A text-book of operative veterinary surgery

A TEXT-BOOK

OF

OPERATIVE

VETERINARY SURGERY.

BY

GEORGE FLEMING, LL.D., F.R.C.V.S.,

Principal Veterinary Surgeon to the Army,

AUTHOR OF 'TRAVELS ON HORSEBACK IN MANTCHU TARTARY,' 'HORSE-SHOES AND HORSE-SHOEING,' 'ANIMAL PLAGUES,' 'PRACTICAL HORSE-SHOEING,' 'RABIES AND HYDROPHOBIA,' 'COMPARATIVE ANATOMY OF THE DOMESTICATED ANIMALS,' 'MANUAL OF VETERINARY SANITARY SCIENCE AND POLICE,' 'CONTAGIOUS DISEASES OF ANIMALS,' 'TEXT-BOOK OF VETERINARY OBSTETRICS,' 'TUBERCULOSIS FROM A SANITARY AND PATHOLOGICAL POINT OF VIEW,' 'HUMAN AND ANIMAL VARIOLÆ,' 'ACTINOMYKOSIS, A NEW INFECTIOUS DISEASE OF MAN AND ANIMALS,' 'PROPAGATION OF TUBERCULOSIS,' ETC.

WITH NUMEROUS ILLUSTRATIONS.

LONDON:

BAILLIÈRE, TINDALL, AND COX,

20, KING WILLIAM STREET, STRAND.

NEW YORK: WILLIAM R. JENKINS.

Dedicated

(By permission)

TO

FIELD-MARSHAL

HIS ROYAL HIGHNESS THE DUKE OF CAMBRIDGE,

K.G., K.T., K.P., G.C.B., G.C.S.I., G.C.M.G.,

COMMANDER-IN-CHIEF OF THE BRITISH ARMY;

PRESIDENT OF THE ROYAL VETERINARY COLLEGE;

IN GRATEFUL ACKNOWLEDGMENT OF THE DEEP INTEREST HE HAS FOR VERY MANY YEARS TAKEN IN THE PROGRESS OF VETERINARY MEDICINE AND SURGERY, AND IN RECOGNITION OF THE BENEFIT WHICH THE ARMY AND THE PUBLIC GENERALLY HAVE DERIVED FROM HIS GENEROUS PATRONAGE OF, AND SOLICITUDE FOR, THIS IMPORTANT BRANCH OF SANITARY SCIENCE AND THE HEALING ART.

PREFACE.

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, 1884.

A 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 all injuries to which they may be exposed, and the remedying of all malformations and deformities, whether these be congenital or acquired. The study of the diseases for which surgical intervention is necessary, and which comprises their nature, seat, etc., 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 all 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 for 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 any 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, struggling, 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, and which they do not understand the object of; for an anæsthetic cannot always be conveniently or safely administered, while the position in which animals must be secured is seldom that 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 subdue 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 perfect 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 perhaps still more so.

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 a different kind in some respects, but still 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 possible; 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 divined, 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, pyæmia, or embolism, 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 which is absent, 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 cauterisation ; and *complicated operations* are those in which there is difficulty or delicacy in dissection (as in lithotomy, neurotomy, 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 presence of hæmorrhage. 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 tympanitis 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 each operation 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, and 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 any 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 some time 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 effective; and if they are likely to be broken during operation, there should be duplicates of them; this is particularly necessary if they are new and untried. To the smaller instruments, which may be dropped or knocked from the fingers by the struggles of the animal, a bright-coloured cord or ribbon should be attached to the handle, by means of which they may be secured to the wrist, or more readily found if they chance to fall among the litter on which the patient is placed. They should be arranged on a tray or in a shallow basket, and held or laid con-

venient to the operator, so that he may be able to take any one of them he may at the moment require. The larger instruments may be arranged on a bench, table, or even on a cloth or sack on the ground. Sponges, bandages, lint, suture thread or wire, hæmostatic, antiseptic or other dressings, water, sacks filled with hay or straw to prop up the body, head, or limb, etc., should all be provided as the occasion may require. Much of the success of an operation depends on the preliminary arrangements.

In nearly all veterinary operations, one or more 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.

In some operations, the seat of operation may require previous attention; for example, the skin may require cleansing, or removal of the hair by means of scissors or razor; or the hoof may require to have the shoe removed, and a portion of the horn cut away, etc.; or it may be necessary to empty the bladder or rectum. In the more simple and trifling operations, little, if any, preparation of this kind may be needed; but in proportion as they are complicated, so is the necessity for every provision and precaution being adopted, in order to ensure success.

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 moist grass field, a dung-heap covered with straw, a straw bed, or a floor laid with sawdust, peat, or tan. If possible, it should be under cover if the weather is bad. In some cases the stable, loose-box, or cow-shed will suffice. For the smaller animals, a 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 apparatus 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 administration of an anæsthetic agent, by temporarily depriving of sensation the part to be operated on (local anæsthesia), or by the production of nausea or a sedative effect in giving medicinal agents, is 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; at the same time the means of torture are often the means of constraint or restraint.

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. These apparatus, 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 it is to be operated upon in the standing or recumbent position. In applying the apparatus, great care and tact are required to avoid injury and prevent accidents.

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 semi-circular 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 materials, 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.

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 at the ends. This is placed high

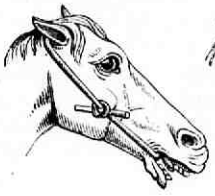

FIG. 1.
POLISH GAG.

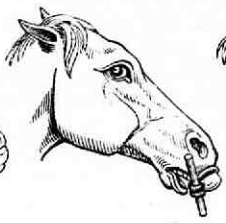

FIG. 2.
SHORT TWITCH.

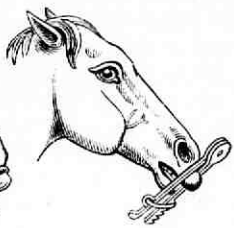

FIG. 3.
IRON HINGED TWITCH.

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. 1), 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. 4.
TWITCH.

The ordinary twitch (Fig. 4) 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 (Fig. 12). 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 agony 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. 2); 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. 3, 5) 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. 5.
IRON HINGED TWITCH.

FIG. 6.
WOOD HINGED TWITCH.

branches (Fig. 3). 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. 6) 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 always 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. 7, 8 *a*),

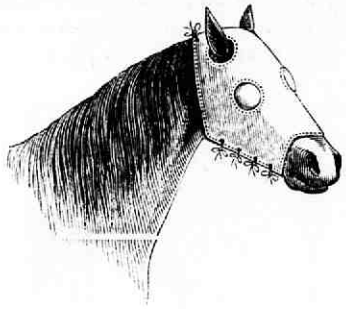

FIG. 7.—THE MASK.

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. 8, *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

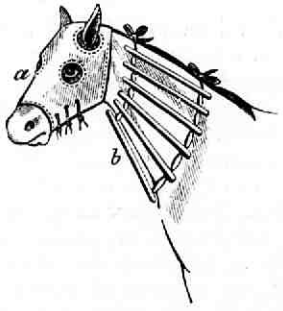

FIG. 8.—THE CRADLE, OR NECKLET.—*a*, Mask; *b*, Beads.

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 each other, either by knots on the cords, or by short pieces of wood perforated from end to end, and strung on the cords between each long piece. 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. 9) is a round wooden 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)

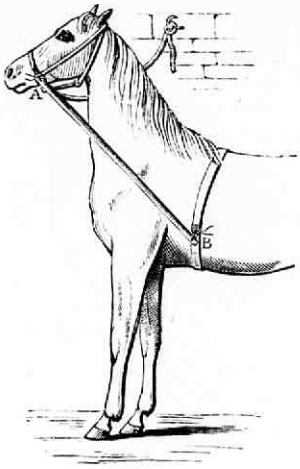

FIG. 9.—SIDE-ROD.

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 often employed to attach the pastern to the fore-arm. The leg is well flexed at the knee, and the rope or strap is then passed round the fore-arm and pastern, a complete turn being made, if necessary, for greater security, around the pastern (Fig. 10). A leather strap with buckle is to be preferred, as it is

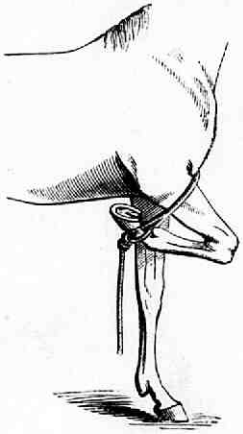

FIG. 10.—FORE-LEG SECURED.

easier applied and removed, and not so likely to injure the limb. To prevent contusion by the hoof or heels of the shoe, it may be necessary to interpose some soft substance between them 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 put 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. 14). 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. 11, *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. 11.—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,

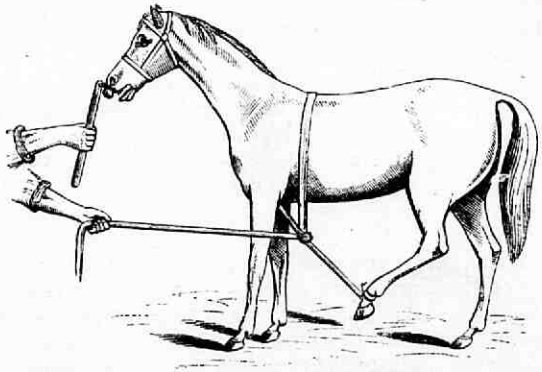

FIG. 12.—SECOND MODE OF SECURING THE HIND-LEG BY SIDE-LINE.

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. 12). 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. 13); 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,

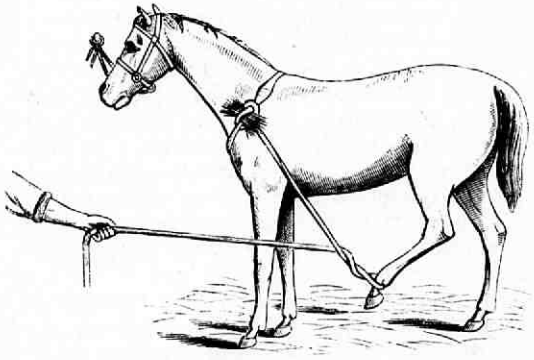

FIG. 13.—THIRD MODE OF SECURING THE HIND-LIMB BY SIDE-LINE.

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. 13) 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. 14).

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. 15). 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.

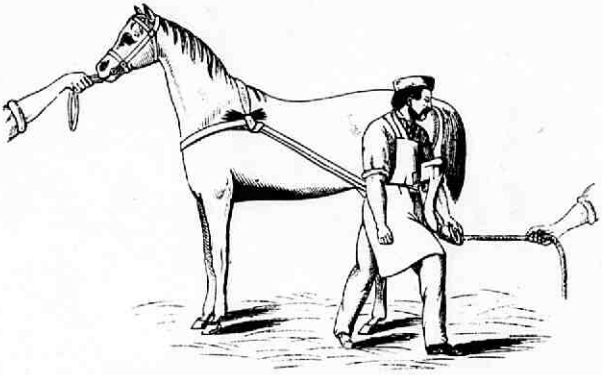

FIG. 14.—FOURTH MODE OF SECURING THE HIND-LIMB BY SIDE-LINE.

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.

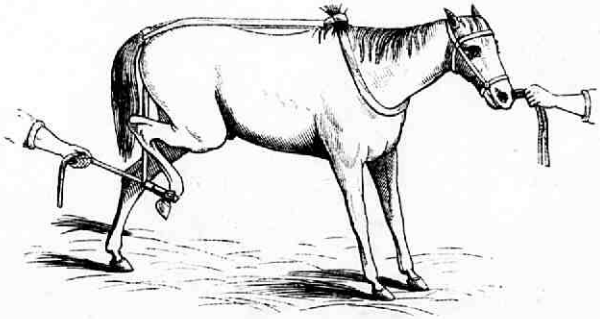

FIG. 15.—FIFTH MODE OF SECURING THE HIND-LIMB BY SIDE-LINE.

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. 16).

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.

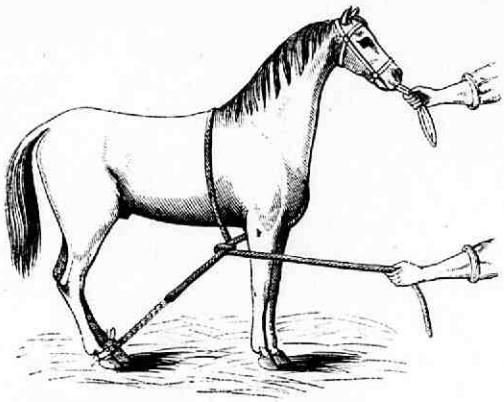

FIG. 16.—METHOD OF SECURING BOTH HIND-LEGS.

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

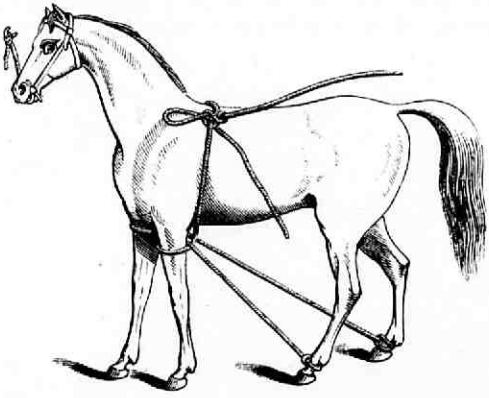

FIG. 17.—METHOD OF SECURING FORE AND HIND LIMBS IN THE STANDING POSITION.

within the fixed portion, and are tied over the back immediately behind the shoulders, as shown in the figure (Fig. 17). 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 a sufficient length.

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

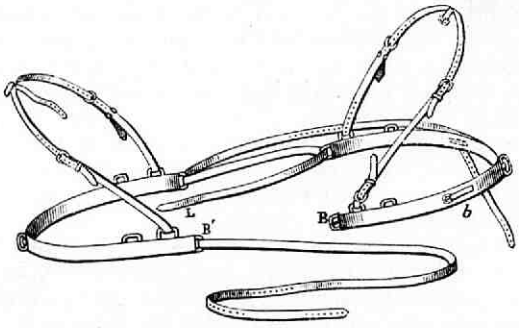

Fig. 18.—Raabe and Lunel's Hippo-Lasso.

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. 18) 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 down 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, either fixed 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. 19). 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 also. 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

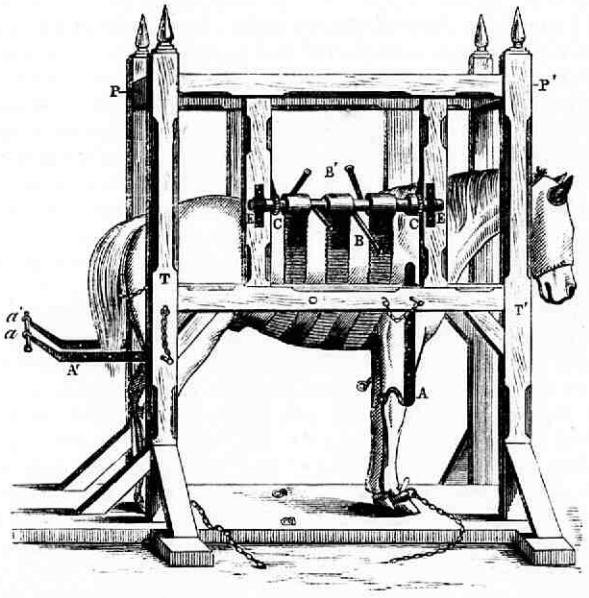

FIG. 19.—POST TRAVIS.

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, litter, manure, 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 it is not only well adapted so far as size is concerned, but that it is 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 flexible. 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. 20). 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 its side, when the ropes can be fastened to the neck portion, and the fore-limbs secured to the hind ones by

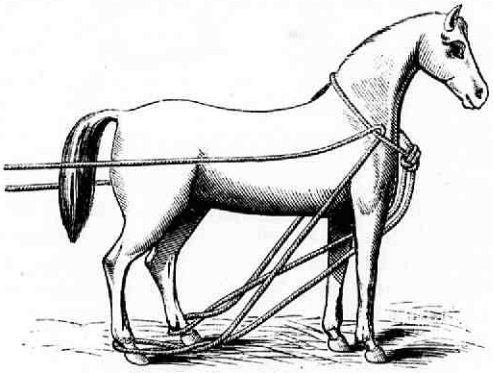

FIG. 20.—CASTING-ROPE APPLIED.

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 a 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 all that 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. 21), through which

the rope runs; and below this a second, a check-knot, which holds 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

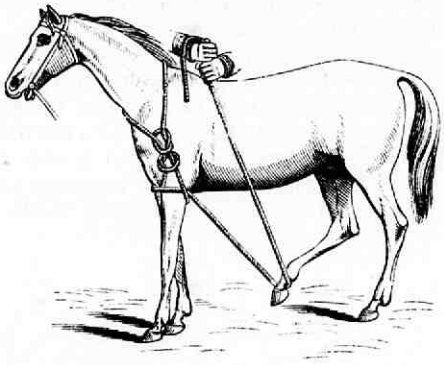

FIG. 21.—ROHARD'S METHOD OF THROWING DOWN A HORSE.

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 somewhat tightened round them by bringing the limbs close together. An assistant keeps up the portion round the fore-arms, while the

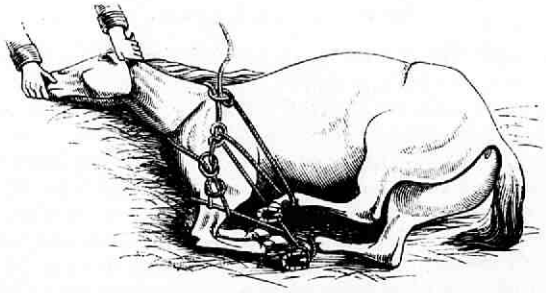

FIG. 22.—ROHARD'S METHOD OF SECURING THE HORSE WHEN THROWN DOWN.

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. 22). 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-

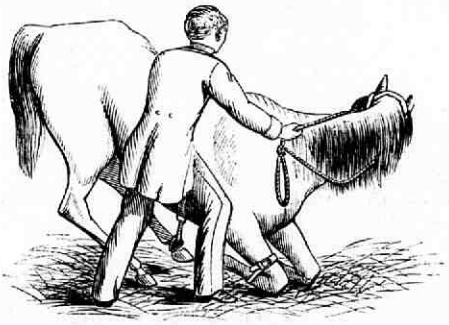

FIG. 23.—RAREY'S METHOD OF THROWING DOWN A HORSE.

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. 23).

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, if need be, another at the shoulder or tail, throws 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

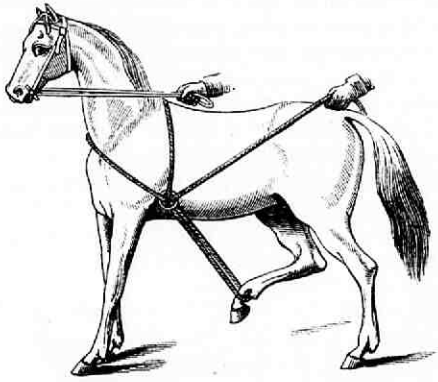

Fig. 24.—Russian Method of Throwing Down a Horse.

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. 24), 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, four fathoms 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 or mistrustful 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. 20). 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 hoofs and 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 metallic 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. 25). 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.

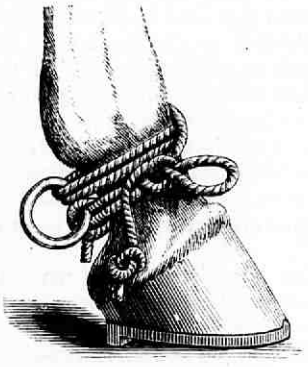

FIG. 25.—IMPROVISED HOBBLE.

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 rather square, 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. 26).

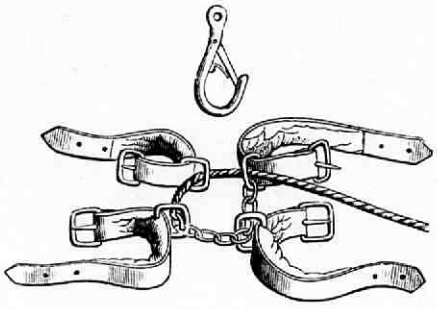

FIG. 26.—ORDINARY HOBBLES, WITH SPRING-HOOK FOR CHAIN.

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. 27, *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.

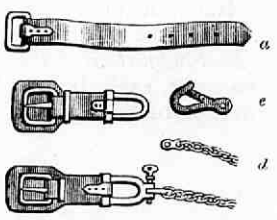

FIG. 27.—IMPROVED HOBBLE: *a*, *b*, THE TWO PORTIONS OF A DETACHED OR FREE HOBBLE; *c*, THE PRINCIPAL PORTION OF THE CHIEF HOBBLE; *d*, THE TERMINAL LINK OF THE CHAIN; *e*, SPRING HOOK.

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

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. 26, 27, *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. 28).

A very simple, economical, and secure fastening is in use at the Brussels Veterinary School. It is merely a piece of iron bent into a lyre shape (Fig. 29), 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. 28.
MODIFIED SPRING HOOK.

FIG. 29.
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

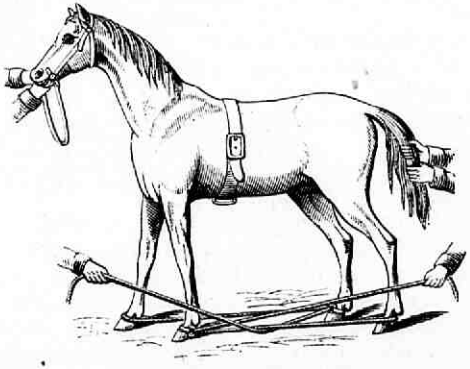

FIG. 30. STUTTGART METHOD OF THROWING DOWN A HORSE.

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

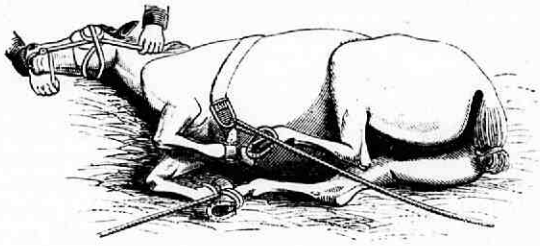

FIG. 31.—HORSE SECURED BY THE STUTTGART METHOD.

parts of the left. Two or three men seize hold of each rope, one set pulling in a backward direction, the other (those holding the right or under rope), in a forward direction; and assistant at the tail, and other at the head, pull and push these parts toward the right side (Fig. 30). 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 the abdomen, prepuce, penis, or scrotum, after the horse is thrown the

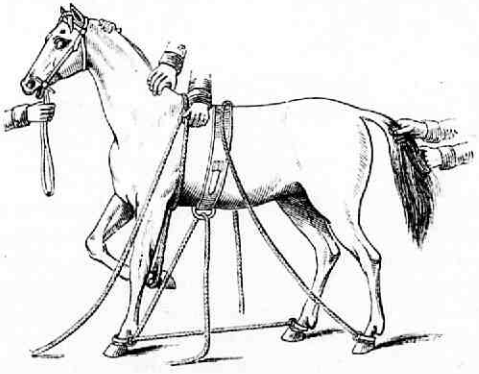

FIG. 32.—DANISH METHOD OF CASTING A HORSE.

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. 31). 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. 32). 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

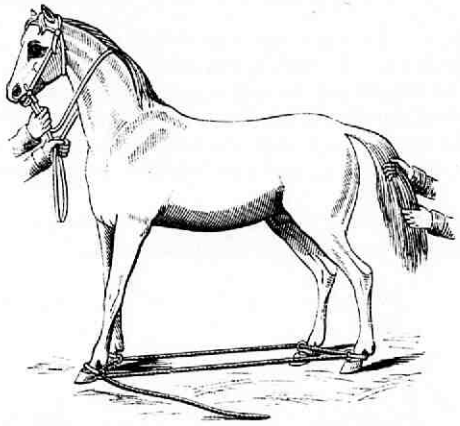

FIG. 33.—BERLIN METHOD OF THROWING A HORSE DOWN.

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. 33). 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, and 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, and 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 aides, 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, has been introduced by an American castrator, Mr. Miles, who has been very successful in practising this operation. The following description of the method has been obligingly supplied by 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 metal loop at one extremity; a twitch, one foot long in the stick, and a spreader.

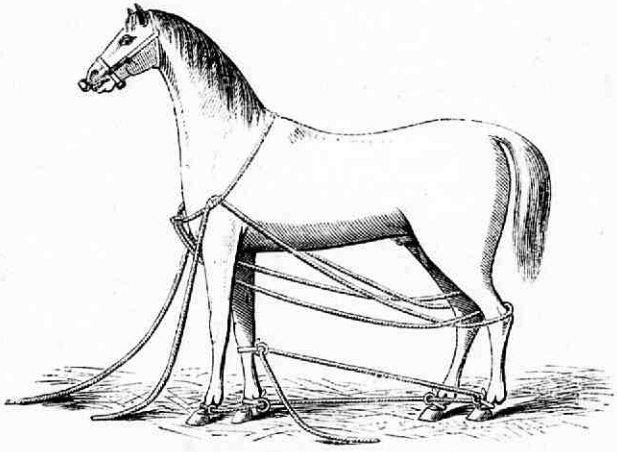

Fig. 34.—Miles's Method of Casting a Horse.

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. 34).

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.

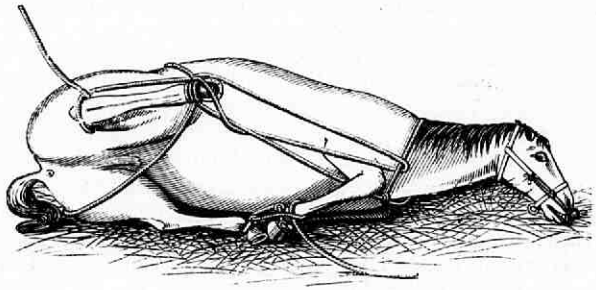

FIG. 35.—MILES'S METHOD OF CASTING A HORSE.

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 (and 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. 36).

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.

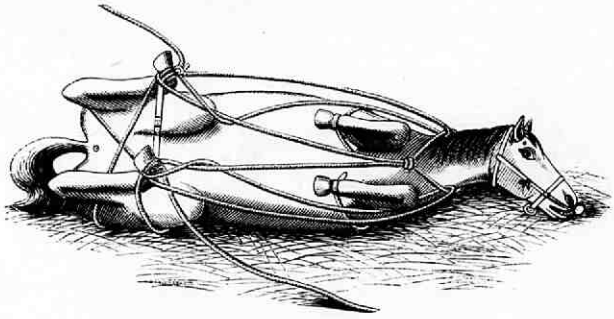

FIG. 36.—MILES'S METHOD OF CASTING A HORSE.

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: One set of side-lines alone are required, and no spreader. 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

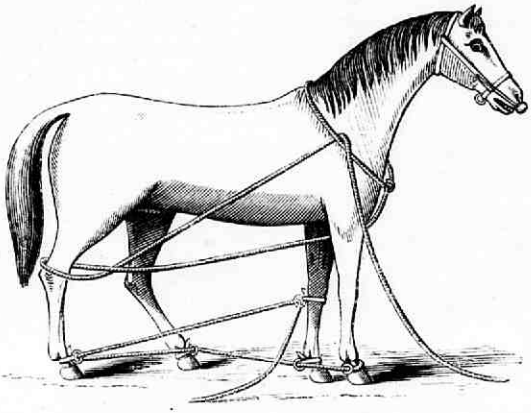

FIG. 37.—MILES'S METHOD OF CASTING A COLT.

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.

H. *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. 38). 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

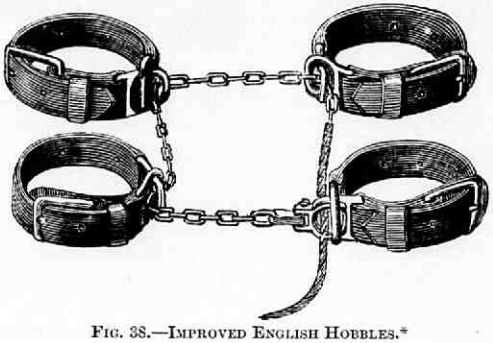

FIG. 38.—IMPROVED ENGLISH HOBBLES.*

to have the horse lie on the right or the left side. If we suppose the

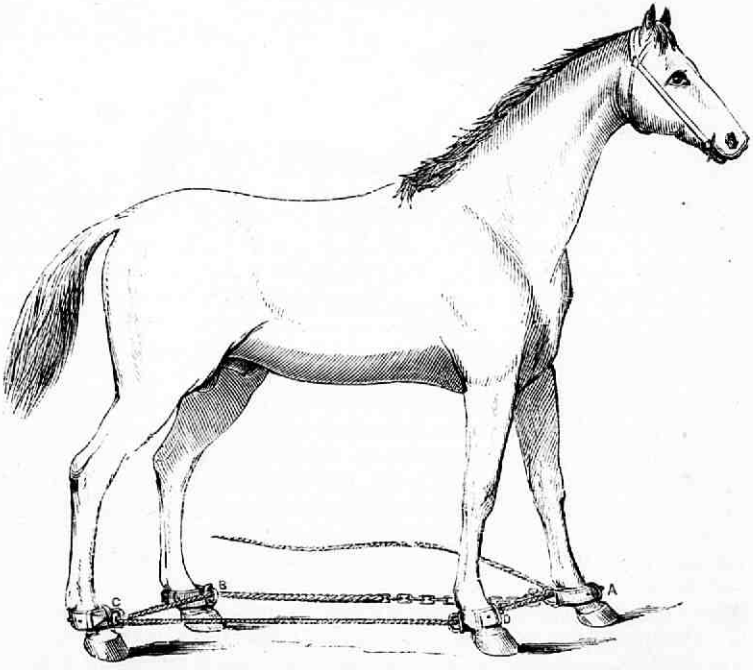

FIG. 39.—ENGLISH METHOD OF THROWING DOWN A HORSE WITH HOBBLES.

chief hobble to be placed on the left fore-pastern (Fig. 39, 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. 39). 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. 40), the tail pulled backward and to the right side, and the fore-arm rope also outwards on the right side; while the man in front pulls or pushes

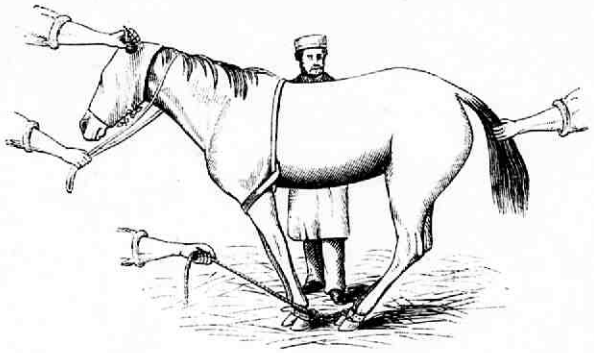

FIG. 40.—HORSE BEING THROWN DOWN.

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. 40). 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. 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 together, by means of the strap and buckle, towards the middle of these hobbles (Fig. 41).

FIG. 41.—CROSS HOBBLES.

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 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.

An ordinary hobble and rope will also suffice for this purpose; but it is well to have the neck protected from chafing by placing a cloth around it, or a strong leather collar to directly attach the rope to would be an improvement.

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 be placed towards the chest, to pull the line upwards and backwards (Fig. 42).

(*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.

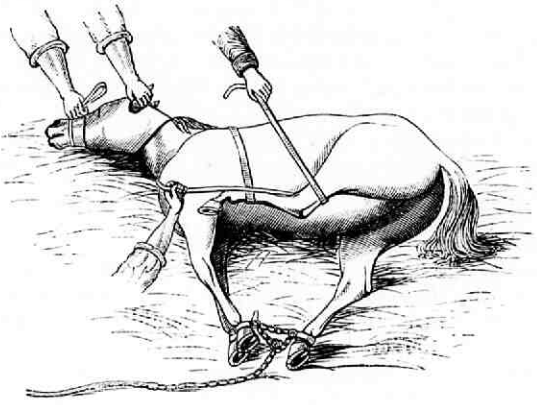

FIG. 42.—FLEXION OF THE HIND-LEG IN THE LATERICUMBENT POSITION.

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 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. 43), where an assistant, standing at the croup,

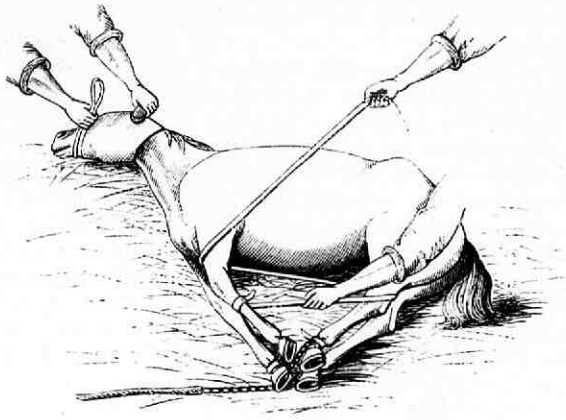

FIG. 43.—ATTACHING THE FORE TO THE HIND LEG IN THE LATERICUMBENT POSITION.

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. 44).

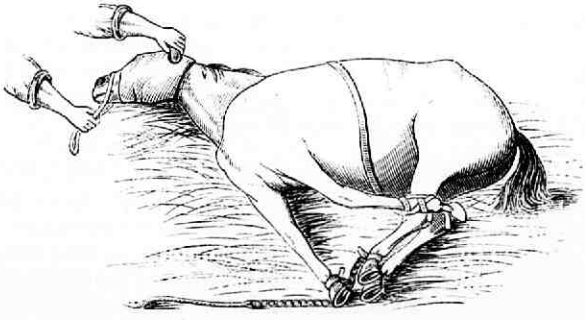

FIG. 44.—THE FORE ATTACHED TO THE HIND LEG IN THE LATERICUMBENT POSITION.

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 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 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 bruises.

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; if possible, a thick rug should cover the body; and if fracture of the cranium or orbital arch is likely to happen, the mask or leather blinds should be worn.

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 preventible. 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 exclusively 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 means of the tail, can stand up freely; 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 perspiration, 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 in the lateral position, this latero-flexion of the pelvis can only take place towards the side which is uppermost. And it is also observed that if the horse latero-flexes the pelvis while on its back, 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 metarcarpus. Even here, however, the strain-

ing can not be entirely prevented. In one of my cases, in which I operated, on account of a spermatic fistula, 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. A horse thrown on a high dung-heap is less liable to a vertebral fracture than one thrown on a thin layer of straw, or the mere floor. 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 *vastus longus* 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 casual 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 dung-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 the hobbles 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 Achilles* 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 case of subcutaneous operations.

'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.' *

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—nay, essential 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

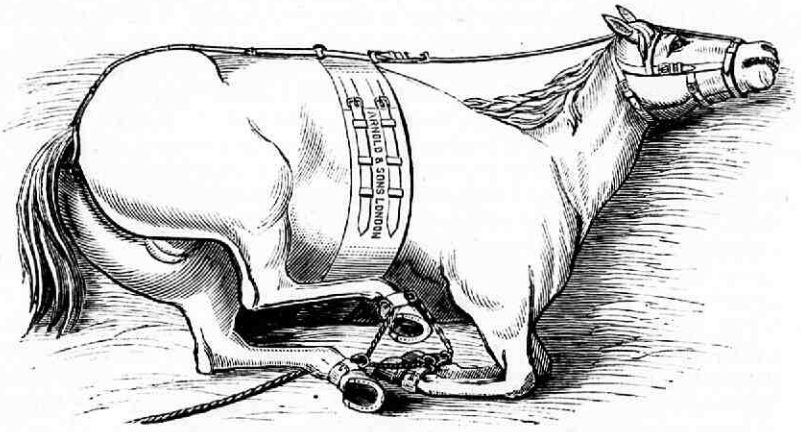

Fig. 45.—Head and Crupper Apparatus to Prevent Broken Back.

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. 45). This apparatus, introduced by Mr. E. Cooper Smith, M.R.C.V.S., answers well.

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

* 'Wochenschrift für Thierheilkunde und Viehzucht.'

first brought to notice by Hœrdt, and improved by Fromage de Feugre, Kersting and Owen, and which consisted of a vertical table 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.

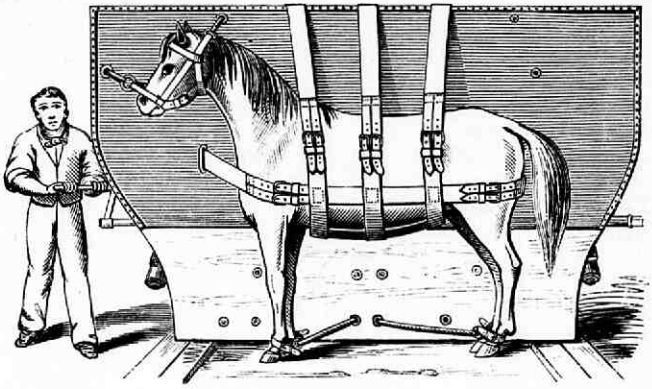

FIG. 46.—OPERATING TABLE: VERTICAL POSITION.

This machine has been still further modified and improved, until now it is almost perfect. Occupying but a small space, it is composed chiefly of ironwork, with a large oak platform, the face of which is covered with well-stuffed cow-hide leather, and furnished with head-collar, girths, hobbles, etc., necessary to secure the horse, and which

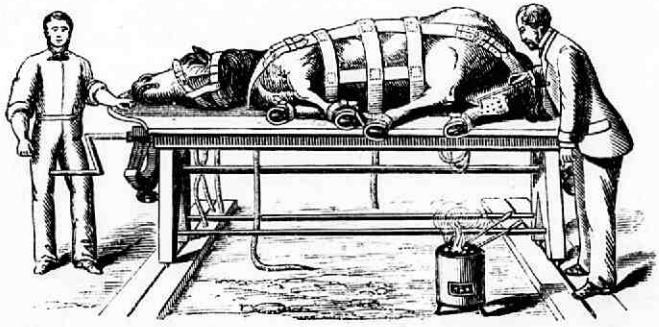

FIG. 47.—OPERATING TABLE: HORIZONTAL POSITION.

are fixed on the other face while the horse is standing, and the platform is vertical. 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. 46 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 young lad can readily bring the platform and horse to the horizontal position.

In Fig. 47 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. The advantages of such a machine are obvious. They may be summed up as follows :

1. Avoidance of the dangers attending the ordinary system of throwing horses down.
2. Allowing the horse to get upon its feet again, easily and without danger.
3. Perfect safety of the operator, who can operate easily and comfortably.
4. Assistants are dispensed with.
5. Saving of time for the operator.
6. Economy in space, and no expense for litter.
7. Greater cleanliness.*

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 horns 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 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,

* The agent for these machines is M. H. Figuière, 57, Rue Nau, Marseilles.

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

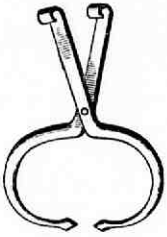

FIG. 48.
SIMPLE NOSE-CLAMP.

FIG. 49.
SCREW NOSE-CLAMP.

FIG. 50.
NOSE-CLAMP, WITH KEEPER.

construction, but in principle it is the same. In some patterns it is merely hinged, and the hand maintains it closed (Fig. 48); in others it has a screw (Fig. 49), or a sliding keeper, which keeps it closed (Fig. 50), and this may be supplemented with a spring (Fig. 51). 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.

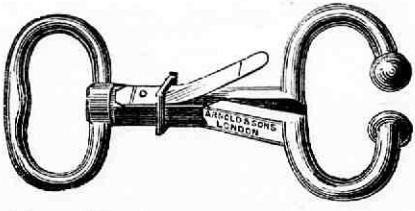

FIG. 51.—NOSE-CLAMP, WITH SPRING AND KEEPER.

It may be remarked that bulls, and sometimes troublesome cows, 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. 52). A round piece of the nasal septum is cut out by means of the nose-punch (Fig. 53), 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. 54) 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. 55). There are various other patterns of rings, but in all the principle is the same.

FIG. 52.—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. 53.—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. 56). 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 :

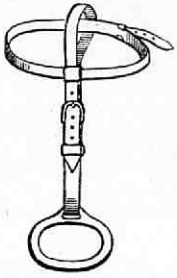

FIG. 54.
ALSACE NOSE-RING AND HEAD-STALL.

FIG. 55.
ALSACE NOSE-RING APPLIED.

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

2. Carry the tail inside the hind-leg which threatens danger, bringing it round the front of the thigh (Fig. 57), where it is firmly

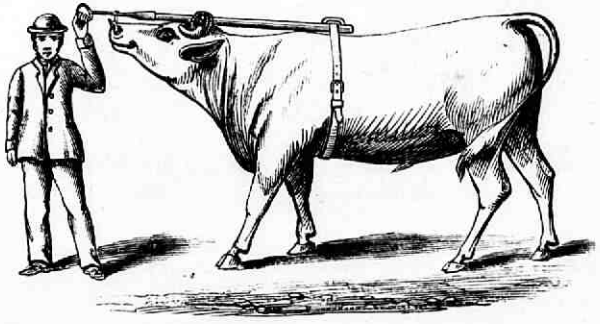

FIG. 56.—VIGAN'S CONTROLLING APPARATUS FOR OXEN.

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

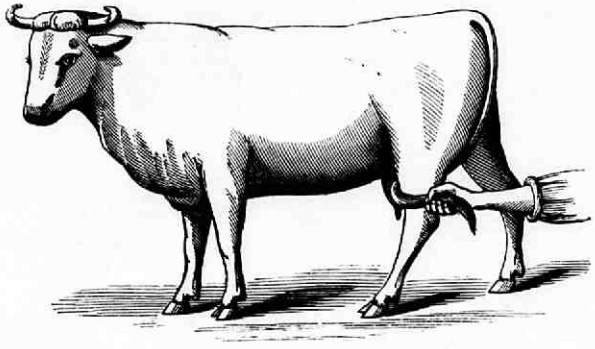

FIG. 57.—SECURING HIND-LEG BY MEANS OF THE TAIL.

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 pastern, to the fore-arm of the same side, round the neck, or round the horns.

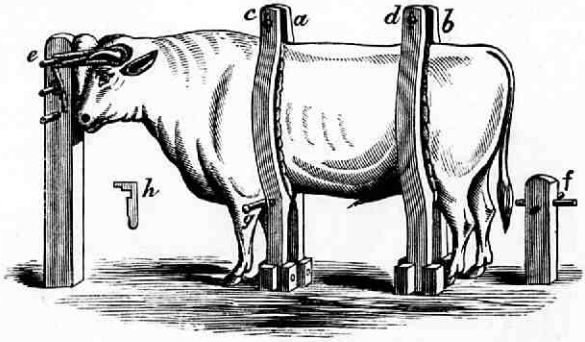

FIG. 58.—OX TRAVIS. *a*, *b*, *c*, *d*, THE FRAMEWORK FIRMLY FIXED IN THE GROUND, THE UPRIGHT LATERAL POSTS BEING CURVED TO FIT THE BODY OF THE OX, AND *c* AND *d* BEING THE TRANSVERSE BARS UNITING THESE; *e*, *f*, POSTS TO WHICH THE HEAD AND HIND-LIMBS ARE TIED; *g*, A SUPPORT FOR THE FORE-LIMB; *h*, 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 labour animals, they are frequently submitted to operation, a 'travis,' or stocks, is used to fix them in when they are uncontrollable (Fig. 58). This differs somewhat from that in use for the horse, though on an emergency the horse 'travis' will suffice.

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.

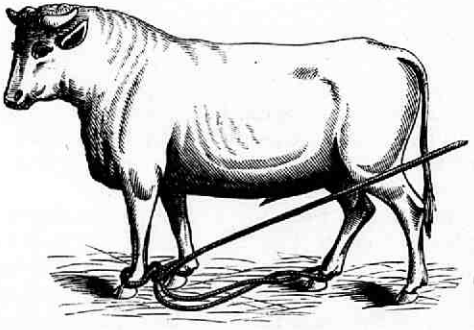

FIG. 59.—THROWING DOWN AN OX BY MEANS OF A ROPE.

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. 59.

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

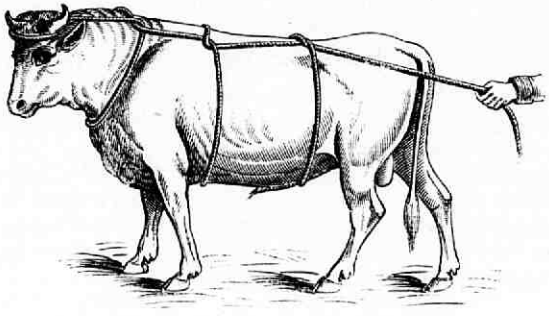

FIG. 60.—RUEFF'S METHOD OF THROWING DOWN THE OX.

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. 60.

It may be mentioned that the neck-rope employed for throwing down horses for castration (Fig. 20), 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 creature 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 rather stiff piece of twine, 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 it 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. 61.—GAG-SPECULUM FOR THE PIG.

end, and 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. 61). 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 operator cannot be too circumspect, both in seizing and operating on these creatures.

In operating on the dog, the mouth should 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. 62).

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 blind-

FIG. 62.—TAPE MUZZLE FOR THE DOG.

folded 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 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. The dog may be thrown down and the limbs fixed as in the case of the sheep.

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 limbs may be fastened together, as with the sheep.

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.

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.

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 the 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 movement, 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. 63). A convenient size, suiting the average number of horses, is twelve inches in length from end to end, and twenty inches in circumference.

* 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 ethylic ether, and half a fluid ounce of pure or absolute ethylic alcohol (sp. gr. 795) is perhaps the most usual form of combination of these combined anæsthetic substances. The substitution of methylene bichloride for the chloroform is an improvement, and Dr. Richardson, in his early experiments in the introduction of methylene bichloride, 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 bichloride, one fluid ounce and a half; absolute ethylic alcohol, half a fluid ounce. Or, methylene bichloride, 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 methylic 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.

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

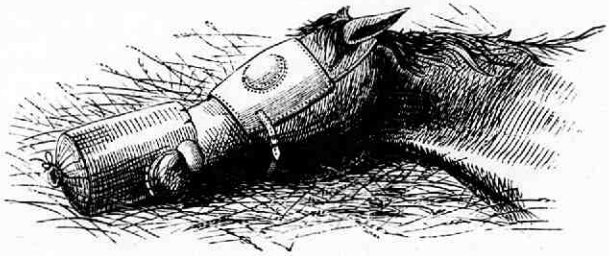

FIG. 63.—COX'S CHLOROFORM-BAG APPLIED.

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 handkerchief 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 movement of the finger placed within it, and a little cold water dropped into the mouth from a sponge is sucked and swallowed.

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. 64), though less portable than the canvas-bag, is yet more durable. It is a wide nose-cap, made of leather, fitting over 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.

FIG. 64. — GRESSWELL'S CHLOROFORM NOSE-CAP.

Close attention is necessary in admitting 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, friction applied to the limbs, especially 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 lesser 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. If a dog, the limbs should previously be tied, and the animal placed on its side. A cat should be wrapped in a cloth, the head being left free; or it may be put in a bag, a closed box, or under an inverted bucket, the anæsthetic being poured on a cloth, sponge, or a bit of cotton wool, at the same time. 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.

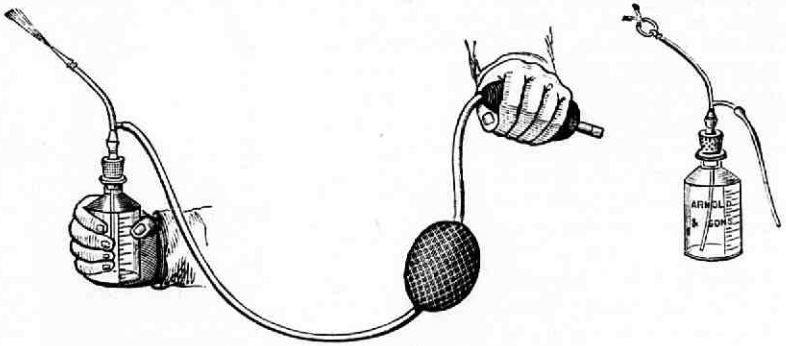

FIG. 65.—ANÆSTHETIC SPRAY APPARATUS.

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 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; by the application of a strong solution of carbolic acid; or by ether spray—the ether being thrown upon the part by means of a special apparatus (Fig. 65), and intense cold produced through the evaporation of the ether from the surface.

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. 66.—Ordinary Scalpel.

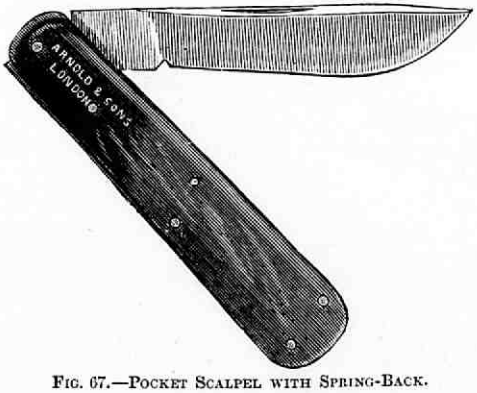

Fig. 67.—Pocket Scalpel with Spring-Back.

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, neurotomy, herniotomy, etc.

FIG. 68.—DOUBLE SPRING-BACK BISTOURY, WITH SHARP AND PROBE-POINTED BLADES.

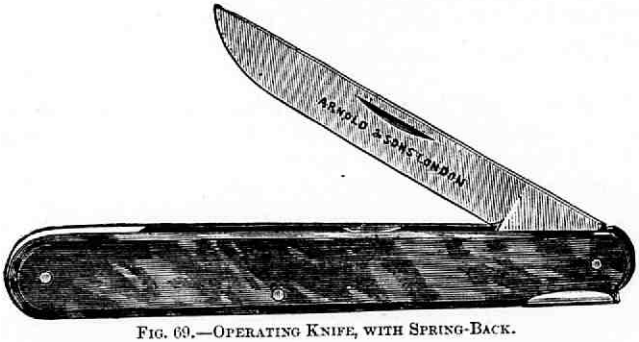

FIG. 69.—OPERATING KNIFE, WITH SPRING-BACK.

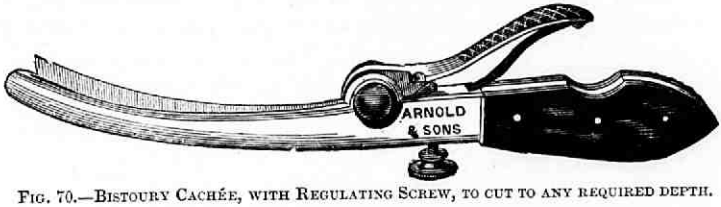

FIG. 70.—BISTOURY CACHÉE, WITH REGULATING SCREW, TO CUT TO ANY REQUIRED DEPTH.

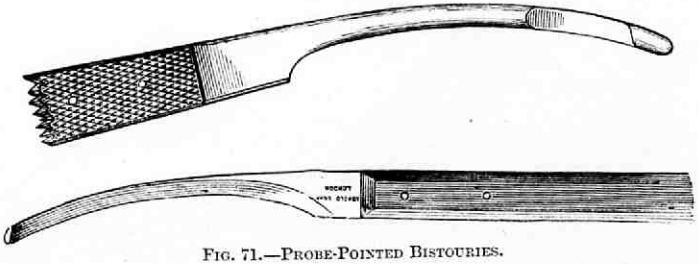

FIG. 71.—PROBE-POINTED BISTOURIES.

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

The *bistoury* may have a free or a concealed blade (*bistoury cachée*, Fig. 70)—the latter is employed for opening fistulæ and

sinuses; and it may have a sharp or a blunt point—probe-pointed (Figs. 71).

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

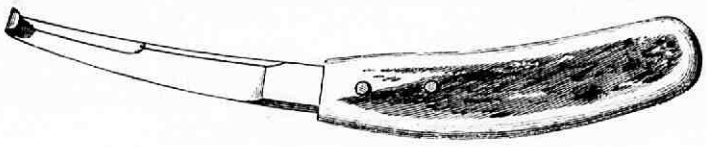

FIG. 72.—DRAWING-KNIFE, OR SEARCHER.

left side, and may have a double cutting edge (Fig. 72). 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.

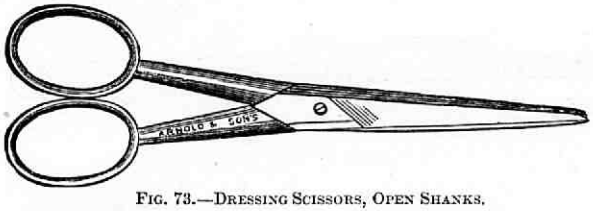

FIG. 73.—DRESSING SCISSORS, OPEN SHANKS.

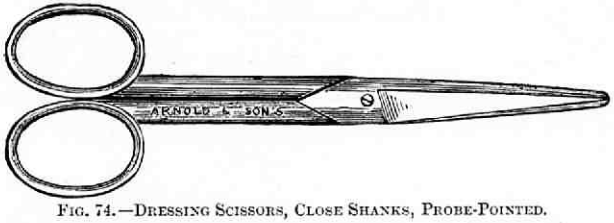

FIG. 74.—DRESSING SCISSORS, CLOSE SHANKS, PROBE-POINTED.

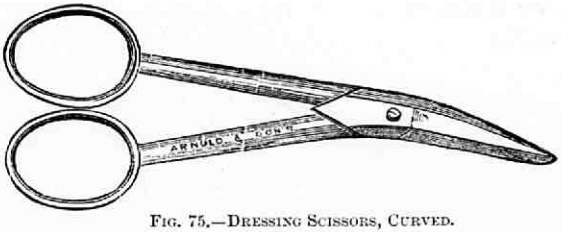

FIG. 75.—DRESSING SCISSORS, CURVED.

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 (*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

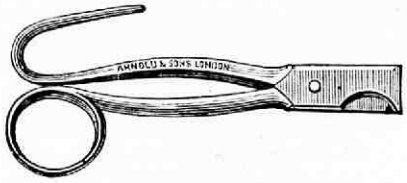

FIG. 76.—ROWELLING BISTOURY.

strong, and so arranged that it cuts the skin to a certain depth (Fig. 76).

The *forceps* are of various kinds, but the ordinary dissecting forceps is that generally used (Fig. 77). They should be moderately strong,

FIG. 77.—ORDINARY DISSECTING FORCEPS.

FIG. 78.—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. 78).

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. 79.—FIRST POSITION.

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

1*st Position.*—The first position (Fig. 79) 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.

2*nd Position.*—In this position (Figs. 80, 81), 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,

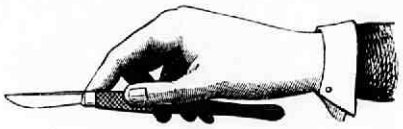

FIG. 80.—SECOND POSITION.

FIG. 81.—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.

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

FIG. 82.—THIRD POSITION.

(Fig. 82), instead of downwards towards the palm of the hand, and, like that position, is adapted for delicate and limited dissection.

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

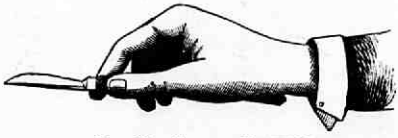

FIG. 83.—FOURTH POSITION.

the edge of the knife being in the opposite direction (Fig. 83), 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. 84.—FIFTH POSITION.

edge of the knife being directed towards the operator, and the left hand manipulating the director (Fig. 84).

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

FIG. 85.—SIXTH POSITION.

in dividing tendons, ligaments, or cartilages—this position (Fig. 85), 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

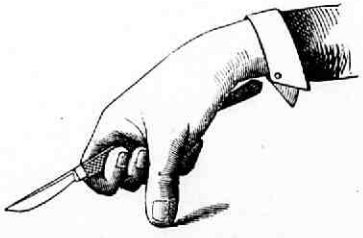

FIG. 86.—SEVENTH POSITION.

movement is limited, but must be steady and strong, the knife is firmly grasped in the hand: this rests on the pollex (Fig. 86), 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 ampu-

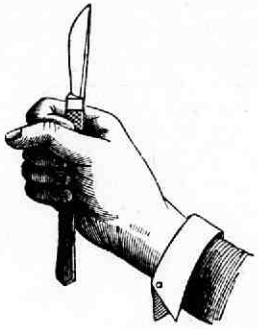

FIG. 87.—EIGHTH POSITION.

tations, the knife, which may be long, is held in the full grasp of the hand, blade upwards, and nearly vertical (Fig. 87).

MANNER OF HOLDING THE DRAWING-KNIFE OR SEARCHER.—For this useful 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. 88). In this position, in order to cut, the knife is

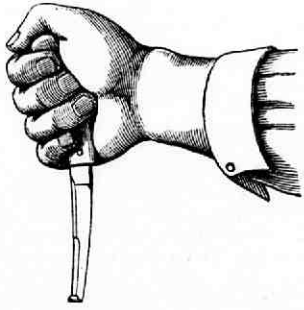

FIG. 88.—FIRST POSITION.

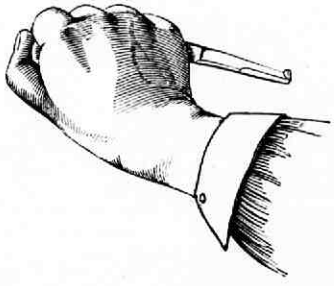

FIG. 89.—SECOND POSITION.

drawn towards the operator. When the resistance is very great, both hands may be employed to grasp the handle, or the left pollex 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. 89).

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 free from rust, and as clean, smooth, and sharp, as possible.

In general, all instruments should be washed, thoroughly dried, and slightly oiled as soon as possible after using. The washing may be done with a cloth or sponge, but the nail-brush should be used for the joints of nippers and the teeth of the saw. The wiping may be done with a towel, and then with a bit of cloth or chamois slightly oiled. All joints should be kept well oiled. The oiling should be especially thorough when instruments are to be packed away or disused for some time, and particularly at the sea-shore. Scalpels, and other instruments with wooden or ivory handles, should not be allowed to soak in water, lest the rivets become loose after drying. Wooden handles should be occasionally oiled. Scalpels and cutting instruments generally, and especially such as have keen edges and delicate points, should be protected from contact with each other and with other objects. If not kept in a case, they may be laid in a small tray, like the cover of a note-box, lined with chamois or velveteen. When several are to be carried at once, each handle should be held between two fingers, so that the blades may not touch.

In wiping a scalpel, hold it firmly in the left hand, and let the cloth cover the right thumb and index, as in wiping a table-knife; do not let the cloth come upon the edge. The scalpel should be wiped four times: first with a moist cloth to remove all blood and fragments; then with a dry cloth; then with an oiled cloth or chamois; and, finally, with a clean dry cloth or chamois. The fingers should not touch the blade after the final wiping. If the blades of scissors are lock jointed, they should be separated. The blades are to be treated like scalpels; clean the joint thoroughly, and keep it oiled.

All scalpels and delicate pointed instruments generally should be packed as follows: thrust the point into a bit of cork, then wrap well in a piece of thin paper, which should project well beyond the blade, and be twisted or bent over, so as to keep the cork in place.

Instruments that have become tarnished, may be repolished by rubbing with a piece of chamois or cloth on which has been put oil and rouge. Perhaps the best way to apply the polishing material is to wrap the cloth around the end of the index for small instruments, or roll the cloth or chamois into a bundle for large instruments. In both cases, the surface to be polished is rubbed as in scouring household knives, taking care to avoid contact with the edge of the instrument.

Rust should be removed with a dull knife, and then the polishing may be done as above. When an instrument is badly tarnished, the polishing with rouge is a tedious process; in this case fine emery may be used to remove the tarnish, and

then rouge for the final polish. The emery should be applied as directed for rouge.

Instruments may be very nicely polished by using, in place of rouge, the fine whitish ashes that may be found in grates or stoves in which anthracite coal is burned.

If rouge is added to the oiled leather used for wiping the instruments after they are washed, the polish may be retained indefinitely.

Sharpening Instruments.—For honing, it is desirable to have two oil-stones—one very fine for finishing, and one somewhat coarser for commencing the sharpening, and for sharpening the coarser instruments. Place several drops of fine olive oil, or sewing-machine oil, on the stone, and, with a cloth devoted to the purpose, rub the surface to remove all dirt, and expose the cutting particles of the stone. After the stone is well wiped, put two or three more drops of oil upon it, and spread it round with a scalpel.

Look at the edge of the instrument to be sharpened with a magnifying glass, holding the edge of the blade up and between the eye and the light. This is to see if there are any notches in the edge; if there are, they should be removed by rubbing the edge on the fine stone. After making two or three sweeps across the stone, look at the edge again to see if they are all removed. If they are not, continue to grind the edge on the stone till they are. If they are slight, the edge need be ground off only in their immediate neighbourhood; if they are deep, however, the entire edge should be removed, or it will become wavy. When the edge is smooth and free from nicks, it should be honed; if quite dull, first on the coarse, and then on the fine stone.

In case the instrument is a scalpel, (1) grasp the handle in such a way that the index and medius shall oppose the pollex, and the end of the handle shall touch the palm. (2) Place the blade flat on the stone, and then lift the back very slightly. (3) Move the knife with a curving sweep toward the left, so that the point of the blade shall be at the lower left corner at the end of the sweep. (4) Then turn the blade over, always turning the edge away from the stone. Do this by rolling the handle in the fingers. (5) After the knife is turned, it should be moved across the stone from left to right, exactly as described for the motion from right to left. The handle, of course, points in the opposite direction. In this method of honing, which is that employed by the best cutlers, *the edge precedes the back;* the blade is so placed on the stone that it follows the handle, and the sharpening is from heel to point. If the blade were pushed across the stone, instead of being drawn as above, the sharpening would be from point to heel.

In the beginning of the honing, one may press quite firmly, and draw the same side of the blade over the stone three or four times without turning it; but when the edge becomes thin, the blade should be turned at every sweep. In case the edge should turn over, producing the so-called *wire edge*, it must be removed by drawing the edge along some fine-grained substance, like horn or ebony. One should be careful not to get any of the detached wire edge on the stone, as it would be liable to produce nicks in the edge of the knife.

(1) Use the coarse stone until the knife will cut a thin shaving from the convex surface of smooth writing-paper. (2) Wrap the paper around a lead pencil, remove the pencil and rest the blade flat upon the paper. Press down slightly, and push the blade, *edge forward*, along the top of the curve. If the knife is sharp, it will cut a thin shaving from the paper. (3) Another very excellent way to judge of moderate sharpness is to rest the tang of the blade on the end of the medius, and to feel the edge by moving the ball of the index along it in such a way that if a cut were made it would be a mere shaving from the cuticle, like that from the paper. If the knife is sharp, it will *take hold*, as it is called, *i.e.* one can feel that it is cutting. The ball of the index is very sensitive, and one can judge quite correctly of the smoothness and sharpness of the edge.

When the edge is sufficiently sharp throughout its entire extent to cut a shaving from the cylindrical paper, or to take hold of the finger or the edge of the cork, the fine stone may be used. (1) In using this stone, the blade should be turned at every sweep, and continued until it will cut a hair near its base or near the point where it is held. (2) It often happens that some parts of an edge are sharp and others not. In such a case the dull parts alone can be applied to the stone

by using the edge of the stone. When the scalpel will cut a hair close to a fixed point, it is sufficiently sharp for ordinary dissecting.

In *stropping*, a good razor-strop is required to give the final keenness and smoothness to the edge of a cutting instrument. It is a waste of time to employ it before the degree of sharpness indicated for the fine stone is attained, as the strop sharpens very slowly. Grasp the knife and carry the blade across the strop with a long curving sweep exactly as in honing, except that the *back of the blade precedes the edge*. The blade should be turned at the end of every sweep across the strop, thus drawing it from right to left as often as from left to right. Use first the red and then the black side of the strop, pressing only moderately, and the nearer a perfect edge is attained the more lightly pressure should be made. Continue the stropping on the red side until the knife will cut a hair of the head a short distance from the point where it is grasped by the fingers—then employ the black side until the edge will cut the fine hairs from the back of the hand and wrist a short distance from their base when the knife is moved toward the fingers. If the knife has a perfect edge, it will cut these fine hairs so easily that one can hardly tell by the feeling when a hair is divided.

Scissors are much more difficult to sharpen than scalpels, and the fine ones should be sent to the cutler, unless the operator is very skilful. Place the blade, so that the oblique face formed by grinding shall rest flat on the stone. Draw the blade, edge foremost, across the stone with a curving sweep, as for scalpels. Test for sharpness with the finger, or by attempting to cut moistened tissue paper.

In sharpening *concave edges* generally, the edge of the stone—somewhat rounded—should be used, instead of its face. Draw the blade along the stone, so that the edge precedes the back, as for scalpels. Test the sharpness with the finger.—*Wilder and Gage*, 'Anatomical Technology.'

The drawing-knife and searcher are usually sharpened by rubbing them with the rounded edge of a rag-stone, a fine and small round file being used for the curved end.

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 shaved off by means of an old 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. 79, 85), 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

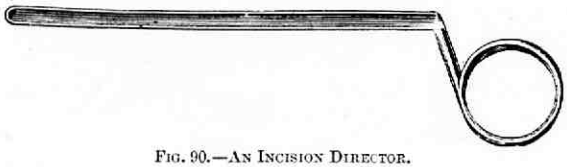

Fig. 90.—An Incision Director.

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 organs or tissues.

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. 90) or the finger, to guide the knife. The knife or bistoury may be held in the third or fourth position (Figs. 82, 83), 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. 83) 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. 91.—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. 84) the director or cannulated sound is most useful (Fig. 90). 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. 82, 84), 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. 83), 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. 82). 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. 79, 80, 81)—as to scrape, shave, pare, or dissect the part by short fine cuts. In order to do this, the overlaying 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 kind of movement. If necessary, the knife is held in the seventh position (Fig. 86), 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. 92).

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 perpendicular in the first or eighth position (Figs. 79, 87), 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

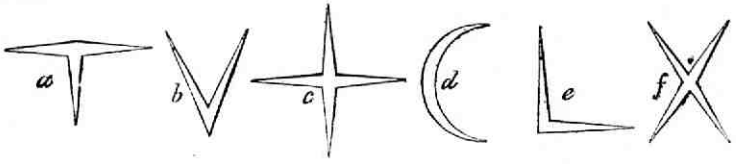

Fig. 92.—Form of Incisions: *a*, T-Shaped Incision; *b*, V-Shaped Incision; *c*, Crucial Incision; *d*, Crescentic Incision: *e*, Rectangular Incision; *f*, X-Shaped Incision.

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 traverse, 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, and 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 other 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

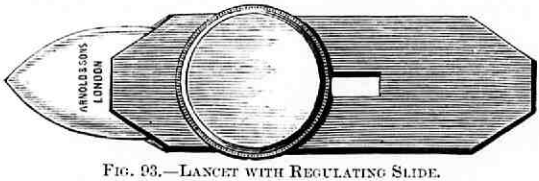

FIG. 93.—LANCET WITH REGULATING SLIDE.

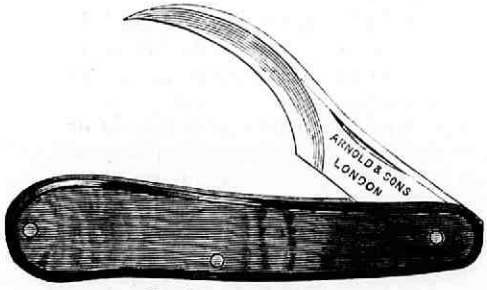

FIG. 94.—ABSCESS KNIFE.

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. 93). 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. 94).

To use the ordinary lancet, it may be firmly held like the knife in the first or second position (Fig. 95), 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

FIG. 95.—MANNER OF HOLDING THE LANCET.

FIG. 96.—ANOTHER MANNER OF HOLDING THE LANCET.

pollex and index, which are more or less advanced, according to the depth to which it is to be plunged, the other fingers being slightly flexed (Fig. 96). 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

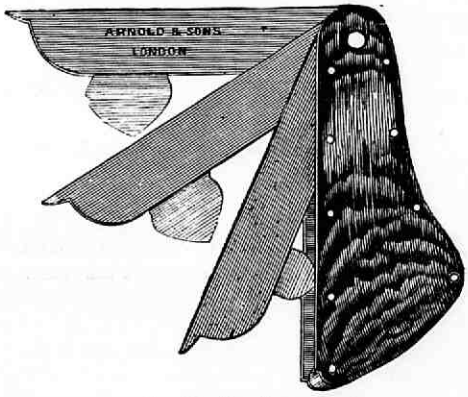

FIG. 97.—THE FLEAM.

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. 97). In consequence of this arrangement, the blade has only a certain depth of penetration—a circumstance which makes it useful in certain operations, as phlebotomy or phlebocentesis.

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. 98, or they may

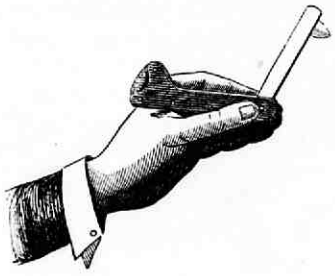

Fig. 98.—Manner of Holding the Fleam.

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

Fig. 99.—Trocar for Puncturing the Rumen.

Fig. 100.—Trocar for Puncturing the Chest.

Fig. 101.—Trocar for Puncturing the Intestine.

pyramidal point, the other being fixed in a wooden handle. 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 the purpose for which they are employed—the larger size being used for puncture of the rumen in the ox (Fig. 99), medium for the chest

(Fig. 100), and the smaller for puncture of the intestine in the horse (Fig. 101), and the exploration of tumours or cavities.

Sometimes trocars are slightly curved.

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. 102). The instrument is then pushed through the tissues by a slight rotatory motion

FIG. 102.—MANNER OF HOLDING THE TROCAR.

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 oil or 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

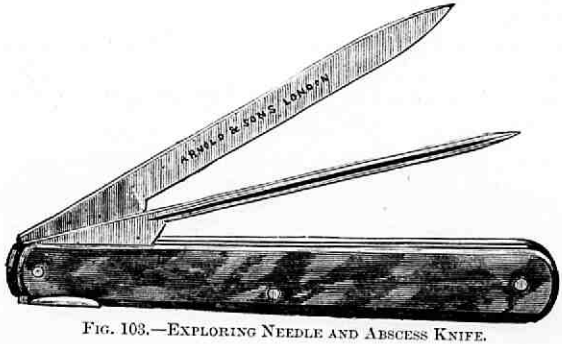

FIG. 103.—EXPLORING NEEDLE AND ABSCESS KNIFE.

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 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. 103-4-5-6). 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 needle, it may be punctured or incised by a lancet or bistoury, and

Fig. 104.—Fine Exploring Needle.

Fig. 105.—Improved Exploring Needle.

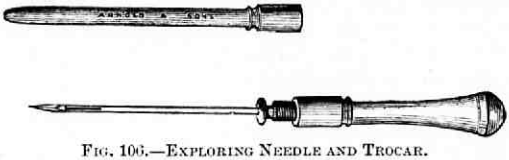

Fig. 106.—Exploring Needle and Trocar.

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 Injecting Syringe-needle.*—This differs but little from puncturing with the finer exploring-needle. With thick-skinned animals, it often expedites the operation, and

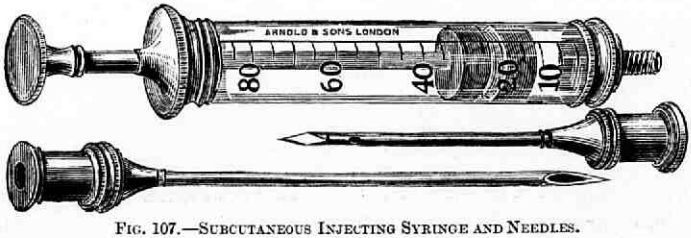

Fig. 107.—Subcutaneous Injecting Syringe and Needles.

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 or stylet (as in Fig. 107), this is not necessary, all that is required being to raise a fold of skin, push the trocar through the base of it, beneath the level portion, into the subcutaneous connective-tissue ; then withdraw the stylet, 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, and which is effected by a suction instrument invented by him, is of much value in exploratory puncture, and especially in withdrawing fluid

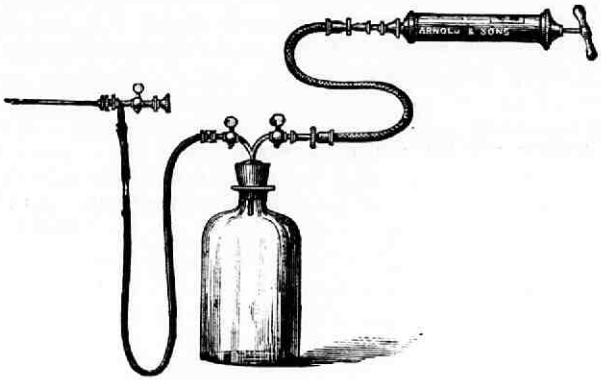

FIG. 108.—MODIFIED ASPIRATOR.

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

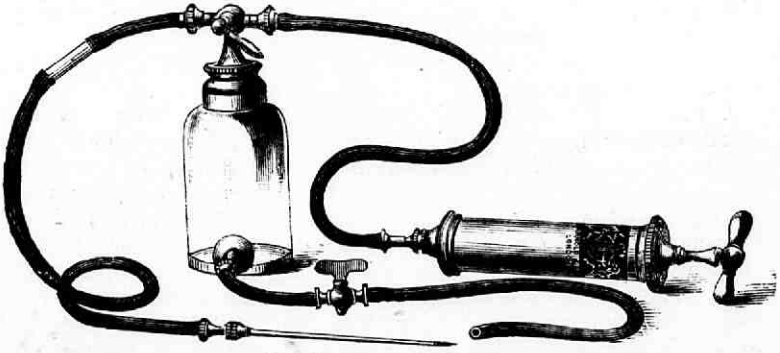

FIG. 109.—IMPROVED ASPIRATOR.

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. 108, 109). 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. 109), 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

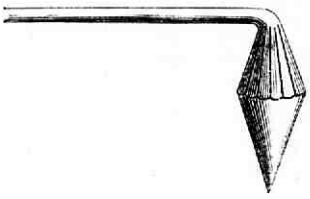

Fig. 110.—Puncture Cautery.

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. 110), 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 of any subsequent collection of matter. 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 (HÆMOSTASIA).

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, uncipressure, 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 Ordinary Bandage*—An ordinary 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 presses the blood out from the member. An incision may be made through the bandage, in order to expose

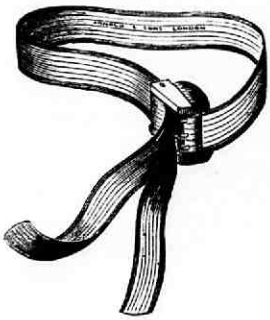

FIG. 111.—FIELD'S TOURNIQUET.

the part to be operated upon (as in neurotomy), without greatly diminishing the constriction caused by the bandage.

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 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. 111) consists of a strong webbing strap with brass fastener, through which the strap is drawn to tighten 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 rope or 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 of bandage, or 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 gangrene may result.

5. *Compression by Elastic Band or Bandage.*—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 bandages 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 pound 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.

Instead of applying a bandage, if it were possible to hold the limb vertical for a time (as by placing the animal dorsicumbent), then apply the elastic tourniquet, there would 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 110° to 125° will temporarily arrest bleeding from such organs as the vagina or 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 tow or charpie 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, contracting, or coagulating the tissues and effused blood.

Perhaps the best of all the chemical hæmostatics is the *liquor ferri sesquichlorati*, which forms with the blood a dark leathery *magma* or clot, that adheres very closely and tenaciously. 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. This styptic has the disadvantage of producing a subsequent slough, beneath which sanious suppuration takes place.

Nitrate of silver and potassa fusa 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 produce a thin layer of slough, and thus retard union.

Cauterization.—Chemical or *potential* caustics are not often employed in veterinary surgery, as the actual cautery or hot iron (*ferrum candens*) is simpler, more potent and controllable. 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 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*, *acupressure*, and *uncipressure*.

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 tow, lint, cotton or charpie, and bringing the borders together by means of *sutures* (*interrupted*, *twisted*, *continuous*), or *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 gangrene.

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 it fingers upon 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 subdue 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 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 charpie, in order to stop bleeding. From the readiness 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. In some cases, as in bleeding from the rectum, uterus, vagina, or nostril, plugging with loose, detached pieces of tow, lint, or charpie, is inconvenient or unsatisfactory. It will be found advantageous to the operator, and more comfortable to the patient, to make a plug, or *tampon*, by taking a piece of cloth, cotton, or linen, from one to two or three feet square, according to the region and the size of the animal; place the fingers of one hand in the centre of it, and so pass it into the cavity to the necessary depth; the space left by the hand can then be filled with tow or other material, so as to fully distend it, and in this way cause pressure on the bleeding surface. This plug may be left in for a day or two, removal being effected by gentle traction on the cloth.

LIGATURE.—Ligation of a bloodvessel consists in tying a 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, hæmorrhage from veins being only exceptionally checked in this way—and then they are large venous trunks. Ligation of veins should be avoided, as it is apt to induce phlebitis; 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 relational 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 escape embarrassment should the parts not present their usual arrangement.

The instruments required are: *ordinary dissecting forceps* (Fig. 77); *dissecting scalpel* (Fig. 66); *artery forceps* of various kinds, provided with springs which cause them to retain hold of the vessel (Figs. 112, 113); *artery clamps* (Figs. 114, 115); *tenaculum* (Fig. 116);

FIG. 112.—ARTERY FORCEPS.

aneurism-needle (Fig. 117); *steel director*, with the groove opening at its extremity (no *cul-de-sac*); *retractors*, or *blunt hooks*; *suture materials.*

For mediate or immediate ligation, the scalpel, dissecting forceps,

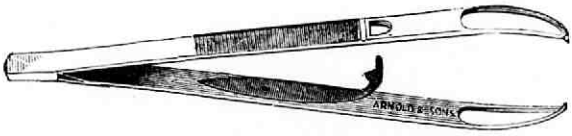

FIG. 113.—IMPROVED ARTERY FORCEPS.

artery forceps and clamps, tenaculum, and ligature material, are only necessary; for ligation in continuity, the other instruments are required in addition. It is well, if possible, to have the forceps and other instruments nickel-plated, to prevent rusting.

FIG. 114.
DIEFFENBACH'S ARTERY FORCEPS, OR CLAMP.

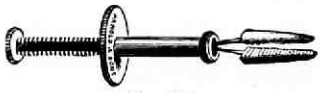

FIG. 115.
IMPROVED ARTERY FORCEPS, OR CLAMP.

The ligature may be of strong lint, or silk thread, twine, catgut, or other material.* The lint, or silk thread, should be sufficiently strong, and be well waxed, to prevent it fraying or untwining, and also to assist in securing the knots. The catgut ligature is rendered

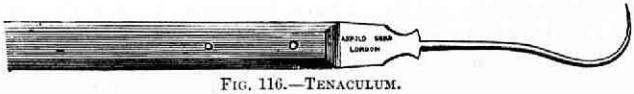

FIG. 116.—TENACULUM.

antiseptic, by steeping the catgut, first in a solution of chromic acid (1 per cent.) for twelve hours, and subsequently in sulphurous acid

* Messrs. Arnold and Sons, of 35, West Smithfield, London, supply an excellent ligature silk which possesses the following advantages: It is pure silk, free from all dressing or colouring matter; it will not kink or curl under any circumstances; is of great strength, and being plaited, will tie securely without untwisting.

for the same length of time, then dried. Before using, it should be plunged into a watery solution of carbolic acid, which can be kept on the tray containing the instruments. It is supposed that catgut ligatures, and other ligatures composed of animal tissues, may be absorbed in the wound, in the course of time, and thus allow of more speedy healing. But whether these, or lint or silk ligatures, are employed, their effects are the same.

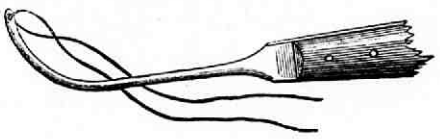

FIG. 117.—ANEURISM NEEDLE.

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.

Sometimes the ligatures are metallic.

Allusion will be made hereafter to the antiseptic procedure sometimes adopted during the performance of certain operations, and in the treatment of wounds.

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. 118). Whether or not there is an assistant, the artery is occluded by placing the middle of the thread below it; then, carrying up both ends, make first a simple knot (Fig. 118), 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 tighten and tie the thread (Fig. 119). It is necessary to form the knots properly, as in Fig. 120; if they are tied as in Fig 121 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 is

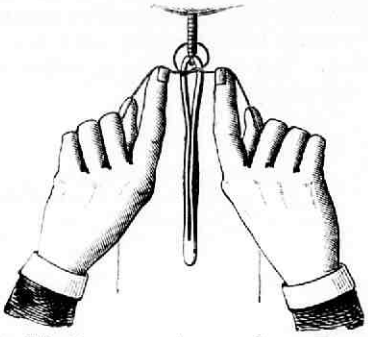

FIG. 118.—LIGATING AN ARTERY: SIMPLE KNOT.

properly applied, when the forceps are loosened there is no bleeding from the vessel.

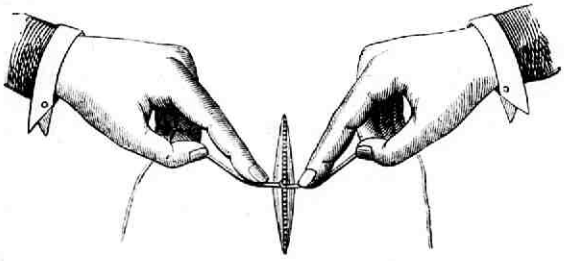

FIG. 119.—APPLYING A LIGATURE TO AN ARTERY.

One end of the thread is cut off, the other being left hanging from the wound, and in from six to ten days the thread may be

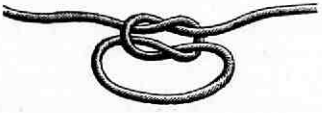

FIG. 120.
LIGATURE PROPERLY TIED.

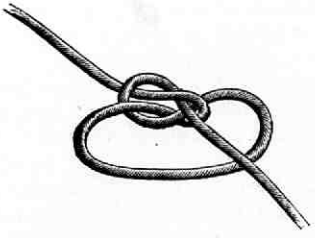

FIG. 121.
LIGATURE IMPROPERLY TIED.

entirely removed by gentle traction. Sometimes, when the wound has to be closed, both ends are cut off when the ligature is tied, the

remaining portion becoming encysted; but this procedure is not to be recommended with the horse, as abscess may form. Metallic or catgut ligatures are more 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 chance to 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-waxed thread, is passed, or made to 'dip,' through the tissues whence the bleeding proceeds, and which have been drawn forward by forceps or the tenaculum. The needle being withdrawn, the thread is brought round the part, but as little of the tissues as possible, so as to enclose the entire end of the artery, and tied firmly, as above directed.

Mediate is not so certain or satisfactory as immediate ligation, and can only be regarded as an exceptional proceeding; as the ligated tissue dies, or the ligature suppurates through very slowly, so that it requires a long time to separate, while the constriction of the vessel is not great. 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 required as in the other kinds of ligation, and, in addition, an aneurism-needle and ligature thread or wire.

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 at 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 slightly stretched by the middle finger and thumb of the left hand,

placed on each side of the line of incision (Fig. 122). The scalpel should be held in the first position (Fig. 79), or in a slight modification of that position (Fig. 122).

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,

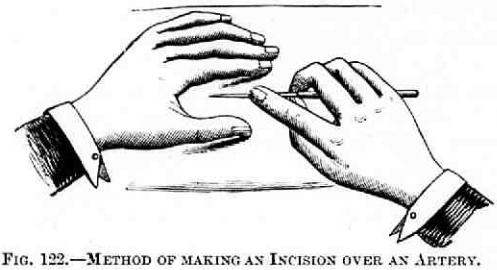

FIG. 122.—METHOD OF MAKING AN INCISION OVER AN ARTERY.

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. 84), which is inserted through a small hole made by pinching up the parts with the forceps, and cutting with the blade of the knife on the flat (Fig. 123). Muscles may also have to be divided, but this should

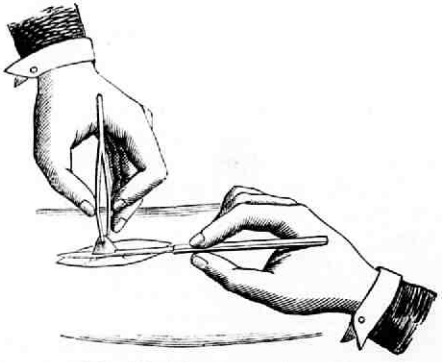

FIG. 123.—EXPOSING AN ARTERY.

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 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. 123). 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 waxed ligature (Fig. 117), is introduced beneath the vessel, the point being inserted between it and neighbouring vessels and structures, and turned round the latter (Fig. 124), 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 may now be scratched through with the finger-nail, or 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 had 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. 118, 119, 125), 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. 119, 125); 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. 120). 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

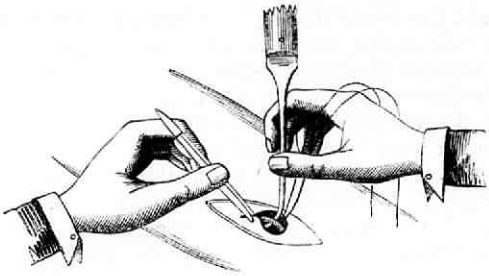

FIG. 124.—PASSING THE LIGATURE UNDER AN ARTERY.

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* side of the artery will at once discover whether pulsation is stopped and the vessel secured.

One end of the ligature is then cut off close to the knot on the vessel, and the other end allowed to hang out of the wound, which may be partly closed by a few points of suture, or by a bandage

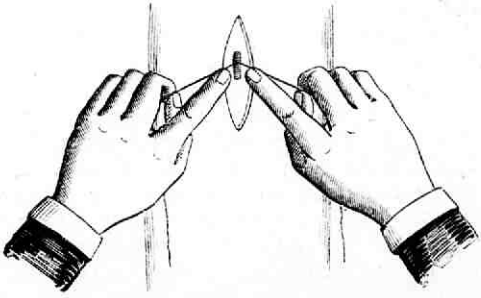

FIG. 125.—LIGATING AN ARTERY IN ITS CONTINUITY.

and compress—an appropriate dressing, if necessary, being previously placed on the wound. 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 itself 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 Ligatures.—The application of a ligature to an 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, fibrine is quickly deposited, and in the course of fifteen or twenty hours there is a clot extending to the first collateral branch; this clot gradually consolidates, fills the vessel, and prevents the admission of blood after twenty or thirty hours.

These phenomena succeed each other more rapidly as the animal is young, healthy, and the blood plastic. With cattle, as with weak animals, they are more tardy.

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.

After a time this clot becomes filiform at its free extremity, and is gradually absorbed.

The first effect of the ligature is to cause adhesive inflammation in the constricted artery; after four or five days, suppuration occurs at the seat of ligature, when the latter is detached usually from the tenth to the fifteenth day. Sometimes the suppurative process set up by the ligature destroys the adhesions, and the thrombus or clot cannot resist the pressure of the blood, which is only prevented from escaping by the union that has taken place between the two inner coats. Therefore the necessity for employing gentle traction on the ligature when division of the artery is near—from the tenth day, in order to remove it early, as its presence may increase the inflammation and carry it on to suppuration.

In ligating arteries, the operator should remember that the ligature ought to be so applied as to *cut* through the two inner coats of the vessel, leaving only the outer coat intact. It ought also to be applied transversely to the diameter of the vessel, pressing the loop down closely upon it with each forefinger, so as not to include the point of the forceps; and in tightening the loop to press downwards the threads adjoining it, that its hold may be retained. Extraneous textures should not be included, if possible, as they might cause the ligature to become loosened. Neither should the ligature be applied to any *projecting* portion of the artery, as the vessel is there denuded of its proper nutrient vessels (*vasa vasorum*); as a consequence, plastic lymph is not thrown out, and when the slough-ring separates hæmorrhage is inevitable.

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 and fibrine form a plug. Arteries of all sizes may be occluded by torsion—small vessels being readily occluded by a few turns of the ordinary forceps.

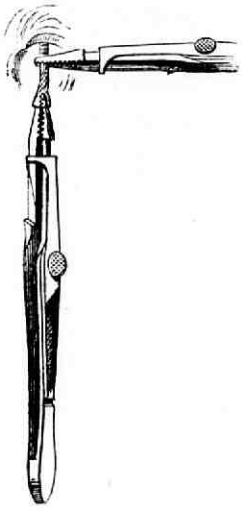

FIG. 126.—TORSION OF AN ARTERY.

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

a. The artery may be gently withdrawn from the tissues, and isolated for about half an inch by one pair of serrated artery forceps which seize it somewhat obliquely, while its attachment is firmly held transversely by another pair; the free portion is then twisted off in about a dozen turns, steadily made by the first pair (Fig. 126).

b. The end of the vessel is drawn forward half an inch, seized in

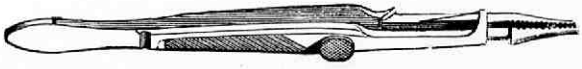

FIG. 127.—TORSION FORCEPS.

the same manner, and merely twisted several times, without screwing it off entirely.

In arresting hæmorrhage by torsion, the forceps should be strong and accurately closing, and the points of the pair which seizes 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. 126, 127).

Torsion is, from several points of view, preferable to ligation. The twisted portion of an artery not being killed, no sloughing of the end ensues when this portion is allowed to remain in the wound, if other circumstances are favourable.

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. The twisted condition of the artery, itself usually a persistent change, and the reduplicated sheath of the two inner coats, above, acting as a valve, are quite sufficient provision against the recurrence of hæmorrhage at the time of operation and subsequently; but there is also the supervention of clot-formation from this sheath, and extending further up the vessel.

ACUPRESSURE.—This is the temporary metallic compression of an artery, and it may be accomplished in either of 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.*

In one form or other, 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 purulent or other 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. Thus the artery is plugged, and the plug undergoes structural changes, becoming adherent to the

* I have employed this method of acupressure on two occasions, with complete success. One of these was a wound inflicted by a cavalry lance, which divided the metacarpal artery. No facilities being at hand, a long brass pin and a piece of twine were employed to arrest the hæmorrhage.

interior of the vessel. But there are no changes in the coats of the vessel itself at the seat of acupressure—no division of the inner coats; 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.

UNCIPRESSURE.—Where there is bleeding from a deep wound and the artery cannot be directly seized, traction made with the tenaculum in a certain direction compresses the vessel by the tension, and thus arrests the hæmorrhage. Forced compression of this kind, where the artery is not very accessible, may be made by means of spring forceps. The bleeding vessel may be isolated or seized with surrounding tissues, the forceps being left in place for a few minutes for small arteries, and for larger ones as long as twenty-four hours, when they will be occluded by coagulum.

Other methods of arresting hæmorrhage have been proposed, and may sometimes be adopted with advantage. One of these is *scraping* through the coats of the artery with a jagged-edged knife. The artery being exposed, and held tense, a few light scrapes up and down lacerate the coats and produce the same result as torsion.

Another method is tearing the artery—a method adopted more especially in the castration of young animals.

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, of the same species—or of an alcoholic saline solution. Transfusion may be accomplished by means of an ordinary glass-syringe, fitted with a stop-cock and a cannula. 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. 128, *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

* See *Lancet*, vol. ii. 1882, p. 435.

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 adherent on the inner surface of 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

FIG. 128.—TRANSFUSING APPARATUS: *a*, LE PAGE'S; *b*, AVELING'S.

grains; chloride of sodium, thirty grains. One fourth of the powder 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 the glass-syringe is used, a clean vessel, rather deep to retard

coagulation, should receive the blood—both it and the syringe being warmed up to the temperature of the blood.

A subcutaneous vein having been opened in the patient—the opening being only large enough to admit the cannula of the syringe,—and the blood having been drawn at the same time from the healthy animal into the receptacle, the syringe is filled from this, and passed into the cannula in a slow and equable stream.

In this procedure, care must be taken that no bubbles of air are injected, that the transfused blood does not approach to coagulation, and that the vein be not injured by the cannula.

If blood cannot be procured, warm water may be injected. (See 'Operations on Veins.')

SECTION V.

CLOSURE OF WOUNDS.

After cleansing 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*, or *bandages*, and *compresses*, after bringing the sides of the wounds into direct and close apposition.

Adhesive Plasters.

Adhesive plasters are of much utility in veterinary surgery, when properly applied; they are particularly valuable in the case of the smaller animals, or in the union of a wound when there is not much traction or movement, where the skin is thin and vascular, and when it is scarcely divided, or 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, and which will adhere quickly and strongly to the parts to which they are applied. Sometimes isinglass-plaster (a solution of ichthyocolla in water, mixed with a little spirits of wine, and painted over a thin firm silk-stuff or paper) 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.* 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-Arabic 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, just as the wound is likely to unite without or with suppuration; 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 or 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—which is, however, rare in the horse—or cicatrization; 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

* 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.

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.

Sutures are themselves a source of irritation, and often they tear out and further disfigure the part; while their application is always painful.

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 cold water, or light brushing with a wet sponge, 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, cauterized by the hot iron, rubbed with tincture of arnica, alcohol, or oil of turpentine, or be trimmed by means of sharp scissors; the cessation of bleeding need not be waited for. 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 between the thumb and index of the left hand—when from within to without, two fingers of the same hand 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 the escape of discharges.

MATERIALS AND INSTRUMENTS.—The chief suture material is thread, or fine cord, made of hemp, lint, or silk, 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 thread should not be too thin, as it is then more apt to cut through the parts. The thread may be single, or formed by the union of two or more threads bound closely together by beeswax, to make a flat thread, which has a wider surface, and is less likely to cut through the tissues. Arnold's plaited ligature-silk answers well for sutures.

In veterinary surgery it is not unfrequently 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. This suture-wire possesses the advantage of strength, fineness, causing less irritation, and remaining longer in the wound without exciting inflammation or ulceration, than the thread. 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. It admits, therefore, of ready introduction and knotting as a suture, and it may be left in the tissues for many days without inducing suppuration or inflammation along its track. 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 special form of suture instrument (Fig. 129) has been devised by Captain Russell, F.R.C.V.S., 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 or prolapsus of the vagina

or uterus, 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

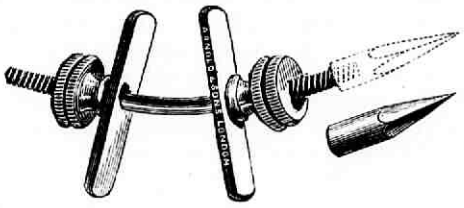

FIG. 129.—SUTURE INSTRUMENT.

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 nickel-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 purposes (Figs. 130, 131). 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. 131).

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.

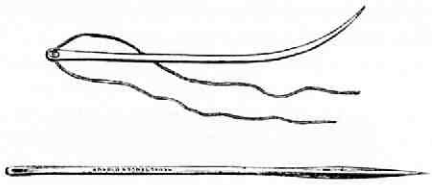

FIG. 130.—SUTURE NEEDLES: SMALL, FOR THREAD.

FIG. 131.—SUTURE NEEDLES: LARGE, FOR WIRE.

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 dissecting-

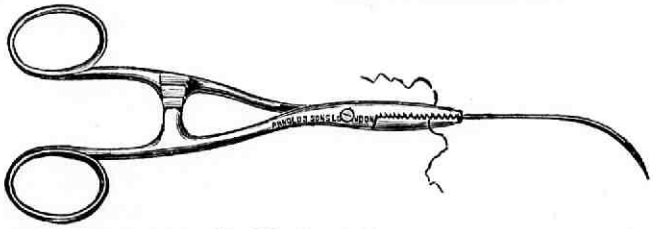

FIG. 132.—SUTURE FORCEPS.

forceps, pliers, or special forceps (Dieffenbach's forceps, Fig. 132, is the best), 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

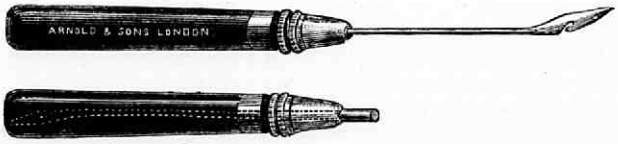

FIG. 133.—IMPROVED SUTURE NEEDLE WITH HANDLE.

instrument through the tissues (Fig. 133). 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. 134).

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.

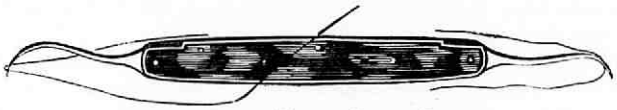

FIG. 134.—FOLDING TUBULAR SUTURE NEEDLE.

A very useful instrument of this kind is shown in the annexed figure (Fig. 135). 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-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.

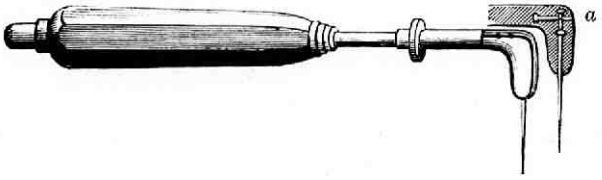

FIG. 135.—PIN FORCEPS, OR DIRECTOR.

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 the 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 introduction 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 undesirable or unnecessary. It is formed by separate threads passed between the borders of the solution of continuity, and tied independently. Commencing in the 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 its depth 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 as

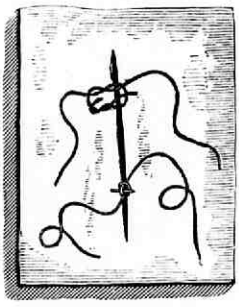

FIG. 136.
INTERRUPTED SUTURES: TYING.

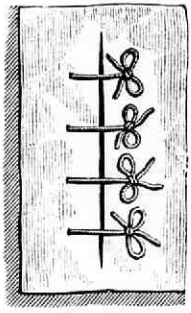

FIG. 137.
INTERRUPTED SUTURES: TIED.

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 the wound, as it might not allow pus to escape.

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. 136), or a bow and end knot (Fig. 137); 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. 137).

2. *Looped Suture.*—This somewhat resembles the interrupted

suture, and is useful in special cases, as in wounds of the intestine, uterus, etc. 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 non-waxed 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. 138), 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 intestines, and thin parts of the skin. Unless carefully applied, however, it is apt to corrugate the lips of the wound, and has the additional disadvantage,

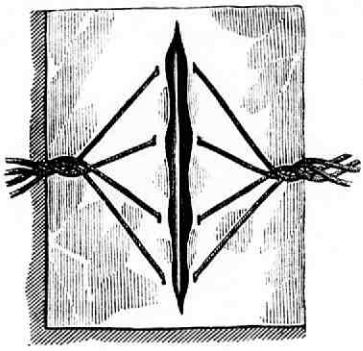

FIG. 138.
LOOPED SUTURE.

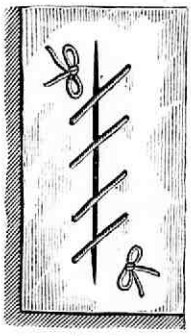

FIG. 139.
UNINTERRUPTED SUTURE.

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. 139). 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 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 common brass pins of small or large size, steel 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 thread (waxed, if need be), twine, 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. 140),

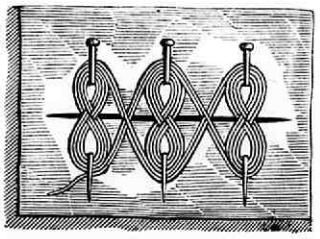

Fig. 140.
Twisted Suture: Figure of 8 Twist.

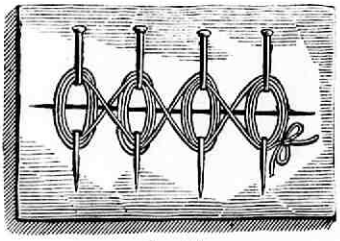

Fig. 141.
Twisted Suture: Circular Twist.

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 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. 141).

5. *Single Pin Suture.*—This is a useful suture for a small incision, 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 thread or tow being made into a double loop or hitch, the end portions inwards (Fig. 142), 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

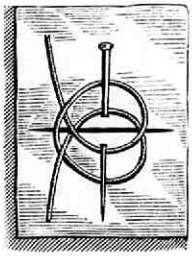

FIG. 142.
SINGLE PIN SUTURE.

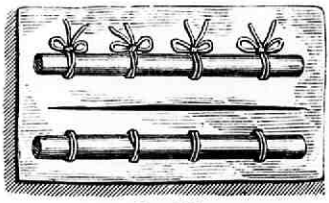

FIG. 143.
QUILLED SUTURE.

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. 133). 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, gum catheter, 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. 143).

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 between the left thumb and index, 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

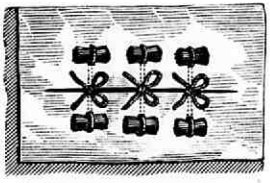

Fig. 144.
Dossiled Suture.

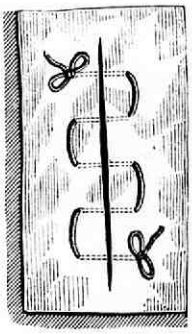

Fig. 145.
Zigzag Suture.

is tied in the centre of the wound (Fig. 144), 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. 145).

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

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. 146).

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

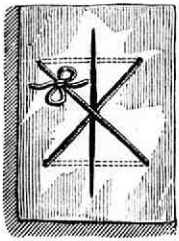

FIG. 146.—X SUTURE.

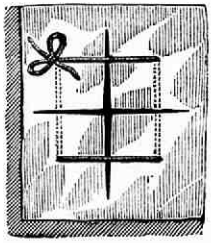

FIG. 147.—T SUTURE.

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. 147).

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 tension. 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.

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, 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 quilled 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, like wire, it is non-absorbent, or nearly so, 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 species and age of the animal, the nature and thickness of the tissues involved, the character of the wound, and the thickness or otherwise, as well as the material, of the sutures. 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; suppuration occurs more readily in the horse and dog than the ox and pig; 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 putrid 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.

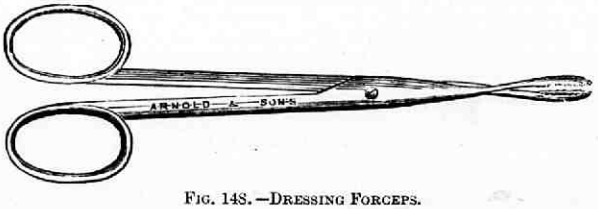

FIG. 148.—DRESSING FORCEPS.

The instruments usually required are the ordinary curved trimming scissors; dissecting or dressing scissors (Figs. 73, 74, or 75); dissecting-forceps (Fig. 77); dressing-forceps (Fig. 148), to remove

foreign bodies and old dressings; scalpel (Figs. 66, 67); bistoury (Figs. 70, 71); probes of various sizes, in silver, whalebone, or lead; syringes—large and small—to wash out wounds and inject fluids

FIG. 149.—SYRINGE FOR WASHING OUT WOUNDS.

(Figs. 149, 150)—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

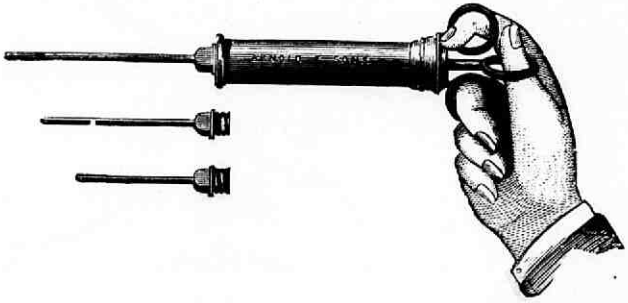

FIG. 150.—SYRINGE FOR INJECTING FLUID INTO WOUNDS AND FISTULÆ.

silver (Fig. 151); spray-producer (Fig. 152). The latter is a bottle (containing solution of carbolic acid) fitted with from one to three flexible tubes, to direct the spray in one or more directions, when it is

FIG. 151.—CAUSTIC HOLDER.

propelled by the hand-bellows in communication with them, by means of another pliable tube.

B. Materials.

The materials are applied immediately to the surface of the wound, in order to absorb discharges, protect it from the air or other external influence, maintain warmth, promote healing, afford pressure and support, etc.

The most important material in veterinary surgery is *tow*, which takes the place of lint and charpie in human surgery, and is the coarse or broken part of flax or hemp; it is preferred to the long

hemp itself. There are two kinds—coarse and fine—but the latter is chiefly employed. It should be fine, soft, clean, and free from rough portions. It imbibes fluids, forms a good medium for the application of remedies, and assists cicatrization. It is sometimes cut up into short pieces with scissors, and applied 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. 152.—FLEXIBLE SPRAY PRODUCER.

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 seton in 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, *cotton*, *cotton-wool*, *charpie*, and other similar materials 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.

FIG. 153.—SQUARE COMPRESS.

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

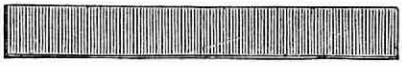

FIG. 154.—LONG COMPRESS.

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

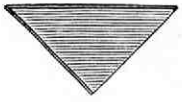

FIG. 155.—TRIANGULAR COMPRESS.

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. 153), as its name implies, is a perfect square, formed by folding the cloth in that

FIG. 156.—CRAVAT COMPRESS.

manner. The *long compress* (Fig. 154), may be the same piece of cloth folded lengthwise; while the triangular compress (Fig. 155) is the square compress doubled so as to bring its two angles together. The *cravat compress* (Fig. 156) is the triangular compress folded two

or three times from the apex to the base; and the *Maltese Cross compress* (Fig. 157), and *half Maltese Cross* (Fig. 158), are formed from the square compress—in the first the four angles are divided, and in the second only two. The *double-tailed* (Fig. 159) and *treble-tailed compress* (Fig. 160) are folds of cloth with one or two long cuts at

FIG. 157.
MALTESE CROSS COMPRESS.

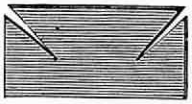

FIG. 158.
HALF MALTESE CROSS COMPRESS.

one or both ends. The *graduated compress* (Fig. 161 *a*, *b*) is a long and wide compress doubled several times in a series of gradually decreasing folds, to form a kind of prismatic-shaped mass. It is useful to

FIG. 159.
DOUBLE-TAILED COMPRESS.

FIG. 160.
TREBLE-TAILED COMPRESS.

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. 162) is

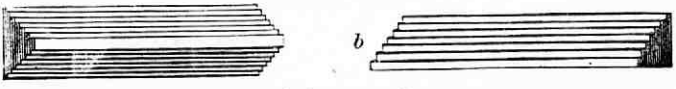

FIG. 161.—*a*, *b*, GRADUATED COMPRESS.

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 em-

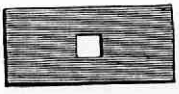

FIG. 162.—PERFORATED COMPRESS.

ployed in veterinary surgery. *Bands* may be of tape, or long strips 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 from three to six inches wide, and of variable length—generally one or two yards. It may be torn 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

FIG. 163.
BANDAGE IN SINGLE ROLL.

FIG. 164.
BANDAGE IN DOUBLE ROLL.

one end for a few inches, and tying the divisions in a simple knot so as to prevent further tearing. 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. 163) has

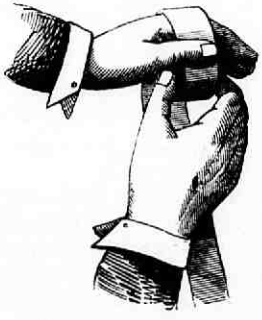

FIG. 165.—MANNER OF ROLLING BANDAGE.

one end free, the other being in the centre of the roll. In the *double-roll bandage* (Fig. 164) 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. 165).

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 some medicament; 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

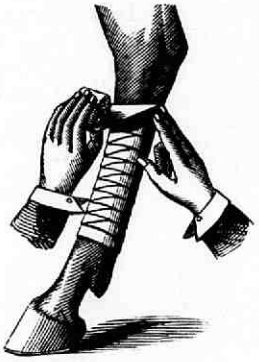

FIG. 166.—MANNER OF APPLYING A SPIRAL BANDAGE IN HALF-TWISTS.

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, the fingers of the other hand preventing the bandage slackening (Fig. 166). 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 trunk 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. 166. 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. 167.
SIMPLE FOREHEAD-BANDAGE
(FRONT VIEW).

FIG. 168.
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. 167, 168; 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. 169, 170).

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. 169.
COMPOUND FOREHEAD BANDAGE (FRONT VIEW).

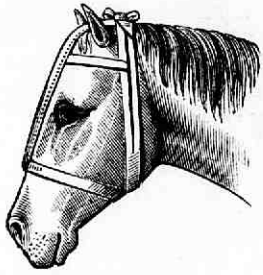

FIG. 170.
COMPOUND FOREHEAD BANDAGE (SIDE VIEW).

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. 171, 172).

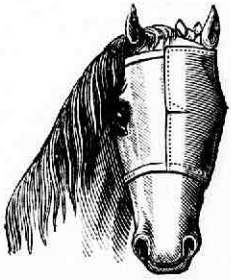

FIG. 171.
MONOCULAR BANDAGE (FRONT VIEW).

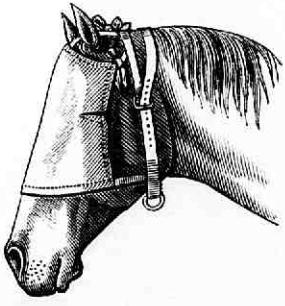

FIG. 172.
MONOCULAR BANDAGE (SIDE VIEW).

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. 173, 174).

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

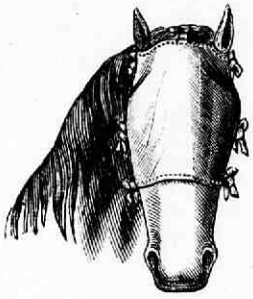

FIG. 173.
BINOCULAR BANDAGE (FRONT VIEW).

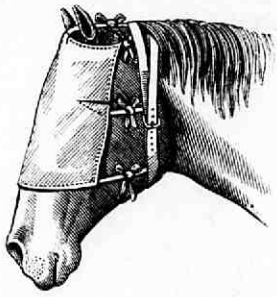

FIG. 174.
BINOCULAR BANDAGE (SIDE VIEW).

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. 175.
EAR BANDAGE (FRONT VIEW).

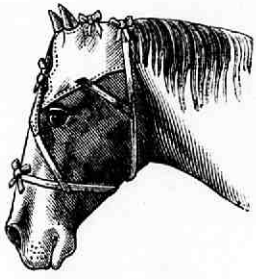

FIG. 176.
EAR BANDAGE (SIDE VIEW).

as to keep the ears erect, by tying together—two and two—the tapes or bands sown on their inner border (Figs. 175, 176).

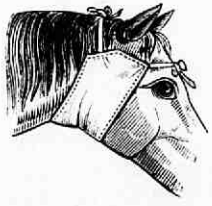

FIG. 177.—THROAT BANDAGE.

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 moss-peat, kept in position by quilting. It may be advantageously made, at times, of sheep or lamb's skin.

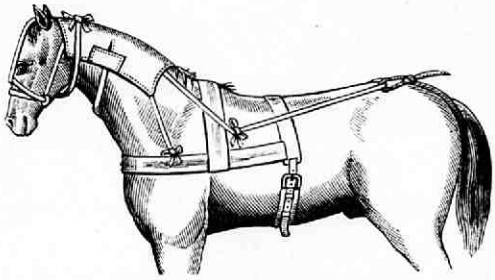

FIG. 178.—TOP OF NECK BANDAGE.

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

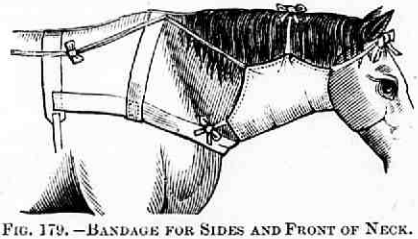

FIG. 179.—BANDAGE FOR SIDES AND FRONT OF NECK.

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. 178). 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. 179).

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

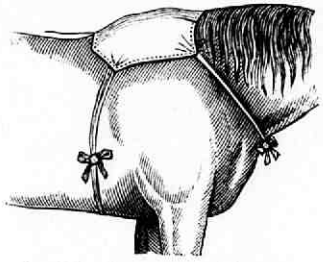

FIG. 180.—BANDAGE FOR WITHERS.

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. 180).

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

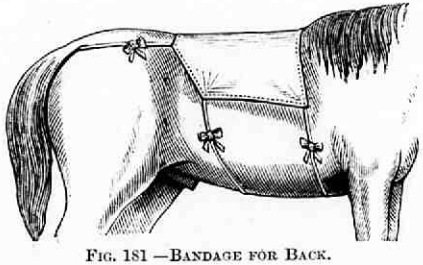

FIG. 181.—BANDAGE FOR BACK.

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. 181).

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. 182).

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

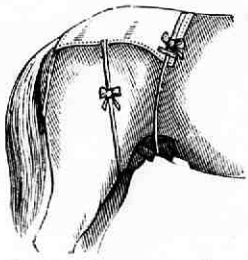

FIG. 182.—BANDAGE FOR CROUP.

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

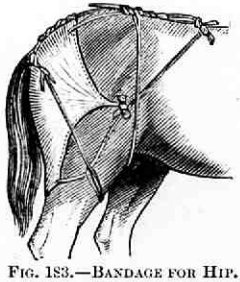

FIG. 183.—BANDAGE FOR HIP.

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. 183).

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 into the perinæum. It has four bands at each corner, the two anterior (Fig. 184, *a*, *a*) passing upwards inside 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. 185). This bandage may be employed to cover wounds in this region, and as a suspensory

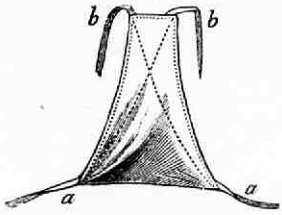

FIG. 184.—BANDAGE FOR TESTICLES, FORM OF.

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

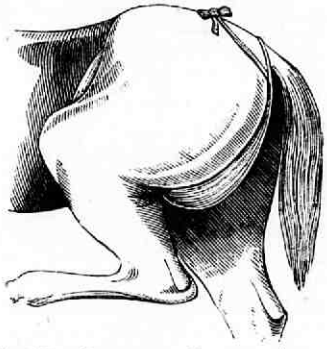

FIG. 185.—BANDAGE FOR TESTICLES, APPLIED.

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. 186.—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. 186).

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

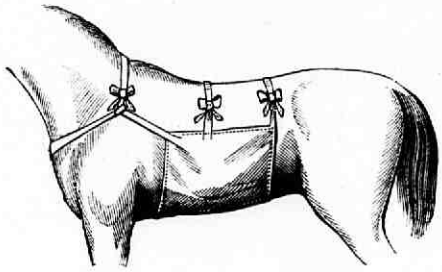

FIG. 187.—BANDAGE FOR ABDOMEN.

on the withers. A cross-band may pass between the latter, across the chest, to keep the bandage forward (Fig. 187).

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. 188.—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. 188).

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. 189).

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

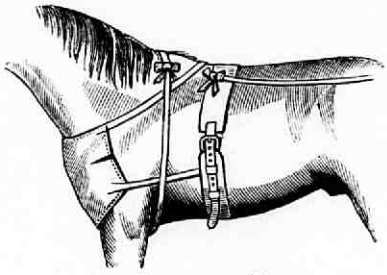

FIG. 189.—BANDAGE FOR BREAST.

and the front of the arm. It is placed obliquely on the shoulder. The two upper bands (Fig. 190, *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

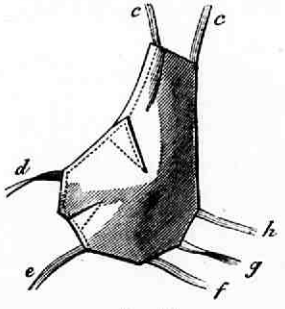

FIG. 190.
BANDAGE FOR SHOULDER, FORM OF.

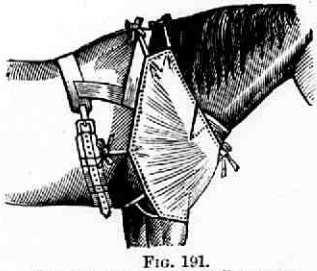

FIG. 191.
BANDAGE FOR POINT OF SHOULDER, APPLIED.

side of the withers, while the two upper posterior bands are tied to the surcingle (Fig. 191).

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 (Fig. 192).

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-arm. Above

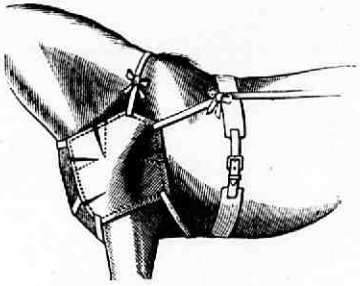

FIG. 192.—BANDAGE FOR SHOULDER, APPLIED.

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. 193).

21. *Bandage for the Elbow.*—This is a difficult part to apply a bandage to. A piece of cloth, somewhat triangular in shape, with

FIG. 193.—BANDAGE FOR FRACTURED SCAPULA.

a wide plait at the base, and smaller plaits at each side (Fig. 194), is attached by five bands. The upper posterior one (Figs. 194, 195, *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. 196).

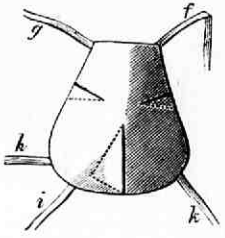

FIG 194.
BANDAGE FOR ELBOW, FORM OF.

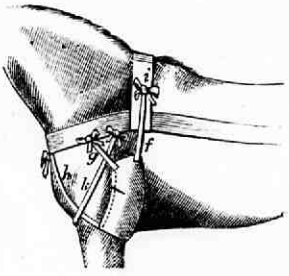

FIG. 195.
BANDAGE FOR ELBOW, APPLIED.

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 trapezium, 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. 196.
BANDAGE FOR FORE-ARM.

FIG. 197.
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. 197).

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. 198).

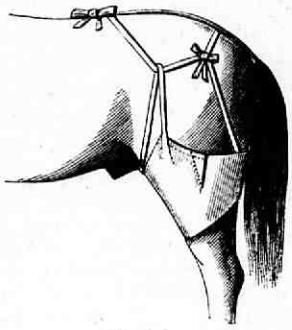

FIG. 198.
BANDAGE FOR STIFLE, APPLIED.

25. *Bandage for the Thigh.*—In shape somewhat like the last, this bandage has three gussets, two of which (Fig. 199, 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)

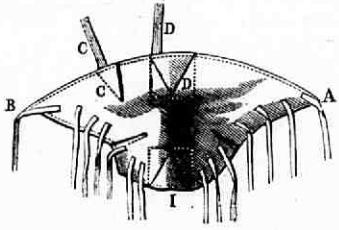

FIG. 199.
BANDAGE FOR THIGH, FORM OF.

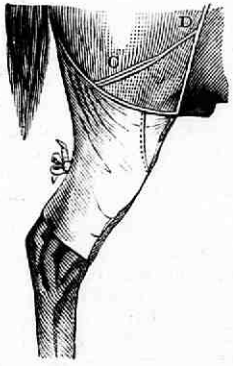

FIG. 200.
BANDAGE FOR THIGH, APPLIED.

passes along the flank, and is tied to the crupper on the loins; 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. 200).

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. 201). Four bands on its upper border attach it to the thigh bandage or crupper, and the sides are joined by tapes in front (Fig. 202).

FIG. 201.
BANDAGE FOR HOCK AND SHANK, FORM OF

FIG. 202.
BANDAGE FOR HOCK AND SHANK, APPLIED.

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 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 (p. 132).

For the other larger domesticated animals, these bandages are applicable; for the smaller animals fewer are employed, and they are modified in form. In the *dog*, for instance, there is an ear-bandage, rendered necessary in diseases of that part, and which is a kind of night-cap fastened around the head by wide tapes (Fig. 203, *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. 203, *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 to be as

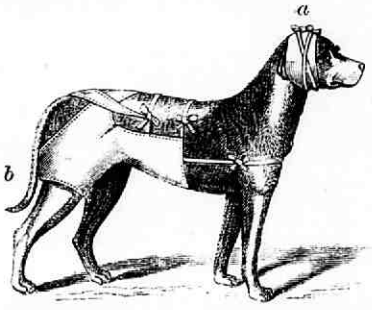

FIG. 203.—BANDAGES FOR DOG: *a*, EARS; *b*, MAMMÆ.

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 decomposing tissue, or foreign matter be allowed to remain in a wound, it may give rise to gangrene and septic infection. Therefore, in proceeding to dress a wound, attention should be particularly directed to cleansing it thoroughly, and protecting it from morbid influences which lead to decomposition and putrefaction. 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 four-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 gently sponging them with carbolized water, or passing over them a stream of a two-per-cent. solution of carbolic acid, or injecting it by means of a syringe into the bottom of the wounds. The

skin around the wounds should also be kept clean and free from discharges and crusts.

After the wound has been cleaned 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.

In applying dressings, the avoidance of pain to the animals, either at the moment of application, or subsequently, should be observed, as this will spare suffering and prevent the patients attempting to remove them.

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 or sanious 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 little suppuration, and cicatrization is going on favourably.

After an operation, the first dressing is not generally removed until the third or fourth day; though in operations on the foot of the horse, one, two, or three weeks 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 appropriated, by a band of tow 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, pus, or discharges, the whole should be moistened with tepid 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, by the finger or, better, forceps, and when the wound is exposed it should be cleansed without irritating it or making it bleed. If it requires surgical intervention, this should take place as speedily as possible, after which it should again be dressed without delay.

Effects of Dressings.—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 with those atmospheric germs 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 or first intention union should always be aimed at.

Cleansing of the wound is, therefore, of great moment, as blood and foreign bodies will prevent primary union, while their contact with infective germs may lead to troublesome results. Removal of the primary wound secretion is also advisable, as its absorption may induce fever and inflammation. The admission

of particles or germs which may cause decomposition, should be averted by an appropriate fluid—as a two-per-cent. solution of carbolic acid. In dressing wounds, or even during the performance of operations in which tissues are incised, the carbolic acid spray—evolved by the spray-producer (Fig. 152)—may be employed with advantage. Or antiseptic irrigation may be effected by means of a large or small syringe (Figs. 149, 150). If carbolic acid is inappropriate, a useful antiseptic fluid is a four-per-cent. solution of carbolic acid with 0·1 per cent. thymol.

If, from improper treatment, decomposition and putrefaction occur—if the borders of the wound and the tissues are swollen and infiltrated with serum, and symptoms of general infection are manifest, the wound should be opened to its full extent, washed with a four-per-cent. solution of carbolic or boracic acid, cleaned out with sponges or pledgets of tow, mortified tissues removed, gangrenous skin divided to where it is sound, punctures made to allow imprisoned serum to escape; then the whole should be washed with the same solution, and dressed antiseptically. In some cases antiseptic gauze may be advantageously applied,* as well as dossils or pledgets of carbolized tow. Bran, when carbolized, forms a good dressing for superficial wounds, especially when there is discharge: and an excellent application—preferable, perhaps, to any other of the kind—is moss-peat powder. I have had this employed with the greatest success in veterinary surgery, and it has been no less beneficial in human surgery. The absorbent and deodorizing power of this powder is very great, and its lightness is an additional advantage. When treated with a five-per-cent. solution of carbolic or boracic acid, and dried, it is one of the best antiseptic dressings which can be employed. It is enclosed in thin gauze bags; and the wound being dressed in the ordinary way, a bag is placed upon it and secured by a bandage. Boracic acid is a good and safe antiseptic. It may be used in solution, or lint, tow, or moss-peat may be saturated with it and dried. Whether or not the antiseptic treatment of wounds be adopted, it must be remembered that cleanliness and rest are the main factors in rapid and favourable union.

---

* There are several ways of preparing this gauze, but the most common is steeping ordinary cotton in a fluid composed of carbolic acid one part, common resin five parts, paraffin seven parts.

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 *fascia; 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 impossibility 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. 204), 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, 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 or setons 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 will be the fracture. A few of the more important luxations will now be considered.

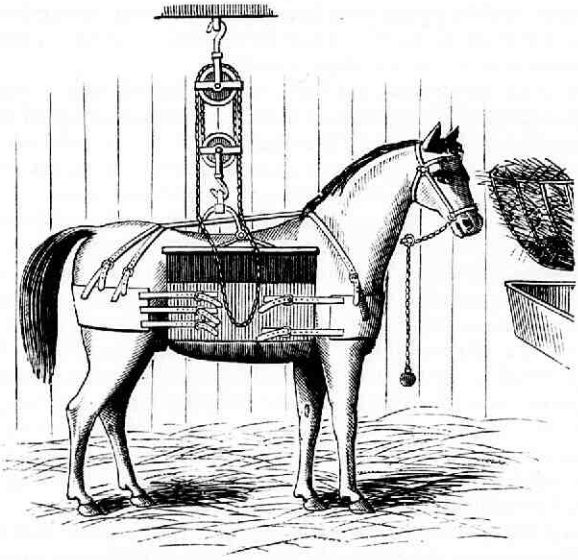

FIG. 204.—HORSE IN SLINGS.

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 last 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.*

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

* A remarkable instance occurring in my practice, is recorded in the *Veterinarian* for 1874, p. 412.

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 is not 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 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. 222), 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* causes of fracture are 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* or *compound*. If the number of 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 by local or general accidents or diseases, such as contusions, wounds, or laceration of soft tissues, rupture of vessels, and 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 kind of false aneurism. Suppuration, gangrene, arthritis, pyæmia, tetanus, traumatic fever, traumatic emphysema, and other complications of a more or less serious nature, accompany 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 intense pain to which some fractures give rise, sometimes causes 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, false 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 temper 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 by means of 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 Arabic, 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 either 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), 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 immobilize 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 no creases. It is generally advisable to bandage the greater portion or all 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 casement 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, greyish-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 partial or total gangrene of the soft tissues ensue, marked by much tumefaction, often by coldness of the limb, perhaps by bad odour, bullæ, discharge, and symptoms indicative of great pain. 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 as limited as possible.

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 it, if it be a 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 subdued, according to the directions given, before reduction and bandaging. In comminuted fracture, detached pieces of bone must be removed, if they are embedded in the soft tissues, before 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 former, and wait until consolidation of the callus has taken place before it is attempted.

Particular Fractures.

Only a few particular fractures will be alluded to here.

1. *Fracture of Cranial Bones.*—When there is no displacement, surgical interference with the bones is not necessary. 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 fluids 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

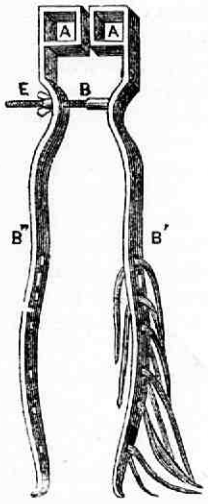

FIG. 205.
APPARATUS FOR FRACTURE OF THE NASAL BONES.

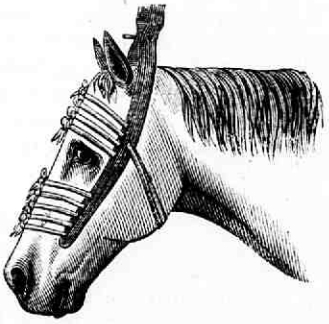

FIG. 206.
APPARATUS APPLIED.

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 interruption to 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. 205). 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. 206). 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 bone 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 injury. 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.

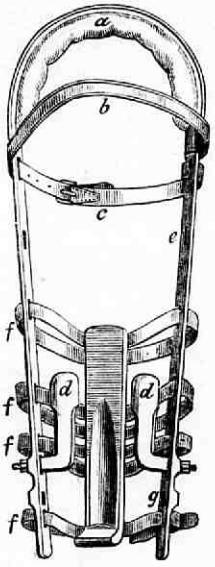

FIG. 207.
APPARATUS FOR FRACTURE OF THE LOWER JAW.

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-

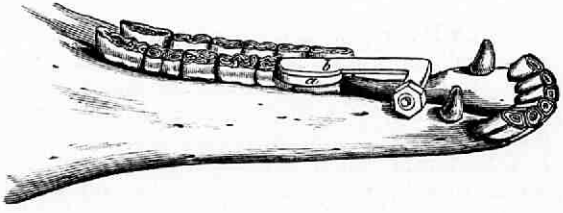

FIG. 208.
ONE FLANGE OF APPARATUS RESTING ON MOLAR TOOTH; *a*, MARGIN IN CONTACT WITH THE CHEEK; *b*, SURFACE FOR CONTACT WITH THE UPPER MOLAR.

posed of two lateral portions (Figs. 207 *e*, 209), fitting to the sides of the face, suspended from behind the ears by a padded strap (Fig. 207 *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. 208).

All these apparatus should be so adjusted as to lie evenly, and without pressing 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 pledgets of tow placed on it (thickest immediately over the injury).

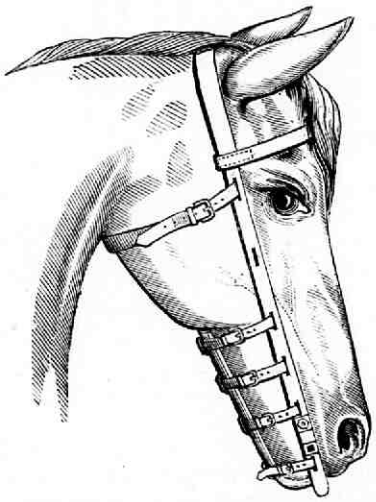

FIG. 209.—APPARATUS APPLIED.

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

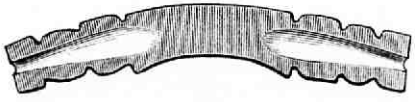

FIG. 210.
SPLINT FOR FRACTURED HORNS.

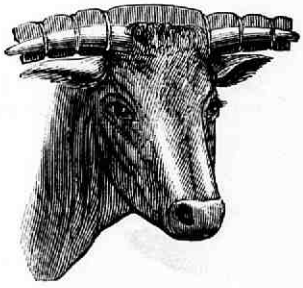

FIG. 211.
SPINT APPLIED TO FRACTURED HORN.

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. 210). The splint may or may not be the full length of the horns (Fig. 211), 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 tie up one of the

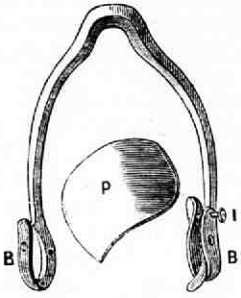

FIG. 212.
APPARATUS FOR FRACTURED SCAPULA.

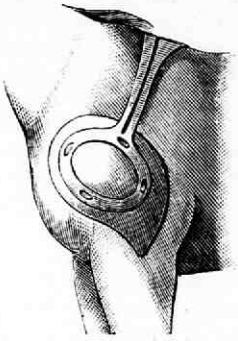

FIG. 213.
APPARATUS APPLIED TO THE SHOULDER.

fore-legs (as in Fig. 10), and secure the animal to a post by a rope round the neck.

Collections of blood or pus in the sinuses may be removed by depressing the head to one side, by means of a sponge or syringe

FIG. 214.
IRON SPLINT FOR FRACTURE OF BONES OF THE FORE LIMB.

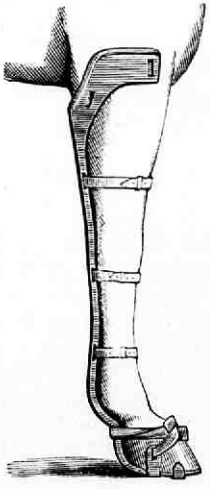

FIG. 215.
IRON SPLINT APPLIED.

(or aspirator), or causing the animal to shake its head by pouring a little water in the ear.

Fracture of the Scapula.—This is rare, and, provided there is no displacement, 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. 193). 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,

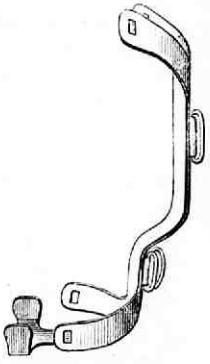

FIG. 216.
IRON SPLINT FOR FRACTURE OF THE LOWER BONES OF THE LIMB.

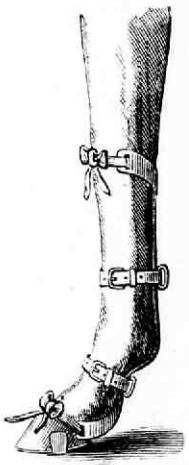

FIG. 217.
IRON SPLINT APPLIED TO THE LIMB.

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. 212, 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. 213).

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

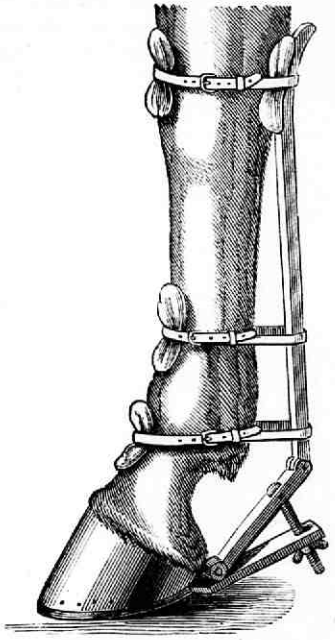

FIG. 218.
ADJUSTING SPLINT FOR LUXATIONS AND FRACTURES OF THE LIMB.

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. 214), fitting on the plantar surface of the foot by lateral clips, and eylets 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. 219.
APPARATUS FOR LUXATED OR DEFORMED FETLOCK.

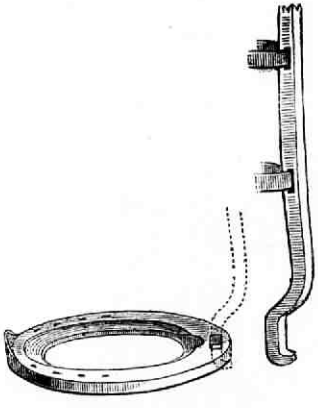

FIG. 220.
MOVABLE IRON SPLINT.

the upper part of the arm as tightly as necessary; there are slits on each side for straps to fasten it round the arm (Fig. 215). 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, or 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. 216, 217). This may have an adjusting

mechanism, to prevent distortion, while maintaining immobility, of the limb (Fig. 218).

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. 219).

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. 214, 215,

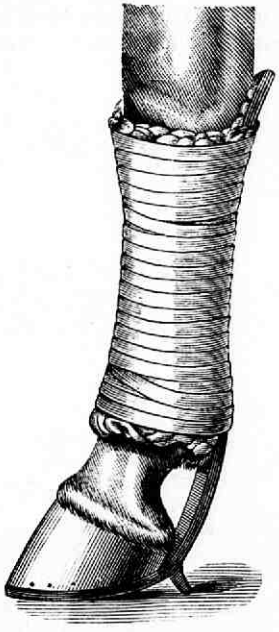

FIG. 221.
IRON SPLINT BANDAGED ON THE LIMB.

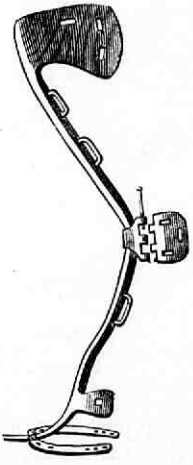

FIG. 222.
IRON SPLINT FOR THE HIND LIMB.

216, 217), 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. 220). 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. 221).

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 adopted (Fig. 222). 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 too 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 the starch or pitch bandage.

Other fractures need not be mentioned here, as the most frequent are alluded to.

SECTION II.

REMOVAL OF TUMOURS.

Tumours (and also organs, or portions of them) are removed by excision, ligature, tearing, puncture, 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 tentaculi. The tumour itself may be seized by the hand, forceps or tentaculum; 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 hæmorrhage 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 most suitable, the tumour being held by forceps. The resulting hæmorrhage may be suppressed in the ordinary way.

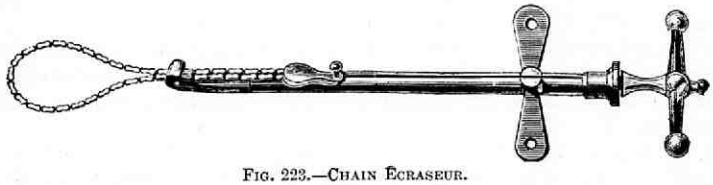

FIG. 223.—CHAIN ÉCRASEUR.

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 or several strands 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. 223), others for the wire (Fig. 224), and others, again, for both chain and wire (Fig. 225).

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 co-incident 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.

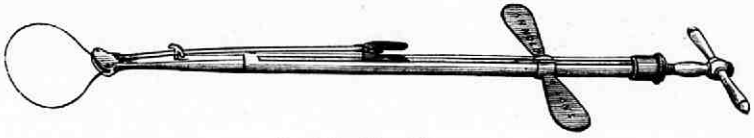

FIG. 224.—WIRE ÉCRASEUR.

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 neighbouring 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 unfixed from the instrument, passed around the tumour, and again fixed), the stem of the écraseur being held in the left hand, while the right turns the handle or screw portion, or, if a ratchet

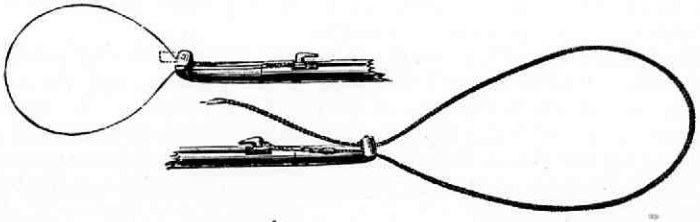

FIG. 225.—ÉCRASEUR FOR CHAIN AND WIRE.

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 limit, in consequence of the slowness with which the instrument acts. This is

obviated in some écraseurs, particularly in that of Beach (*Universal Ecraseur*), in which the motion can be accelerated or retarded by a simple contrivance.

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 mortification does not rapidly ensue. This is sometimes attempted to be expedited by the application of the cautery or caustic ointments—as that of arsenic sulphide.

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 eyelets at the head, near the point, or in the middle, according to requirement.

Double Ligation is effected by passing the needle, armed with a strong, double, waxed 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 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 individually 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. 226). 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. 227, 228). Another method is to employ two needles, one pierced

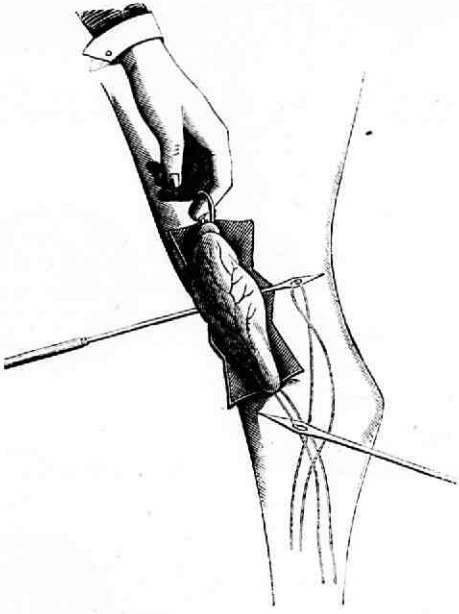

FIG. 226.—MANNER OF PERFORMING QUADRISECTIONAL LIGATION.

with an eyelet at the head, the other in the middle (Fig. 229, 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. 230), and brought out at the opposite side, where it is cut off. The female eyelet has in this way received the double thread of the first (Fig. 231), and is now pushed down through the tumour, carrying four threads with it (Fig. 232), 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. 233); 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. 227), and these are tightly bound round each segment (Fig. 228).

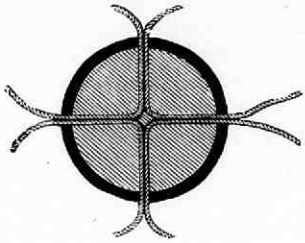

FIG. 227.
LIGATURES SEPARATED IN QUADRISECTIONAL LIGATION.

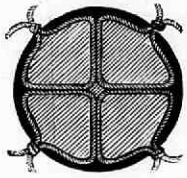

FIG. 228.
LIGATURES TIED IN QUADRISECTIONAL LIGATION.

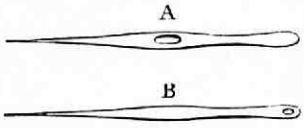

FIG. 229.
LIGATING MALE AND FEMALE NEEDLES FOR QUADRISECTIONAL LIGATION.

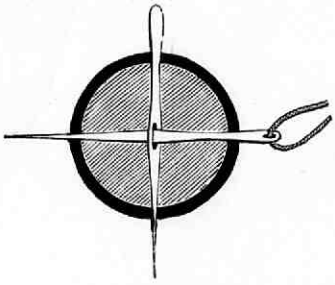

FIG. 230.
MANNER OF PASSING THE NEEDLES.

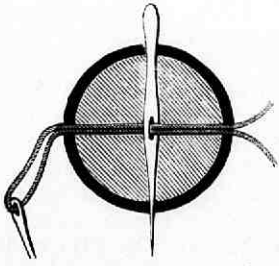

FIG. 231.
MANNER OF WITHDRAWING THE MALE NEEDLE.

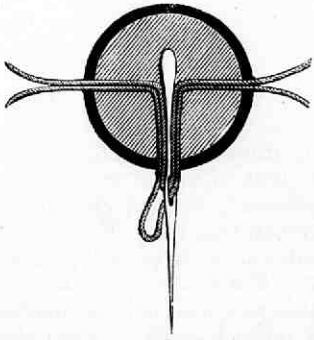

FIG. 232.
MANNER OF FORMING THE DOUBLE LOOP.

Subcutaneous Multiple Ligation is effected by the use of a long, strong thread passed through three needles (Fig. 234), 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. The tumour (Fig. 235, A) is supposed to be subcutaneous and spherical, and a fold of skin being raised vertically towards its

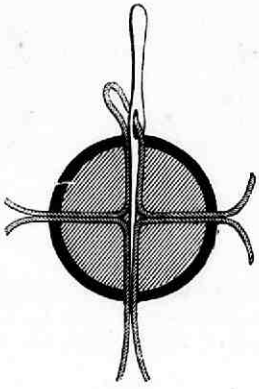

FIG. 233.
MANNER OF WITHDRAWING THE FEMALE NEEDLE.

upper third, the first needle (A) is pushed through this. The fold is let go, and one part of the ligature is passed, subcutaneously, around a third of the tumour (Fig. 235, C). The second needle (B) is pushed into the tumour at the point of exit of the other (Fig. 236, 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

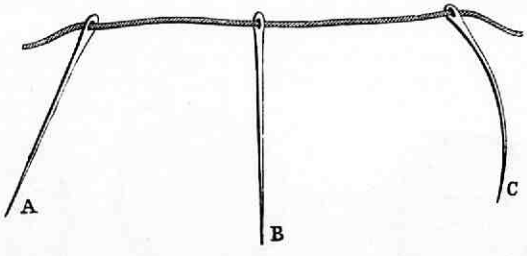

FIG. 234.—NEEDLES FOR MULTIPLE SUBCUTANEOUS LIGATION.

third of the tumour is now enclosed in a loop (B, C, D), the two ends of which issue from the same opening (Fig. 237), while there is a second thread between the upper third and the two lower thirds of the tumour (Fig. 238, *f f*). The same procedure is carried out on the lower third, which leaves the middle third included between two parallel threads (Fig. 239, 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

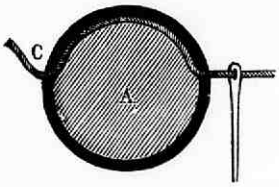

FIG. 235.
MANNER OF PASSING THE SUBCUTANEOUS MULTIPLE LIGATION.

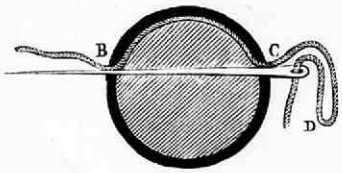

FIG. 236.—*Ibid.*

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

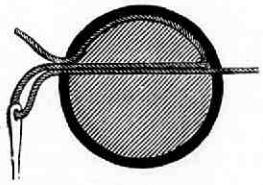

FIG. 237.—*Ibid.*

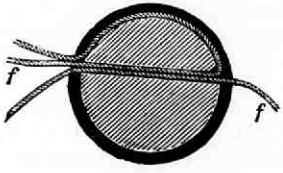

FIG. 238.—*Ibid.*

being included in their special loops (Fig. 240). The ligatures being tied sufficiently tight, the ends are cut off, and the operation is completed.

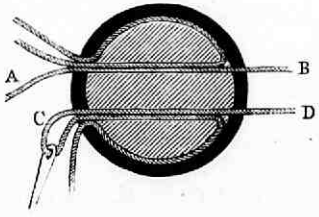

FIG. 239.—*Ibid.*

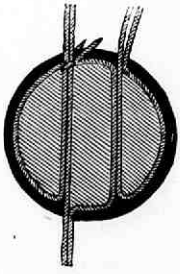

FIG. 240.—*Ibid.*

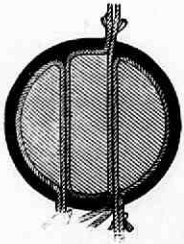

FIG. 241.—*Ibid.*

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 mortification of the part beyond the ligature. For this purpose, simple india-rubber drainage tube, 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 a double well-waxed 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 slit the nostril, in order to reach them.

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 BY PUNCTURE.—Puncture is only partially efficacious in certain kinds of tumours, cauterization, caustics, or other means being conjoined with it.

5. REMOVAL OF BONY TUMOURS.—According to their density and situation, these require particular operative treatment. When very dense, the soft tissues having been 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 tumours in process of formation, the operation of *periosteotomy* is sometimes performed. This is a simple operation. For instance, in the bony tumour 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 above, or slightly below the tumour; this incision is short, and is quickest and most conveniently made by the rowelling scissors, or bistoury (Fig. 76), through a raised fold of skin. A small blunt seton-needle may be passed through the wound, beneath the skin above the tumour, in order to divide the connective-tissue, and this is followed by a short button bistoury, slightly curved, the cutting edge being convex. This is carried flat over the tumour, then turned, so that the sharp edge is in contact with the periosteum, which is incised. The periosteotom is then withdrawn. The object of operation is incision of the periosteum, and, to some extent, of the tumour.

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, if ever, 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) 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 stalk or shank, and the cauterizing portion (Figs. 110, 242, 243, 244, 245, 246). The latter is thick at the base, for the retention of heat, and somewhat thin or pointed (not sharp), 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 applied in lines, or points arranged in lines. It consists in passing a

VARIOUS FORMS OF CAUTERIES.

FIG. 242.

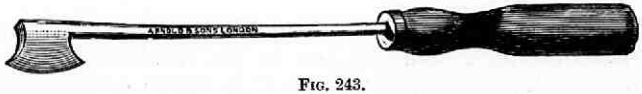

FIG. 243.

FIG. 244.

FIG. 245.

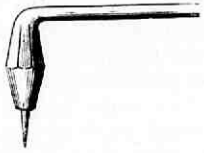

FIG. 246.

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. 242, 243), or conical for points (Figs. 110, 245, 246).

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 these (Figs. 247, 248). Sometimes the lines, passing in one direction, are enclosed in a circle (Fig. 249); sometimes they pass in two or

more directions (Fig. 250); or they may pass in a radiating direction (Fig. 251), or be arranged in the form of a lyre (Fig. 252). 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.

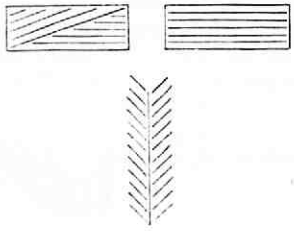

FIG. 247.—CAUTERIZATION DESIGNS.

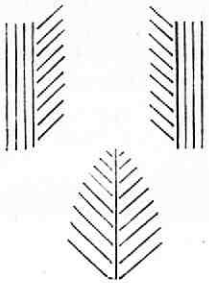

FIG. 248.—*Ibid.*

For certain regions, however, it is found that the lines should pass in certain directions. For instance, on the shoulder (Fig. 253, A), they are parallel, and slightly oblique from before downward. For the point of the shoulder they may be made within a ring which en-

FIG. 249.
LINES IN A CIRCLE.

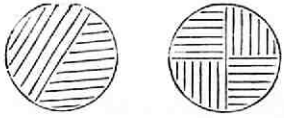

FIG. 250.
LINES IN TWO DIRECTIONS.

circles the part, and be arranged as in Figs. 250 and 253 (E). For the withers, two parallel lines alongside the dorsal spines, from which other lines pass parallel and obliquely (Fig. 248), right and left. On the loins the lines may be parallel to the spine, or diagonal on each

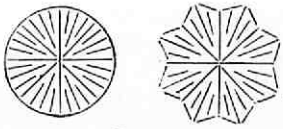

FIG. 251.
RADIATING LINES.

FIG. 252.
LYRE-SHAPED DESIGN.

side (Fig. 253, 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 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. 254, 255, 256, 257.

The design should always be as simple as possible.

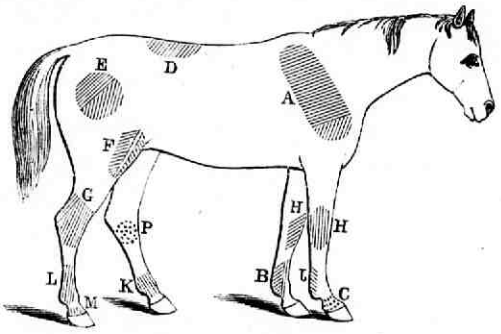

FIG. 253.—THE VARIOUS ARRANGEMENTS OF CAUTERY LINES.

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 regularity of 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 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. 248).

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 circum-

scribed. 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.

MANNER OF TRACING THE LINES WITHIN CIRCLES.

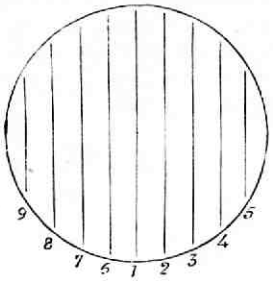

FIG. 254.

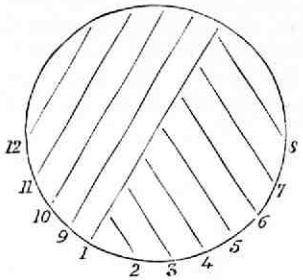

FIG. 255.

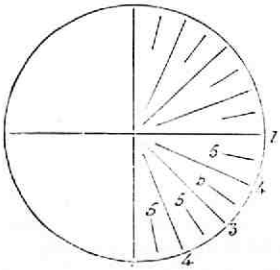

FIG. 256.

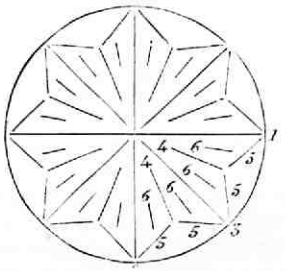

FIG. 257.

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 (Figs. 110, 245), 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. 258). 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 limited surface, as on the hock or pastern (Fig. 253, 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 often beneficial 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

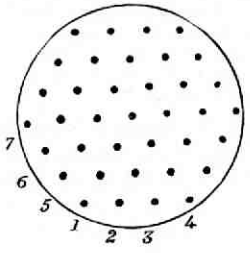

FIG. 258.—CAUTERIZATION IN POINTS.

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. 242—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 re-heat. 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 every respect this instrument is preferable to the ordinary cautery, 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. The thermo-cautery should supplant the ordinary firing-iron, especially as the cautery itself may be of various shapes.

The cauterizing instrument should be held lightly, the edge or point perpendicular, and it may be drawn towards or pushed from the operator.

The first cauteries should 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.

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 each application, 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 transpiration, 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 inflammation and tumefaction are not sufficiently developed, a vesicant may be applied over the part; but this requires care, and is not necessary in every case, nor yet in many cases, as is so often imagined. In all cases the animal should rest for some days, if the limbs are operated upon.

When the pain and inflammation are excessive, and the lines open and 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 agent, under these circumstances, is perhaps carbolic acid, in the form of carbolized oil; this agent, from its promptly sedative effects, its astringent property, and antiphlogistic tendency, is 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. 246), 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, according to indications. The penetrations may be about half an inch apart, and their depth vary. They may pierce the periosteum (as in exostoses, periostoses, bony tumours in the neighbourhood of the articulations, etc.); synovial dilatations, especially of a chronic nature; morbid tissues; chronic engorgement of the limbs; indurations; and along the course of inflamed veins and lymphatics. 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 (Figs. 110, 245), or a special elongated iron, according as occasion requires. 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, gangrenous 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, tympanitis, 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 often 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. Their action is the same. They are energetic local stimulants, suppurants, and counter-irritants; and are 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. 76), (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

FIG. 259.—SETON-NEEDLE IN HANDLE.

'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. 259), 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 as those for passing setons through the frog) the curvature is great, and made laterally, instead of on the flat (Fig. 260).

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.

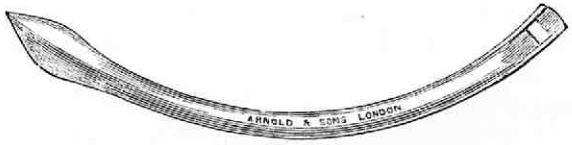

FIG. 260.—SETON-NEEDLE CURVED LATERALLY.

For small animals—as the dog—the needles are proportionately 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 either tie by both ends when it is 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. 261). Some practitioners prefer cord to tape. The seton is medicated with some stimulant substance—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, three or four 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, male laurel (*Daphne laureola*), arsenious acid, bichromate of potass, bichloride of mercury, etc.

FIG. 261.—MANNER OF TYING THE END OF A SETON.

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 suppuration, or at least extensive serous effusion, may ensue: the first is the object in the horse, the second in the ox. 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 pus 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 engorgements, 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 the pus gravitating

towards the limbs. The sides of the chest are often setoned, in disease of that cavity or its contents, notwithstanding the small amount of subcutaneous connective-tissue existing there, and the tendency to grangrene. Two setons are generally inserted on each side, a wide interval between them, and their direction is vertical or oblique; the intercostal spaces being selected for the entrance and exit incisions, and the seton being passed above the external thoracic vein, which must not be wounded. 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 are often resorted to, and may be placed in any part of this region. 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 part 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. 76); 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. 259), 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, prevent it offering an obstacle to the tumefaction which ensues, or the escape of pus.

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 rather curved moderately-sized blunt needle; 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 suture 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 Chest.—Restraint the same. Incisions, two or three; direction vertical, or following an intercostal space, situated between the ilio-spinalis muscle and the superficial thoracic vein, the needle passing from above to below.

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 often passed through the plantar cushion for the cure 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. 260), 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 the finger,

handle of a scalpel, or cutting through the connective-tissue with scissors or knife, if it is too dense, 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 is formed attention is required. The seton may 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 water, and to prevent depilation by the discharge, the integument may be protected by smearing it, when dry, with vaseline, or carbolized glycerine or lard.

To prevent the horse tearing out the seton with its teeth, the head may be tied close to the rack, or the cradle (Fig. 8) or side-rod (Fig. 9) may be employed.

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—more than a month, for instance—it may cease to promote suppuration, or ulceration or sloughing of the skin over its track may occur.

When the seton is no longer required, it should be withdrawn by cutting off one of its ends, and pulling this through the wounds; if there are two or more setons, an interval of a day or two should elapse between the withdrawal of each, and after removal light pressure may be made daily over the track, to remove any pus which forms and promote healing, and cleanliness should be enjoined.

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 be allowed 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, gangrene, 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 tumour 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.

If there are signs of gangrene—as rapidly increasing, hot, very painful, and diffuse tumefaction, rigors, fever, bad odour—then the seton should be removed, Condy's fluid (diluted), or solution of boracic or carbolic acid injected into the wounds (which may require to be enlarged), with scarification of the œdematous parts, and other measures necessary to combat septicæmia.

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 has for its object the introduction of soluble and very active medicaments into the subcutaneous connective-tissue. It has been already briefly alluded to at page 90. The region to be 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 (Fig. 107), and the manner of using it is described at page 90. If a syringe is not available, an opening may be made in the skin by rowelling scissors or bistoury, or a sharp seton-needle, and a pouch formed in the connective-tissue, into which the medicine may be poured, the wound in the skin being afterwards closed by suture. This method is not advisable, however, as there is danger of abscess, sloughing, or gangrene of a large portion of the integument.

Intra-venous Injection.

Intra-venous injection is sometimes resorted to for the introduction of soluble medicines, virus, 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 employed in phlebocentesis may be the Pravaz syringe (Fig. 107), an injection-tube with a sharp point, or an ordinary lancet or fleam.

The animal is secured in the standing attitude, with, if necessary, the nose-twitch applied.

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, 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

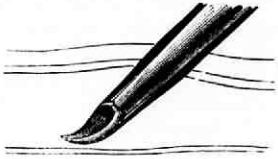

FIG. 262.—TROCAR FOR INTRA-VENOUS INJECTION.

with the ordinary trocar, unless great care is exercised), it is advisable to employ a pen-shaped trocar with the tip turned up (Fig. 262).

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. Another precaution to be observed, is withdrawing an amount of blood equivalent to the volume of fluid to be injected, in order to avoid disturbance in the circulation and respiration.

In intra-venous injection of the virus of contagious pleuro-pneumonia (recommended as a protective measure), the utmost care must be observed, so as to prevent escape of the fluid into the surrounding connective-tissue. In order to ensure safety, the bovine animal is secured in the standing posture, the hair is shaved or clipped off the skin where the incision is to be made, the vein is made turgid, and a short parallel incision is made in the skin over it. The apparatus consists of two very narrow cannulas, fitting one within the other, the outer or largest being shorter than the inner, the latter having a blunt extremity, and the former being sharp to penetrate the wall of the vein. The opposite extremity of each is sufficiently wide to receive the tube of this syringe. Through the

skin-incision the sharp-pointed cannula is passed into the vein, keeping it sufficiently oblique to prevent the opposite wall being injured. The blunt cannula is then passed into the sharp one, and the syringe being adapted to it, the virus is slowly injected through it into the vein. Before withdrawing the cannulas, the inner or blunt one, soiled by the virus, should be cleansed by sucking and pushing the blood in the jugular through it several times, by means of the syringe; and to prevent contact of the virus with the external wound, the sharp cannula should have been previously passed through a very thin piece of indiarubber, which in this way covers the external wound, so that if any of the virus escapes from the syringe it falls upon this covering.

In intra-venous injections, the external wound may be closed by suture.

Intra-tracheal Injection.

Intra-tracheal injection is sometimes practised in the treatment of disease, and particularly for the introduction of very soluble and active medicaments into the system. The ordinary Pravaz or other syringe, 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. If the medicament should happen to be of an irritant nature to the connective-tissue, when the syringe is removed from the cannula the interior of the latter should be washed out by injecting a little clean water through it, before it is withdrawn from the trachea.

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 and destructive. It has been adopted 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 the case of synovial tumours, and the operation will now be noticed in regard to these.

In the majority of cases, it is advisable to place the animal in the recumbent position, and the part to be operated upon exposed. The most prominent part of the tumour 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 clipped or shaved

* 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.

off at this point, which should be away from vessels, nerves, and ligaments, as well as articular surfaces (if a joint). A fine 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, causes the 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, it is rarely necessary to apply any bandage or dressing to the wound. Inflammation usually sets in, with considerable tumefaction; this gradually disappears. In articular capsules, however, the inflammation may assume a very severe form, and produce destructive arthritis.

Should a first injection not prove successful, it may be repeated after a certain time—in four or six months.

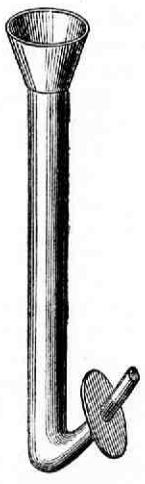

FIG. 263.—NASAL IRRIGATOR.

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 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 12 inches long and 4 inches in circumference, with its extremity expanded into a cup-shaped cavity 2¼ inches in diameter; while the smaller portion is 8 to 10 inches in length, and has a circular plate or opercula fixed around its middle by means of a hole in the centre (Fig. 263). 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 viruliferous fluid to a membrane which is readily absorbent, introducing it directly into the blood or lymph-stream (as into the blood and lymph-vessels), or by incision, puncture, or abrasion of the skin or mucous membrane, or subcutaneously by seton, syringe, or other means.

The first of these has been already alluded to (see 'Injection'); we will, therefore, only refer to the others.

1. *Incision.*—This, which consists in making one or more small incisions through the derm, 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 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 sailmaker's or 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, especially in what may be designated 'protective inoculation.' 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 and purity of these matters. 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 do harm. All vessels or utensils used in the inoculation should be heated in an oven for several hours, or held in the flame of an Argand burner for several minutes. Instead of syringes, which are frequently the cause of error, owing to the impossibility of making them sterile, 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* or *phlebocentesis;* 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. 93), scalpel or bistoury, or fleam (Fig. 97). 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 round towards the opposite side. After a sufficient quantity has been obtained, the wound in the skin and vein 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 (page 122, Fig. 142), the pin being only passed 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.

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. 98), 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, and prove that it is patent. If the hair is thick or long, damping and smoothing it down with the finger will render the vein more visible and accessible to the touch. The point of the fleam being placed very close to the skin, but not touching it, immediately over the middle of the vein, and at a short distance below its bifurcation, 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 form 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 in the same wound, or 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 ambi-

* Sometimes in the horse, and always in 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—a circumstance which explains the difficulty sometimes experienced in obtaining a full stream when the operation had been properly performed.

dextrous, 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. 96), 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, which should not be dragged or pulled. Should it bulge after the tow or twine has been twisted round the pin, it may be gently pressed down by the finger. The skin should be cleansed by a damp sponge.

It may be desirable to abstract blood more than once at brief intervals, and this may be done by operating on the opposite jugular vein, re-opening the first wound, or making a new wound beneath or above it. With a view to re-opening the first wound, in closing it the co-aptation of the two lips is not made complete, a little lard may be interposed, and the ligature is not drawn so tight as usual. After a certain time, on removal of the ligature and the pin, by drawing apart the lips of the wound, and distending the vein, the blood escapes in a stream. This procedure, however, is likely to lead to inflammation and suppuration; and it is better to make a new puncture, half-a-dozen of which may be made on the same jugular.

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 opening the vessel in this situation, as it is more easily accomplished, and is not followed by any extra risk.

The only precaution necessary after the operation, is prevention of rubbing of the wound by the animal; this is usually done by tying it up short by the head, and not allowing it to lie down. It 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 and the 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

removed, and it is rarely necessary 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.

In the OX tribe bleeding from this vessel is not usually practised.

In the OVINE species blood is sometimes abstracted from the external saphena, about the middle of the outer side of the thigh. The animal is placed latericumbent on the ground, bench, or table, the limb to be operated on being uppermost, the other three limbs fastened together; a ligature is tied round the upper part of the leg to 'raise' the vessel below, which is opened by a fine lancet. A bandage compress is kept on the wound for a few hours afterwards.

Bleeding from the Cephalic or Plat Vein.—The HORSE is maintained in the standing position, the fore-leg opposite being held up, and that operated upon being placed inward, in order to render the vein more apparent. The vessel is opened at the part passing between the arm and fore-arm, where it is readily felt, the puncture being easiest made by the fleam, because of the mobility of the vessel and thickness of the skin. The operator stands at the shoulder; if the left vein is to be opened, the instrument is held in the right hand, blade downwards, the three last fingers in the space between the sterno-humeralis and mastoido-humeralis muscles to steady the hand and

compress the vessel, and the left hand striking the blade. If the right vein is to be opened, the fleam is held in the left hand, and the operator stands on the right side. The wound is closed by a pin suture. Sometimes the fleam perforates the opposite side of the vessel, and this gives rise to a thrombus; but the accident is usually of no importance.

In the OX this vessel is rarely opened.

In the SHEEP the procedure is to place the animal latericumbent, the side to be operated upon uppermost, the limb carried backwards, and the wool removed from the front of the arm; compression is here made by the thumb, and the vein opened below this point by the lancet. The wound is closed in the ordinary manner.

The DOG is operated upon in a similar position and manner to the sheep.

Bleeding from the External Thoracic or Spur Vein.—The HORSE is maintained in the standing position. The operator places himself behind the shoulder, his face towards the hind-quarters. Compression is made on the vessel immediately behind the elbow, and the fleam or lancet employed to open it (the former when the skin is thick), the instrument being held in the hand next the ribs, and an intercostal space being chosen. The wound is closed as in the other vessels.

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 (preferable to the lancet), 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 (Fig. 57). 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, with the lancet ready in his mouth, 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 (except in the Ox, when injection of the virus of Pleuro-pneumonia is made into it). 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 to be closed.

Phlebotomy is rarely practised on BIRDS. The jugular or humeral vein may be punctured. The humeral vein is to be preferred, the puncture being made close to the articulation of the carpus with the metacarpus. The fowl is placed dorsicumbent, the wing is extended, the feathers concealing the vessel removed, a ligature tied round its upper part to distend the vessel, and the wing left free for a few seconds to allow the blood to accumulate; then the wing is held, the vein punctured by the lancet, and when sufficient blood has escaped, the ligature is removed and the wound closed by one or two sutures made by a very fine needle. Blood can be abstracted from the jugular, though this vessel is difficult to fix in birds. The feathers are removed from the part, the vein is fixed above and below by the thumb and first finger of the left hand, while it is punctured by a lancet with the right hand. The wound is closed as in the humeral vein.

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 continued 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.

Arterio-Phlebotomy.

Arterio-phlebotomy is very seldom practised by the veterinary surgeon, though it is resorted to by amateurs and empirics. A portion of the tail or ear of an animal is amputated, in order to obtain bleeding from arteries and veins at the same time. This operation needs no further notice.

Capillary Blood-letting.

Capillary blood-letting, which may also be designated arterio-phlebotomy, as the capillaries connect the veins with the arteries, is not unfrequently 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. 93) is advantageous; should a bistoury be used, it ought to be wrapped round with tow, leaving only as much of the point uncovered as is necessary, and the small incision should be made from before to behind. The blood flows freely, and, if no arterial branches are divided, gradually ceases, the animal being allowed to champ and swallow the blood, or drink bran gruel. If the hæmorrhage 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 face.

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. The hæmorrhage ceases spontaneously.

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 junction 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 (held as in Fig. 88), 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 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 or poultices 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.

Dry cupping is of little value, wet or scarified cupping being that which is most serviceable in animal surgery.

The cupping instrument is a metal or glass vessel, in shape like an ordinary tumbler. Before using it, the skin is scarified to the required extent; then a small piece of paper, tow, or any other inflammable substance is lighted by a taper inside the vessel, which is immediately inverted on the part. The rarefaction of the air within the vessel produces suction on the scarifications, and consequent abstraction of blood. Wetting the interior of the vessel with alcohol

and igniting this answers well. The part may be cupped before it is scarified, the incisions being made immediately on the removal of the instrument, and then re-applied. To remove the vessel from the surface, it is inclined to one side, while the skin is pressed down at the edge, so as to admit the air. The instrument can only act on those parts which are sufficiently level to admit of its close application, and the skin of which is pliable and very vascular. The hair should always be removed previously.

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, exposed to the vapour of boiling water, or a hot poultice may be applied.

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 tumour or thrombus (the so-called 'primary false aneurism'), 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; and it is rarely necessary to occlude the vessel by ligature, compression being usually sufficient to check the hæmorrhage. (*See* 'Surgical Hæmostatics,' p. 98.) The subcutaneous blood-tumour disappears by absorption, and recovery is generally very prompt. In accidental puncture of the carotid, death has sometimes occurred from this tumour extending up the neck, compressing the larynx, and producing suffocation.

Puncture of the Trachea.—This is a very uncommon accident, and if it occurs 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. Puncture of the pneumogastric nerve in the ox has caused

the animal to emit plaintive cries, difficulty in deglutition, and vomiting. Recovery took place spontaneously.

Puncture of Bones.—This may happen where the bloodvessels are in proximity to bones, the fleam wounding the periosteum or becoming implanted in the osseous tissue, perhaps its point breaking off and remaining there, producing inflammation, suppuration, caries, and intractable fistulæ.

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 siffling 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.

The accident most frequently occurs 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.

When the air has obtained entrance into a vein, the first thing to be done, to prevent more gaining ingress, is to close the wound by the finger; next, to allow more blood to flow either from the same vessel or from another, at the same time having recourse to aspersion with cold water over the face and friction to the limbs.

Hæmorrhage.—Secondary hæmorrhage is not unfrequent, and may be due to the operator, in 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, and still more frequently in birds, as a result of blood-letting. Constriction 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 vinegar or 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 suppurative phlebitis, when, if the pus does not find an issue externally, it may pass into the circulation and produce pyæmia. 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 condition may be due to a rusty or dirty lancet or fleam, to undue irritation to 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 vein at this part may require to be opened in order to allow the escape of pus. The actual cautery, in points, has been employed successfully on the abscess. 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, 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.

As the operation is very painful and protracted, an anæsthetic should be administered.

Thrombosis.—This condition is a result of phlebotomy, and is due to the formation of a clot, or 'thrombus,' in and around the vessel at the seat of operation, and occurs perhaps most frequently in the jugular vein of the horse, being related to, or independent of, phlebitis. It may ensue immediately after bloodletting, or at a later period, and be due to several causes, as unskilfulness on the part of the operator in penetrating both sides of the vessel, employing a defective instrument, the opening in the integuments being smaller than in the vein, improperly closing the wound, etc.; or when it happens some time after the operation, it may be owing to the wound being rubbed either by the animal or by its harness. To avoid this accident, it has been recommended to bleed above the valves in the jugular, which are marked in thin-skinned horses by a slight transverse ridge in the course of the vein. If inflammation is not present or only commencing, the application of refrigerating lotions or cold water, and slight compression, will usually cause the thrombus to disappear. If inflammation has set in, the treatment recommended for phlebitis must be adopted.

Ligature of Bloodvessels.

The ligation of bloodvessels generally has already been described at page 99. 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 Myostasis*, 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 'knicking,' and the fashion of knicking 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 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

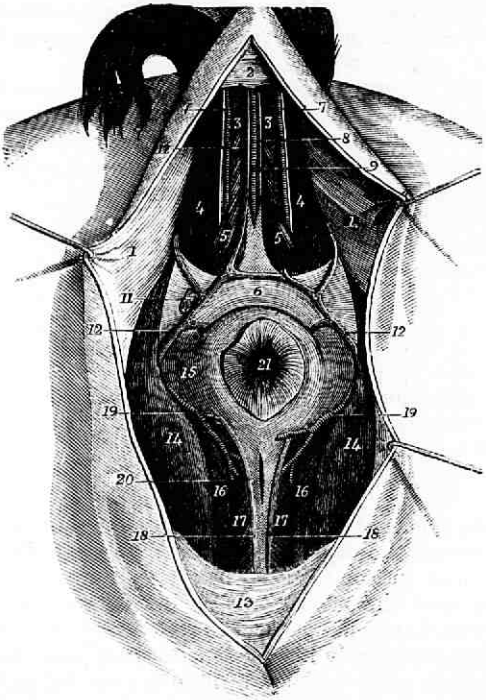

FIG. 264.—ANATOMY OF THE COCCYGEAL REGION: 1, 1, SKIN; 2, PORTION OF THE SHEATH OF THE COCCYGEAL MUSCLES; 3, 3, INFERIOR SACRO-COCCYGEAL MUSCLES: 4, 4, LATERAL DITTO; 5, 5, ISCHIO-COCCYGEAL MUSCLES; 6, SUSPENSORY LIGAMENT OF THE ANUS; 7, 7, LATERAL COCCYGEAL ARTERIES; 8, DEEP COCCYGEAL VEIN ACCOMPANYING 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.

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 ground should be level and not slippery. It is very rarely necessary to cast it, 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. 265), 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 instruments. 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 excised. 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, the suspensory ligament may be injured, and a large cavity left, in which a fistula 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 portions 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

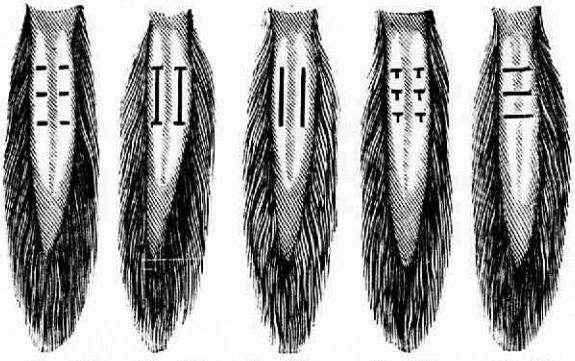

FIG. 265. FIG. 266. FIG. 267. FIG. 268. FIG. 269.

should be seized by the forceps and excised by the scissors, as if allowed to remain they will slough away slowly.

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 four inches distant, the two being united by a longitudinal incision (Fig. 266). 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. 267).

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. 268), 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. 269), 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. 93), 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 tenotom 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 tenotom 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 cold water, 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 suppuration is established or 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 ways in which this elevation is accomplished are various; only the principal will be noticed. It may be observed, however, that one or two days before the operation the apparatus should be applied to the animal, and especially if it be irritable or restless.

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,

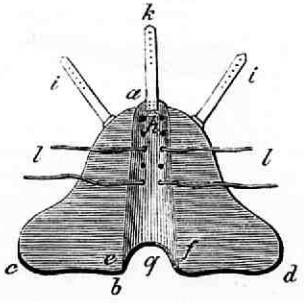

FIG. 270.—BARTLET'S APPARATUS.

which would be likely to retard the circulation and produce gangrene, 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. 270), 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*). Figure 271 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 breastplate 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, 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.

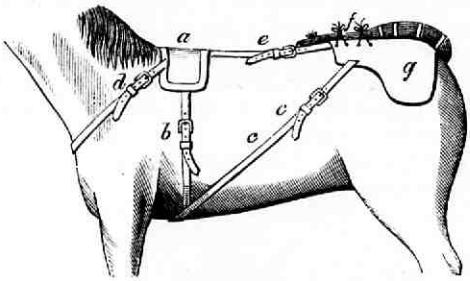

FIG. 271.—BARTLET'S APPARATUS APPLIED.

Objections have been made to those appliances which bent the 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. 272, A), roller or surcingle

(B), to which the collar can be fastened at top and bottom 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

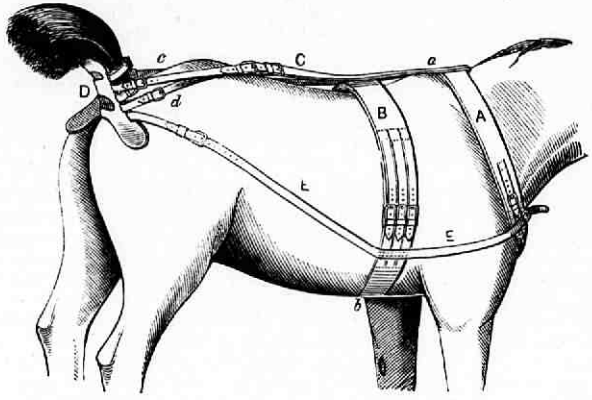

FIG. 272.—TAIL SUPPORT APPLIED.

either side. The support itself is made of a light trifurcate piece of iron channelled for the reception of the tail (Fig. 273), 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

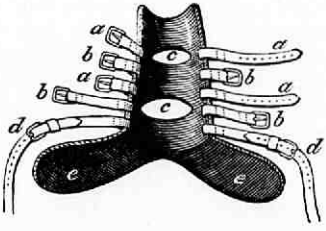

FIG. 273.—TAIL SUPPORT.

tail in the support; others (*b b b b*) join the diverging back-straps (Fig. 272, *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. 272, 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 sesquichloride of iron, 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 caries, necrosis, and fistulæ may result, the latter being most frequent after subcutaneous myotomy. Fistulæ often form near the anus, or in the anus itself after the operation; and sometimes the incisions in the tail take on an unhealthy ulcerated condition, due to friction.

Tetanus is at times 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 latter by a strong aponeurosis, the two layers of which envelop this border, and closely adhere to it. It very 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-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

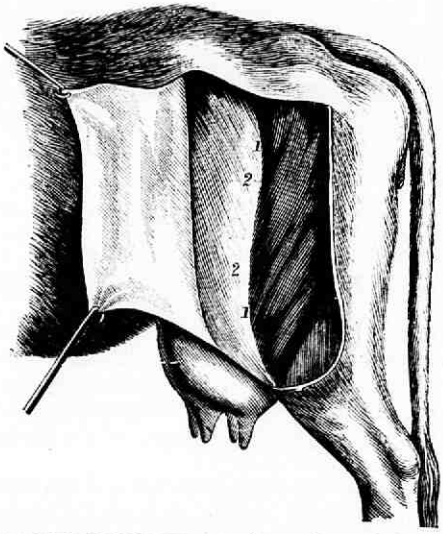

FIG. 274.—ANATOMY OF THE LONG VASTUS AND FASCIA LATA: 1, 1, ANTERIOR BORDER OF THE LONG VASTUS: 2, 2, FASCIA LATA AT ITS UNION WITH THE LONG VASTUS.

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 applications, 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 forearm, 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 tenotom 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 aponeurotom, 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 inflammation runs high, cold-water irrigation is useful, and if suppuration results it may be necessary to establish a dependent opening for drainage.

Tibial Aponeurotomy.

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 ter-

minal tendon of the oblique flexor of the phalanges (Chauveau—the *Flexor pedis accessorius* of Percivall). Into the incision he introduces his tenotom, 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 tenotom, he passes this beneath the tendon of the oblique flexor 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 moistened with the solution every day for six or eight days. Bathing the limb with tepid water is often of much benefit, and hastens the cure. After the operation, the horse should remain in the stable during from three to four months. An improvement in walking is, at the end of this time, immediately perceived, and this becomes more and more evident, until a complete cure is generally obtained in the course of four to eight 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, a cure 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 is practised to remove the tension on that membrane when a node is forming beneath it.

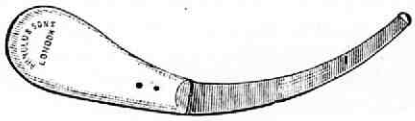

FIG. 275.—PERIOSTEOTOMY KNIFE.

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. A slight fold of skin is raised transversely 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 tumour, the cutting edge of the knife is turned towards it, and the periosteum cut through as the instrument is withdrawn. A special knife, or 'periosteotom,' has been devised for this operation, the blade being curved, the point blunt, and the convex border sharp (Fig. 275).

CONSECUTIVE TREATMENT.—The wound is to be antiseptically dressed, and inflammation subdued by cold-water irrigation.

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 cure 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, pointed bistoury or dermotom, to incise the skin, and a sharp-pointed tenotom (Fig. 276), as well as a blunt-pointed tenotom (Fig. 277). The latter should have a more or less curved, narrow blade.

Fig. 276.—Sharp-Pointed Tenotom.

Fig. 277.—Blunt-Pointed Tenotom.

The tendons or ligaments should be divided subcutaneously, the division 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 tenotom is introduced into the skin incision, cutting edge towards the skin, and beneath the dermotom (if this is employed), which is held firmly in place a short distance from the point by the thumb and index-finger, in order to prevent any deviation or undesired penetration, should the horse struggle. The dermotom being withdrawn, the tenotom is 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 slight sawing and gouging 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 tenotom 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 trapezium, is performed to remedy bending over at the knees, the retraction of these tendons producing that deformity, and which is generally the result of excessive exertion, though it may also be due to congenital defect, for remedying which the operation is most particularly indicated. One or other of the two tendons may be divided—the external by preference, and 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. To complete the operation, and make the limb perfectly straight, it is sometimes necessary to divide the perforans tendon (plantar tenotomy), either at the same time or subsequently.

Anatomy.—The external flexor muscle of the metacarpus is situated on the outer side of the forearm, forming its posterior border, its tendon dividing into two branches, the anterior of which, funicular, is inserted into the head of the external peroneus (small metacarpal bone), while the posterior, large and short, is inserted into the trapezium, 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 forearm, and has a single tendon, which is inserted into the trapezium, 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, about two inches above the trapezium.

Operation.—The animal is laid on the side opposite to that on which is the limb to be operated. 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 transverse 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 tenotom 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 cracking sound.

Or the tenotom 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, about two inches above the trapezium, between the two tendons, on the posterior face of the limb, the tenotom 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.

Carbolized lint or tow is then applied to the wound, and retained by a bandage.

CONSECUTIVE TREATMENT.—The wound only requires frequent dressing and cleanliness. A shoe with a long toepiece and low thin heels should 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 inflammation, 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 tendons alone is practised when the perforatus tendons are not involved. In the majority of cases, at first it is only the deep flexors which have undergone retraction, but it ends in 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

* This the French designate *mouvement de bascule.*

the fore-limb, is covered by the fibrous expansions of the carpal and metacarpo-phalangeal sheaths, in the hind-limb by those of the tarsal and metatarso-phalangeal 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 peronei (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. Between the suspensory ligament and the bone there are the interosseous vein and two arteries ; on each side of the tendons is the external and internal collateral vein, accompanied by the principal phalangeal artery, which is the satellite of the internal plantar nerve : in the fore-limb the artery is internal, in the hind-limb it is external.

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, and therefore space for the division of the tendons.

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 section of the tendons must be made, unless there are special reasons to influence operating otherwise : in the fore-limb, the point for operation is a little below the middle of the cannon-bone, and about an inch above the blunt extremities of the splint-bones ; in the hind-leg, it is exactly at the middle of the cannon-bone.

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 or dermotom, 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, and 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 tenotom 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, which it should make a fulcrum of, 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 tenotom, and the movement given to this by the operator, soon leads to division of the cord, which is manifested by a particular snap, separation of 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 limb to be operated upon. 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 tenotom, 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 forearm of the same side. A rope round the hoof or pastern suffices for producing extension of the lower articulations; the foot of the 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 dermotom is passed flat through 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 tenotom, 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 resulting 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 tenotom 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 tenotom being turned backwards, the back resting on the suspensory ligament, 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 *Peroneo-prephalangeal tenotomy*, and the second as *Cunean tenotomy*.

Peroneo-prephalangeal 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 forearm of the same side. The scalpel

or dermotom is pushed, flatways, through the skin and beneath the posterior border of the tendon in the upper or middle third of the metatarsal region, near the junction of the tendon with the anterior extensor of the phalanges. Then the tenotom (blunt-pointed) is introduced beneath the dermotom, which is now withdrawn, 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.

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 limb to be operated upon, the opposite or (upper) hind-leg being fixed to the lower third of the uppermost forearm. 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, because of the bony tumour, 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.—The hair is removed 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 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 exostosis 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. 278). A probe, blunt-pointed seton-needle, or a director, is then passed under the tendon, which is divided transversely (Fig. 279).

FIG. 278.
INSIDE OF THE HOCK, WITH CUNEAN TENDON EXPOSED.

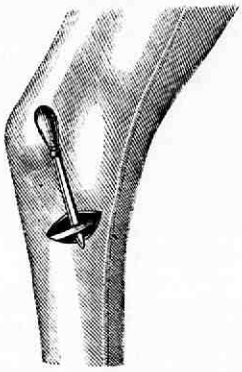

FIG. 279.
THE CUNEAN TENDON RAISED FOR DIVISION.

Second Procedure.—The position of the animal and the seat of operation are the same as in the first procedure. The dermotom 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 tenotom is then passed flatways beneath the scalpel, which is withdrawn, and the tendon is divided from below upwards.

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 trapezium.

OPERATION.—The dog is placed latericumbent, the limb to be operated on being uppermost, and held by an assistant. A very narrow-bladed scalpel (or penknife) is passed, flatways, through the skin, behind the tendons, about one-fourth of an inch above the trapezium, 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, is indicated in certain cases of cervical abscess in which this ligament is involved in disease, or when, by its compression, it increases the tumefaction and suppuration; and also when it is necessary to expose diseased bone, etc.

Operation.—The horse is generally placed in the latericumbent position, and the head well extended 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 dermotom 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 through the fistula, 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 removed.

Hæmorrhage is arrested by plugging with fine carbolized tow or lint.

After the operation, the cervical muscles should be aided in sustaining the head, by means of a broad supporting head-collar, which maintains it slightly elevated.

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 tenotom is then passed, flat, behind the ligament and in front of the perforans tendon, the vessels and nerve 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 tenotom 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.

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, 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 is 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 complicated wounds.

Opening bursæ should be avoided by exact anatomical knowledge. The accident is known by the escape of synovia, which takes place from the wound; but if tenotomy has been subcutaneous, it is generally not so serious. Tumefaction, suppuration, and not unfrequently fistulæ, are the consequence. The treatment must be based on general principles.

Severe inflammation must also be combated by the ordinary measures. When there is a sero-purulent discharge from the wound—a prelude to abscess—a vesicant applied over the part either produces resolution, or the appearance of one or more fluctuating points, which should be opened to allow the escape of pus. 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.

CONSECUTIVE TREATMENT.—This is generally that applicable to simple wounds. A pledget of carbolized lint or tow is placed on the wound, 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.

Hæmorrhage and suppuration are comparatively rare, if tenotomy is performed subcutaneously and, as far as possible, antiseptically.

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. 218, 219. 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. 220, 221, may be employed.

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 of the plantar nerves, in order to deprive the horse's foot of sensation, thus relieving the animal from pain and consequent lameness. Nerve-stretching might, in some cases and under certain circumstances, be resorted to for the relief or cure of pain, or for the modification of motor or reflex properties of nerves, in animals. Simple division of nerves is sometimes practised for temporary relief from pain, or to subdue inordinate muscular contraction in certain parts. Plantar neurotomy and nerve-stretching will only be alluded to here.

PLANTAR NEUROTOMY OR NEURECTOMY.

Plantar neurotomy 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* neurotomy (the hind-limbs are very rarely operated upon), implies resection of the main branches of the plantar nerves above the fetlock, before they give off divisions to the phalanges; and the latter, which may be termed *digital* neurotomy, is the operation below the fetlock, where one of these divisions can be resected. In order to perform plantar neurotomy with safety and certainty of result, an accurate knowledge of the disposition of the nerves is necessary.

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 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;

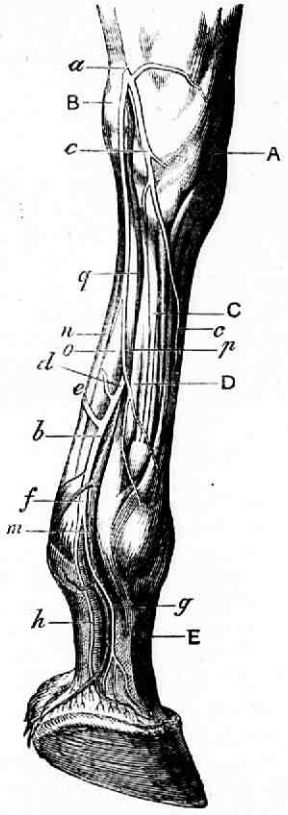

FIG. 280.

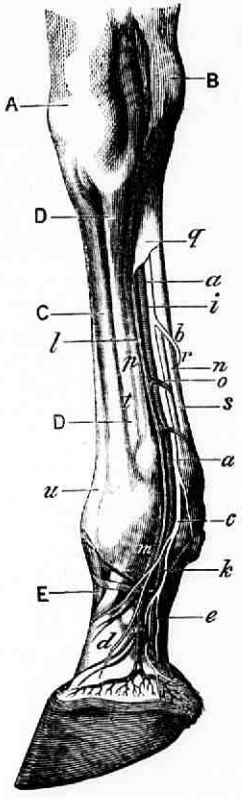

FIG. 281.

VESSELS AND NERVES OF THE HORSE'S FORE-LIMB: A, CARPUS; B, TRAPEZIUM; C, METACARPAL BONE; D, SMALL METACARPAL BONE; E, OS SUFFRAGINIS, OR LARGE PASTERN BONE.

FIG. 280.—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 DIVISION *g*, POSTERIOR DIVISION *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. 281.—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 DIVISIONS; *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 AND 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.

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 unaccompanied by any vessel, the internal having the artery and vein related to it in this part. Below the fetlock, the main branch 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 or neurotomy-knife, scalpel or rowelling bistoury, dissecting forceps, aneurism or suture needle and thread, sponge and cold water, fine carbolized tow or lint, calico bandages, a tourniquet, cord, or elastic bandage.

The animal is placed latericumbent, the side of the limb to be 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 that on the external side of the uppermost limb; the animal being turned over, in order that the same course may be followed on the opposite sides of the limbs.

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 may be previously immersed in cold water, or have cold water bandages placed upon them, until 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, a slit being made in it over the course of the nerves when these are about to be exposed. 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 forearm (if the hind-leg is to be operated on), or to the tibia (if the fore-limb), of the same side.

The hair is removed from the skin where the nerve is to be exposed; this may be done by means of scissors, or shaving with the scalpel.

The incision is made in the skin immediately over the nerve, by

means of the scalpel, the integument being made tense by the left hand placed underneath the leg. 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 the 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 not necessary 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 scalpel, so as to expose the nerve, the presence of which is recognised by its white colour, its resistance, and its sensitiveness, manifested by compressing it gently. If bleeding obscures the view, the blood should be removed by means of a damp sponge lightly applied. The neurotomy knife is then passed flat under the nerve, and when the sharp part is at the point of section, the edge is turned towards the latter, which is smartly divided. Many operators prefer the aneurism needle armed with a thread, which is passed beneath the nerve, and the thread is disengaged and tied tightly round the latter (which causes the horse to struggle), as in ligaturing a bloodvessel; then the probe-pointed bistoury takes the place of the needle, and the nerve is smartly divided by it above the ligature. By means of the thread, 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 artery is recognised by its position, its firmness, and its sensitiveness; though when the horse is anæsthetized there is 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 bones 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.

ACCIDENTS.—The chief accidents are wounding the bloodvessels and opening the bursæ. If the artery is wounded, it must be ligatured; the vein or bursæ may be closed by a tow compress and bandage. Inflammation of the latter may be combated by cold-water bandages or irrigation. In order to avoid risk of disturbance in the nutrition of the foot, when several nerves are to be resected, some operators only divide a few of them at a time; *i.e.*, if both fore-feet are to be totally deprived of sensation, the nerves on one side of each limb only are cut, those on the other sides being divided a few days afterwards. But I have never observed any bad results follow division of all the nerves at one operation.

CONSECUTIVE TREATMENT.—When the operation is completed, the lips of the wounds are placed together, a small pledget of carbolized tow or lint is laid upon

each, and a linen bandage is applied evenly and moderately firm. Unless there is much swelling, the bandages need not be removed. If the wounds suppurate, then they must be treated on ordinary surgical principles.

The horse should be kept absolutely quiet for a few days, then gently exercised until the wounds have healed, which will probably be one or two weeks. But beyond gentle exercise, no considerable exertion should be undergone within a month, or even longer, after the operation.

Close attention must be paid to the feet afterwards, and great care should be observed in shoeing, so as to avoid punctures or injury to the vascular structures.

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 with 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;

Fig. 282.—Ordinary Amputating Saw.

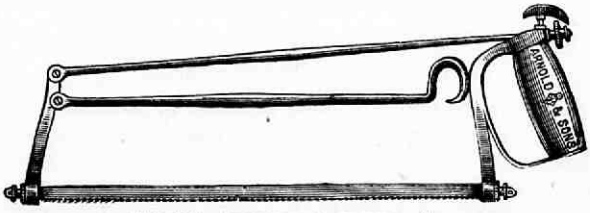

Fig. 283.—Improved Amputating Saw.

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.

Amputations are usually performed with sharp instruments, as the ordinary scalpel or bistoury, or special knives; or by means of the ligature, clamp, écraseur, or electro-cautery wire.

The operation, especially when performed with sharp instruments, 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; abscess, suppuration, and fistulæ; phlebitis; pyæmia; 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, and which can be successfully utilized in breeding, the amputation of 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 pregnant and 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

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. 284) 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

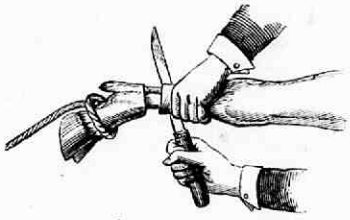

FIG. 284.—CIRCULAR AMPUTATION

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. 285) 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

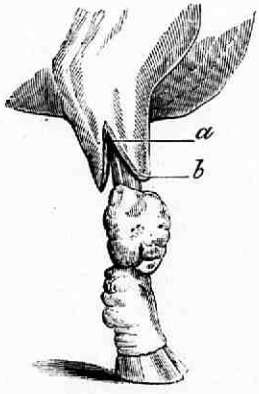

FIG. 285.—FLAP AMPUTATIONS: *a*, POINT WHERE THE BONE IS SAWN THROUGH *b*, ANTERIOR FLAP.

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 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. 286 A) is effected by 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

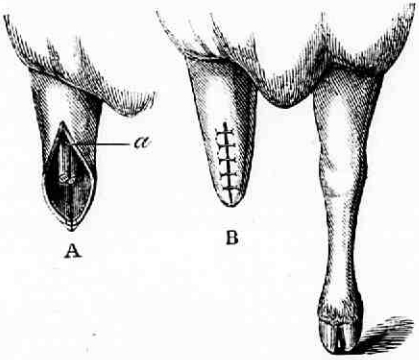

FIG. 286.—OVAL OR OBLIQUE AMPUTATION: A, OBIQUE SINGLE FLAP; *a*, POINT OF SECTION OF THE BONE; B, THE FLAP SUTURED.

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 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 nippers; ligatures and sutures; a tourniquet or Esmarch's tubing; with sponge, bandage, tow or lint, and a basin of clean water.

The animal should be securely fixed latericumbent, an anæsthetic being administered, if possible. The hair should be removed from the part about to be operated on; and the limb 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*) requires 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. 80, 81, 87), 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 the ligatures of vessels (if these have been ligated) are gathered together and placed at the most dependent part of the wound; 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 and the removal of ligatures.

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 which may be 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 at 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 height 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 (without sutures), 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 forearm 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 cold water, 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 caries or 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. 287, 288). The tail being placed in the concavity of the 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 ordi-

nary 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. 244). This

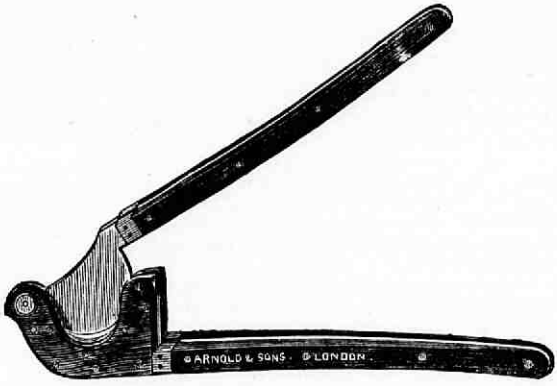

FIG. 287.—ORDINARY DOCKING MACHINE.

iron is applied repeatedly, and in a slightly rotatory manner, to the bleeding surface until blood ceases to flow, the soft tissues being more or less carbonized and destroyed. To form a thicker eschar and more speedily check the bleeding, a little ring of horse-hair, or a small quantity of powdered resin, is sometimes put on the cauterized

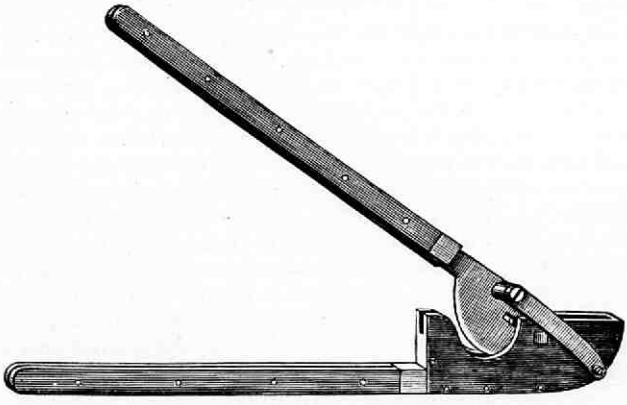

FIG. 288.—IMPROVED DOCKING MACHINE.

surface, and burned 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 by a pledget of tow secured by tape; or the hæmorrhage may be sup-

pressed by simply applying the pledget to the wound, and retaining it there by tying the hairs of the tail across it. Even the hairs themselves 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 affected 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, leading even to gangrene. In other cases, the bones become necrosed or carious, suppuration is set up and continues for perhaps a long time 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 of the œstrus bovis. 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 in 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 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 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, and the operation is more serious.

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 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 cold water, 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, and a few drops of water in its ear will cause it to do so more energetically. 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 bandage (Fig. 157) 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 only 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 continned until the granulations have at least partially closed the wound, and suppuration has ceased. The animal must be secured, while being dressed, by a short collar-rope attached to a post, the opposite fore-leg being strapped up.

The edge of the horn should be rounded with a file or rasp.

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.—An ordinary gouge will suffice, 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 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

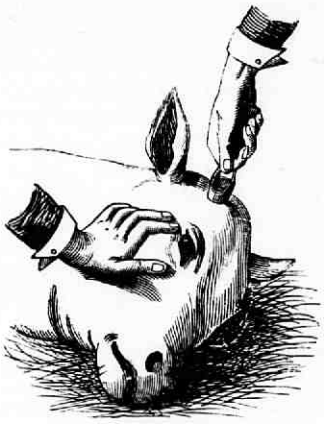

FIG. 289.
REMOVING THE HORNS OF THE CALF—FIRST STAGE.

the soft tissue to the frontal bone (Fig. 289), completely isolating the little knob of horn. The hand is then depressed until the instrument is more or less horizontal (Fig. 290), and the portion is

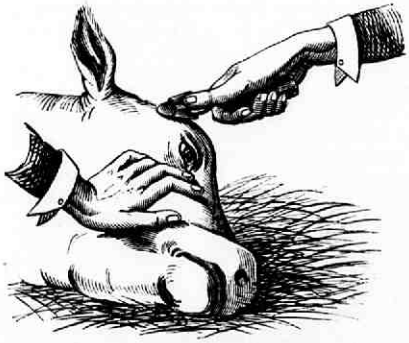

FIG. 290.—*Ibid.*, SECOND STAGE.

gouged out. The wound is sponged, 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, as they are apt to increase and hasten gangrene; 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 74 to 85. It is usually made by means of the scalpel, or sharp or blunt-pointed bistoury and director (Fig. 90); or the finger may act as a director. 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 in-

cised than fibrous—the cuts always extending beyond the strangulation. If this is caused by an aponeurosis, a T-shaped, crucial, or stellate incision (Fig. 92, *a*, *c*, *f*) is best.

If there is hæmorrhage, this must be checked in the manner described at page 98.

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 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 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 by 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 better to leave them in place than 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 and suppuration is going on. In many cases it may even be advantageous

FIG. 291.—BULLET FORCEPS, WITH SHIFTING BLADES.

to wait for this period, the foreign body being then more easily extracted.

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 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.

FIG. 292.—CURETTE BULLET EXTRACTOR.

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. Trepanation is more particularly performed on the head, under these circumstances.

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. 148) 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. 291) 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, 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. 292).

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 oil or lint, or other detergent and germicide dressing, 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. Setons through the wounds are to be condemned, unless perhaps in exceptional cases, as when there may be detached pieces of bone which cannot be removed by manual skill. Primary and secondary hæmorrhage, or fractures of bones, must be treated in the manner already prescribed.

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 on 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 opening the maxillary sinuses, and 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 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 fistula, 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 or brace-and-bit have often been employed as trephining instruments, but each of

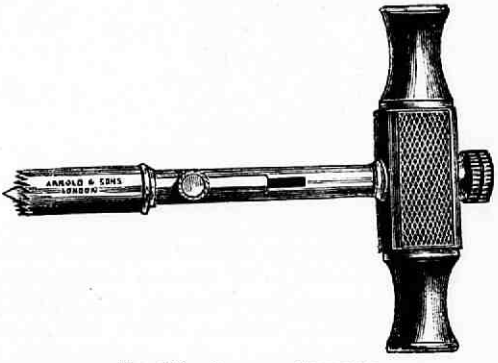

FIG. 293.—ORDINARY TREPHINE.

them has been modified to serve the purpose better. The common surgical trephine (Fig. 293) consists of a stalk, handle, and sharp-toothed cylinder, or circular saw, in the middle of which is a steel point 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. 294, *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 piece of bone cut through by the trephine, and to prize 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.

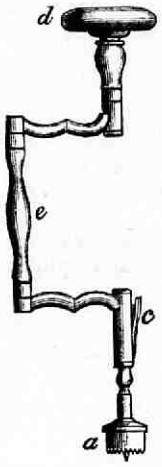

Fig. 294.—Brace and Bit Trephine, or Trepan.

A brush is also convenient to remove the bone sawdust during the operation; and in addition to all these, a bone-gouge and mallet are useful in special cases, and sometimes a bone saw should be at hand; while dissecting forceps, scissors, suture needles and thread, as well as a sponge and water, are always necessary. Fine tow (carbolized), a head bandage (if the head is to be operated on), 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.

But it is most frequently resorted to in disease of the 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

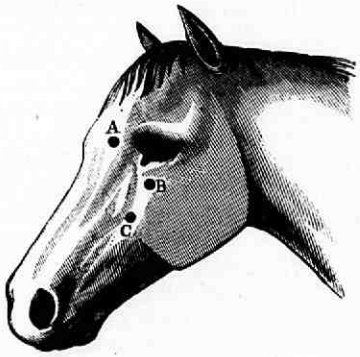

FIG. 295.—POINTS FOR OPENING THE SINUSES IN THE HORSE'S FACE: A, OPENING INTO THE LEFT FRONTAL SINUS; B, *Ditto* SUPERIOR MAXILLARY SINUS; *Ditto* INFERIOR MAXILLARY SINUS.

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. 295, 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, the superior being next that cavity, the inferior lower down the face.

The *superior sinus* communicates with the frontal, ethmoidal, and spheroidal 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 best point for opening it is at an equal distance between the internal angle of the eye and the zygomatic ridge (Fig. 295, 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 meatus 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 fangs of the fourth, and sometimes also those of the third, molar. It should be opened about half an inch above the zygomatic ridge, about an inch before its termination (Fig. 295, C). Lower than this point, the branches of the glosso-facial artery and vein are exposed to injury.

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 opening is made where the bone has become thin and elastic from the internal pressure.

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 trusses of straw, or sacks filled with that material placed beneath; 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. 92, *a*, *b*, *c*, *d*) is made through the skin to the periosteum. 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 point 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 in order to prevent injury to the subjacent membrane. 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, the blade of a strong knife or an elevator is pushed into the groove and raises the piece on one side, while the thumb of the left hand steadies it on the other side. When detached it is seized by the forceps and removed.

In trephining the cranium, great care is necessary to avoid wounding the meninges of the brain or pushing in the disc of bone. Any asperities remaining around the margin of the opening should be removed by means of strong cutting forceps.

The wound is then cleansed, and any ulterior operation required is performed.

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. The trephine should be small —not more than half an inch in diameter, and the opening made where the bone is attenuated and elastic, as the hydatid may then be probably 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 to be clipped or shaved away from around 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 extravasated blood or pus. The trephine, with its centre-pin projecting and fixed in 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, is rotated with a firm, steady, and even-moving, but light-bearing action.

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 with the gouge.

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 entozoa 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. 167, 169). The bandage and dressing are not removed for several days, but kept damp with carbolized water; after which the lint and pledgets of tow should be renewed.

Trepanation of the sinuses or face bones does not require such careful consecutive treatment, as a rule. If the openings are to be immediately closed, it is sufficient to place the borders of the incised skin in apposition, and apply either a pitch plaster or bandage over the wound.

But if it is desired to keep the sinuses open for some time, this may be effected, by filling the apertures with a firm pledget of tow, lint, or linen. A cork steeped in a solution of carbolic acid answers very well. But these should always be secured to the head, collar, or horn by a piece of twine to prevent their falling into the sinus. When the wound is to be healed, it is only necessary to leave out the plug or tent.