or cleft in its posterior half—the middle commissure or lacuna. Pyramidal in shape, its apex and body cover the plantar aponeurosis and navicular bursa and bone, a very important region of the foot from a surgical point of view. The periople or coronary frog-band is merely a continuation of the horny frog around the upper part of the wall, and serves to protect the newly-secreted horn from evaporation.

In order to establish the prognosis of the traumatic lesions that are met with in the different regions of the foot, as well as to execute with certainty the operative intervention these lesions necessitate, it is indispensable to know exactly the topography of these regions. Cadiot and Almy have described them very lucidly, and we will follow their description.

At the anterior part of the foot are found on proceeding from without inwards: (1) At the coronet (*a*) the skin of the coronet, the periople and the wall; (*b*) the cutiduris and the podophyllæ; (*c*) the expansion of the anterior extensor of the phalanges and the reticulum processigerum, as well as the small bursa between the extensor pedis tendon and the pyramidal process of the os pedis; (*d*) the second phalanx, the anterior cul-de-sac of the synovial capsule of the foot joint, and the third phalanx. (2) Lower, between this first zone and the point of junction of the wall and sole: (*a*) the wall; (*b*) the podophyllous tissue; (*c*) the reticulum processigerum; (*d*) the phalanx. It is to be remarked that in front the synovial capsule of the pedal joint is protected by the extensor tendon, the subcutidural fibro-connective tissue layer, the coronary cushion, and the upper part of the concavity into which this cushion fits; that at its superior limit, in front of the margin of the os coronæ, its cul-de-sac is only covered by the tendon of the extensor, the subcutaneous layer, and the skin.

On its lateral aspects, at the quarters, there are, as in front, a first layer formed by the skin, the coronet, the periople, and the wall, and a second constituted by the coronary cushion and the podophyllous tissue. Lower down there are found in the greater part of this region: (*c*) the lateral cartilages; in front

(*d*) the lateral ligaments of the pedal articulation and the lateral cul-de-sac of the synovial capsule; (*e*) the inferior part of the second phalanx, the upper border of the third phalanx, and the navicular bone; behind there is the plantar cushion, and in the inferior moiety (*c*) the reticulum processigerum; (*d*) the wing of the os pedis; and (*e*) the plantar cushion, the plantar aponeurosis, and the small sesamoidean sheath.

In the posterior region are found, immediately above the frog: (*a*) the skin; (*b*) the plantar cushion; (*c*) the plantar aponeurosis; (*d*) the synovial cul-de-sac in the hollow of the pastern; (*e*) the second phalanx and the navicular bone. On each side, at the heel, (*b*) is the lateral cartilage; and at the part covered by the base of the frog (*b*) are the velvety tissue; (*c*) the coronary cushion; (*d*) the plantar aponeurosis; (*e*) the sesamoid sheath and the navicular bone.

The inferior region of the foot is conventionally divided into three zones: First, the *anterior*, circumscribed in front by the parieto-solar commissure, behind by a line perpendicular to the axis of the foot and at a tangent to the point of the frog; second, the *posterior*, limited behind by the summit of the bars and the base of the frog, and in front by a transverse line tangent to the anterior angle of the median lacuna of the frog; third, the *middle*, comprised between the preceding two.

In these three zones the hoof-horn is lined by the velvety tissue. The other planes are: in the anterior zone (*c*) the plantar reticulum; (*d*) the phalanx; in the posterior zone (*c*) the plantar cushion; (*d*) the plantar aponeurosis; (*e*) the small sesamoid sheath and the posterior border of the navicular bone. In the middle zone, first, in its median portion (*c*) the plantar cushion; (*d*) plantar aponeurosis; (*e*) the small sesamoid sheath; (*f*) the posterior part of the plantar surface of the phalanx, the interosseous ligament, and the navicular bone; second, on the sides the wings of the phalanx and the lateral cartilages.

Influence of the Hoof in Injuries and Diseases of the Foot.

The hoof, to a considerable extent, controls the operative procedure required to be adopted for the relief or cure of disease or injury to the horse's foot, as it also largely influences the course and termination of the traumatic and pathological disorders to which this organ is liable, and in all operations this hard and dense capsule has to be dealt with. Traumatic lesions are much more frequent than those arising from disease, and they are generally more amenable to prompt treatment, though, as septic infection very readily occurs, they are the most serious in their consequences if not quickly attended to. Suppuration and inflammation proceeding to gangrene produce the direst results when they are not speedily combated by removal of the imprisoning hoof-horn. The pain is extreme, as is the lameness, and traumatic fever runs higher than that from injury to any other part, while complications, even extending to distant organs or regions, are not infrequent sequelæ. Death is sometimes the consequence of an apparently trifling injury to the foot, and often appears to be due solely to the intense agony the animal experiences, and which it expresses by its movements, its attitudes and general behaviour.

It is therefore of the utmost importance that the veterinary surgeon's services be enlisted early in cases of injury or disease, the seat and nature of which he must ascertain before he can proceed to treatment. This investigation is sometimes easily carried out; at other times it is difficult, and unless great care and judgment

be exercised mistakes are liable to be made, and the chances of a favourable recovery gravely compromised. The action and attitude of the animal in some cases afford an indication of the seat of the mischief; then there is increased temperature of the foot if no external lesion is evident, and there may be redness of the skin if it is not pigmented; in some cases there may even be swelling in the vicinity of the coronet or heels, and percussion of the hoof at the spot where the damage is will cause immediate manifestation of increased pain. Often the injury is caused by puncture of a nail in shoeing, or a nail or other sharp body picked up while travelling, which may enter the sole or frog, penetrate to the vascular tissues, and remain there; therefore it is necessary that the most careful and minute examination be made so as to ascertain the cause and the extent of the injury.

Examination of the Foot.

Among the measures resorted to in order to discover the seat of injury in the foot is percussion of the hoof. This percussion is applied by tapping gently with a light hammer or special percussor the wall or sole; this is tolerated until the injured part is

Fig. 624.—Compression Forceps, for ascertaining the Seat of Pain in the Horse's Foot.

reached, when the animal immediately shows signs of pain. In percussing the wall, if it is a fore foot, the opposite fore foot is

Fig. 625.—Another Pattern of the Same.

held up by an assistant; if it is a hind foot, the fore foot of the same side is held up. The percussion should be light, and methodically applied.

Compression is also usefully applied with the same object, the instrument employed being the shoer's pincers or a special com-

pression forceps (Figs. 624, 625). In using this the foot is held up, and the examiner, opening the jaws of the instrument, seizes the margin of the hoof, including a considerable portion of the sole and wall, and makes a series of firm squeezes all round it from heel to heel; pressure on the injured part at once produces a manifestation of pain. The frog can also be included in this testing.

The seat of pain having been ascertained, in nearly all cases horn must be removed in order to get rid of any foreign body that may be causing pain, or to relieve the inflamed and tumefied tissues from pressure and constriction, as well as to give exit to any fluids that may prove prejudicial to the parts with which they are in contact; for these fluids cannot find their way through the horn, and if it be pus that is imprisoned, it may burrow widely and produce extensive disintegration and mischief before it finds vent at the summit of the hoof.

Instruments for Operations on the Hoof.

Various instruments are employed for the removal of horn. One of these, and the one that is most necessary for removing the hard surface-fibres of the wall, is the shoer's coarse rasp.

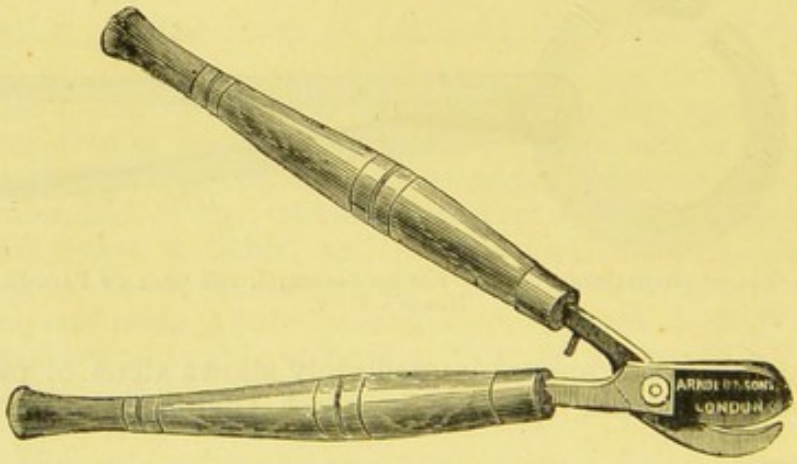

Fig. 626.—Hoof-cutter.

This and the hoof-cutter (Fig. 626) is also employed to shorten the wall at its lower margin. Then there is the shoer's draw-

Fig. 627.—Straight-handled Drawing-Knife.

ing-knife, which may have either a double or a single edge, or the straight-handled and straight-bladed drawing-knife with a double edge (Fig. 627). When the rougher and stronger horn has

been taken away by these, then, for the purpose of making thin grooves or excavations and seeking out foreign bodies, a small knife named a ' searcher ' is used (Fig. 628). Various other knives are resorted to in dealing with the hoof in the course of operations of different kinds (Fig. 629).

Fig. 628.—Hoof Searcher.

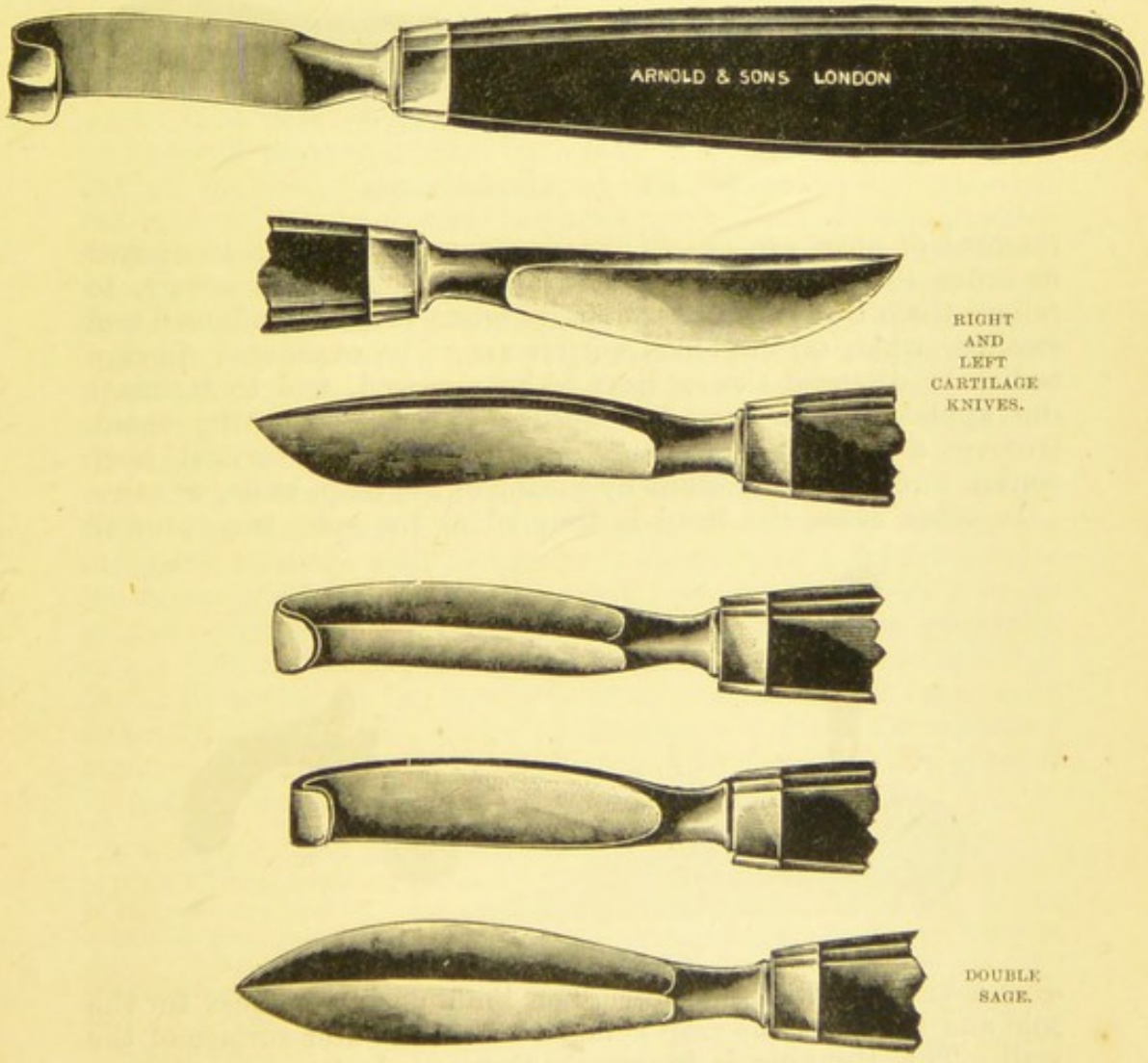

Fig. 629.—Different Kinds of Hoof Knives.

Saws are also necessary in some operations to make incisions in the hoof (Figs. 630, 631), and even hoof gimlets have been devised to bore through the horn and allow the escape of imprisoned pus or serum.

OPERATIONS ON THE HOOF.

Operations on the hoof are undertaken for the correction of deformities in the lower parts of the limbs, and in the treatment of injuries or disease of it. In orthopædic surgery the management of the hoof often plays a most important part in rectifying defects and distortions in the direction of the limbs, while the capsule itself affords support or means of attachment of apparatus devised for that purpose.

For the relief or cure of disease, and in the treatment of injuries to the foot, operations, chiefly consisting in the judicious

Fig. 630.—Hoof Saw, Straight Border.

removal of horn, are nearly always necessary. Horn is excised in order to ascertain the condition of the parts it covers, to relieve them from injurious pressure when they are inflamed and swollen, when serum, blood, or pus are to be evacuated, foreign bodies or diseased tissues have to be removed, and to facilitate the application of remedial agents to parts requiring them. Grooves are sometimes deeply cut in the wall in vertical, horizontal, or oblique directions by means of the rasp, knife, or saw.

In other cases the horn is thinned at the sole, frog, or wall

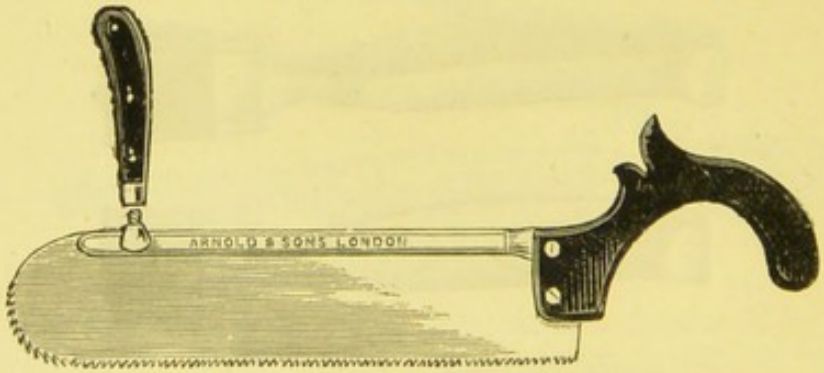

Fig. 631.—Hoof Saw, Convex Border.

over a small or wide surface. The knife usually suffices for the sole and frog, but the rasp is needed for the outer surface of the wall. This thinning is frequently the prelude to serious operations, and is usually continued until the white soft horn contiguous to the keraphyllæ is reached, and is rendered so thin that it readily yields to the pressure of the finger. Care must be taken, however, in thinning the wall towards the coronet not to cut so deep as to injure the long papillæ that, arising from the surface of the coronary cushion, are lodged in the upper end of the horn

fibres. In thinning the wall the surface operated on is usually wider above than below, and the sides of the thinned space are bevelled, so as not to leave a thick abrupt margin. The extent to which the horn is thinned will depend upon circumstances.

The avulsion of a portion of the hoof-horn is often rendered necessary in cases of disease, but it is such a painful operation that unless subcorneous effusion or suppuration has already more or less detached the horn, the animal should be placed recumbent, and a general anæsthetic administered.

To remove a section of the wall it is usual to well thin the horny sole at the corresponding part; then two grooved lines are made in the wall at the limits of the part that is to be torn away, the hard surface of this having been already removed by the rasp. The lines should not be quite vertical, but slightly converging as they approach the margin of the hoof. The grooves ought to be wide—from a fourth to half an inch, and their external side should slope somewhat outwards. Care must be taken not to cut into the podophyllous membrane. The two grooves are united at the bottom by a third, and they are excavated as close as possible to the keraphyllæ without drawing blood. Isolation of the piece is now completed by means of a strong, short scalpel or one of the straight-bladed hoof-knives already described (Fig. 627), which, held firmly in the hand, the thumb resting on the wall, is pressed by its point through the soft horn remaining at the bottom of the grooves; but the vascular membrane beneath must not be deeply wounded. The piece of horn has now to be detached, and this may be accomplished by pushing the blade of a chisel underneath one corner of it at the bottom of a groove, resting the instrument on the wall alongside the groove as a fulcrum while the piece is pressed upwards to some extent to enable it to be seized by pincers or strong pliers. The piece is now gradually raised by a series of jerking up-and-down movements until it is detached as far as the coronet, when the movements are made laterally and steadily, so as to disengage it from the coronary cushion, which must be pressed upon with the fingers to prevent its being lacerated.*

* When portions of the hoof-wall have been lost by accident or operation, it requires a considerable time to repair the loss by a new secretion from the surface of the coronary cushion, and until this is completed the animal may not be utilisable, because of the difficulty of attaching a shoe to the hoof. To overcome this difficulty various devices have been resorted to. The one that has been most successful is the employment of guttapercha to fill up the breach in the wall. This material can be prepared in such a way that it will adhere with the utmost tenacity to the horn, and become so solid and hard that it will sustain the perforation and the strain of the shoe-nails upon it as perfectly as the hoof-wall itself.

To prepare it, first a cementing solution must be made by cutting some guttapercha into thin slices, which are put into a bottle with a glass stopper, along with sulphuret of carbon, the proportion of these ingredients being about twenty-five of guttapercha to one hundred of sulphuret of carbon. They must be shaken now and again until the guttapercha is completely dissolved. The bottle must be closely stoppered, and then the preparation will keep for a long time. When the solution is required for use the bottle must be well shaken

Avulsion of the sole is carried out in a similar manner. This was a favourite operation of the farriers of a former age, and was practised for all kinds of lameness which were supposed to have their origin in the foot. But 'unsoleing' or 'drawing the sole,' as it was termed, is now a somewhat rare operation, though in certain cases of disease it has its utility; but unless it is already almost detached by effusion the operation should not be attempted before the animal is rendered insensible by an anæsthetic, as it is excruciatingly painful. The abominable cruelty perpetrated so frequently by unfeeling farriers in the operation of unsoleing would not be tolerated nowadays. The Horse is, of course, recumbent. The sole and frog are pared thin—to about one-eighth of an inch; a groove is made with the drawing-knife around the margin of the sole and close to the white line. This groove should be from one-fourth to half an inch wide, and must extend around the entire sole and through the bars, which should have been well thinned; it must be sufficiently deep to allow the straight-bladed knife to pass through the pellicle of horn remaining at the bottom. This is done by commencing at the heel that is lowermost, the knife being held firmly in the hand, the point inserted in the groove, and the thumb resting on the sole, so as to prevent the knife wounding the velvety tissue. The sole, having been in this way separated from the wall from heel to heel, is raised at the front part by the chisel, which has its leverage on the border of the wall, until pincers or pliers can firmly seize it. An assistant holds these, and, by a succession of to and fro movements of the sole, detaches it, while the operator, by means of the chisel, raises it all round from heel to heel. In this way the sole and frog ought to be completely detached without the vascular tissue being much, if at all, damaged. When only a portion of the sole is to be removed, this is isolated from

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so as to render it homogeneous, and if it is too thick some more sulphuret of carbon must be added. Secondly, some guttapercha to fill the breach is prepared by heating it in a warm bath or in warm water at a temperature of 96° to 100° Fahr. When softened it can be moulded with the fingers into a suitable shape and kept at the same temperature until it is applied.

The part of the hoof to which it is to be fixed is to be well cleaned and rasped; then the lower part of the breach is filled up with the softened guttapercha, so as to make the quarters of the hoof the same in height. A shoe is then to be put on. The wall is now covered with the solution, which is put on with a brush, and a layer of the softened guttapercha is placed on this, and it is made level and fixed by means of an iron at a dull red heat—not hot enough to make the gutta burn. This layer is covered by some turns of wide tape, the ends of which are fixed on the gutta. Another layer of the gutta is laid on in the same way until the breach is completely filled up and the surface is on a level with that of the wall. The hot iron is passed also over this surface to render it quite flat and adherent. The foot is now put into a bucket of cold water in order to make the gutta solidify. When quite cold, which it may not be for one or two hours, the iron may again be passed over the surface to make it quite smooth and level.

Into this mass of gutta nails may be driven and clenched as in the hoof-horn, so that not only is the shoe firmly retained, but the unsightliness of a defective hoof is got rid of.

the adjacent parts by means of grooves, as in the avulsion of pieces of the wall, and torn off in the same manner.

In these avulsions of the hoof-horn, if much hæmorrhage is anticipated, a tourniquet should be applied to the limb just above the fetlock joint.

Fissure of the Hoof, Sand-crack.

Fissure of the hoof, commonly known as 'sand-crack,' is far from uncommon, the splitting or fissuring taking place in the direction of the wall fibres. The accident usually occurs at the inside or outside quarter of the front hoofs and in front of the hind ones. The separation between the fibres may be merely on the surface, when the sand-crack is designated *superficial*, or pass completely through the thickness of the wall and involve the sensitive tissues within—deep sand-crack. Following the direction of the fibres they are usually *rectilinear*, when they occur at the upper part of the wall only they are *coronary*, when confined to the lower region they are *plantar*, and when extending from top to bottom they are *complete*. They may also be *simple* or *complicated*.

Though accidentally produced, it would seem, from observed facts, that there is a hereditary predisposition to this splitting of the hoof.

Simple sand-crack, especially if it is at the lower part of the wall, rarely causes lameness; but if it occur at the upper part and extend to the sensitive tissues, then the pain and lameness may be great, especially in movement, as then the podophyllæ in the vicinity are torn, stretched, and squeezed by the alternate opening and closing of the fissure. Dirt and dust and other foreign matter also obtain access, and bleeding is followed by tumefaction and suppuration, and after a time by swelling at the coronet. When the sand-crack is complete and treatment is not adopted, if the animal is continued at work, then the case becomes complicated with gangrene of the vascular tissue and caries, or even necrosis, of a portion of the pedal bone. Then the lameness is extreme. These complications occur most frequently in the hind feet of heavy draught horses.

When the fissure is simple and there is little or no lameness, all that is required to be done is to keep the sides of it close together, and hasten a new growth of horn from the coronet. To bring the sides together and prevent movement in the fissure, the hoof may be bound firmly by tarred twine passed closely around it from top to bottom, after the part has been well cleaned and dressed with Stockholm tar. If the fissure is at the toe, a shoe with high clips at each side of this region greatly assists the immobilization. To expedite the growth of sound horn the inunction of Stockholm tar, or any stimulating ointment, such as cantharides, applied to the skin of the coronet immediately above the fissure is usually sufficient; but a more prompt result

is obtained by drawing one or two horizontal lines with the actual cautery at the junction of skin and horn, close to the crack.

When the fissure is deeper and more complete, the tarred twine will not be so likely to prevent movement, and then recourse may be had to clamping the sides, so as to bring them more firmly and closely together. This is done by passing through the hoof-wall, at a short distance from the fissure, nails, wire, or clamps, which can be tightened as much as is required. For this purpose holes are drilled through the wall with a drill-stock (Fig. 632) across the fissure, but not penetrating too deeply,

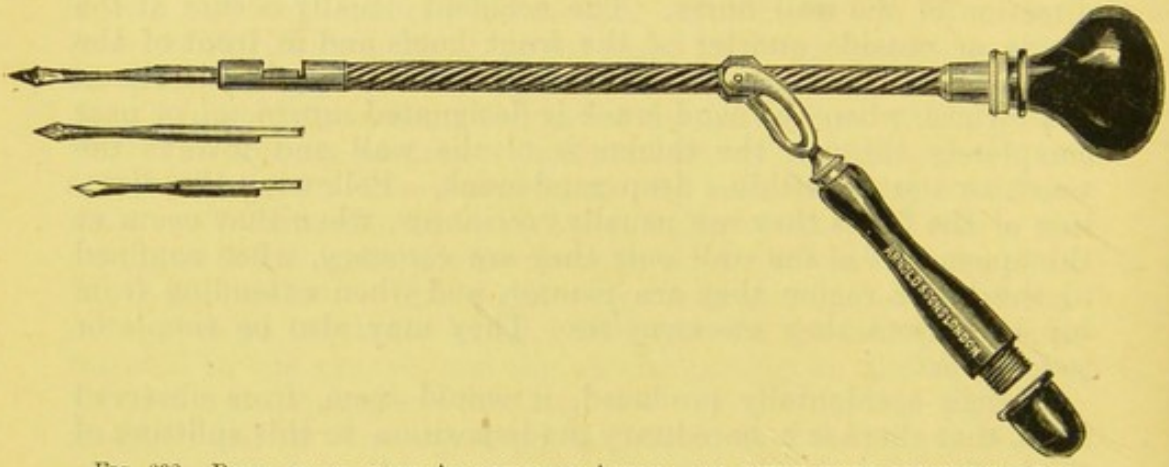


FIG. 632.—DRILL-STOCK, WITH ARCHIMEDIAN ACTION, AND FITTED WITH DIFFERENT SIZED DRILLS TO BORE HOLES IN THE HOOF-WALL.

and nails, soft iron pins, or pieces of wire, are passed through, and the ends brought together and twisted to the requisite tightness by pliers; these ends are then beaten level on the surface of the wall. The number of nails or pins required need never exceed three, and in some cases one, well placed and tightened, will suffice. The upper one should be at least three-fourths of an inch or one inch from the coronet.

Clamps are still more easily applied and are as useful. They are merely small pieces of strong iron or steel wire, the ends of which are pointed and bent round. A small indentation is burned into the hoof-wall on each side of the fissure by means of an iron (Fig. 633), which makes the two indentations at the same

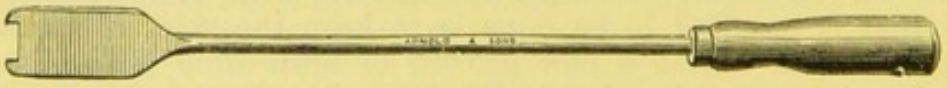


FIG. 633.—IRON FOR BURNING INDENTATIONS IN HOOF-WALL FOR INSERTION OF CLAMP.

time. Into these depressions a clamp is placed, and the ends of this are pressed sufficiently towards each other to close the fissure, this pressure being effected by means of special forceps (Fig. 634).

Instead of this clamp there is sometimes employed a divided one, operated upon by a screw in the middle, which brings the

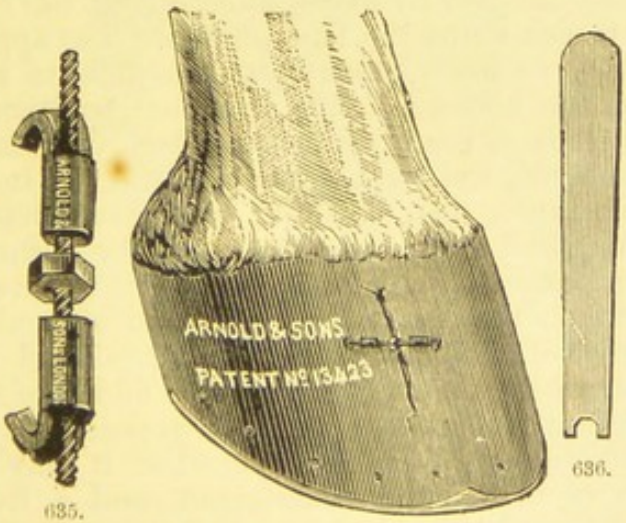
two portions as close as may be required by means of a nut and spanner (Figs. 635, 636). This, though it possesses some advantages, is clumsier on the hoof, and becomes entangled among litter in the stable.

These clamps should be of different sizes to suit small, medium, and large hoofs. After they are inserted it is advisable to cover the fissure with something that will exclude moisture and dirt

FIG. 634.—SAND-CRACK FORCEPS AND CLAMP.

(such as the guttapercha solution described in note, p. 671, or mastic composed of one part sal ammoniac and two parts of guttapercha); this also tends to make the clamp more secure. If more than one clamp is required, they should not be placed nearer to each other than three-fourths of an inch.

It is considered advantageous to prevent contact of the lower border of the wall with the shoe at the part corresponding to the



635. 636.

FIG. 635.—SCREW CLAMP FOR SAND-CRACK.

FIG. 636.—SPANNER FOR SCREWING UP SCREW CLAMP.

fissure, and this can be most readily effected by removing some of the border of the wall.

In many cases the Horse is capable of immediate work.

In severe and chronic cases, when there is much lameness and perhaps suppuration, and relief is not afforded by paring the horny sole in front, bathing and poulticing the foot, there is reason to suspect injury to the podophyllæ and even more serious lesions; several procedures may be adopted to relieve the com-

pression exercised by the horn. One is to make a groove on each side of the fissure, but a little distance from it; the grooves are to pass obliquely downward, converging towards and joining each other near the bottom of the wall. The horn between these two lines is to be well thinned, but the vascular tissue is not to be exposed. Fomentation and poulticing may now again be tried for a few days longer, and if the lameness persists it will be necessary to proceed to avulsion. The grooves already made are cut deeper until the vascular tissue is nearly reached; the separation of the triangular piece of horn between them is completed by cutting through the thin pellicle of horn at the bottom of the grooves, and the piece is torn off in the manner already described.

Now the extent of the damage can be ascertained, and it may be necessary to dissect away dead tissue, to open an abscess, remove necrosed fibres from the extensor pedis tendon, and even scrape the pedal bone itself to get rid of caries.

In performing such a painful and somewhat tedious operation as this is, the animal must be recumbent and receive an anæsthetic.

The operation completed, the surface of the wound is dressed with an antiseptic solution and well covered with boric powder, enveloped in antiseptic gauze, and moderately firmly bandaged. The foot may be placed in a leather boot, or swathed in a piece of calico or canvas, which is supported externally by bands of plaited straw passing across the sole and brought up around the foot, where they are tied by pieces of cord (Fig. 637).

A word as to poulticing the Horse's foot. The application of a warm poultice is in many cases most beneficial in allaying pain and softening the hoof-horn, but continual poulticing for some days has generally a most pernicious effect in diminishing the vitality of the living tissues, especially if the poultice is made of an alkaline substance, such as bran. When suppuration is going on this softening and diminished vitality of the tissues allows the more rapid formation of pus, and permits it to spread, burrow, and form fistulæ; therefore the application of poultices should be limited as to duration, and their effect should be carefully observed. An antiseptic should always be added to them.

After the operation just described the dressing may be allowed to remain undisturbed for some days, when it may be removed, the condition of the wound ascertained, and a fresh dressing applied. The wound soon cicatrises, and the podophyllæ become covered with horn of their own secretion; but until this takes place the new wall-horn thrown out from the coronet must not be allowed to descend. The formation of podophyllous horn can be stimulated by the application of Stockholm tar, and when it has reached a certain thickness the space may be filled up with guttapercha in the manner already explained. Then the Horse may be able to resume work, the coronet being stimulated by the tar to push down the wall growth.

Quarter-crack—i.e., fissure in the wall of the fore-foot hoof, at the inside quarter, rarely the outside one—is, perhaps, most

frequently observed in the lighter breeds of Horses, especially those with contracted hoof or low heels.

It is very often troublesome, and gives rise to lameness, and the same serious consequences as result from toe-crack in the hind foot. But the fissure cannot be clamped owing to the thinness of the wall in this region. When not serious a groove made across it at its upper third, about two and a half inches long and one-third of an inch wide, prevents movement of its borders. This groove may be made by the drawing-knife, but a half-round rasp is preferable. Or the borders may be thinned as near to the podophyllæ as possible without wounding them. Or two con-

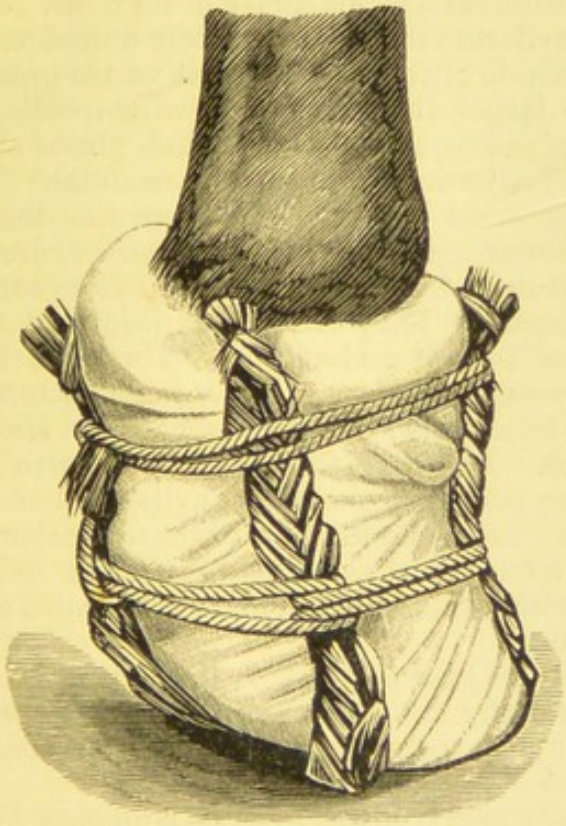


FIG. 637.—HORSE'S FOOT DRESSED AND ENVELOPED IN CALICO OR CANVAS SUPPORTED BY PLAITED STRAW BANDS.

verging grooves may be made, as in toe-crack. The wall should be lowered at its border at the part corresponding to the fissure, so that it will not come in contact with the shoe. The coronet should be stimulated to increased secretion, either by one or two short lines made by the actual cautery immediately above the fissure, or by the application of a mild vesicant. The crack may then be covered with a thin layer of tarred tow, which is retained by tarred twine passed round the hoof many times. Such treatment will probably enable the animal to continue working.

In severe cases where there is gangrene of the podophyllæ, abscess of the coronary cushion, or even caries or necrosis of the

bone, the hoof-wall must be stripped off in the manner prescribed for toe-crack and the diseased parts treated in the same fashion.

Finally in all cases of sand-cracks, a round shoe, or a bar-shoe, should be put on to assist immobility.

Horn Tumour, Keratophyllocele, Keratocele.

Tumours are often formed inside the hoof, and in contact with the sensitive tissue. That which forms on the inner surface of the hoof-wall is named a *Keratophyllocele*, and that which is found on the upper surface of the horny sole is designated a *Keratocele*. Such tumours do not appear to form on the horny frog, probably because of the softness and elasticity of its horn.

The keratophyllocele is most intimately united to the wall for a portion or the whole of its extent, and it varies greatly in volume, some being no larger than a thick sewing-needle, while others are the size of a pea or a bean pod. Their shape also varies from cylindrical and fusiform to conical or pyramidal. They pass in a vertical direction from the cutigeral groove at the upper part of the wall to its lower margin in some instances, even passing into the groove; but more frequently they are not so long, and occupy only a limited space. They are due to injury to the coronet, to the hoof-wall, or to the podophyllæ. They are frequently the result of sand-crack, treads on the coronet, puncture or undue pressure by the shoe-nails; and driving back the shoe-clip too tight is a fertile cause. Anything, in fact, that will give rise to chronic inflammation, or stimulate the podophyllæ to increased secretion of horn, will lead to the production of these tumours, though it is very probable some of them may be formed independently of inflammatory action, just as keratomata are formed elsewhere without such influence.

The same may be said of the sole tumour or keratocele, which is, however, generally hemispherical, and constitutes an integral portion of the horny sole, varying in size from that of a pea to a small plum.

These tumours nearly always cause lameness by the pressure they exercise on the sensitive tissues, though it would appear that in exceptional cases they become developed without giving rise to any symptoms of their existence, but then their growth is very slow. The pressure the keratophyllocele exerts produces wasting of the podophyllæ and even of the pedal bone immediately in proximity to it.

The wall is usually more prominent externally when the tumour exists, and when the horny sole is pared at the region corresponding to it, there is indication of its presence by an alteration in the appearance of the sole, by a separation from the wall, by the exposure of the lower end of the tumour, or even the manifestation of a fistula that sometimes coexists with a keratophyllocele. Percussing the wall causes much pain over the part where the tumour is situated. In the case of a keratocele, when

the sole is pared it is usually observed to be discoloured around the part where the tumour is, and the horn immediately over the growth remains hard and dense when the other portions of the sole are soft, elastic, and even exuding blood when the paring is carried to the extreme degree.

The only radical cure of a keratophyllocele is to remove it, and this is accomplished in the same manner as in extirpation of sand-crack. Isolate the portion of wall covering the tumour by means of a groove on each side, but instead of the grooves converging from top to bottom, as in the sand-crack operation, they ought rather to diverge as they descend. If the tumour does not extend to the cutigeral groove, the two lateral grooves are joined by a horizontal one, so as to isolate the growth superiorly. The same may be done inferiorly if the tumour does not reach the lower border of the wall, but in the great majority of cases it does. The grooves having been cut sufficiently deep, the thin pellicle of horn remaining at the bottom is cut through by a strong scalpel or hoof-knife, the piece of wall raised at the bottom end, and with the tumour attached it is then removed by pincers.

Or the wall covering the tumour may be rasped very thin, then isolated by the grooves already mentioned, and carried from top to bottom; the bottom of the grooves is cut through by the scapel, and the piece of horn, together with the growth, is excised.

If the podophyllæ are diseased they will require removal, unless suitable medication is likely to restore them to a healthy condition.

The wound is to be treated antiseptically with boric powder and lint, and properly bandaged. The granulations which are thrown out soon become covered with a layer of horn that gradually thickens and hardens. This is to be kept somewhat thin and even until the new wall growing from the coronet has covered it. The growth of the wall is accelerated by stimulating the coronet.

With regard to keratocele of the sole, the portion of this involved in the growth can be removed in the same manner as the wall—isolation by grooves on each side, and tearing off the piece of sole. The same after-treatment is to be adopted.

In these cases, whenever the wound is sufficiently covered with horn, the Horse can be utilised by adopting appropriate shoeing and dressing.

Wounds.

Wounds of the foot are very frequent—more so than in any other region of the body, and they are often of a most serious character, not only because of the nature of the tissues injured, but also because these are covered by the hoof, which offers an obstacle to their healing, and is a barrier to their surgical treatment. Therefore in nearly every case this has to be removed to a more or less considerable extent, in order not only to relieve the

injured part from pressure, but also to permit of an examination being made so as to ascertain the nature and extent of the injury, and to facilitate treatment.

Pricks and Drawn Nails.

A Horse is said to be 'pricked' when a shoe-nail is improperly driven, and, instead of only penetrating the non-sensitive and non-vascular horn, is so deflected that it penetrates inwards and injures the sensitive structures within the horn.

Pricks vary in severity: in some cases the injury is just a touch on the sensitive structures; in more severe ones the nail pierces those structures; and in extreme cases the nail not only penetrates the insensitive horn, but passes through the sensitive structures, and even through the edge of the os pedis.

Pricks are caused either by the carelessness of the driver or owing to the driver being temporarily deaf from catarrh. Deaf blacksmiths should never be employed.

A slight prick may not cause lameness for several days, and only when exudate is poured out and causes pressure on the sensitive structures does the lameness appear. In such cases the lameness is accompanied by heat in the foot and flinching when the hoof is hammered. On removal of the shoe, the offending nail on withdrawal is found to be bluish; the inoffensive and properly driven nails are found to be bright or rusty. On pressure with the pincers over the injury the animal flinches.

Technic.—The nail-hole must be thoroughly pared out with a searcher, and usually when it is bottomed one finds some grayish matter, more like mud than pus, lying there. This should be washed away, and the foot placed in a poultice for a few hours, and the poultice may be renewed twice or thrice. The next day, if the lameness has diminished, the hole may be filled with tar and tow or with some antiseptic dressing, the shoe replaced, and a leather sole put on, care being taken to leave out any nail from the seat of injury.

In more severe pricks the animal is found to be lame immediately, and on removing the shoe the offending nail is found to be covered with blood, and blood is seen oozing out of the nail-hole.

In these cases the foot should be placed for an hour or so in a bucket of antisepticised hot water, then the hole should be filled with an antiseptic powder, and the shoe tacked on until the next day, in the meantime keeping a wet swab round the coronet. If the animal be sounder the next morning, the shoe may be fixed on properly, and a leather sole put on, after filling the hole with a dressing, and in another day or two the animal will probably be fit for work; but if the lameness does not disappear, we conclude that pus is forming, and further searching and poultices may be necessary.

In some cases the irritation is so great that the sensitive structures, as soon as the horn is trimmed away and opportunity

thus arises, become much swollen, and protrude as granulations through the wound, and in such cases the sole must be carefully thinned away from around the orifice, and when this is done the animal experiences immediate relief.

The foot must be carefully inspected daily, and when necessary more of the sole may require to be pared away, and the poulticing continued for another day. When the pain is subsiding and acute sensibility of the granulation diminished, one may then cleanse it thoroughly, and apply first an astringent, and then tow and tar and a slip-sole, the dressing to be applied daily till the granulation has disappeared and its surface is covered with new horn; and in a few days the shoe may be properly fastened on—the tar and tow and leather sole included—and the animal put to work.

Gathered Nails.

A Horse is said to have a 'gathered nail' when a nail is found more or less embedded in some part of his sole or frog.

Gathered nails are of various kinds, the worst being the French nails, which are long and made of wire, and which penetrate deeply. But we find all kinds of nails and screws picked up or gathered.

In many cases the gathered nail does not penetrate through the insensitive horn, but remains partially embedded in it. In these cases they may cause no immediate lameness, but in time get worked through the horn and injure the sensitive structures, and then cause lameness. In other cases the offending nail gets driven right through the horn, injures the sensitive structures, and causes immediate and great lameness.

A Horse frequently may gather a nail and then drop it; this happens when the nail is perhaps fastened to a piece of wood, such as a box lid, on which the horse may have trodden. In these cases the greatest care must be taken in searching for the hole made by the nail. The sole and the frog must be carefully pared all over, so that the surgeon may see the slightest trace of a puncture; too often is this neglected, with the loss of the animal as a result.

When such an injury is caused, the offending body must be found and removed, and the hole must be dressed out, and the surrounding horn thinned away so as to ease the pressure. The foot must then be placed in antisepticised hot water for an hour, and afterwards a poultice should be applied. In favourable cases the animal may be found free from pain the next morning, and there may be no local lesions, and the wound may appear clean and healthy. In such cases one should apply some antiseptic dressing, tack on the shoe, and put in a slip-sole, but do not send the animal to work for a day or two at the earliest, as it frequently happens that a fresh irritation is set up by exercise, and the animal again becomes lame, and usually this lameness is of a more severe and protracted character.

One cannot be too insistent upon apparently sound animals receiving several days' rest after such injuries to the foot.

Nails may be picked up by any part of the sole or frog. The frog is a common seat, as it is soft and nails penetrate it; the surface of the sole (unless pared) is an uncommon seat, as it is hard and resists penetration; but the line just between the sole and the frog is a common seat, and the further forward the gathered nail is in this line the greater is the danger.

If the nail enter at the posterior end of the line, it will only injure the substance of the frog; but if it enter near the point of the frog, it may penetrate deeply and injure the tendon of the perforans, or may pierce it and injure the navicular bursa, or even the bone itself. In these cases the lameness is intense; there is considerable systemic disturbance, and in the course of a

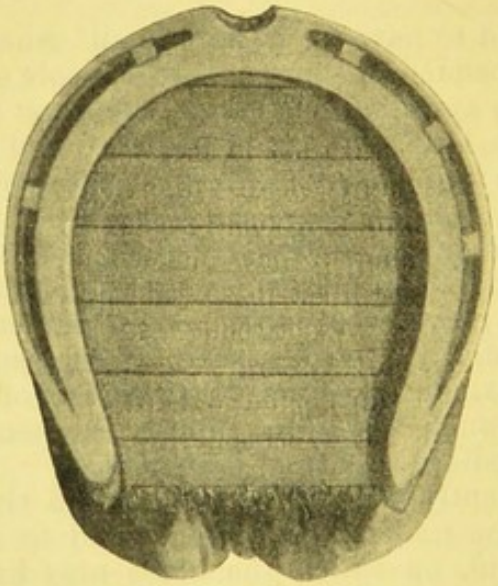


Fig. 638.—Foot with Splints Inside of Shoe.

day or two the animal will be found suffering from irritative fever. On examination of the wound, blood will probably be found oozing out, and in the course of a day or two, if the tendon be injured, there will be pus and synovia, or even blood, pus, and synovia, and if the bone be injured, there will be an offensive odour from the discharge.

In such cases the wound must be thoroughly cleansed, and in it should be placed a mixture of chalk and pure carbolic acid in the proportion of 1 to 100, or iodoform powder, or boracic acid powder, and on top of that a pad of tow, and (the shoe being on) this pad kept in position with wooden splints (Fig. 638). The animal must have a good bed to lie on, or if it be a hind foot that is injured, it should be placed in slings.

In many cases the sole may be underrun with matter, and then

it becomes necessary to dress away all the underrun portion of sole. If the injury affect the navicular bursa, the case is almost hopeless.

Drawn Nail.

This term is applied when a blacksmith, knowing that a nail is wrongly driven, withdraws it, and redrives it in a proper manner and place, or leaves that nail out altogether. In such cases lameness may be apparent at once, or not until after the lapse of a day or two.

If foot lameness be suspected, it is advisable to *count* the clinches and the nail-heads, as defaulting blacksmiths often insert a *dummy* nail-head in the place of a proper nail. In other cases, where all the nails have been inserted, the nail at the injured place will be found to be driven sometimes lower, sometimes higher, than its neighbours.

On examination, signs of pain are exhibited on hammering and pinching the foot at the seat of injury.

After removal of the shoe, we will notice in dressing out the nail-hole that it branches at the bottom, and one branch (the one caused by the drawn nail) penetrates inwards, and the other one (the one caused by the correctly driven nail) branches outwards. The seat of injury must be cleaned out and a poultice applied, and in a day or two the animal should be ready to shoe, and after another day's rest go to work.

It, however, occasionally happens that the nail is so badly driven that it causes injury similar to pricks, and must be treated accordingly.

Quittor.

By a 'quittor' we mean the presence of one or more suppurating sinuses in the foot, these sinuses having external openings in the coronary band or the skin immediately about the coronet.

Quittors are caused by pricks, gathered nails, drawn nails, bruised soles, corns, frostbites, and injuries to the coronet which have been neglected, and in consequence of which neglect pus has formed and burrowed to the easiest place of exit—that is, the soft tissues above the hoof.

Prior to the formation of a quittor there is always pain, heat, and swelling of the coronet, and every effort must be made to prevent the formation of an abscess at the coronet by endeavouring, in the case of injury from nails or corns, to give the matter an exit below; and if the injury to the coronet be direct, then cold applications or blistering may retard the formation of pus.

When a quittor is established, it becomes absolutely necessary that each sinus must have made in it an orifice at its most dependent part. Most sinuses are cul-de-sacs, with their openings at a higher level than their blind ends.

In some cases the thinning of the sole and enlarging of the

opening on the solar aspect of the foot will give exit to the pus which has been burrowing upwards.

It frequently happens that the sinuses do not extend deeply down below the horn, and in these cases a horizontal groove may

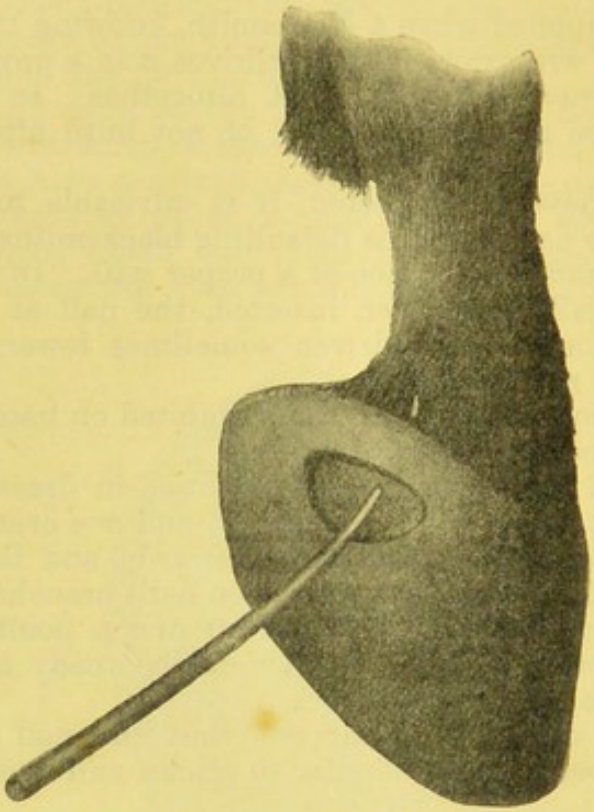


FIG. 639.—SEAT OF OPERATION FOR QUITTOR.

be made through the horn at a little below where the sinuses terminate. This groove or hollow should be about the size of half a walnut, and the horn must be pared down to the sensitive structures and the sinus exposed. Then a pointed iron, heated to a red or yellow heat, should be passed through from the groove upwards and out above the coronet, thus completely eradicating the sinus.

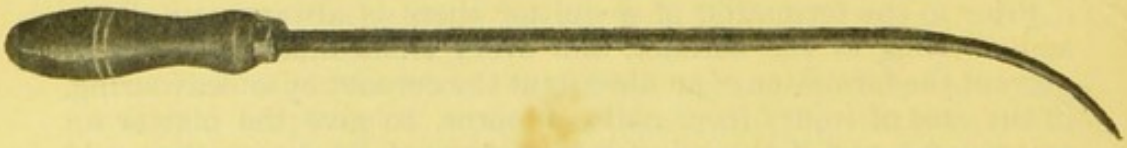


FIG. 640.—POINTED IRON FOR QUITTOR.

In other cases it may be necessary to strip off the horn from the seat of injury to the coronet, and lay open the sinuses.

The animal must first have the horn pared thin at the sole; then two deep grooves should be made through the wall, one on

either side of the piece it is intended to strip. Cocaine should then be injected into the region of the pastern, or the animal should be cast and placed under an anæsthetic. A tourniquet should be applied to the leg, then with a pair of pincers the piece of horn must be carefully torn off from the sensitive laminæ, the horn being seized at the solar aspect and torn upwards towards the coronet, the greatest care being taken not to injure that important structure.

All diseased tissue should be clipped or pared off, and each sinus opened up with a bistoury, so that it shall have an opening not only above the coronet, but one below. In many cases all the openings above the coronet may be made to have one common opening below.

It often happens that the lateral cartilage becomes affected, and in these cases, after the horn has been removed, the coronet must be carefully detached from the underlying tissues, and when loose may be easily stretched out with a blunt hook, so as to expose the underlying cartilage. When this body is diseased, the affected portions are noticed to have altered in colour, and often to have a bluish or greenish hue; the portions may be pared off with a special knife (Fig. 629). In other cases the cartilage may be so much diseased that it becomes necessary to completely cut off a part of it, and this is done with a knife or a pair of curved scissors.

Occasionally it happens that the pedal bone is fractured, and I have frequently, after removing the horn as above, also removed the portion of bone, and had a successful termination to the case.

Whatever be the nature of the operation, the after-treatment is much the same, and that is, render the wound thoroughly aseptic, apply antiseptic gauze, then lint, and finally bandages. Place the animal in the stable, and, if necessary, in slings. Do not remove the dressings for two or even three days, unless the animal becomes fevered and there is a smell from the wound.

Seedy-Toe.

It frequently happens that certain parts of the sensitive structures in the hoof are indirectly pressed upon by the clips of the shoe, and as a result, though there is not an acute inflammation, there is a malsecretion of the horn from these sensitive parts, which causes a separation between the crust and the sensitive laminæ. This horn is generally seen in a broken-down condition, dried, and somewhat like cheese, and is called 'seed.'

As the pressure is most usually caused by the *toe*-clip, the term 'seedy-toe' is aptly applied; but we sometimes have it caused by the side-clips, yet the same term is employed. A Horse with seedy-toe is not necessarily lame, but only lame when the disease is very extensive. If he be lame, he will go on his heel, and there may be a bulging of the horn at the toe, and in tapping the hoof there with a hammer a resonant sound will be heard.

When the shoe is taken off and the hoof pared at the toe, we usually find, after the removal of the first layer or two of horn with the drawing knife, that a quantity of 'seed' escapes, and leaves a space between the crust and the sensitive structures. This space may extend half-way up the hoof, and contain more or less of loose 'seed.'

The treatment is to remove all the diseased horny matter, leaving nothing but healthy tissue, and to then fill up this cavity with tar and tow, replace the shoe, and avoid any further pressure from the clip by leaving it off, and using a clip, or clips, opposite healthy horn.

In some cases it may be necessary to remove the sound crust of horn in front of the toe, even half-way up the hoof, so as to get at the bottom of the cavity.

If the affection involve much hoof structure, we may, after the operation, blister the coronet and give a month's rest.

This affection is sometimes due to an internal pressure from the exudate which occurs in laminitis or from some inherent cause, or may be due to the shoe being too narrow and all the pressure put on the outside crust.

Canker

Is a malignant disease of the foot of the Horse. It has several characteristics :

1. It may arise without any seeming exciting cause, such as thrush or injuries.
2. It is most intractable.
3. It is accompanied by a colourless discharge, which prevents any firm cohesion of the horn fibres to one another, and has an odour of sulphuretted hydrogen.
4. It tends to spread all over the foot from the sole to the coronet, and also to attack the other feet of the animal.

This disease is seen in all classes of animals, but most frequently in well-bred, heavy Cart-Horses, and in those which have fleshy frogs and big, open feet.

It usually commences in or near the frog, and is frequently secondary to an ordinary injury. In fact, many cases commence as injuries, and then from no known cause alter their character from the ordinary ones into the ones specified above.

The disease spreads rapidly over the foot, and gives rise to considerable lameness. It spreads between the sensitive and horny tissue, and causes the latter to soften and become sponge-like, and bulging below it is found the sensitive layer greatly thickened, but not greatly congested.

Treatment of every description has been tried, with success in

some cases and failure in others, but the following lines should be followed:

1. Treat the animal constitutionally with tonics, such as arsenic, and get it in good, but not high, condition.
2. Remove all loose horn and all diseased non-vascular tissue possible.
3. Apply dry dressings, such as iodoform and charcoal, boracic acid, chinosol, chalk, etc.; then apply tow or cotton-wool, and, having a shoe on, keep the dressings in place with splints, as in Fig. 638.

In two or three days the dressing may be carefully removed—not torn off nor soaked off, but pulled off as gently as possible; then fresh dressing may be applied. If in taking off the dressing any loose tissue be noticed, it must be carefully removed. In some cases it may be necessary to strip the sole completely off, and then the animal must be placed under an anæsthetic, and the operation performed as on p. 671. (See Avulsion of the Sole.)

Recovery may occur after a few dressings, but frequently cases take months before the disease ceases to spread and healthy horn grows.

Frost-bite.

In towns where car companies or other people throw salt on the streets to melt the ice or snow, these people seldom think that a freezing mixture is thereby formed, which, if it get as a splash on a Horse's leg or coronet, is very apt to cause a frost-bite.

In some cases this mixture sticking to the foot is very apt to be rubbed off by the opposite fetlock when the Horse is in motion, and then there is a deposit of freezing mixture on one or both fetlocks, and if either fetlock be at all injured by ordinary brushing, it is in grave danger of being 'bitten.'

The symptoms are somewhat puzzling, unless one is on the look-out for this particular affection. The animal within a very few minutes becomes intensely lame, so lame, in fact, that a fractured bone or a picked-up nail is at once suspected, but on examination nothing can at first be found. Within a few hours, on careful pressure with the fingers over all parts of the affected leg, the surgeon ultimately arrives at a most painful spot, which may be slightly moist and may have a bad odour. This is shortly followed by great swelling of the limb, and within a few days a dead piece of tissue is seen to be separating at the injured place. When this slough has come away, we can see a deep ulcer, sometimes with angry edges, and tending to increase in size and in depth; but in others it has a healthy appearance, and rapidly heals.

The commonest seats of frost-bite are just at the top of the coronet, in front of the foot, in the hollow of the heel, and on the inside of the fetlock-joint. The 'bite' may only affect the skin,

but very often affects deeper tissues, and all 'bitten' tissues being dead, they slough out, and leave an ulcer of varying depth. They may even extend into the neighbouring articulation, and rapidly cause death.

Treatment.—At the onset of the disease the animal should receive a laxative and a sedative, and if it be in a hind limb it may be necessary to place the patient in slings. The leg must be fomented frequently for half an hour at a time, and in the water should be placed some poppy-heads and camomile flowers. As soon as the 'bite' is located, the slough must be assisted away by poulticing with boiled turnip or bran; these poultices may with advantage contain some antiseptic, such as chinosol or Jeyes' fluid. As soon as the slough has been removed, the animal is much relieved, and the fever and pain rapidly subside. Afterwards the wound should be treated as an ordinary one.

INDEX.

Heavy figures indicate illustrations.

THE END.

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