Surgical and obstetrical operations / by W. L. Williams ; with the collaboration of James N. Frost.

SURGICAL AND OBSTETRICAL OPERATIONS

BY

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Embodying portions of the OPERATIONSCURSUS of Dr. Pfeiffer, Professor of Veterinary Science in the University of Giessen

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FOURTH REVISED EDITION

PUBLISHED BY THE AUTHOR
ITHACA, NEW YORK
1919

Press of
ANDRUS & CHURCH ITHACA, N. Y.

PREFACE TO THE FOURTH EDITION

The reception accorded by the veterinary profession, to the three prior editions of this little volume encourages the author to prepare and publish a fourth edition under the belief that it fills a certain need in veterinary literature. As in prior editions, so in this, much of the material and illustrations from Dr. Pfeiffer's Operations-Cursus are retained, that fact alone indicating the high esteem entertained by the author for his distinguished colleague.

The volume is primarily designed for the use of students in laboratory surgery and embryotomy in which the student performs the surgical operations described, on animals procured for the express purpose, under chloroform anaesthesia whenever possible, after which the subject is destroyed while still anaesthetized. At the same time it has been aimed to render the volume of the greatest possible value to the practitioner consistent with this plan. The operations included under this scheme are necessarily limited to those which can be reasonably well performed on comparatively sound animals of little value and regularly procurable for laboratory purposes. In the present edition the author has enlisted the hearty collaboration of his former student, associate, and finally successor, Dr. James N. Frost, Professor of Surgery. His long experience as a teacher of surgery, his unquestioned skill, and his enthusiastic devotion to progressive ideals in his work add greatly to the value of the volume. The list covers a wide range and is designed to give to the student as thorough training as is practicable in a laboratory course and includes well nigh all the more important varieties of confinement, anaesthesia, disinfection, sutures, bandaging, dressing and other adjuncts to operative work. The chapter on trephining of the facial sinuses has been dealt with at length in order to fully and clearly describe the author's method of operating.

The operation for the surgical relief of roaring in horses, introduced and developed by the author with the collaboration of Dr. Frost in 1905, and soon adopted as the standard throughout the world, has continued to engage our attention and every effort has been made to keep the technic thoroughly up to date.

Generally but one method of operating is described, the one chosen being that which in the author's experience has proven the most valuable in actual practice. No operation has been introduced purely for practice but each one has been tested and known to have practical value.

When two methods of operating are given, they are inserted because each has definite points of superiority over the other. One method may be specially applicable in a given case, another in a different patient where the same operation is to be performed. For example, a milk cow is best spayed through the vagina while a heifer must be operated upon by an incision through the abdominal walls.

Considerable stress has been laid upon the surgical anatomy of the parts involved in each operation; some uses of the various operations are mentioned; some of the chief dangers of each are pointed out and in some cases references to literature upon the operation of the diseases for which the operation is designed, are cited.

Figures 14, 15, 17, 23, 29, 35, 39, 40, 49, 50, 53, 54, 55, 57, 60, 61, 64–68 are from Dr. Pfeiffer's Operations–Cursus; and the remaining plates and figuers were either drawn under the direction of the author or were made from original photographs.

W. L. WILLIAMS.

Cornell University, Sept., 1919.

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INTRODUCTION

Many details must be omitted from the succeeding text which are of importance in each operation, but which, if inserted, would render the volume unwieldy in size for the purpose designed.

These details are in a measure alike in each case, and it is assumed that the student has already familiarized himself with them. The more important of these may be summarized as follows :

1. The subject should be securely confined in each case as directed, because the method designated has been found effective in the operation under description, and serves to fix the relations of the parts in such a way as to conform to the surgical anatomy of the region as outlined in the text. It is to be constantly borne in mind that a change in the attitude of the animal may cause profound alterations in the relations of parts, which displacement may greatly embarass the operator, or even prevent his carrying out the operation according to the technic given. In securing an animal for operation the whole body should be confined in a way that will sufficiently control movements and will insure safety to the patient and operator ; the part to be operated upon must be so fixed as to properly limit its motion and in a position to afford the greatest facility for the carrying out of the operation according to the technic given.

2. Anaesthesia should be carefully carried out everywhere possible, because in addition to the humane sentiments involved, the resulting perfect control of the animal is an essential in aseptic or antiseptic surgery. The student should make a careful study of anaesthesia in these exercises and acquire invaluable experience and confidence for their use in actual practice.

3. Disinfection must be scrupulously applied in every detail since upon its effectiveness must rest the verdict of success or failure as measured by modern surgical thought.

The operator's finger nails should be well trimmed, smoothed and cleansed, and his hands and arms thoroughly scrubbed with a brush in hot water and soap for a period of fifteen minutes, and all dirt and old epidermal scales removed. The parts should then be disinfected. This may be accomplished by immersing the hands in a hot concentrated solution of permanganate of potassium for ten minutes and then decolorizing them in a strong solution of oxalic acid in boiled water.

Or the hands may be disinfected after the washing with soap and water by immersing and scrubbing them for ten minutes in a 1 to 1000 solution of corrosive sublimate, but in order to make this thoroughly effective the solution needs be alcoholic, or the hands should first be immersed in alcohol, ether, or other substance capable of dissolving fats and permitting the disinfectant to penetrate to every part without being obstructed by sebum or fat. Great care should be exercised by the student not to touch any object with his hands after they have been disinfected for the operation, unless such object has also been disinfected or sterilized, or in case it becomes necessary to touch objects not sterile, the disinfecting process should be repeated before proceeding further with the operation. This constitutes one of the most difficult of all details for the beginner to acquire, and each failure should be remedied by repeating the process over and over until the habit of maintaining effectual asepsis is acquired and fixed.

The operative field should always be carefully shaved before beginning the operation, and the shaved area should always be ample, so as to insure against contamination from adjacent hairs, as well as to give a clear view of the field. The area should then be disinfected in a reliable manner, that advised for the operator's hands serving as a type. Whenever circumstances will permit, the operative field should be kept in an antiseptic bath or pack for twenty-four

hours prior to the operation in order that the deeper parts of the skin, especially the hair follicles and sebaceous glands, shall become thoroughly disinfected, a process well nigh impossible in a short period.

The suturing, dressing and bandaging of the wound should be carried out carefully in every case and no operation left without completing it in the best manner possible.

The student should make each operation as real as possible and not omit any detail even if he thinks he already knows it sufficiently well, as the repetition of a supposedly familiar detail serves an important purpose in the fixing of a habit which is inestimably more valuable to the surgeon than any theoretical knowledge of technic.

The safe surgeon is he who has so accustomed himself to the technique of asepsis and antisepsis that he carries it out rigidly in an automatic manner and is thus free to concentrate his entire attention on the surgical problems before him. One of the most, if not the most, difficult lesson to teach the student is asepsis, which in its final analysis is cleanliness. It is difficult because cleanliness is an integral element in character. A man is clean or he is dirty. If clean in general, he will be clean as an operator, but if he habitually goes about with dirty hands and in dirty clothing, if his office is filthy, and his surgical equipment unclean and in disorder, it is virtually impossible in such a realm of filth to create an oasis of cleanliness during a surgical operation. Consequently the student in learning surgery must learn cleanliness of habit as a rule of life so that when engaging in a surgical operation, he carries with him the habit of being clean, and surgical cleanliness is then in entire harmony with his daily life.

The student who consults his interests will go yet farther and prior to undertaking any operation on the living subject will study the regional anatomy of the part on the cadaver and learn therefrom all that he can of the structure of the

part, which knowledge he must finally complete upon the living animal. No dissection of the cadaver can ever teach true surgical structure as the dead tissues can not be like the living, but such dissection can and does give great aid and should be pursued as far as it can lead and enough will still remain to be learned on the living subject. It is to be constantly remembered that *anatomy* deals with the structure of the *dead* body while surgical operations are performed upon the *living* structures: they are not alike.

The student should further take occasion to study in connection with each operation the object or objects for which it is performed in practice, its effect on the diseased or other parts, the untoward results to be anticipated, etc.

Suggestions occur from time to time in the text designed to aid the student in these lines and help weave connecting bonds between the operation, its objects and results.

Surgical operations may in themselves be valueless or worse and acquire value only when properly correlated to disease and skillfully performed.

Surgical and Obstetrical Operations

A. SURGICAL OPERATIONS

I. OPERATIONS ON THE HEAD

DENTAL OPERATIONS

The grinding teeth of the horse, consisting of three premolars and three molars in each row, are of such dimensions and attachments that their removal in case of disease or defect often presents difficulties of no small degree.

These teeth attain their greatest size at the time of eruption and most of each tooth remains firmly imbedded in its alveolus while a very shallow crown projects into the buccal cavity. The teeth are gradually pushed out of their alveoli when their crowns are worn away by attrition as age advances and the proportion of the intra- to the extra-alveolar part gradually decreases until in very old animals the alveoli become obliterated and the last vestige of what was once the apex of the fang rests insecurely in the buccal mucosa.

The facility with which teeth may be extracted increases with the age of the animal, being as a rule easily drawn with forceps in old, while in case of freshly erupted teeth in young horses it may be almost or quite impossible to extract them with forceps of any kind, except in those cases where they have become somewhat loosened as the result of disease or accident. When aberrations in development occur, leading to the formation of dental tumors or odontomes the possibility of extraction by means of forceps is frequently wholly excluded. In cases where dental disorder has led to empyema of the facial sinuses, even if the tooth may be drawn by means of forceps, further operation is generally

necessary, in order to assure recovery, by the removal of the effects of the disease of the tooth.

The removal of molars may therefore involve extraction with forceps, trephining the dental alveolus with repulsion of the tooth and trephining of the sinuses because of empyema or other pathologic conditions referable to the dental affection; consequently all of these should be studied as related topics.

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1. EXTRACTION OF TEETH

Figs. 1 and 2

Instruments. Extracting forceps, fulcra of various sizes, mouth speculum with abundant lateral working room, tooth-pick, splinter forceps, reflecting lamp.

Technic. In simple cases with a quiet animal the patient may be sufficiently confined by being backed into a corner or very much better by being secured in stocks. In complicated cases or very resistant animals, it is best to place the patient upon the operating table or in default of this, to cast and secure in lateral recumbence on the sound side.

Apply the speculum and identify the diseased tooth by manual exploration; determine if the tooth be of unnatural size or form, if it be loose, if the gums be separated from its neck at any point, if it be out of line with the other teeth in the row, if it be painful to the touch, if it be split, etc. An external tooth fistula or a tumefaction over the affected member may aid in distinguishing it. Aid may also be had by illuminating the mouth with a reflecting electric or other lamp.

It is highly essential, both for the examination of the teeth and for operating upon them, that the halter be very loose about the cheeks. When closely fitted to the animal

while the jaws are closed, the wide opening of the mouth by means of the speculum causes the nose-chin band of the halter to become very tight and presses the cheeks against the labial surfaces of the grinders so forcibly as to prevent easy access to that surface. The halter pressure also causes pain and abrasions of the buccal mucosa owing to the forcible pressure of the cheek against the corners of the superior grinders.

Remove any accumulations of partially masticated food by means of the toothpick or fingers.

In applying the forceps, have an assistant draw the tongue out at the commissure of the lips on the sound side and introducing one hand into the mouth, place the index finger on the posterior border of the diseased tooth and with the other hand, push the opened forceps backward upon the dental row until they reach the diseased member, then firmly grasp it with the instrument, pressing the jaws down as deeply as possible against the alveolus.

In many cases the diseased tooth can be clearly seen, especially with the aid of the reflecting lamp, and the forceps may be readily applied by the sense of sight, which is frequently preferable to that of touch.

Withdraw the free hand from the mouth, grasp the forceps handles firmly and loosen the tooth in its alveolus by establishing and maintaining as long as necessary a gentle to and fro lateral movement. The tooth is thus loosened in its alveolus by causing it to revolve very slightly back and forth on its long axis, thereby spreading the alveolar cavity. Care is to be taken not to apply too great force to the tooth in attempting to loosen it by rotation. If the force applied is excessive, the tooth fractures transversely at or below the gums and thereafter extraction with forceps becomes impossible. When the tooth has become well loosened, the fact is indicated by its revolving with the forceps and by an audible crepitant sound caused by the

passage of air bubbles to and fro through the blood and lymph in the alveolus. Maintain the forceps in position with one hand and with the other introduce the fulcrum to a point where the depression on its superior surface will receive the projecting rivet-head of the instrument or in an otherwise secure position affording a safe support, while the inferior surface rests evenly upon the crown of a tooth anterior to that which it is desired to extract, as is shown in Fig. 1. The fulcrum needs to be held firmly in place in order to prevent it from gliding away under pressure.

In extracting the first premolars there is no opportunity for resting the fulcrum on teeth anterior thereto and consequently forceps have been made with fulcra beyond the forceps jaws resting upon teeth more posteriorly situated. This is not essential. If the tooth is thoroughly loosened, as it should be, one hand placed in the interdental space with the dorsal surface against the jaw and the volar grasping the instrument, will serve as an effective fulcrum.

In other cases an iron or steel fulcrum is not essential, but a stick of hard wood of proper size and form acts quite as efficiently and may even keep its position better because the teeth upon which it rests sink into it somewhat. On the whole the fulcrum is not so important as some have considered it, since, after a tooth is loose enough to be drawn with its aid, a very trifling additional loosening will permit it to be easily lifted from its alveolus without it.

The tooth fang is extracted by forcing the handles of the forceps toward the jaw in which it is located, so that as it is gradually drawn out the forceps tend to pivot on the fulcrum in a way to permit the tooth to emerge from its alveolus in the direction of its long axis. By referring to Fig. 2 it will be seen that the long axes of the different teeth vary, that of the molars being obliquely forwards from fang to crown towards the incisors, while the crowns of the premolars are directed obliquely backwards toward the

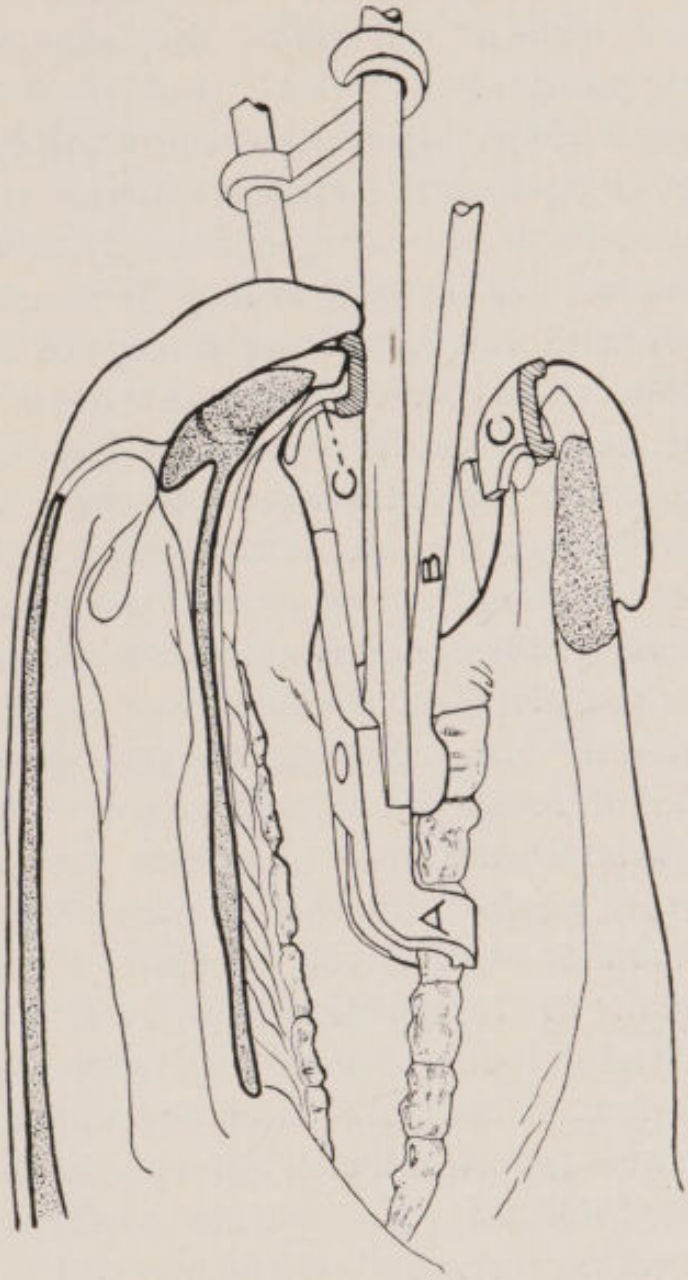

FIG. I

Extraction of Teeth.

Sagittal section through the oral cavity, showing plan for extracting the third inferior premolar, viewed from within the mouth.

A Forceps jaws applied to third premolar.

B Fulcrum resting upon first premolar.

CC. Plates of mouth speculum resting upon incisor teeth.

molars. The slant of the teeth is most marked at the ends of each arcade while at the middle they acquire an almost perpendicular position.

In drawing the last molar the back of the forceps will generally strike against the opposite dental arcade before the tooth has completely emerged from its alveolus and in order to complete its removal it may be necessary to take a deeper hold with the extracting forceps or withdrawing these, complete the operation with the hand. In young horses where the teeth are very long, we have found it impossible to complete the extraction until the tooth has been divided transversely by means of the tooth cutting forceps.

The dangers in the extraction of teeth are chiefly:

1. The transverse fracture of the tooth, leaving the fang still fixed in the alveolus, a danger not infrequently unavoidable when the crown has become greatly weakened by disease so that it lacks the necessary power of resistance; under most other conditions transverse fracture may be largely guarded against by the careful securing of the patient in a manner to effectively prevent sudden throwing of the head while the forceps are applied, and by using good judgment in the amount of force exerted while loosening the tooth in its alveolus. As stated above, one should not expect to be able to extract with forceps the teeth of very young horses which have not become partly detached by disease or in which the fangs are the seat of odontomes.

2. Fracture of the alveolar walls is an accident which may generally be prevented by proper care in the application of force and the avoidance of any attempt to extract a tooth when the existence of an enlargement of the fang is apparent or suspected.

3. The tooth may slip from the forceps into the pharynx and be swallowed, an accident avoidable by proper securing of the patient and by inserting the hand into the mouth as the tooth begins to emerge from its alveolus, and if need be, by grasping it with the fingers.

2. REPULSION OF TEETH

Fig. 2

Uses. The removal of molars, pre-molars, tooth fangs from which the crowns have been broken away, alveolar odontomes, etc., which can not be removed safely by means of the forceps.

Instruments. Mouth speculum, razor, convex scalpels, trephine, bone gouge, Luer's sharp bone forceps, (rongeur forceps) light and heavy bone chisels, mallet, tooth punch, curette, compression artery forceps, scissors, needles, thread, absorbent cotton, antiseptic gauze, extracting forceps, splinter forceps, tenacula, metal probe.

Technic. Secure the animal in the lateral recumbent position with the affected side up. The operating table affords by far the best means for securing for the convenience and safety of operator and patient. If the sinuses are so involved as to make possible the inhalation of pus, blood or other injurious matter, perform tracheotomy in ample time to avert danger. Anæsthetize locally or generally as required. Shave and disinfect the operative area and trephine according to the method described in the following chapter, down through the alveolar plate immediately over the fang of the affected tooth. Avoid dulling the trephine by striking it against the tooth fang.

If an external fistula exists, the identity of the affected tooth is best determined by passing a metallic probe through it against the diseased fang, while one hand is passed into the mouth and the location of the probe more fully ascertained. Care should be exercised in trephining not to injure the adjoining teeth. This is best accomplished by palpating with one hand inside the mouth and the other outside in a manner to locate the fang of the affected tooth. The danger is further decreased by using a trephine, the diameter of which is considerably less than the antero-posterior diameter of the tooth.

The identification of a given tooth often gives much difficulty to the beginner. The identification should be made by passing the finger tips along the lingual or inner surface of the row of teeth involved and enumerating them from before backward. The line of demarcation between two contiguous teeth is to be recognized by the depression between their necks. The student must remember that the first premolar has a much greater antero-posterior diameter than the succeeding teeth. Care needs to be taken, also, not to confuse the longitudinal grooves due to the plicae in the dentine and enamel, especially of inferior grinders, with the inter-dental depressions.

After removing the disc of bone isolated by the trephine, control all hemorrhage and then enlarge the opening and remove the bony tissues till the tooth fang is bared its entire width. Insert a scalpel or bone chisel betwen the external face of the bone and the soft tissues at the oral margin of the trephine opening, and having one hand in the oral cavity with the fingers resting upon the alveolar border on the lateral side of the tooth to serve as a guide, push the scalpel or chisel along between the bone and soft tissues until it emerges from the gums alongside the affected tooth. Extend this separation backward and forwards until the soft tissues are completely detached from the alveolar wall over the entire area of the diseased member.

When operating upon the superior molars, the fangs of which are covered by the zygomatic ridge, the chisel or scapel cannot be pushed directly from the trephine opening into the mouth between the soft tissues and the bone because the line is concave instead of direct. In these cases it is best to detach the soft parts from the zygoma only, at first and then remove the plate of the ridge with the bone forceps or chisel, after which the line into the mouth is direct and the instrument can be readily pushed between the soft

and osseous tissues for the remainder of the distance and the separation completed.

The operator needs to use great care in making his way through the zygoma down to the mouth. Just beneath the ridge, the larger branches of the facial nerve (7th, cranial nerve) run parallel to the ridge directly under the skin. If the operator inadvertently cuts or injures the nerve branches, the lips are paralyzed and drawn to the opposite side. The paralysis may be permanent and greatly disfigure the animal. The operator needs to be careful, also, in this part of the operation to avoid wounding the subzygomatic artery and vein, SZ, Figs. 8, 9, which run parallel to the zygoma, deeply imbedded in the masseter and lying almost immediately against the bone. In separating the soft tissues from the bone, therefore, the operator must be careful to keep immediately against the bony plate.

The trephining for the repulsion of the superior molars involves the invasion of the facial sinuses. In a majority of cases, the sinuses are the seat of empyema, so there is the double object of removing the diseased tooth and providing means for overcoming the empyema. This is described in the following pages under trephining of the sinuses.

The repulsion of the inferior grinders is one of the most hazardous operations undertaken by veterinarians, unless accurate anatomical knowledge and surgical technic are brought to bear upon the operation. The inferior grinders are wedge-shaped, the fang being the apex of the wedge. The inner and outer alveolar plates rest directly upon the tooth. If the punch slips by the fang of the tooth and engages either internal or external plate, disaster follows. The masseter muscle covers the fangs of the inferior molars and the operator must avoid mutilating it as far as possible in order to prevent unsightly blemishing. The best plan for laying bare the alveolar wall over the fang of the tooth

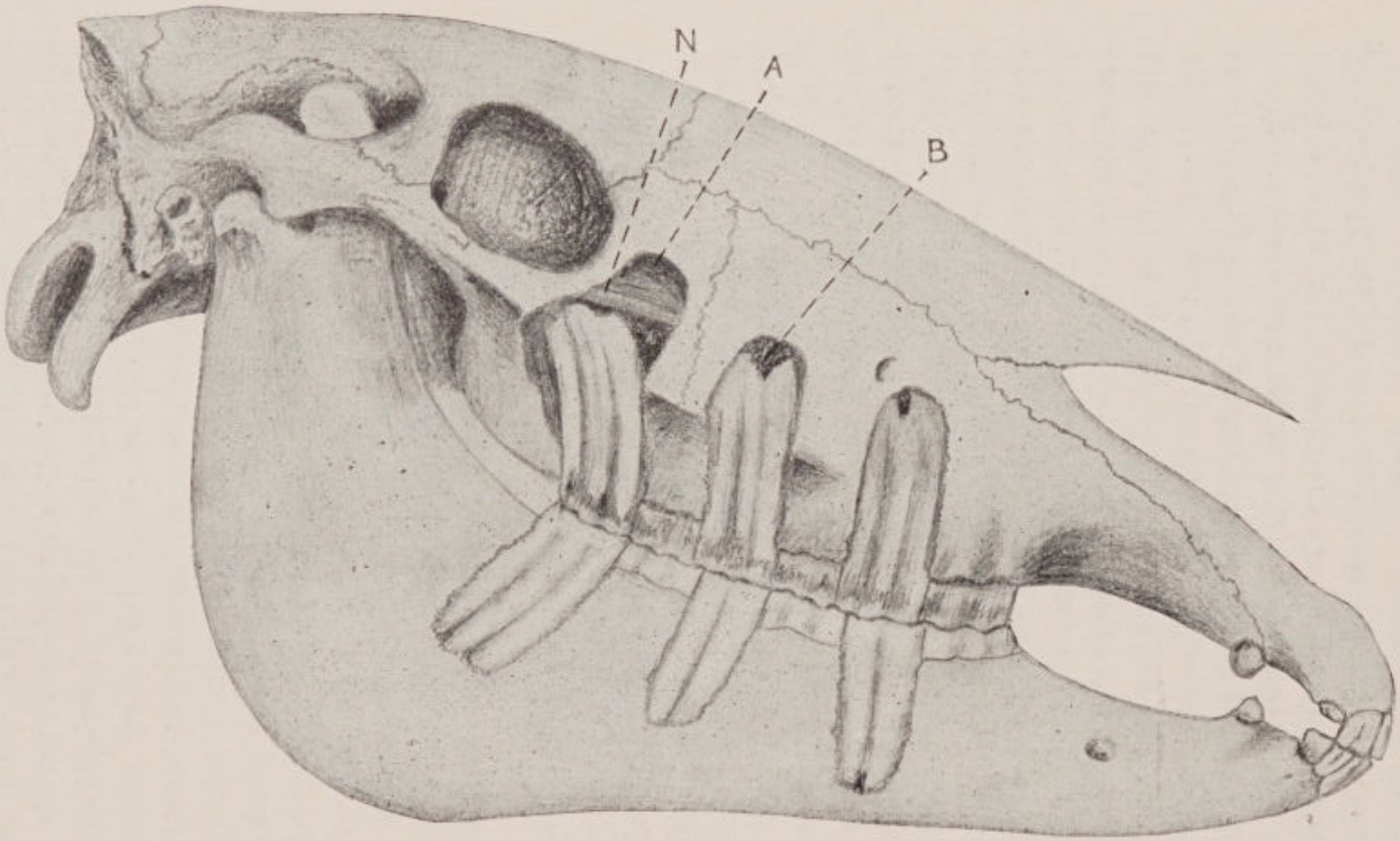

FIG. 2.
Repulsion of Molars.

Head of four year old horse, with the second premolars and first and third molars laid bare to illustrate plan for repulsion; A, superior maxillary sinus; B, inferior maxillary sinus; N, conduit of superior maxillary division of trifacial nerve.

it is desired to repel, is to make a curved incision at the antero-inferior angle of the masseter muscle commencing about one inch above the border of the inferior maxilla, just behind and parallel to the parotid duct. Follow the duct until the inferior attachment of the masseter is reached, and then turn backward along the inferior masseter border for a sufficient distance. Detach the inferior maxillary attachment of the masseter as far as may be required and turn up the semicircular flap thus acquired, laying the surface of the bone bare.

After properly locating the region of the tooth fang, the trephining may proceed. By this method the operator avoids wounding the 7th nerve to produce paralysis of the lower lip, and also reduces to a minimum the resulting scar, and has the best access to the field for trephining.

The bone of the operative area having been properly bared, the trephine opening completed, and the soft tissues over the course of the tooth detached from the trephine opening into the mouth cavity, the operator should proceed to remove the external alveolar plate as indicated in Fig. 2.

With a light, well sharpened, narrow bone chisel cut away and remove the external alveolar plate over the entire extent of the tooth, from the oral margin of the trephine opening into the mouth cavity. Hold the chisel so that the outer edge is inclined from the center of the affected tooth toward the adjoining one, thus making a bevelled channel through the alveolar plate tending to loosen the isolated section of bone by driving it outward. Drive the chisel for only a short distance on one side, then upon the other, and thus break the alveolar plate away in small sections and avoid an extension of the fracture to neighboring alveoli and damage to adjacent teeth. Care should be taken that the bone chisel is sharp, otherwise extensive fractures of the bone occur. With gouge and chisel remove all remnants of bone over the lateral side of the tooth laying it completely bare as shown in Fig. 2.

The soft tissues of the part should not be disturbed beyond the excision of the circular piece covering the disk of bone removed by the trephine, and the detaching of them from the portion of bone to be chiseled away.

When the tooth has been bared so that every part of its lateral surface can be seen or felt, the punch may be placed against the end of the fang, a few firm, quick blows given with the mallet, so directed that the force is in a line with the long axis of the tooth, and the organ driven into the mouth where it is seized by the forceps or the hand and removed. If the tooth be not readily and safely dislodged in this way, place the heavy bone chisel against it and with the aid of the mallet comminute the tooth by breaking it transversely and splitting it longitudinally, in which process the fragments are generally loosened from the alveolar walls and can then be readily removed with the aid of the gouge, or heavy dressing or splinter forceps. The repulsion of inferior grinders is generally rendered more safe by dividing them transversely with the chisel at one or two inches from the fang and prying out the detached piece. The operator then has a square end against which to place the punch. The shortening of the tooth also facilitates pushing it into the mouth as it does not jam against the superior grinder. Remove carefully all fragments of tooth or of loosened bone, cleanse and disinfect the wound, pack with antiseptic gauze and dress daily.

In cases where a fistulous opening remains after repulsion of molars without the removal of the alveolar wall, or if a tooth has been drawn by means of the forceps and the alveolus fails to heal, the bony plate should be removed in the above manner and the alveolar cavity thus opened freely for inspection and remedial measures.

Dangers. Wounding of the adjoining tooth is to be avoided chiefly by carefully locating the fang of the affected one and placing the instrument as exactly as possible over

its centre, by using a trephine not exceeding 2 to 2.5 cm. in diameter and cautiously sawing through the compact layer of the external plate only, removing the cancellated tissue with the gouge and extending the opening in the desired direction after the outlines of the tooth fang have been clearly determined. If an adjoining fang is wounded, the tooth should be removed as it will not heal but will result in a permanent tooth fistula.

Fracture of the alveolar walls of the inferior maxilla may occur during the removal of the external alveolar plate with the chisel or the repulsion of the tooth with the punch. The first is to be averted by care in having the chisel sharp, by observing the precaution of making a bevelled cut through the bone, by using only moderate blows and driving the instrument alternately for a short distance on each side. The second danger of extensive fracture may be averted by being cautious to see after each stroke on the punch that it has not slipped inward along the median side of the tooth, pressing the internal plate away from the tooth and tending to produce a longitudinal fracture nearly or quite as long as the dental arcade. Careful digital exploration in the mouth may discover this fracture while still "simple", but a stroke or two more will convert it into the very much more serious "compound" fracture opening into the oral cavity. Keeping one hand constantly in the mouth at the point of impact is always desirable as a precautionary measure.

Transverse division of the tooth while yet in situ by means of the bone chisel, as above described, is a great safeguard against fracture of the jaw by lessening the force required in repulsion and by the removal of the tapering fang, which then leaves a more secure base for the punch to act upon. It should never be forgotten that the impact from the punch must always be as nearly parallel to the long axis of the tooth as is possible.

The fracture of the superior maxilla and bony palate is not so probable as the preceding and is preventable by moderate care in the denuding of the tooth before punching, by comminution of the tooth in proper cases, by the careful adjustment of the punch and by applying the force in the proper direction.

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TREPHINING THE FACIAL SINUSES

Figs. 3-11

The facial sinuses of the horse constitute an exceedingly intricate and extensive group of cavities, communicating more or less freely with each other or with the exterior through the medium of the upper air passages, of which they are to be regarded as a part.

Their arrangement and relations permit them to frequently become the seat of, or central figure in, many forms of disease which require for their differential diagnosis, amelioration or cure, the operation known as trephining. Their extent and relation to each other and to surrounding parts vary greatly with age. They may also be profoundly changed as a result of disease, resulting not infrequently in the frontal, superior and inferior maxillary sinuses ceasing to exist as separate compartments and becoming merged into one vast cavity. The general position, extent and relation of these are indicated by Figs. 3–11.

It is to be noted that in cross sections the superior and inferior maxillary sinuses appear to be reversed in relation to their nomenclature. It is difficult to make a cross sec-

tion of these sinuses in such a manner that the antero-inferior extremity of the superior sinus does not show below and external to the inferior one. The inferior maxillary sinus is *inferior* in the sense that it is nearer to the nasal opening, so that with the head in a vertical position or in a longitudinal section, the inferior sinus is below the superior, while if the head be placed horizontally or a cross section made, a small portion of the superior sinus may show below the inferior.

The uses of trephining are in a measure common to all the sinuses and are chiefly for the relief of empyema of the cavities involved, necrosis of the bony or cartilaginous walls, tumors of various kinds, especially dental in the young and malignant growths in the old, foreign bodies in the sinuses, differential diagnosis of diseases of this region, etc.

Veterinarians trephine the sinuses by two fundamentally different plans; with and without excision of the cutaneous disk corresponding to the piece of the bone removed. The first is generally used in Great Britain and North America, while the last is the prevailing method in continental Europe and other parts of the world. The reasons assigned for these variations in method are conflicting. To us there seem to be adequate reasons for preferring the excision of the cutaneous disk. We regard as the chief considerations in an operation the following: the reduction of infection to a minimum; the prevention of *pain* during the operation or the after-treatment; the reduction of the *scar* to a minimum; rapidity and certainty of *recovery*; *convenience* in operating and dressing. Inevitably a septic operation, the degree of infection is largely dependent upon the area of the wound, the facility for maintaining cleanliness and the degree of disturbance to the tissues while being dressed. The wound area in the bone is alike in all cases but that in the skin varies greatly. If we compare the usual European technic with that given below we would find the wound

area approximately 2.2 sq. in. in the European method, while in the other we have only about .44 sq. in., or proportionately the wound area in the soft tissues in the two operations would be as 5 : 1.

It is very evident that the technic given below affords immeasurably better facility for maintaining cleanliness in the wound and a minimum amount of insult to the tissues in the process of dressing.

The amount of pain caused in the operation, which should be eliminated by local anaethesia, depends chiefly upon the extent of the skin incision which is essentially equal in the two plans, so that the only difference would be in the dissection of the skin from the bone in the European operation. The pain caused in dressing must be greater in the European method because the detached, overhanging skin must be moved and disturbed each time causing pain and inviting infection. The question of pain in dressing must always be seriously considered as it not only affects the time required for dressing and its efficacy, but has an important relation to the docility of the animal after recovery, some horses having their dispositions permanently ruined by the irritation due to the oft repeated painful dressing of wounds.

The cicatricial contraction of the tissues of the horse is so great that the removal of a circular disk of skin ⅞ to 1½ in. in diameter on the face does not leave a visible scar sc that the question of blemish falls back upon that of infection, which, as asserted above, is far more probable in the continental European method.

The rapidity and certainty of recovery are dependent upon the considerations above discussed. The removal of the cutaneous disk is certainly easier and quicker than the other method. The convenience for dressing is evidently superior when the English and American method is used.

The opening of the sinuses into the nostrils is based upon

the surgical principle that suppurating cavities should be provided with ample drainage from the most dependent part. The direction to leave the external wound open, at first thought, seems antagonistic to general surgical principles but it should be remembered that the wound consists only of the incision through the skin, connective tissue and bone, penetrating a suppurating cavity, and that any object which we can place in this opening can only serve to dam back the secretions of the cavity and can not prevent them from coming in contact with the wounded surface. It must further be regarded that the respiratory mucosa of the upper air passages is not irritated or injured in any manner so far as we can observe clinically by the direct admission of air into them through a trephine, or other artificial opening, but, on the contrary, the suppuration in a sinus is constantly aggravated by the retention of the pus and exclusion of air, and recovery is facilitated by thorough drainage and aeration.

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3. TREPHINING OF THE FRONTAL SINUSES

Figs. 3-11

Uses. Fracture of the bony walls, necrosis, tumors.

The ample communication below with the superior maxillary sinus (See FE. Figs. 5 and 6) prevents the accumulation of pus or fluids in the frontal sinuses even if formed therein unless the superior maxillary sinus first becomes filled and the contents back up into the latter. In empyema of the frontal sinuses, trephining of them alone can not give relief, but calls for a repetition of the operation on the maxillary sinuses.

Instruments. Razor, scissors, convex scalpels, artery forceps, tenacula, probe, trephine, curette, gouge, Luer's sharp bone forceps (rongeur forceps), hammer, chisel,

probe pointed bistoury, dressing forceps, disinfecting and dressing materials.

Technic. The operation may be performed upon the standing animal with the aid of local anaesthesia of the skin, the bone having virtually no sensation. Restless animals may be further secured with the twitch, in the stocks, upon the operating table or by casting on the sound side.

Clip and shave the hair from the region of the frontal bone at that point which the operator has reason to believe is nearest the center of disease. The highest point at which the sinus may be trephined is indicated by F in Fig. 3. At this point the sinus is very shallow, its floor consisting of the cranial plate of the frontal bone. The most central portion of the cavity is reached by trephining on a level with the inferior border of the orbital cavity on the lines FE, Figs. 5 and 6. Trephining at this point gives the operator access to the superior maxillary sinus, SM, Figs. 4–6, through the fenestrum, FE, Figs. 5 and 6. The lowest and generally most essential point for trephining is at ST, Figs. 4 and 5, where the opening affords free drainage externally from the most dependent part of the cavity and at the same time offers ample opportunity for securing dependent nasal drainage by breaking through the superior turbinated bone at ST, Figs. 4, 5 and 11.

By consulting Figs. 7–9, it will be seen that after reaching the level of the nasal septum, a trephine opening immediately against the median line like that at F, Fig. 3, would wound the septum and superior turbinated bone and penetrate the nasal cavity. Consequently the operator must avoid making the trephine opening in this region near the median line, but must keep 1½ to 2 inches laterally therefrom.

With a heavy convex scalpel, make a circular incision at the desired point as large as the area of the trephine,

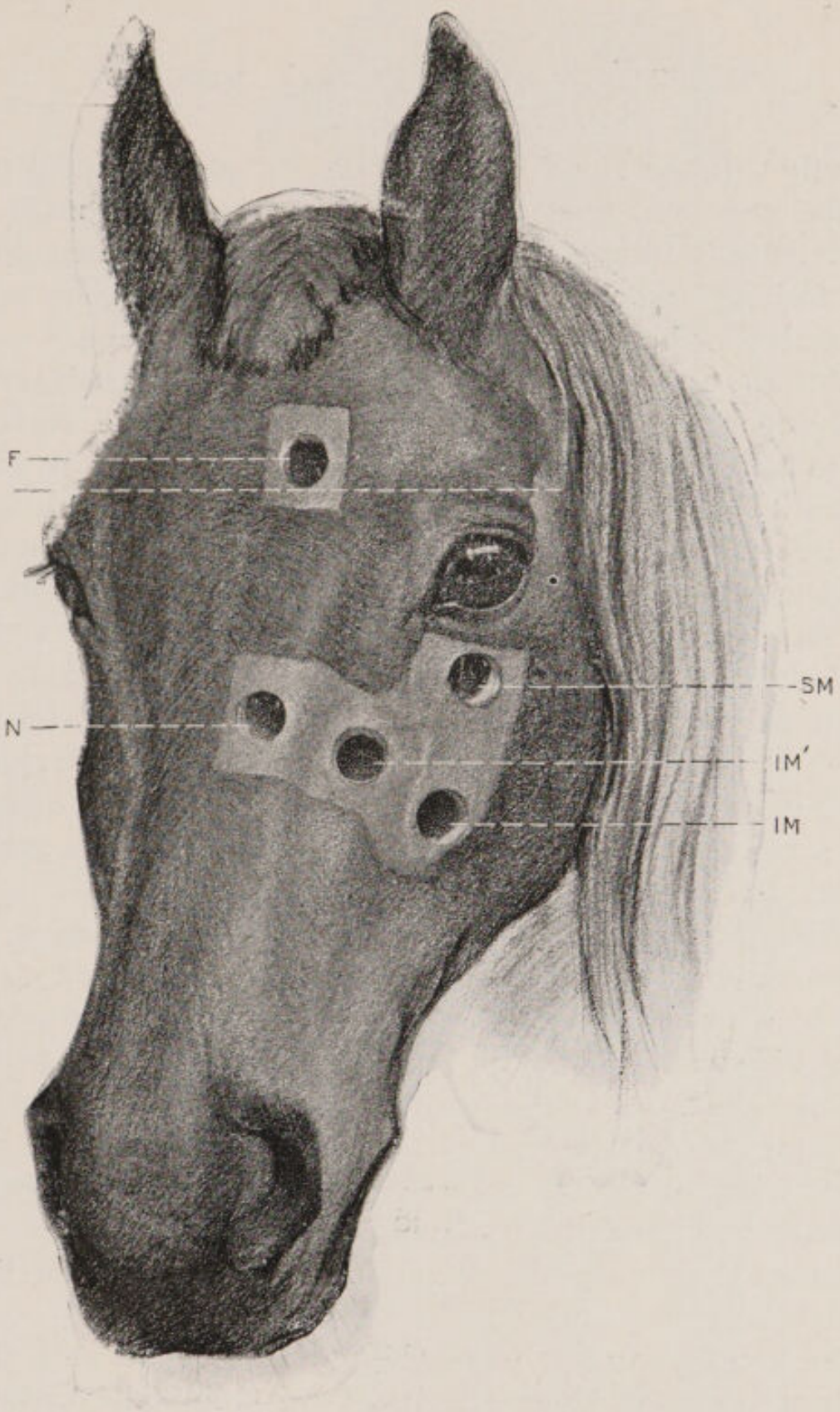

FIG. 3.
Trephining the Facial Sinuses.

F, highest point at which an opening may be made into the frontal sinus without wounding the cranium and brain; N, opening into nasal sinus; SM, opening into superior maxillary sinus; IM, opening into external portion of inferior maxillary sinus; IM′, opening into the median portion of the inferior maxillary sinus.

directly through the skin, subcutem and periosteum down to the bone and remove in one piece the entire mass of encircled soft tissues by seizing the skin with a tenaculum and forcibly separating the periosteum from the bone with the scalpel or bone chisel. Control the hemorrhage.

With the center-bit of the trephine extended, place it accurately upon the denuded area perpendicular to the surface of the bone and grasping the handle firmly, turn it to and fro until the bit has penetrated the bony plate and the saw has cut a distinct groove to serve as a guide, when the center-bit should be retracted and the operation continued until the disc of bone is detached, being careful to maintain the trephine perpendicular to the surface. The operation is facilitated by grasping the shaft of the trephine between the thumb and fingers of one hand, constituting a support in which it may turn back and forth. The pressure under which the trephining is carried out must not be too great or the instrument may become wedged and broken.

When the bony plate which has been isolated begins to loosen, remove the trephine and break or pry out the piece of bone with the bone gouge or chisel. Smooth any uneven edges of bone with a heavy scalpel or by re-inserting the trephine and using it as a rasp. The abnormal contents of the sinus may now escape through the opening or be removed with the curette, forceps or scissors, and the cavity irrigated with an antiseptic fluid.

Leave the trephine wound entirely open and irrigate the sinuses daily with antiseptics.

The frontal being in free communication below with the superior maxillary sinus, the irrigating fluid falls directly into the latter until it becomes filled. The superior turbinated bone of the same side, forming the median wall of the frontal sinus, is commonly perforated by necrosis in cases of serious disease, establishing a communication between the frontal and nasal cavities, through which pus and irrigating fluids readily escape into the nostril.

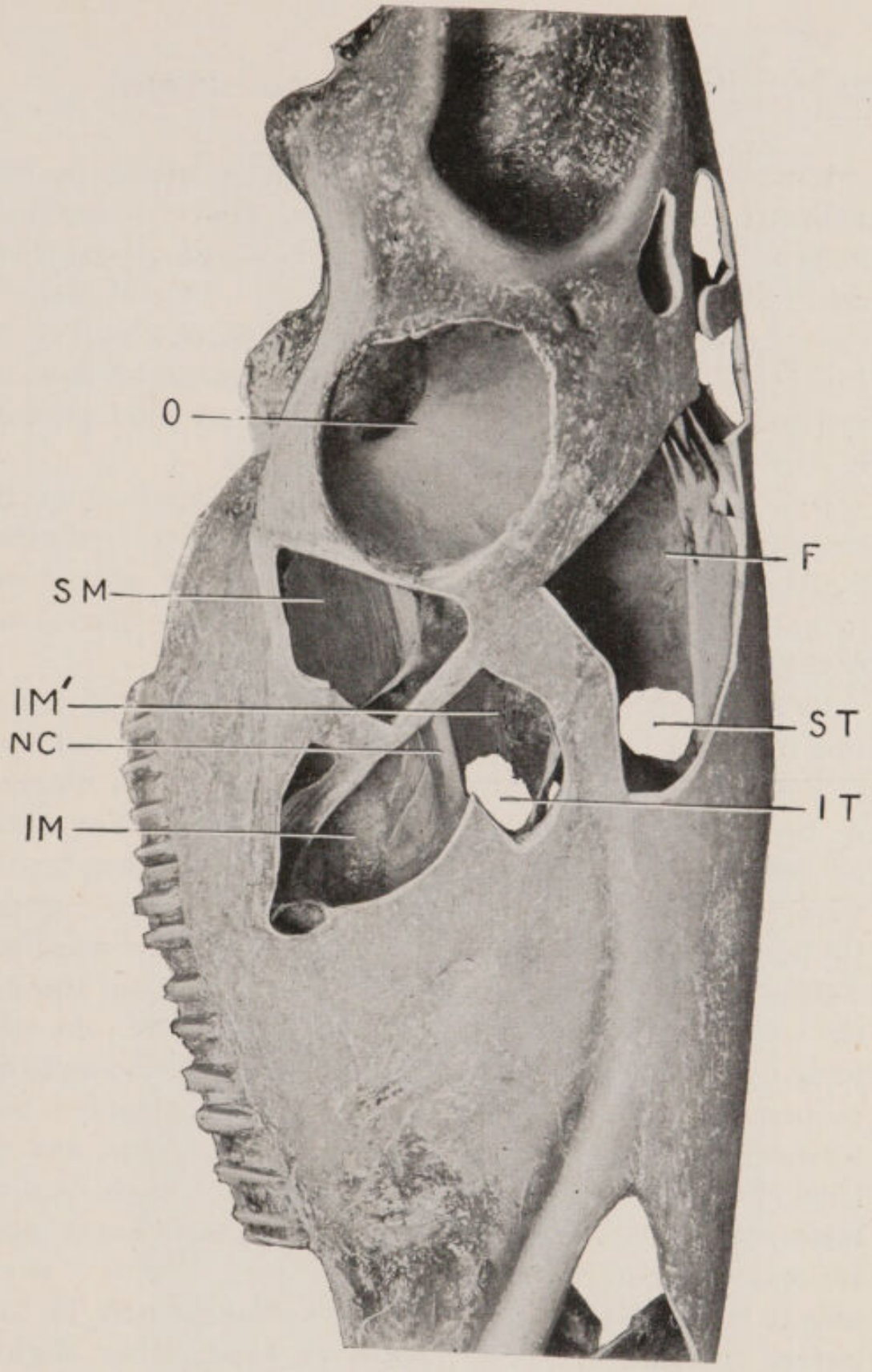

FIG- 4.
Trephining of Facial Sinuses.

Right side of face, viewed laterally, showing extent and relations of the sinuses. O, orbita cavity; SM, superior maxillary sinus; IM'', median portion of inferior maxillary sinus; NC, nerve conduit of superior maxillary trunk of the trifacial: IM, laterial portion of inferior maxillary sinus; F, frontal sinus; ST, opening through superior turbinated bone for the establishment of drainage from the frontal and superior maxillary sinuses into the nasal passage; IT, opening through inferior turbinated bone for the establishment of drainage from the median portion of the inferior maxillary sinus into the nasal cavity.

It has been assumed that pus or other contents in considerable quantity might pass from the superior maxillary sinus into the nasal cavity through the normal communicating slit between the two cavities, but a careful study of the anatomical arrangement of these parts, opposite N, Figs. 7–10, shows very clearly that this is impossible as the margin of the slit acts as a valve and closes it when pressure is applied from within.

In order to prevent the aspiration by the patient of the contents of the sinuses, whether pus, blood or irrigating fluids, and to facilitate their escape from the nostril, any irrigation on the recumbent animal should be carried out with the poll elevated and the nose depressed.

By studying Figs. 4–10 it will be seen that any collection of pus or other pathologic contents in the frontal sinus at F will result in poor drainage so far as may be obtained by trephining through the external wall only. The drainage should be completed whether the contents have formed within the frontal sinus itself, or have entered it through the fenestrum, FE, Figs. 5 and 6, from the superior maxillary sinuses, by making an artificial communication through the turbinated bone between the frontal sinus and the nasal fossa at ST, Figs. 4, 5 and 11. This is to be accomplished by breaking through the thin walls of the turbinated bone by means of a probe or other suitable instrument and enlarging the opening sufficiently with the probe-pointed bistoury or with the finger. In locating the exact point for making this opening in the turbinated bone, it is advisable to pass a slightly curved heavy probe, a pair of long curved uterine dressing forceps or some other slightly curved and somewhat rigid instrument up the nostril to the operative region, and having an index finger in the sinus against the median wall, the movements of the sound can easily be felt and the wall be broken down either by pushing the sound up into the sinus or thrusting the finger downward into the nasal passage.

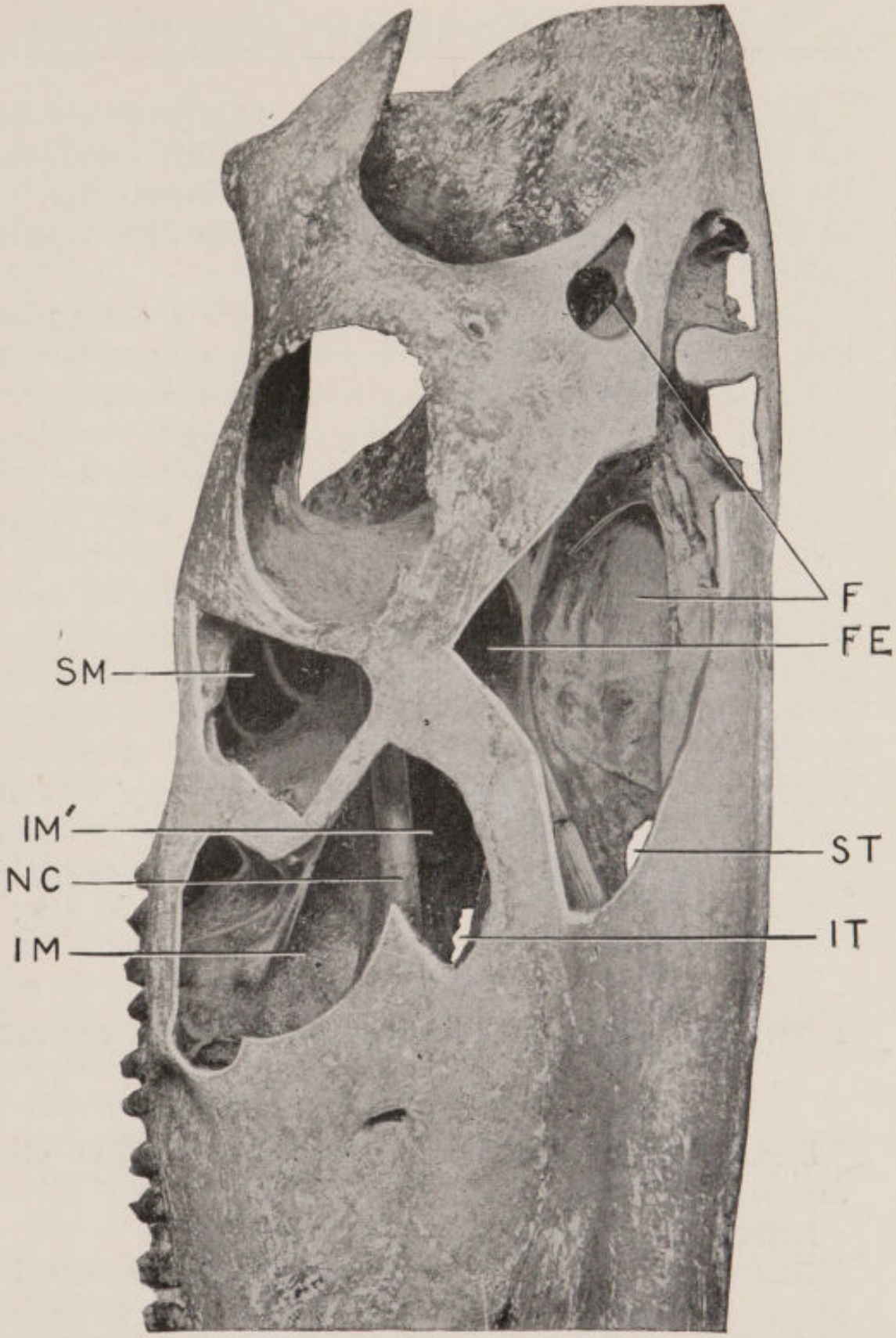

FIG. 5.
Trephining of the Facial Sinuses.

Oblique lateral view of the face with the sinuses exposed. SM, superior maxillary sinus; IM′, median portion of inferior maxillary sinus; NC, nerve conduit of superior maxillary division of trifacial nerve; IM, lateral portion of inferior maxillary sinus; F, frontal sinus; FE, fenestrum of communication between the frontal and superior maxillary sinuses; ST, artificial opening through the superior turbinated bone at the lowest part of the frontal sinus establishing a free communication with the nasal passage; IT, artificial opening through the inferior turbinated bone at the bottom of the median portion of the inferior maxillary sinus, affording drainage into the nasal passage.

In order to prevent aspiration of pus, blood or other fluids after the perforation of the highly vascular turbinated bone, the animal must be allowed to get up immediately. If under general anaesthesia, a trachea tube should be inserted before beginning the operation.

Thread a long probe with a heavy suture about 75 cm. long and inserting it through the trephine opening into the nasal passage, draw it out through the nostril and removing the probe, attach a strip of gauze 75 cm. long to one end of the suture, draw it out through the nostril and tie the ends together on the side of the face to prevent dislodgement. Retain the gauze in position for about forty-eight hours to insure the permanency of the opening through the turbinated bone. In case of severe hemorrhage, the nasal and sinusal cavities may be tamponed for twenty-four hours with a long strip of gauze which may be secured if necessary by suturing to the lips of the trephine wound. In practice the operation can be best carried out generally with the animal in the standing position under local anaethesia. In the standing position hemorrhage and the danger from the aspiration of fluids is greatly lessened.

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4. TREPHINING THE SUPERIOR MAXILLARY SINUSES

Figs. 3-10

Uses. Empyema, diseased teeth, odontomes or other tumors.

Instruments. Same as for the frontal sinuses.

Anatomically there are two maxillary sinuses, superior, SM, and inferior, IM, Figs. 3-10, separated by a thin, imperforate, bony partition. This partition shifts somewhat in position with age and in case of disease undergoes profound changes in location. Some authors advise trephining directly upon the partition in order to open the two cavities

simultaneously. In extensive disease of either sinus the partition between the two frequently becomes obliterated so that there remains but one ; in limited disease the opening of both cavities is ill advised. In extensive disease the existence of a partition may generally be ignored and the trephine opening be aimed at the probable focus of the malady. Should this fail to reach the desired point, the proper location may now be determined by digital or other examination through the first opening. A second operation should then be made to directly reach the seat of the affection and if need be, a third to secure proper drainage.

Shave and disinfect as much of the area as may be required, bounded above by the inferior border of the orbital cavity, laterally by the zygomatic ridge, inferiorly by the lower end of the zygoma, and medianwards by the middle line of the face. Determine the proper point for operation by percussion or otherwise. If it be desired to enter only the superior maxillary sinus, SM, Figs. 3-10, locate the opening beneath the orbital cavity and in front of the zygomatic ridge, SM, Fig. 3, or at any point directly beneath this to midway between SM and IM, Fig. 3, at about the level of the dotted line IM′.

The trephining is carried out as described for the frontal sinuses on page 17. After the trephining has been completed remove any purulent collection or tumors or carry out any other necessary operation in the affected sinuses, and after cleansing, if the trephine opening does not insure perfect drainage of the lateral sac, either lower it by cutting away its inferior border with the bone forceps, or make a second trephine opening at the necessary point.

Since empyema of the superior maxillary sinuses is due in the vast majority of cases to infection derived from diseased teeth or dental alveoli, it is essential after the sinus has been opened that the operator search carefully and minutely over

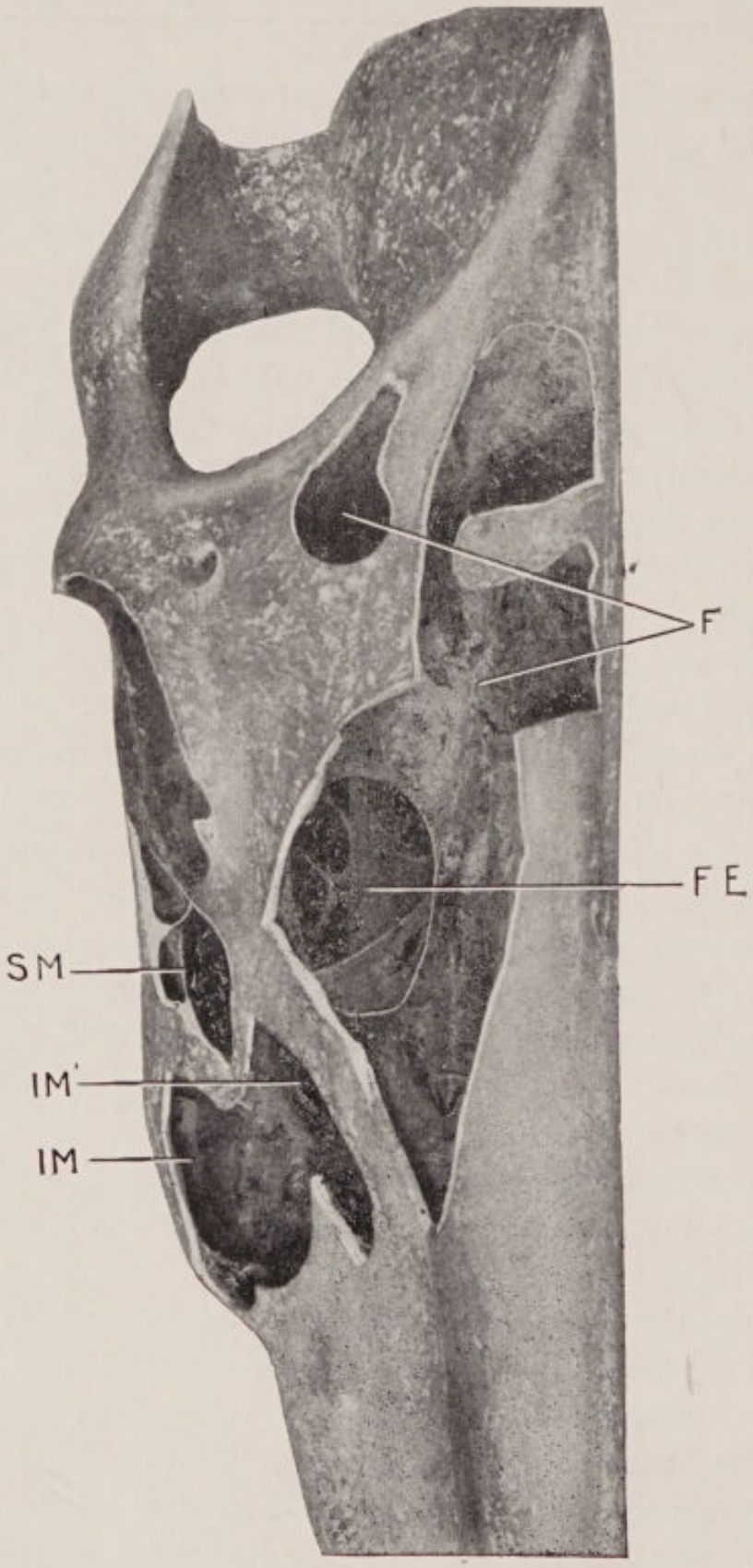

FIG. 6.
Trephining of Facial Sinuses.

Frontal view of right side of face with sinuses exposed. SM, superior maxillary sinus; IM′, median portion of inferior maxillary sinus; IM, lateral portion of inferior maxillary sinus; F, frontal sinus; FE, communication between the frontal and superior maxillary sinuses.

the alveoli of the molars for naked, eroded tooth fangs or for fistulæ leading down into the dental alveoli. If dental disease is recognized, the trephining of the sinus is to be supplemented by repulsion of the offending tooth as described on page 7.

Under the influence of disease, the sinuses may extend far beyond their normal location or may contract or become largely obliterated by being filled with new bone or soft tissue. The median portion of the superior maxillary sinus on the inner side of the bony conduit of the trifacial nerve, NF, Figs. 4–10, can not always be completely drained through the opening SM, Fig. 3. Provision for this must then be made by trephining into the lower part of the frontal sinus and thence breaking through the superior turbinated bone, ST, Figs. 4 and 5, into the nasal passage, or at times it may be feasible to break through the inner wall of the superior maxillary sinus on the median side of the nerve conduit into the nasal cavity. If the inferior maxillary sinus is also involved, good nasal drainage may be had by breaking down the inter-sinusal partition and then penetrating the inferior turbinated bone at IT, Figs. 4 and 5, and inserting through this opening a long and thick strip of gauze which is brought out through the nostril. The ends of the gauze are then tied together on the side of the face to prevent displacement. Retain this in position, renewing daily until the permanency of the opening is assured.

It generally occurs in extensive empyema of the sinuses, that an opening in the turbinated bone takes place by necrosis and in some cases affords the desired drainage while generally the pathologic opening is so placed that it is incomplete.

Leave all wounds entirely open and irrigate daily with antiseptic solutions.

Dangers. Care must be exercised not to injure the superior maxillary division of the trifacial nerve, NF, Figs.

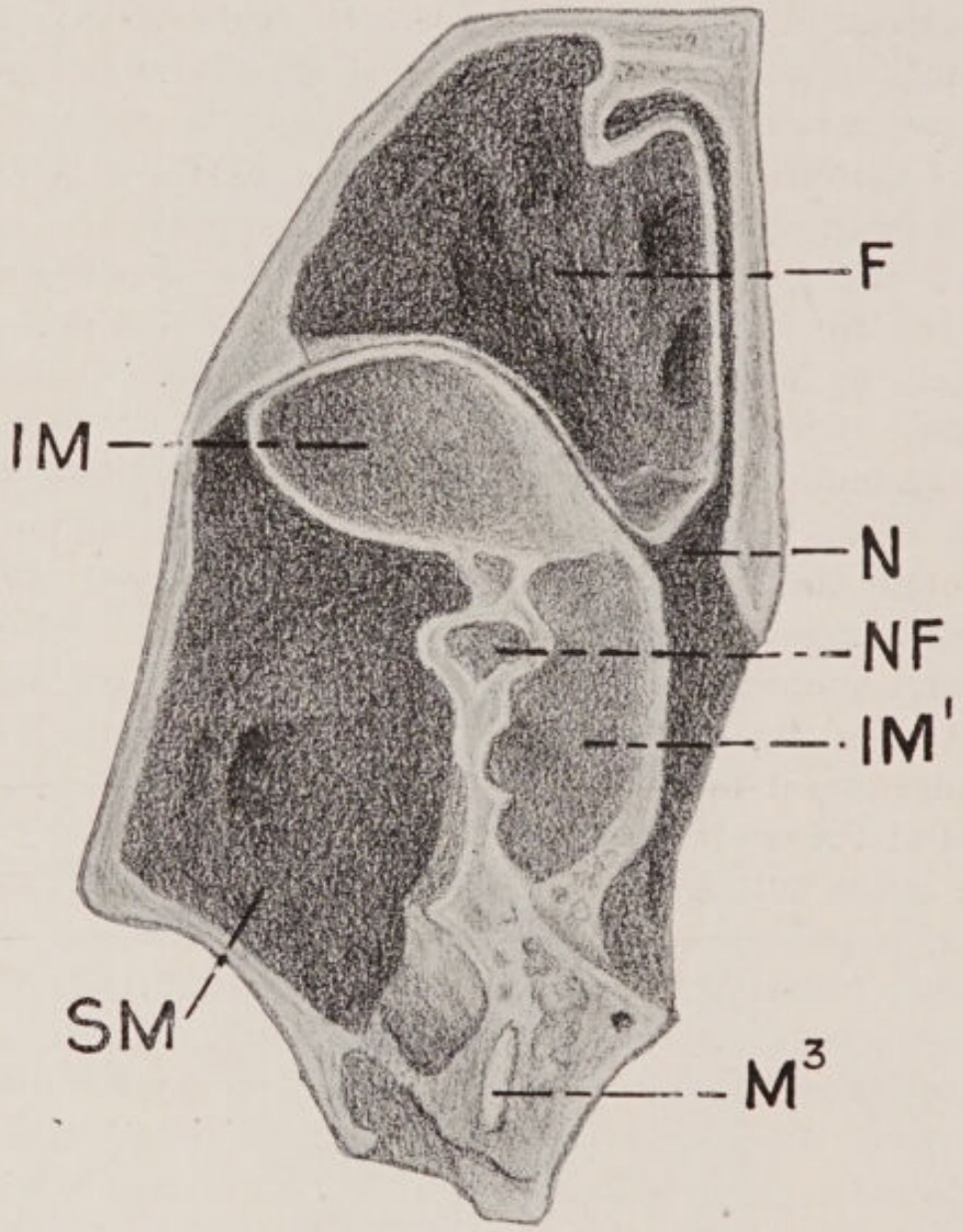

FIG. 7

Trephining of Facial Sinuses

Cross section of the right half of the head of a horse at the posterior border of the last molar. F, frontal sinus ; IM, lateral portion of inferior maxillary sinus at extreme posterior or superior part ; IM′, median portion do. ; N, nasal chamber opposite the communication between it and the superior maxillary sinus ; NF, conduit of superior maxillary branch of the trifacial nerve ; SM, superior maxillary sinus ; M^3, fragment of last molar.

4–10, either in trephining or after the sinuses have been opened. The bony conduit of this nerve is in rare cases entirely resorbed by pressure from dental cysts or other causes, leaving it stretched across the cavity as a white nacrous cord, intensely sensitive. Any injury to this nerve causes intense pain and renders the animal very resistant to the necessary manipulations in the after care of the wound and may leave the patient permanently nervous about the handling of its face.

Hemorrhage is generally not severe and may occur from the skin, where it may be readily controlled by compression or ligation; from the intra-osseous vessels, where it may be checked by pressure with absorbent cotton, by pushing a small portion of cotton into the channel of the vessel with a needle or tenaculum or by plugging the vessel with a conical piece of wood; from the wounded turbinated bones, where it may be stopped by packing with gauze. These tampons should be removed after twenty-four hours.

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5. TREPHINING THE INFERIOR MAXILLARY SINUS

Figs. 3-11

Uses and Instruments. Same as in the preceding.

Anatomical Outline. The inferior maxillary sinus is an exceedingly irregular cavity, differing in details of form and extent in individuals and at various ages. As shown in the illustrations, its disposition might be compared to a pair of saddle bags hanging over the nerve conduit, the lateral and median chambers not very unlike in extent. As suggested in Figs. 4, 5, the floor of the lateral cavity is broken up by irregular bony septa, which in some cases cut the sinus up into quite separate cavities. Sometimes it extends downward barely below the end of the zygoma,

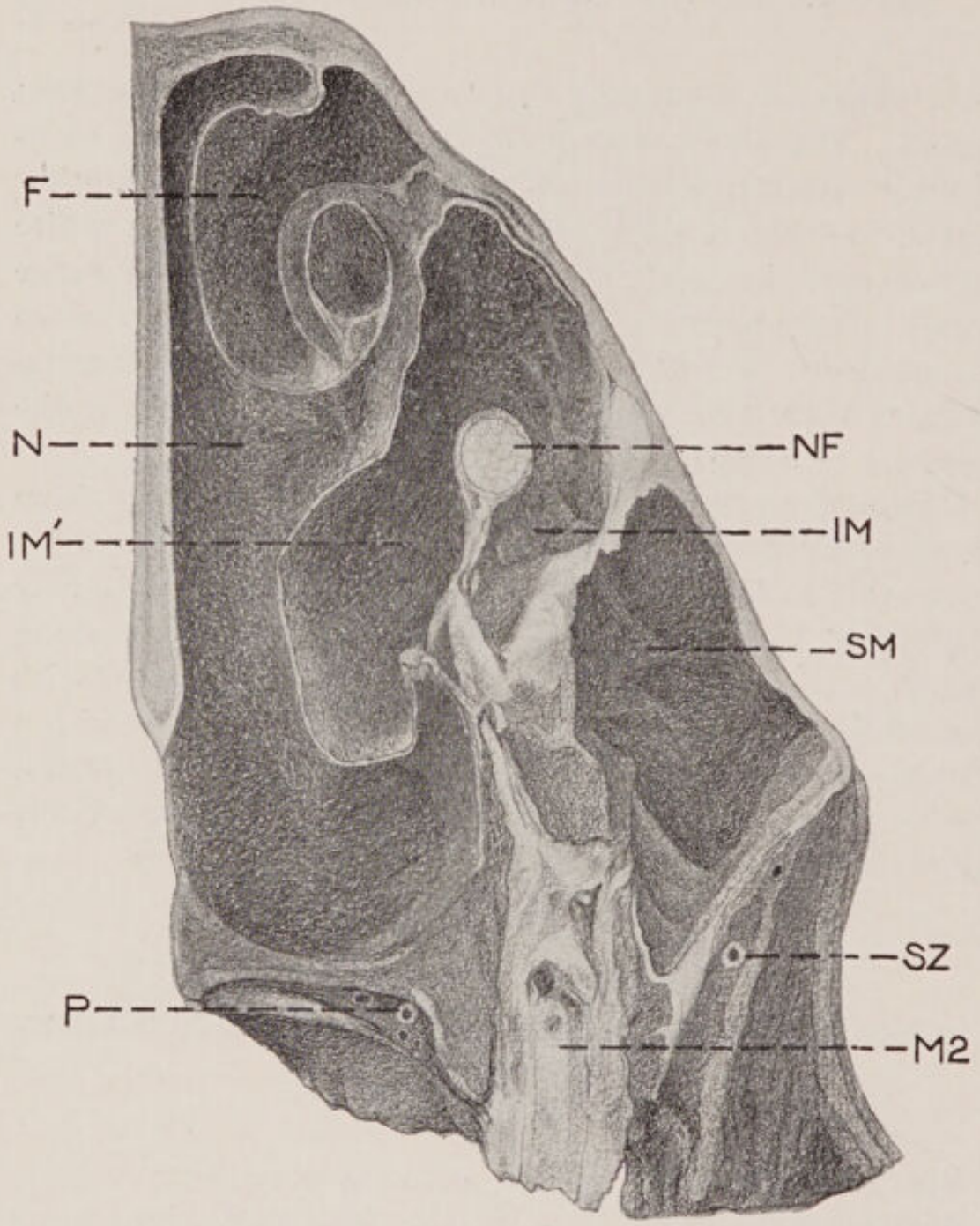

FIG. 8

Trephining the Facial Sinuses

Cross section of the left side of the head of an aged horse at the second molar, seen from the front. F, frontal sinus; N, nasal sinus, opposite the communication between the nasal and maxillary sinuses; IM, lateral portion of inferior maxillary sinus; IM′, median portion of inferior maxillary sinus; SM, superior maxillary sinus; NF, superior maxillary division of trifacial nerve in its bony conduit; SZ, subzygomatic artery; P, palatine artery; M2, second molar.

at other times it reaches down below the intra-orbital foramen. There is hence no rule by which the operator may at all times make his opening precisely at the lower extremity of the sinus.

Technic. The general technic is the same as for the frontal and superior maxillary sinuses, but two trephine openings should always be made. The first opening should be made close against the median side of the zygoma near its lower or nasal extremity, Fig. 3, IM, and the inferior border lowered sufficiently with the bone forceps to provide thorough drainage for the lateral compartment of the sinus.

The second opening is to be made on the median side of the nerve conduit, NC, Figs. 4, 5, as indicated at IM′ in Fig. 3. The location may be accurately determined by palpating with the index finger through the first opening at IM, Fig. 3. This compartment can not be well drained upon the face through either of the trephine openings, so a third opening, penetrating the inferior turbinated bone at IT, Figs. 4, 5, is essential to ideal results by affording free drainage into the nasal chamber. The opening through the inferior turbine is made in the same manner as described for the opening through the superior turbine from the frontal. Thorough search should be made throughout the sinus for the causes of disease. Should diseased teeth be present, remove these and follow by after treatment the same as advised for the two preceding operations.

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6. TREPHINING THE NASAL FOSSAE

Figs. 7-10

Uses. Operations upon the septum nasi, or the turbinated bones, or the removal of tumors or foreign bodies from the nasal passages.

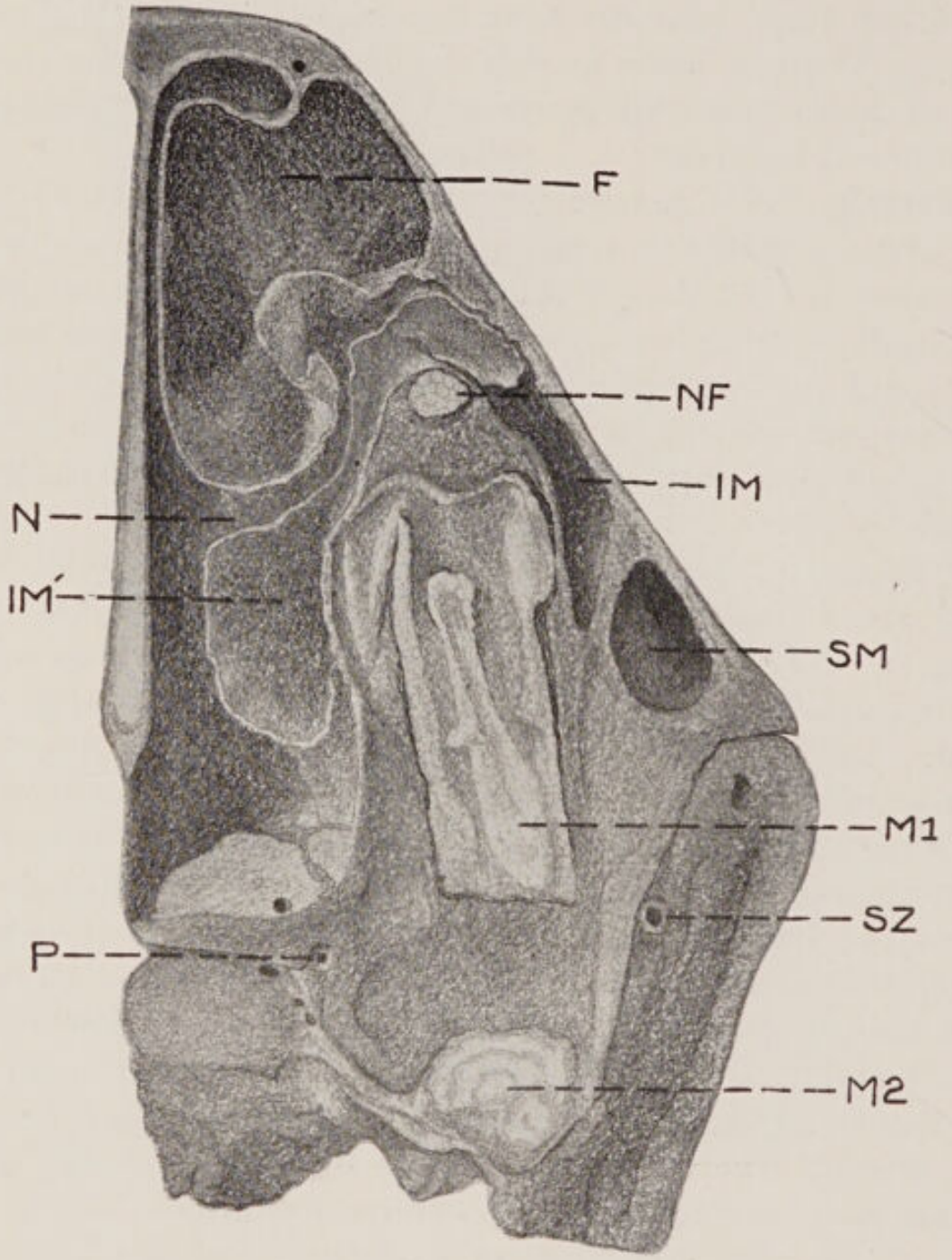

FIG. 9

Trephining the Facial Sinuses

Cross section obliquely downwards and backwards through the right half of the head of a two-year old colt at the first molar. F, Frontal sinus; N, nasal passage at point of communication with the maxillary sinus, IM; IM′, median portion of inferior maxillary sinus; SM, extreme lower end of superior maxillary sinus opened; M1, first molar; M2, second molar; P, palatine artery; SZ, subzygomatic artery.

Instruments. Same as for the frontal sinuses (page 17).

Technic. The trephining, N, Fig. 3, is carried out by the method described above, in the nasal bone, close by the median line of the face and according to indications at any point from a level of the dotted line, SM, Fig. 3, to the juncture between the nasal and pre-maxillary bones near the upper extremity of the false nostril.

A study of Figs. 7–10 will show that the trephining of these cavities requires great care in order to avoid wounding either the highly vascular septum nasi or even more vascular turbinated bones. The operation should be immediately against the septum since otherwise the superior turbinated bone may be wounded or an important intra-osseus artery in the nasal bone, just above its union with the superior turbinated, as shown in Fig. 9, may be severed.

If the turbinated bone is penetrated the frontal, and through it, the superior maxillary sinus is opened and exposed to infection with all its consequences. Special care is accordingly necessary that the trephining should not be carried too deeply, that the bone be barely penetrated, and that the osseous disc be carefully removed in order to avoid the wounding of the turbinated bone, which lies in close proximity to the nasal bone. The operative area is narrow and the trephine used should not exceed 2 cm. in diameter.

Whenever possible the operation should be carried out on the standing animal which decreases the hemorrhage and the danger from the inhalation of fluids. The hemorrhage may be further controlled in operations upon the septum nasi and turbinated bones by spraying the parts with adrenaline chloride and cocaine. Even in the standing animal, if extensive operations are to be carried out on the very vascular septum nasi or on the turbine, it is advisable to preform trachetomy before trephining, and retain the trachea tube in position until all danger has passed. When the animal is confined in the recumbent position, the

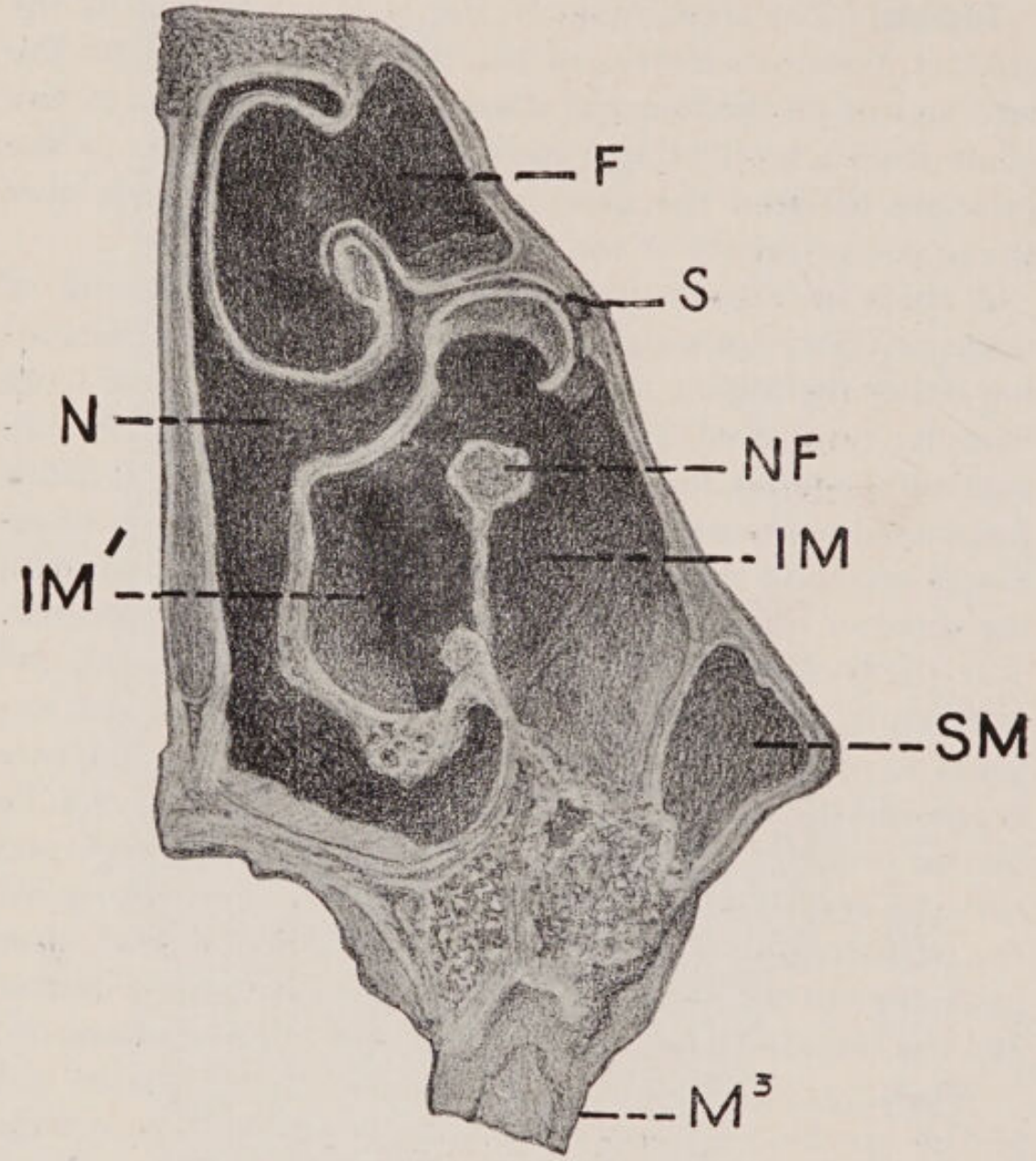

FIG. 10

Trephining of Facial Sinuses

Cross section of the left side of the head anterior to the last molar, and through the widest part of the inferior maxillary sinus. M^3, last superior molar ; SM, superior maxillary sinus at its antero-inferior extremity ; IM, inferior maxillary sinus, lateral portion ; IM′, do. median portion ; N, nasal fossa ; S, sound lodged in lachrymal duct ; NF, trifacial nerve ; F, frontal sinus.

patient's safety demands that tracheotomy be performed in almost all cases before any operation is begun upon the septum nasi or turbinated bones. After tracheotomy, anaesthesia may be maintained by means of an ordinary funnel with its tube bent at right angles and inserted into the trachea tube while the chloroform is dropped on a towel spread over the funnel mouth. After completing any required operation upon the septum, turbinated bones or other parts, hemorrhage may be controlled by packing one or both nasal fossae with single strips of gauze of sufficient size and carefully securing them by sutures to the sides of the trephine wound or otherwise.

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7. POLL EVIL OPERATION

Fig. 11

Instruments. Clipping shears, razor, sharp scalpels, one dozen compression artery forceps, probe-pointed bistoury, probe, Luer's bone forceps, bone gouge, curette, suture and dressing material.

Technic. Clip the foretop and mane and shave the forehead and the top of the neck back to a distance of 8 or 10 cm. or as much farther as may be required to pass beyond and behind the supposed extension of disease, and disinfect the area. Confine the animal in lateral decubitis preferably upon the operating table, place under complete anaesthesia and remove the halter or other headgear.

With sharp scalpel make a longitudinal incision on the median line of the head and neck beginning at a point presumably posterior to the diseased area and carry it over the poll down onto the forehead for a distance of 4 or 5 cm. below the foretop. Continue this incision through the skin, the subcutem, the adipose tissue, AT, Fig. 11, and either through, or passing around alongside the neck ligament,

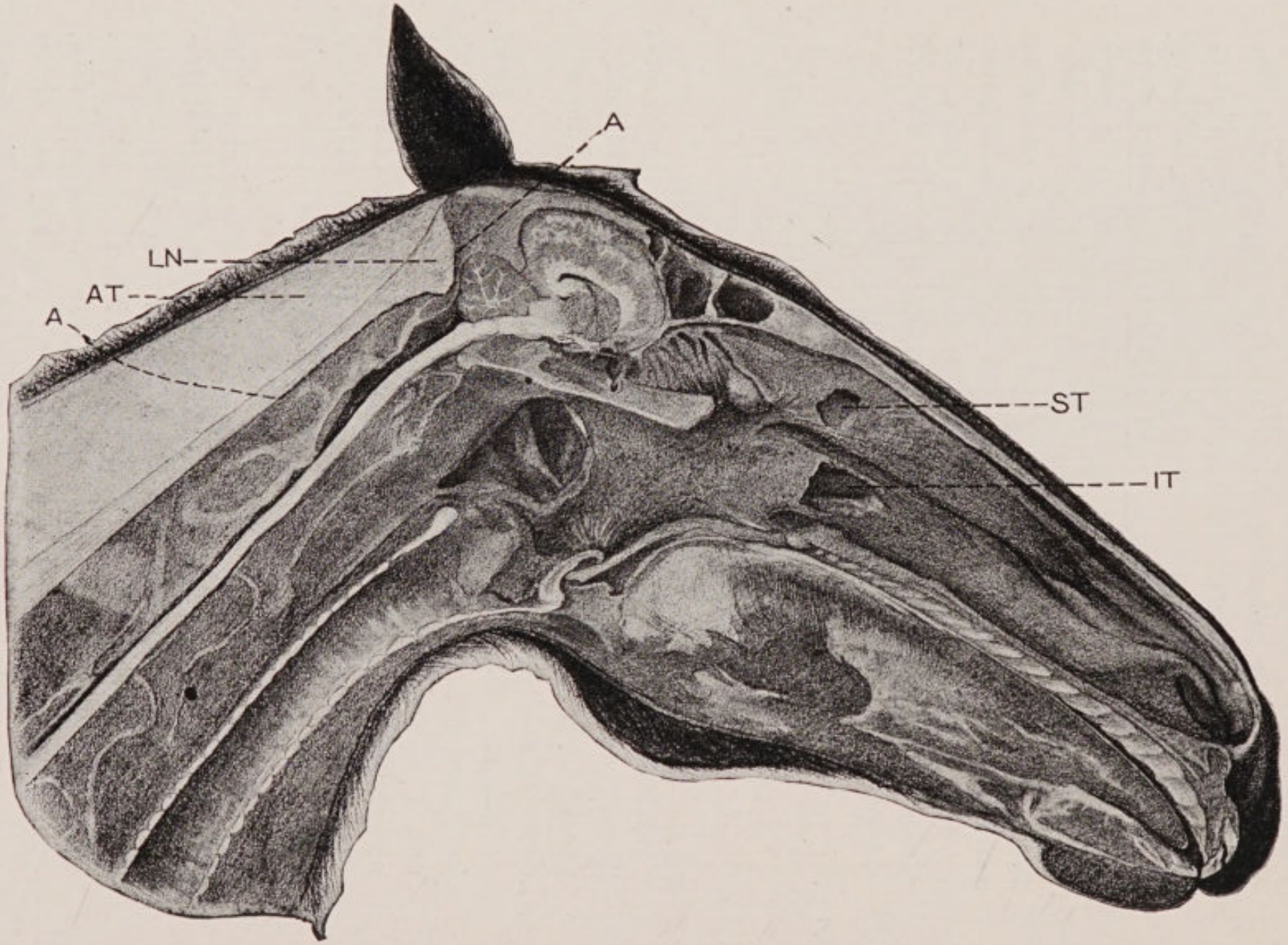
A
LN
AT
A
ST
IT

FIG. 11 Poll Evil Operation

Sagittal section of the head and neck. AA, line of incision in operation for poll evil; LN, ligamentum nuchae; AT, adipose tissue.

Trephining the Facial Sinuses

ST, opening from frontal into nasal sinus through the superior turbinated bone; IT, opening through inferior turbinated bone from the inferior maxillary sinus into the nasal passage.

LN, into the diseased area beneath the latter. Dissect the ligamentum nuchæ away from the adjoining tissues as far back as diseased, divide it obliquely upward and backward as indicated at AA, and detach anteriorly from the base of the occiput. Be careful to remove every portion of the ligament in the area indicated and all calcareous deposits or other diseased tissues.

With Luer's forceps, groove a channel about 2 cm. wide from behind to before directly upon the median line, through the occipital protuberance to the depth of about 2 cm. making the bottom as near as possible on a level with the wound in the soft tissues as indicated by the dotted line, AA. Using Luer's forceps as a curette, detach all vestiges of the neck ligament from the base of the occiput and leave the bone bare and smooth. If the Luer or rongeur forceps are not available the grooving of the occiput may be accomplished with a strong curved bone gouge. Or the grooving of the occiput and curetting away of the attachments of the neck ligament to the base of the occiput may be very effectually accomplished with a hoof knife. *Be careful to avoid penetrating the cranial cavity or the occipito-atloid articulation.* If the operator is not perfectly clear regarding the anatomy of the parts, he would do well to have before him a sagittal section of the head of a horse which may serve as a guide. In curetting the ligamentous attachments from the occiput, the operator should keep the index finger of the left hand at the bottom of the wound, against the occipito-atloid ligament in order to protect it from injury. The operation is rendered more safe also by rigid control of the hemorrhage to which end he needs an ample number of compression artery forceps.

Control the hemorrhage, cleanse and disinfect the wound, pack with antiseptic gauze and suture except at the anterior part, where the tampon should slightly protrude. Disinfect the margins of the wound. Remove the tampon after

forty-eight hours and dress daily with antiseptics. The sutures may or may not be removed according to conditions. In carrying out this operation the chief aim should be to remove all diseased parts, to afford perfect drainage anteriorly, to secure and maintain antisepsis, and to keep the wound directly on the median line, from which no visible scar will result.

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8. DEHORNING OF CATTLE

Figs. 12 and 13

The horns of cattle, useful as organs of offense and defense in the wild state, become valueless, except in appearance, under domestication. They detract from the docility and convenience of handling the animals, and render them less safe for man and for other animals. The development of the horns may readily be prevented in new-born calves by the timely application of caustic potash to the horn germ. When this is neglected and it is later desired to be rid of the horns, the operation designated dehorning is necessary.

Dehorning is performed with either the saw or dehorning shears. Mechanically the saw has the disadvantage of being slower and hence more painful to the animal. It produces a large amount of sawdust which largely drops into the frontal sinuses where it may cause mechanical irritation. It has the advantage of mutilating the arteries of the horn and thereby lessening hemorrhage.

The shears, or dehorners, are generally preferred because the operation (regularly done without anaesthesia) is quickly accomplished so that the cutting pain is for a moment only, the cut through both the skin and the horn core is smoother, leaving less damaged tissue to necrose and disappear, and the wound is left free from sawdust. The shears

have the disadvantage of sometimes fracturing the horn core and of cutting the artery cleaner than the saw and thereby inviting greater hemorrhage. The shears are, therefore, preferable on the whole. In cases of emergency the saw may be substituted, the method of confinement and the point at which the horn shall be severed being alike in each case.

The animal should be confined in stocks, or an ordinary or special stanchion, with the head firmly and securely extended. The securing of the head is best effected by means of a strong rope tied around the neck, with a loop about the nose. The rope does not, by this plan, come in contact with the horns and is not in the operator's way.

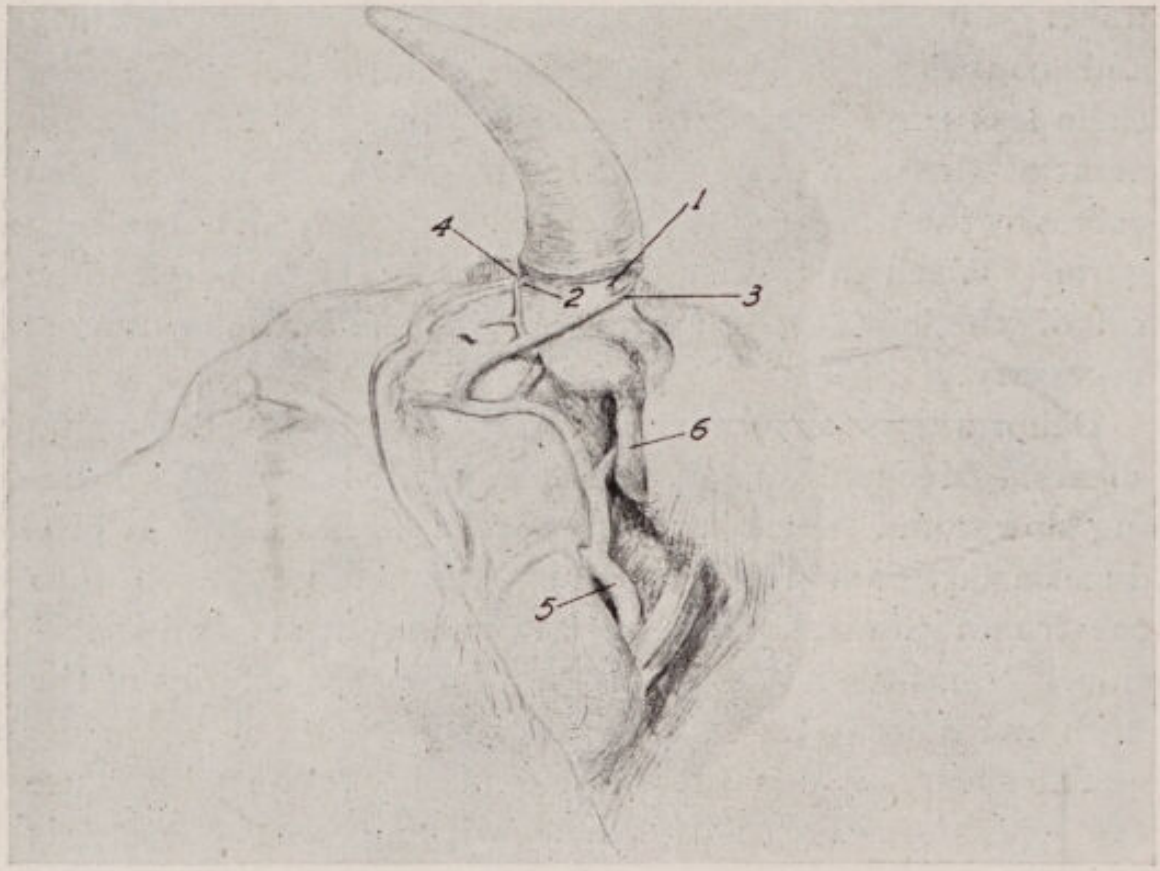

FIG. 12. Dehorning of Cattle

1. Posterior or main artery of horn core; 2, anterior or lesser artery of horn core; 3, 4, posterior anterior arteries of the matrix or corium of horn; 5, external carotid artery.

The point for excision is located on the cephalic side of the matrix of the horn, a distance of about 1 to 1.5 c.m. from the margin of the skin. There are three reasons for selecting this location :

1. It is essential to include a girdle of skin of the width named in order to remove the matrix of the horn. If less is removed, horn is developed and the animal is left with unsightly horny excrescences.

2. The chief arteries of the horn core (extension of frontal bone) are at this point subcutaneous, can consequently retract readily and thereby exert efficient hemostatic power. They soon leave the subcutem and become intra-osseous as shown in Fig. 12 at 1, 2 and Fig. 13 at 1, 2. The intra-osseous artery, when severed, cannot retract promptly and therefore possesses low hemostatic power, resulting frequently in severe, and rarely in fatal, hemorrhage.

3. The horn is more easily excised at this point than elsewhere. If the excision is attempted through the corneous layer instead of at the point indicated, the horn tissue offers great resistance. The application of great force to overcome the undue resistance may cause extensive fracture of the horn core, or may bend or break the blades of the dehorning instrument.

The blades of the dehorning shears should be kept sharp and in good condition. Dull blades fracture the horn core and thus delay healing, and the dullness, by increasing the strain, tends to break the instrument.

Have an assistant grasp the nose firmly by means of a leading ring or with the fingers and steady the head. Apply the dehorners at that point level with the base line of 1, in Fig. 12 and close them promptly, completely excising the horn. Free bleeding generally follows but if the excision is made at the point indicated, the divided arteries contract and the hemorrhage quickly ceases. As shown in Fig. 12,

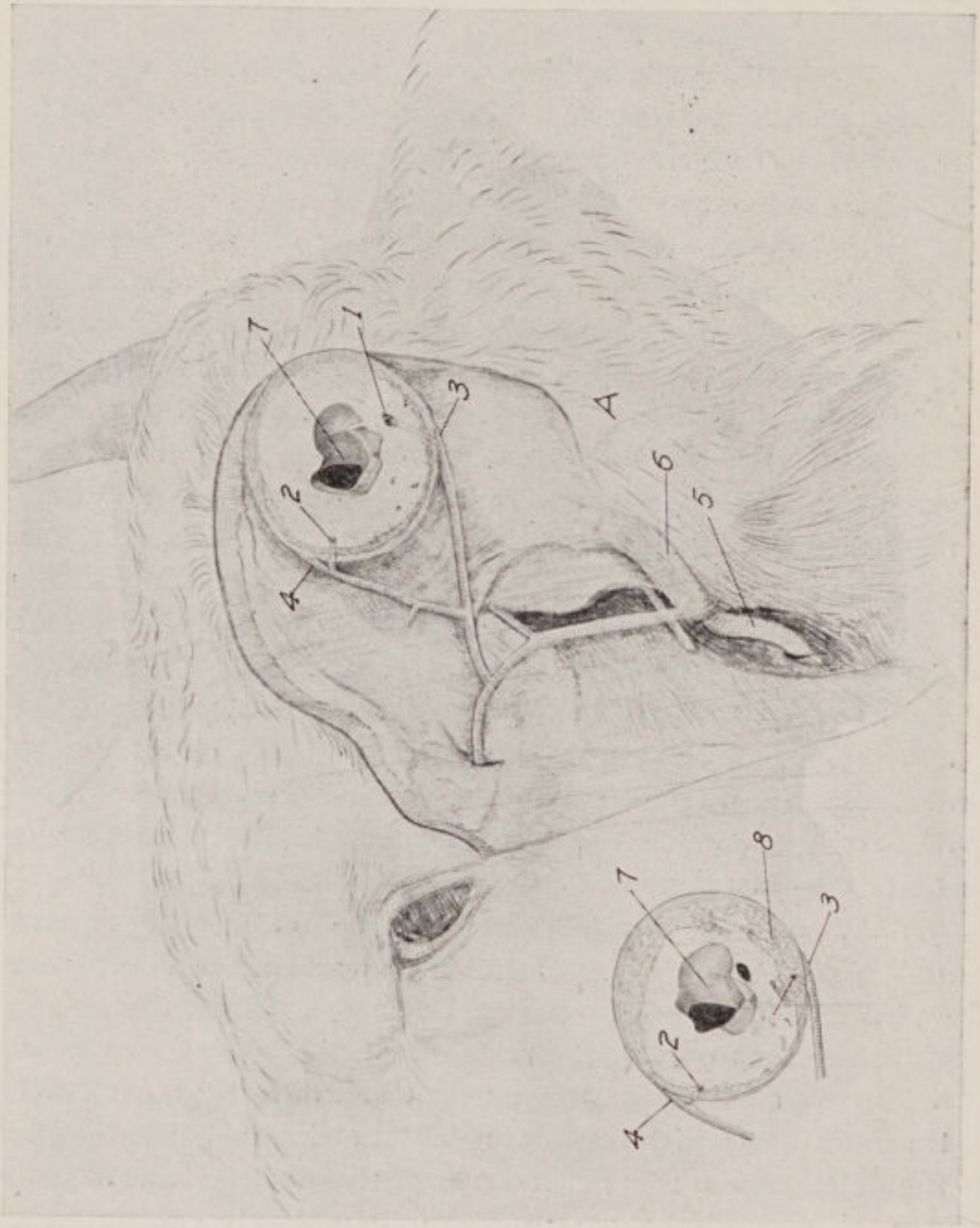
1
1
3
A
6
5
2
4
8
7
3
2
4

FIG. 13. Dehorning of Cattle

A 1, Chief artery of the horn core ; 2, anterior or lesser artery of horn core, both trunks being intra-osseous ; 3, 4, and 5, same as in Fig. 12 ; 7, cavity of horn.

B 1, 2, 3, 4, and 7, same as in A, the chief artery of the horn core being in the horn matrix, 8.

the matrix of the horn is supplied principally by two branches from the common carotid, one of which curves around the base of the horn in the front, the other behind. If one of these should be split longitudinally, the vessel may be unable to retract, and may bleed profusely. The hemorrhage may be controlled by compression forceps, by sutures, or by a ligature surrounding the poll and drawn tightly in a manner to compress the chief arteries of the horn as shown in Figs. 12, 13.

If the excision has been made too peripheral and the intra-osseous vessel severed, the hemorrhage may be controlled by a ligature about the poll as suggested above, or by inserting into the mouth of the wounded intra-osseous vessel, a conical peg of wood and pressing it in firmly.

Any adherent pieces of fractured bone should be removed. No antiseptics or other drugs or substances should, as a rule, be applied. The blood washes them away from the actual cut surfaces and they largely fall into the frontal cavity to cause irritation and harm. The blood and lymph which quickly dry constitute a splendid protective covering.

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9. LIGATION OF THE PAROTID DUCT

Fig. 14

Objects. The destruction of the parotid gland in case of incurable fistula from wounds or abscesses.

Instruments. Razor, convex scalpel, straight probe-pointed scalpel, tenaculum forceps, ligation forceps, tenacula, needle holder, probe, suture and dressing material.

Technic. In case of salivary fistula, insert a probe toward the gland through the fistula into the duct and with a sharp scalpel lay the duct free for a distance of from 1 to 2 cm. on the glandular side of the fistulous opening. If the fistula has its location on the side of the cheek, cast the horse and

shave and disinfect the region on the inferior maxilla where the artery, vein and parotid duct turn around its inferior border. When the operator glides his finger over the vascular region forward and backward, there is felt a resistant cord, the pulsating external maxillary artery about 3 mm. in diameter. Just behind this (towards the oral border of the masseter muscle) lies the external maxillary vein and lying more deeply between the vein and border of the masseter, is the parotid, or Steno's duct, covered by dense connective tissue. Make an incision about 4 cm. long directly over the duct parallel to the artery through the skin and skin muscle. Pick up the connective tissue with a pair of forceps and excise it, laying the duct bare. Care is to be taken while manipulating the duct, not to prick the contiguous vein and cause annoying hemorrhage.

When a salivary calculus exists which cannot be removed through the mouth, or there is a cystic dilation of the parotid duct, make the cutaneous incision at the affected point. After opening the canal, and removing the calculus, etc., close the duct wound by means of intestinal sutures in such a way that the external surface of the lips of the wound in the wall of the duct are brought in contact, or ligate the duct on the proximal side of the point of operation and thereby destroy the gland.

Ligation of the duct is accomplished by passing a strong silk thread beneath it by means of a curved aneurism needle, carrying the ligature around the duct and tying with a surgeon's knot. This destroys the gland by damming back the saliva until the pressure stops its function and causes atrophy. Disinfect the wound and close the skin by means of a continuous suture.

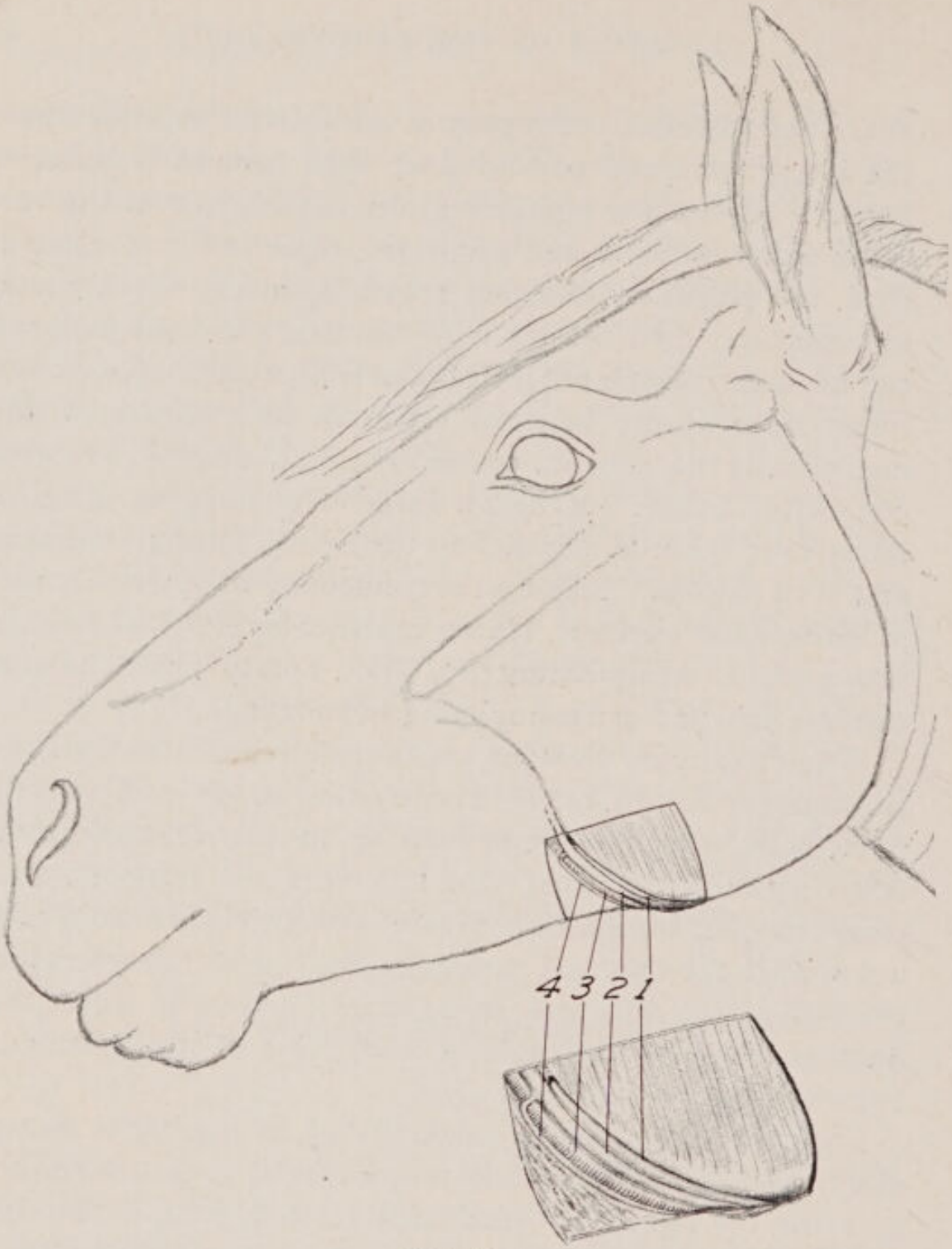

FIG. 14

Ligation of the Parotid Duct

Above, Left side of head showing general topography of operative area.

Below, Detail of vessels at usual operative area.

1, Parotid duct; 2, external maxillary vein; 3, external maxillary artery; 4, retrograde branch of external maxillary vein.

10. ENTROPIUM OPERATION

Instruments. Razor, scissors, convex scalpel, tenaculum and ligation forceps, tenacula, needle holder, needles, thread, absorbent cotton.

Technic. Quiet adult horses may be operated upon in the standing position with the aid of local anaesthesia, other horses and small animals should be secured in lateral re-

FIG. 15

Entropium operation on the superior and inferior eyelids of the dog.

cumbency preferably upon the operating table. Shave and disinfect the skin of the inverted eyelid. Grasp the skin of the eyelid midway between the inner and outer canthus with the forceps and elevate a skin fold parallel with the border of the eyelid to such a height that the inverted member assumes its normal position. Pass a finger into the conjunctival sac to make sure that the conjunctiva is not drawn into the skin fold. Clip the fold off with the scissors immediately below the forceps, removing an oblong piece. Between the border of the eyelid and that of the wound the skin should be left intact for at least .5 cm. Ligate or compress any bleeding vessels and close the wound by means of interrupted sutures. It is usually unnecessary and inadvisable to cover the parts with hood or other appliance since so long as the wound is healing properly the animal will not disturb it.

11. TRIFACIAL NEURECTOMY

Fig. 16

Object. The relief of involuntary shaking of the head.

Instruments. Razor, scissors, convex scalpel, tenacula, aneurism needle, compression artery forceps, needles, thread, absorbent cotton, a strong piece of gauze 12 cm. square.

Technic. Secure in lateral recumbency, preferably upon the operating table, and produce complete anaesthesia. Remove the halter, bridle, or other headgear. Shave and disinfect an area 8 to 10 cm. square over the infra-orbital foramen. Locate by touch the infra-orbital foramen IOF, Fig. 16, below the levator labii superioris proprii muscle and displace this slightly upward toward the median line of the nose until the foramen can be clearly felt below the muscle. With the scalpel, begin an incision somewhat superior to the foramen and near its nasal border and make a wound downward and forward in the direction of the commissure of the lips about 5 cm. long through the skin, muscle and connective tissue down to the nerve and control hemorrhage with the greatest care. If the larger branches of the glosso-facial vessels are severed they should be ligated or twisted. It is even better to ligate or compress these vessels prior to severing them.

Hold the lips of the wound apart with two tenacula or by placing a strong suture through each wound margin and through the skin at a point 6 to 8 cm. distant and tying the sutures tightly, dilate the wound thoroughly and dissect away the connective tissue from the nerve until every part of it is clearly in view. Pass an aneurism needle beneath the nerve trunk and lifting it from the bone, make a search for a small artery which usually passes along beneath it through the foramen, and if this can be found, either ligate it immediately at its point of emergence and again 5 cm. lower down and divide between the two ligatures, or sepa-

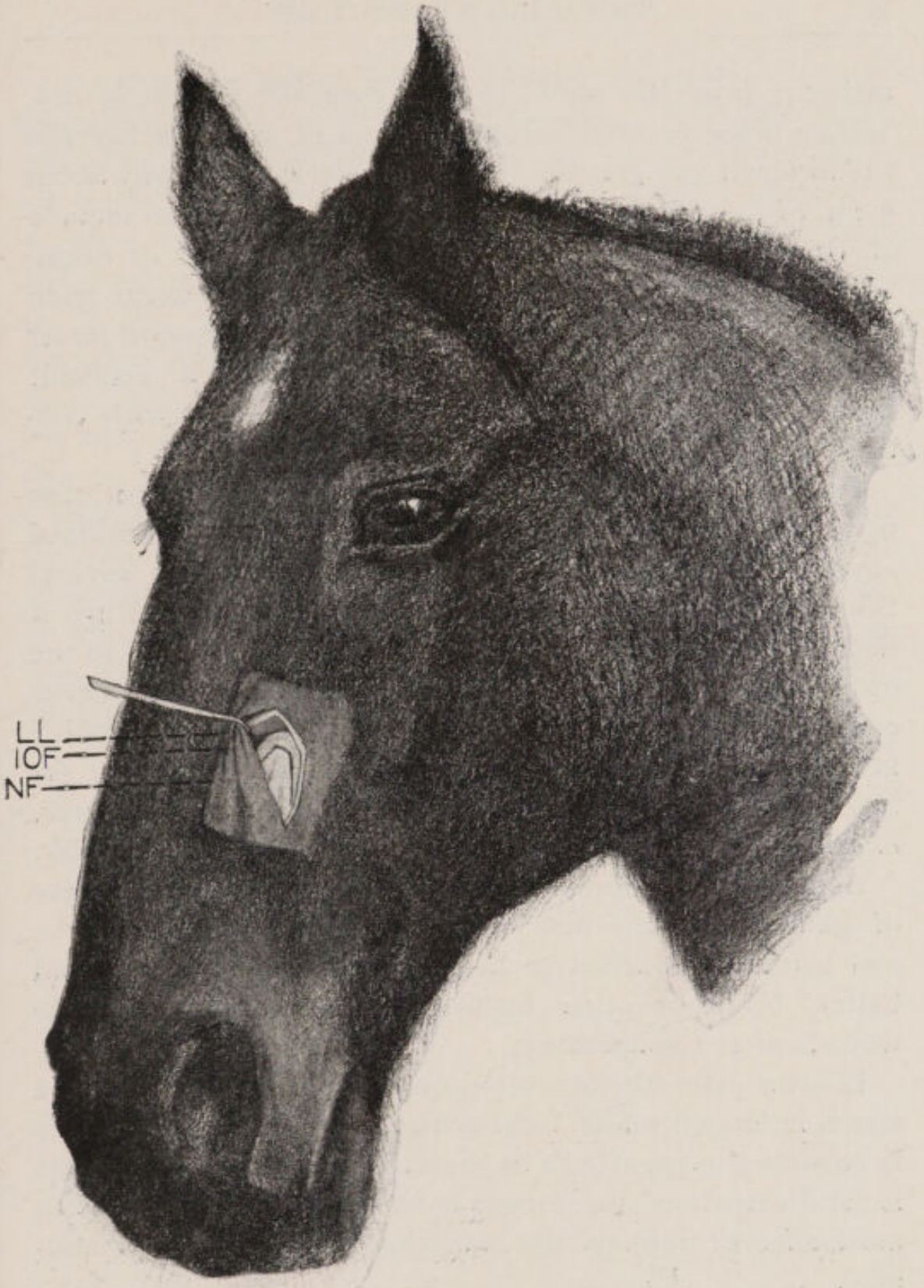

FIG. 16

Trifacial Neurectomy

LL, Levator labii superioris proprii muscle; IOF, infra-orbital foramen; NF, superior maxillary division of the trifacial nerve.

rating it from the nerve, protect carefully against injury. With a probe-pointed bistoury or scissors, sever the nerve at the foramen and grasping the distal end dissect away about 5 cm. of the trunk and excise. Be very careful to include all branches and especially one or two superior or dorsal twigs which are directed upward just as they emerge from the foramen. After the hemorrhage has been brought under complete control and all blood clots have been removed, cleanse the wound carefully, disinfect and close with continuous sutures.

In order to protect this first wound during the operation upon the other side, take the piece of gauze mentioned among the needs for the operation, and folding it several times in a square, place it over the wound and suture it firmly at each corner to the skin. Turn the animal to the opposite side and repeat the operation on the other nerve except the application of the square piece of gauze which is here unnecessary. *If circumstances will permit, it is far safer in actual practice to operate first upon only one side, allowing this to heal and then to operate upon the other side.*

As soon as the animal stands, remove the protective piece of gauze from the first wound, disinfect both wounds, and leave undisturbed to heal by primary union. Avoid halter, bridle or other fixtures which might injure the wounds after the operation.

In some cases the operation may be performed upon the standing animal under local anaesthesia and whenever this is possible it is greatly to be preferred since the hemorrhage is far lessened and the danger from sepsis reduced, but with most affected animals the standing operation is impracticable.

Dangers. The chief danger in the operation is from infection, which causes a severe inflammation in the proximal end of the nerve, aggravates the symptoms and causes much suffering. In order to prevent infection the aseptic precau-

tions needs to be unusually strict in every detail and the anaesthesia, whether local or general, complete. Carefully avoid wounding the neighboring vessels and control completely any hemorrhage that occurs in order to avoid a blood clot in the wound, which always invites infection. It is of even greater importance, whenever practicable, that as suggested above, the operation be performed first on one side only, and when that has healed operate upon the other. In this way one avoids the critical danger of the infection of the first wound while the head of the horse is resting upon that side during the second operation.

Literature. Involuntary twitching of the head relieved by trifacial neurectomy. W. L. Williams, Jour. Comp. Med. and V. A., vol. XVIII, p. 426. Involuntary shaking of the head and its treatment by trifacial neurectomy. *do.* Am. Vet. Rev., vol. XXIII, p. 321 and Œst. Monatsch. Thierheilkunde, Bd. XXIV, s. 211.

II. OPERATIONS ON THE NECK

12. OPENING OF THE GUTTURAL POUCHES

Fig. 17

Instruments. Razor, scissors, convex sharp-pointed and straight probe-pointed scalpels, artery forceps, tenacula, probe, trocar, curette, drainage tubing, suture and dressing material.

Technic. I. *Viborg's method.* The operation is possible with the animal standing, but generally the patient must be cast or placed on the operating table and secured in lateral decubitis with the head extended. By extending the head and compressing the jugular vein, there is brought out the triangle immediately behind the posterior border of the inferior maxilla and below the parotid gland comprised between the posterior angle of the inferior maxilla, the terminal tendon of the sterno-maxillaris muscle and the external maxillary vein.

In this so-called Viborg's triangle after the removal of the hair and the disinfection of the skin which is maintained stretched, make a 5 cm. long incision through the skin and skin muscle immediately beneath the aforementioned tendon and parallel to it. In case of pronounced swelling in Viborg's triangle, the operator must determine the location for the incision by the position of the sterno-maxillaris muscle. The skin, subcutem and cervical fascia having been incised to a sufficient extent, force a passage with the finger or with closed probe-pointed scissors or other blunt instrument through the loose connective tissue on the median side of the parotid gland, to the guttural pouch and penetrate it at its lowest point with the finger or trocar. In order to open the empty guttural pouch as an exercise operation, it is desirable to grasp a portion of its wall by means of forceps. Through the operative wound a drainage tube can be introduced into the pouch, and fixed in position

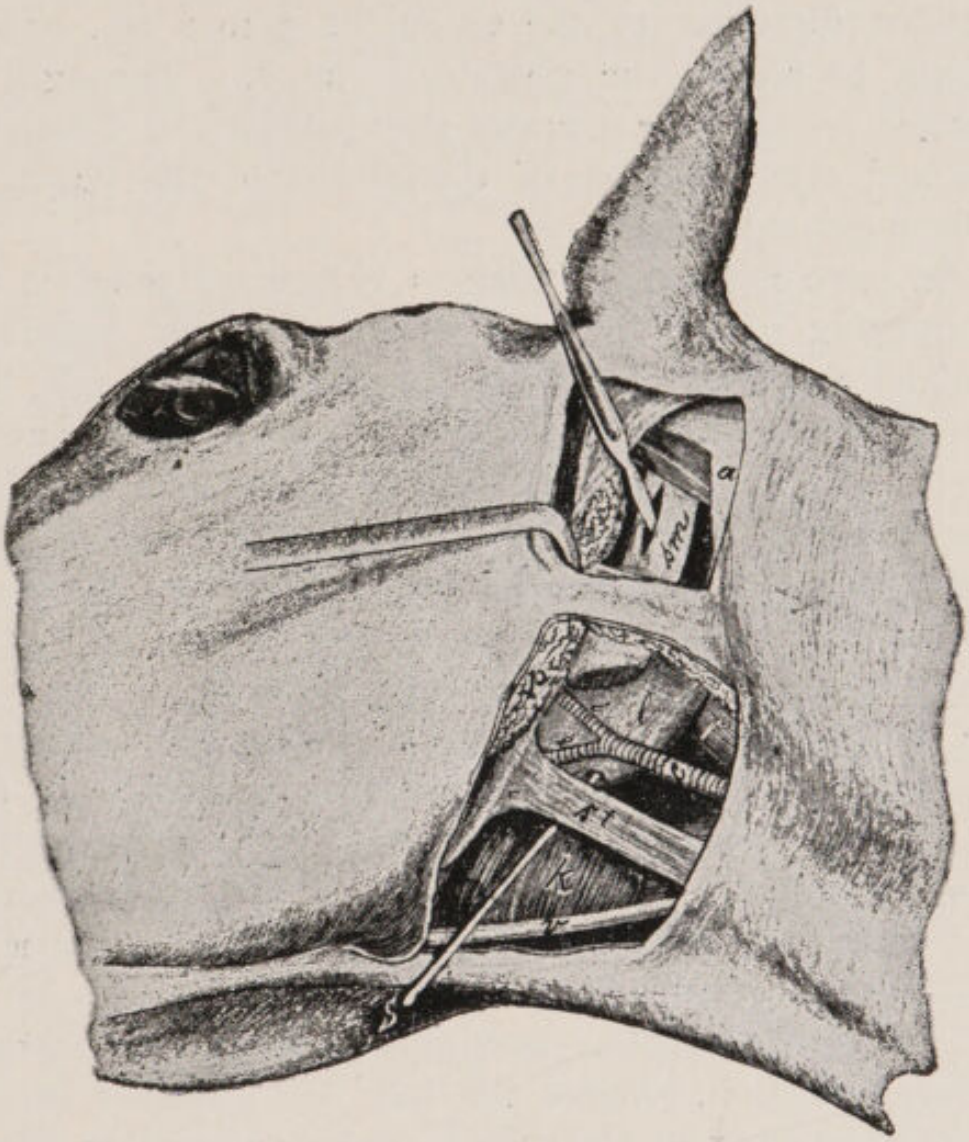

FIG. 17

Opening of the Guttural Pouches (Hyoyertebrotomy) According to Viborg and Chabert

Head and neck of recumbent horse viewed from the side. *sm*, Stylo maxillaris muscle ; *p*, parotid gland ; *l*, guttural pouch ; *k*, larynx ; *st*, sterno-maxillaris muscle ; *r* rectus capitus anticus major muscle ; *c*, external carotid artery ; *e*, external maxillary artery ; *i*, internal maxillary artery ; *v*, external maxillary vein ; *s*, probe penetrating the floor of the guttural pouch ; *a*, wing of atlas.

by sutures. The opening can be enlarged in an antero-posterior direction to the extent of 5 to 8 cm. or large enough to admit the operator's hand. Through this enlarged wound, the operator may palpate the Eustachian tube and other portions of the interior of the pouch and perform desired operations.

A far more common operation in veterinary practice than the opening of the guttural pouches, is the opening of strangles abscesses of the sub-parotid lymph glands, lying between the inner face of the parotid gland and the external face of the guttural pouch. The operation here used is the same as Viborg's for the guttural pouch but does not penetrate that cavity because the inner wall of the abscess has pushed the external wall of the pouch inward so that the former largely occupies the usual location of the latter. The dyspnoea generally prohibits casting the animal and necessitates operating in the standing position. In some cases the dyspnoea is so severe as to demand tracheotomy before the opening of the abscess can be undertaken because the excitement aggravates the difficult respiration to the point of suffocation.

II. *Chabert's method.* Secure the horse in the lateral recumbent position, remove the hair and disinfect the skin beneath the wing of the atlas. Make an incision about 1 cm. in front of the lower half of the wing of the atlas and parallel to it, about 6 cm. long, extending through the skin and skin muscle down to the parotid gland. The incision is facilitated by rendering the skin tense with the left hand and care is to be taken not to wound the auricular nerve which passes directly along the atlas. Draw backward the posterior lip of the wound and separate with blunt instruments the posterior border of the parotid gland from the atlas, to which it is bound by loose connective tissue. Then draw the parotid gland forward with tenacula. At the bottom of the opening thus formed there is seen the

stylo-maxillaris muscle, *sm*, Fig 17, lying against the median side of the parotid gland covered only by the aponeurosis of the mastoido-humeralis muscle. With the handle of the scalpel inclined toward the wing of the atlas, penetrate in the direction parallel to the long axis of their fibers the aponeurotic expansion of the mastoido-humeralis, and the stylo-maxillaris muscles. The puncture is thus located between the ninth and tenth nerves on one side and the internal carotid artery on the other. Since the wall of the guttural pouch rests against the median side of the digastricus or sterno-maxillaris muscle, it is opened by this incision. The operator inserts an index finger along the blade of the knife at first and then withdrawing the instrument passes the other index finger also into the penetrant wound and by forcibly parting these, dilates it. The abnormal contents are then removed by means of forceps, curretting and irrigation. In order to prevent adhesion of the wound lips in the firmly stretched stylo-maxillaris muscle, introduce a strong drainage tube into the pouch and fix it to the external borders of the wound by a suture.

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13. THE ROARING OPERATION

FIGS. 18-22

Instruments. Razor, hypodermic syringe, scalpels, tenaculum, artery forceps, laryngeal speculum, two long curved dressing forceps, hard rubber syringe with long pipe, two soft rubber ventricular burrs, reflecting lamp, razor-shaped scalpel, long angular scissors.

The following technic has for its aim two fundamental objects which are to be kept constantly in mind :

1. It is aimed to bring about a prompt, firm, complete and permanent adhesion of the arytenoid cartilage and vocal cord against the inner face of the thyroid cartilage in the

normal position of forced inspiration, so that no air can become impacted into the ventricle to force the vocal cords and arytenoid cartilage downward and inward to obstruct the free ingress of air.

2. It is aimed to complete the operation without wounding a cartilage either in the essential operation when removing the ventricular mucosa, during the invading incision through the crico-thyroidean membrane, or later, should dyspnoea occur, by inserting the laryngeal tube through the existing incision instead of performing tracheotomy.

Technic. Almost all animals are readily and by far best operated upon in the standing position. The animal should be confined in stocks, or otherwise, in such a manner that his head may be securely held in an elevated and extended position. The safety of the operator further demands that the patient shall be so secured that he can neither rear nor strike. The first is best accomplished by placing a rope or bar across the neck just in front of the withers. The latter may be attained by stretching a stout rope across in front of the forearms or radii. With gentle animals these precautions are superfluous.

Resistant animals need to be cast or confined upon the operating table. General anaesthesia upon the recumbent animal is usually unnecessary, and is only demanded in those cases of unusual resistance to confinement, where the patient may injure itself by its violent struggles.

Ordinarily ample anaesthesia, whether from the standpoint of surgical efficiency or of sentiment, is obtainable by the use of local anaesthetics, in combination with adrenalin.

Shave and disinfect the operative area, and inject subcutaneously a sufficient amount of the local anaesthetic.

Make a longitudinal incision over the larynx through the skin and fascia as accurately as possible on the median raphe, commencing opposite to the anterior extremity of

the thyroid cartilage and extending downward and backward to the region of the first tracheal ring. Separate the sterno-thyro-hyoideus muscle on the median line with the scalpel blade or handle as preferred. Control the hemorrhage. If the operation is performed upon the standing animal with the aid of cocaine and adrenalin, the incision is virtually bloodless.

Locate the crico-thyroidean ligament, triangular in form, bounded anteriorly and on both sides by the thyroid cartilage and posteriorly by the cricroid ring. Error may occur here and the space between the cricoid and first tracheal ring be mistaken for the crico-thyroidean ligament. This is readily obviated by careful digital palpation, which re-

Fig. 18.
Laryngeal dilator.

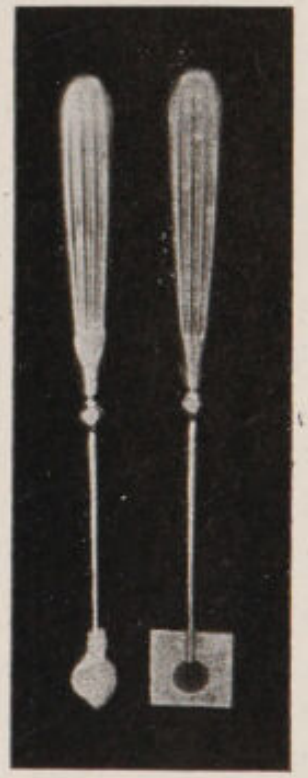

Fig. 19.
Ventricular burr of soft rubber, the sphere on the left having been covered with a thin layer of cotton.

veals the triangular crico-thyroidean ligament with its rounded apex directed forward and its lateral borders sharply defined by the hard borders of the alæ of the thyroid cartilage, while the base of the triangle rests upon the more elastic anterior border of the cricoid cartilage.

Having carefully identified the crico-thyroidean ligament, place the back of the scalpel against the anterior border of the cricoid cartilage, accurately upon the median line, the point directed obliquely backwards toward the cavity of the trachea. Push the scalpel through the ligament into the laryngeal cavity, and carry the incision forward on the median line to the body of the thyroid cartilage.

Detach the slotted piece from the laryngeal retractor (Fig. 18) and insert the closed retractor into the incision through the ligament, the rachet end of the speculum being directed toward the trachea, the curved spurs on the jaws of the retractor resting within the cricoid ring. Open the dilator to the full extent of the crico-thyroidean space. Insert the hook of the slotted piece into the cavity of the thyroid cartilage and secure in position by means of the thumb screw as shown in Fig. 20.

Illuminate the cavity of the larynx. In the standing animal, when facing good light, the natural illumination suffices. The illumination may be improved with the aid of a hand mirror.

Excellent illumination is always available by means of a reflecting electric lamp. With a good lamp the illumination may be perfectly controlled in a dark room or in the darkness of night. When the animal is cast and turned upon his back, the light rays should enter the larynx from above obliquely downward and forward. If the operation is being done in the open field by sunlight, the patient's head should be directed away from the sun, or good illumination fails.

Observe the motion of the arytenoid cartilages, and determine, if not previously done, whether the paralysis is

unilateral or bilateral. Inject with the hard rubber syringe with a long pipe into the larynx and laryngeal ventricles or introduce by means of swabs of cotton held in uterine dressing forceps, a sufficient quantity of the local anaesthetic and adrenalin to blanch and anaesthetize the mucosa. The ventricles are more conveniently injected if the syringe nozzle is bent near the tip.

FIG. 20

The ventricles commonly contain some mucus, which interferes with the securing of the mucosa and should be taken up and removed by means of a small piece of absorbent cotton pressed into the ventricle with the long curved dressing forceps.

When the ventricular mucosa has been effectively anaesthetized and any mucus removed, introduce the soft rubber burr wrapped with a single thickness of heavy, dry cheese-

cloth, or a thin layer of absorbent cotton into the ventricle. *The naked soft rubber burr will not securely grasp the ventricular mucosa, but when wrapped with absorbent cotton or with cheesecloth, and the ventricle properly cleansed of mucus, the burr grasps the mucosa promptly and firmly. While the metal burr, at one time used, grasps the mucosa well, it has a great tendency to tear and mutilate it and most of all it not infrequently wounds the perichondrium and induces a chondritis which causes the operation to fail.* Press the burr *gently* against the bottom of the ventricle, and turn it to the right until the resistance indicates that the mucosa is securely engaged, Careful traction is now applied to the handle, revolving the burr now and then a trifle, until the everted mucosa from the bottom appears beyond the mouth of the ventricle. Grasp the everted portion of the mucosa securely with heavy curved artery forceps and continue traction with these until the ventricular mucosa has been completely everted. Then cut away the everted mucosa by excising it with the razor-shaped scalpel or by means of long scissors at approximately the point indicated by the dotted line in Fig. 22.

While in many cases the muscles of the right arytenoid cartilage appear but slightly, if at all, paralyzed, experience teaches that it is usually best to operate upon both ventricles at once.

(The operation may also be performed without the use of the ventricular burr, but it is more difficult, especially upon the standing animal. The technic is the same until the removal of the ventricular mucosa is reached, when, instead of the burr, the mucosa of the ventricle at its arytenoid border is grasped with the forceps, tension is applied, and the mucosa is incised along the arytenoid border and thence along the summit of the vocal cord. The incision is continued at the point indicated by the dotted line in Fig. 22 until the ventricular mucosa has been isolated from that of

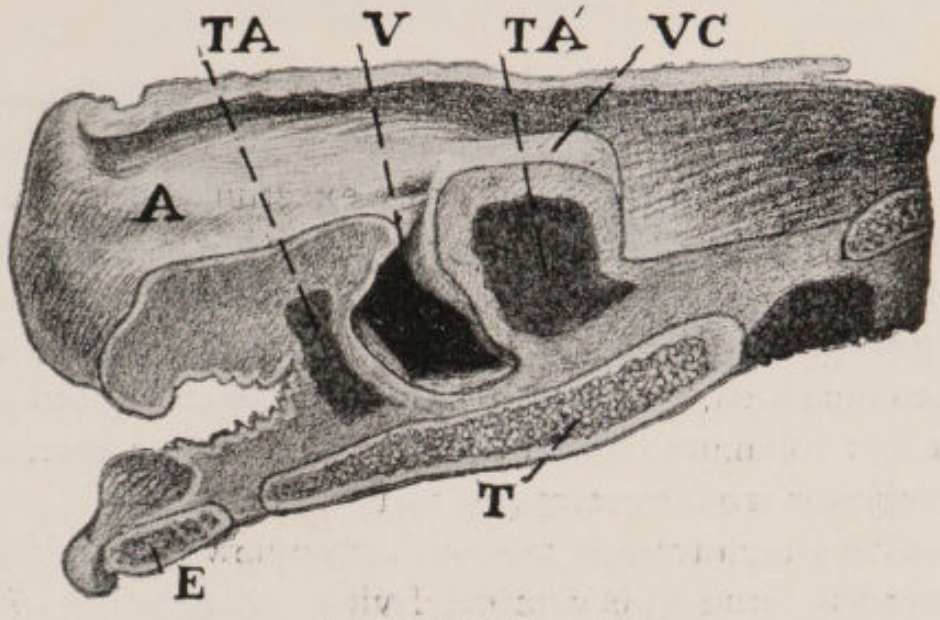

FIG. 21. Longitudinal section through the ventricle of the larynx. A, Arytenoid cartilage; TA, anterior fasiculus of thyro-arytenoideus muscle; TA′, posterior bundle thyro-arytenoideus; VC, vocal cords; V, laryngeal ventricle; T, thyroid cartilage; E, epiglottis.

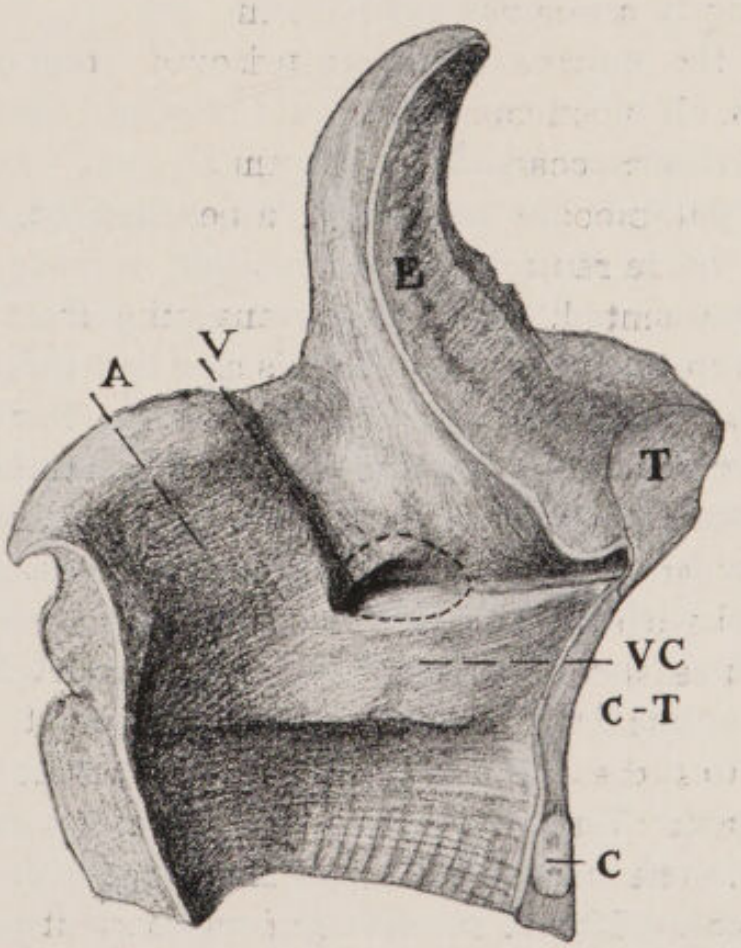

FIG. 22. Sagittal section of the larynx. C, Cricoid cartilage. Other lettering same as Fig. 21.

the larynx in general. Cautiously exerting tension with the forceps upon the incised border of the ventricular mucosa, dissect it away from the loose underlying areolar connective tissue either with the Moeller razor-shaped scalpel or with a scalpel handle. (When the operation for roaring was introduced by the author, this technic was used and recommended, but later researches have convinced both author and collaborator that the technic now recommended is far superior from every point of view.)

However the mucosa is removed, the operator should take care that the removal is complete, since any remnant incautiously left behind in the ventricle may prevent the desired adhesion of the arytenoid to the thyroid cartilage, or a small patch of mucosa being left deep in the ventricle may permit adhesion of other parts, imprisoning the mucous islet and ending in a mucous cyst.

When the mucosa has been removed from one or both ventricles, all blood coagula should be wiped away, and any shreds of tissue removed.

If the patient has been cast, anaesthetized and turned upon his back, turn him upon his side, remove the confining apparatus, and, while he is recovering from the anaesthesia, keep the laryngeal incision open and the larynx free from blood. The hemorrhage is greatest when the animal has been cast and placed under general anaesthesia, less if cast and the operation performed under local anaesthesia, and by far least of all when it is performed upon the standing animal with the aid of local anaesthesia with adrenalin.

As soon as the operation has been completed upon the standing animal, the head may be released and the patient returned to the stall. It may be allowed to eat or drink at convenience. The same is true of the patient cast for the operation, and only local anaesthesia applied. Patients cast and chloroformed should be prevented from eating or drinking for some hours and should be fed sparingly for three or four days.

During the first 48 hours after operating, the patient should be closely watched in reference to dyspnoea either from hematoma in the ventricles or from edema or emphysema of the parts. As a rule of practice, it is best to insert into the wound a laryngeal tube which should be fixed securely to the margins of the external wound by means of heavy sutures, and further security given by passing strong tapes about the neck and tying firmly.

Ordinarily the ventricular wounds should not be disturbed after the operation. The external wound should be dressed daily with antiseptics till healed, a period of about three weeks. Horses used for ordinary work purposes may usually be returned to their work after five to six weeks.

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14. TRACHEOTOMY

Fig. 23

Instruments. Razor, scissors, convex scalpel, tenacula, tenaculum and ligation forceps, trachea tube, and suture material.

Technic. In the superior third of the cervical region, in the neighborhood of the fourth to the sixth tracheal ring, shave and disinfect the skin on the anterior surface of the neck to the extent of 10 cm. long by 5 cm. wide. The operation is best performed upon the standing animal with the head extended. In lateral decubitis the operation is carried out with some difficulty, and generally the operator fails to get the incision on the median line. The operator stands before the right shoulder of the horse with an assistant opposite him.

Render the skin tense along the median line of the trachea with the left hand and then make a drawing cut 5 to 8 cm. long from above to below with the scalpel. The incision should be made carefully upon the median raphe of

the skin, which has very little sensation and the requirements for anaesthesia are small. After the skin muscle is cut through, in order to avoid hemorrhage, separate the two sterno-thyro-hyoïdeus muscles by means of tenacula along the median raphe in the white strip of connective tissue. The opening into the trachea may be made in a variety of ways. The quickest and most crude method is to slit it from above downward through two or three tracheal rings, and pressing the several ends apart, insert the tube through the opening. Since the tracheal rings are in-

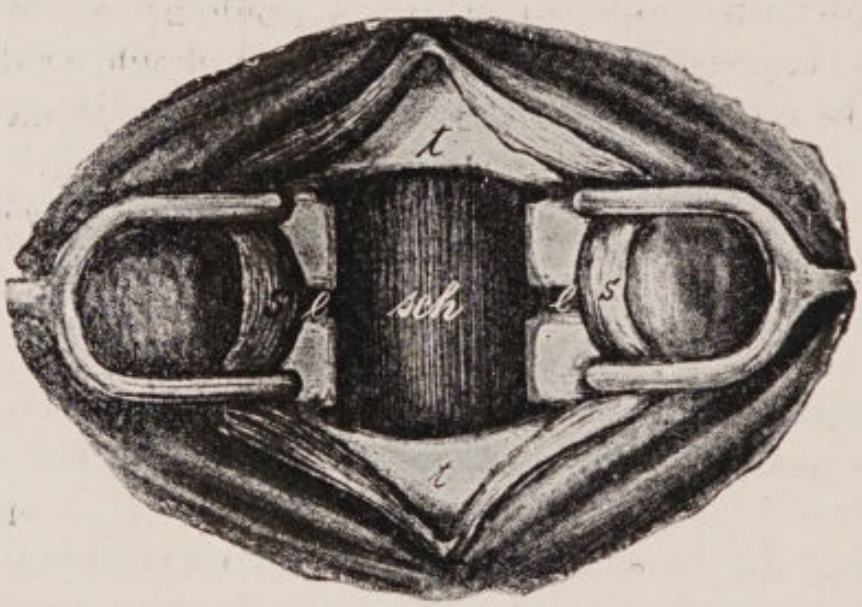

FIG. 23

TRACHEOTOMY, *s*, Sterno-thyro-hyoïdeus muscle; *t*, trachea; *sch*, mucous membrane of the posterior wall of the trachea; *l*, interannular ligament.

complete, being open on their dorsal surfaces, cutting through the ventral portion divides each ring into two separate parts and their being pushed apart distorts them and tends to the causation of chondritis and collapse of the trachea, a danger which increases with the duration of time that the tube is maintained in position. The severing of tracheal rings in tracheotomy is therefore most suitable for hurried operations in impending suffocation where the tube will probably be needed for a short time only.

A second method of operation, illustrated in Fig. 23, consists in making a transverse incision through the inter-annular ligament between the two last exposed tracheal rings the length of the diameter of the tube to be inserted. Make a perpendicular incision upward from each end of this at a point 1 to 1.5 cm. from the median line through one or two tracheal rings, according to the size of the tube. With forceps or tenaculum grasp the segments of partially detached cartilage and remove them by cutting through the inter-annular ligament.

A third, and to us preferable, method is to insert a narrow-bladed scalpel transversely at about the lower third of the lowermost bared tracheal ring and cutting outward and upward in a curved line, to pass through the first inter-annular ligament and continue into the succeeding segment until near its superior border, when the incision is curved downward to eventually reach the starting point, the isolated section of the trachea being securely grasped with a pair of forceps before its excision is completed. By this method no tracheal ring is severed.

The trachea tube is to be removed and cleansed daily as long as its use is necessary, and when discontinued the wound should be left open and dressed with antiseptics.

15. INTRA-TRACHEAL IRRIGATION

Objects. The washing out of oils or other insoluble or irritant substances accidentally introduced into the trachea and bronchi while drenching or otherwise, and the disinfection of the trachea and bronchi.

Instruments. Same as for tracheotomy, and a gravity irrigating apparatus fitted with 3 m. of rubber tubing about 1 cm. in diameter, 5 liters of .6 per cent. sodium chloride solution at a temperature of 37 to 39° C. In cases of suppurative bronchitis, peroxide of hydrogen may be added to the solution.

Technic. Operate on the standing animal. Perform tracheotomy (page 63). Elevate the gravity apparatus containing the irrigating fluid 1 to 2 m. above the patient, have the animal's head slightly elevated, insert the free end of the rubber hose in the trachea tube and let the fluid flow into the trachea in a moderate stream until the animal makes expulsive efforts, when the inflow is stopped and the animal permitted to lower his head and expel the fluid, then raise the head again and repeat until the fluid is expelled clear. Repeat the operation according to requirement.

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16. INTRAVENOUS INJECTION

Fig. 24

Instruments. Scissors, hypodermic syringe.

Technic. The operation is performed on the standing animal on either jugular vein at about the juncture of the upper and middle thirds of the neck; to most operators the right jugular is the more convenient. At the place designated, the subscapulo-hyoideus muscle lies between the jugular vein and the carotid artery and affords some protection against injury of the latter. After clipping the hair and shaving, the skin should be carefully disinfected preferably with tincture of iodine. The vein lies in the jugular groove between the mastoido-humeralis and the sterno-maxillaris muscles, covered only by the skin and skin muscle.

Stand by the shoulder of the horse and compress the jugular with the thumb as shown in Fig. 24 or with the second to the fourth fingers, in which case the ball of the thumb rests on the mastoido-humeralis muscle. The vein becomes filled above the point of compression in the shaved area and stands out as a swollen cord. In fleshy-necked horses efficient compression is more readily attained if the head is somewhat elevated and extended by an assistant. If the vein cannot be made prominent in this way, the

compression should be alternately applied for a time and then withdrawn suddenly when the course of the vein reveals itself by a wave-like movement along the jugular groove.

In cattle, digital compression of the jugular is not always efficient in causing distension. It is more practical to distend the jugular by passing a looped cord around the base of the neck and drawing it tightly. The very conical neck of the cow tends to cause the cord to slip forward and loosen,

FIG. 24

Intravenous Injection

which may be obviated by having an assistant grasp the cord at the top of the neck and, drawing backward, hold it in place. A very efficient method for distending the jugular of the cow is to stretch a strong cord tightly between two posts at the height of the base of the neck, lead the animal against it and secure the head firmly to a post in front sufficiently tight to cause the lower part of the neck to press firmly against the cord.

Just above the point of compression, the vein is the most fully distended and firmly fixed. After testing the hypodermic needle to see that it is open, hold it between the first and second fingers while the thumb covers its basal opening and thrust it through the skin, cutaneous muscle and jugular wall, in the direction of the vein obliquely forward and upward 1 to 2 cm. deep, so that the point of the needle enters the vessel at its most distended part. In this way it is easy to prevent injury to the median wall of the vein. If the vein has been properly punctured, blood will flow from the needle upon the removal of the thumb. If the vein is not entered at the first attempt, the needle should be partly withdrawn and then pushed in again in a slightly different direction.

Be careful that the hypodermic syringe contains no air. *The material to be injected should be warmed to approximately the body temperature.* The syringe is then connected with the needle and the contents slowly discharged into the vein. In withdrawing the needle be careful to press the skin firmly against the underlying part. The omission of this precaution frequently results in the formation of a subcutaneous hematome.

17. PHLEBOTOMY

Fig. 24

Instruments. Razor or scissors, lancet, phlebotomy trocar, pins, suture material.

Technic. *Phlebotomy* may be performed on either jugular vein. The operation is preferably carried out on the standing animal, but is not difficult when the patient is recumbent. The point of operation is at about the boundary line between the upper and middle cervical regions, because it is here that the subscapulo-hyoideus muscle, which separates the jugular vein from the carotid artery, is most voluminous and consequently affords the greatest protec-

tion to the latter. At this point clip or shave and disinfect the skin. Compress the jugular with the finger-tips or with the thumb as shown in Fig. 24. In fleshy-necked animals the course of the vein may be clearly made out by causing its repeated distension and relaxation. In some very heavy-necked horses, or in very restless animals, efficient distension of the jugular is best obtained by cording the neck as described under "Intravenous Injection."

a. *With the lancet* the operation is perferably performed on the right side of the neck. Compress the vein as illustrated in Fig. 24, and hold the lancet between the thumb and index finger in such a manner that it can penetrate the vein only, and then push it in quickly just in front of the compressing thumb through the skin, subcutem and venous wall as deep as the fingers holding the lancet will permit.

Hold the blade perpendicular to the long axis of the vein, and avoid directing the point dorsalward, which would endanger the superior wall of the vessel or cause the lancet to glide over the wall and not enter the vein. When the lancet has entered the vein, extend the wound somewhat toward the head by flexing the hand dorsally. In cattle it is necessary to compress the vein by means of a cord tightly drawn around the neck, the operator taking the same position as with the horse while an assistant holds the animal by the horns or nose, or the vein may be still more effectively distended by causing the patient to press against a tightly stretched cord with the base of the neck as advised for intravenous injection on page 67. Close the wound by means of interrupted or pin suture.

b. *Phlebotomy with the trocar* is performed in the same manner as has been described for intravenous injection. So long as the flow of blood continues, the compression of the vein must not be intermitted. The phlebotomy trocar should be about 5 mm. in diameter.

18. LIGATION OF THE CAROTID ARTERY

Fig. 25, 26

Objects. The control of hemorrhage from wounds or the prevention of hemorrhage during the removal of tumors or other operations in the parotid region.

Instruments. Scissors, scalpel, tenacula, aneurism needle, mouse-toothed forceps, ligation forceps, suture material.

Technic. The operation is possible on the standing animal with the aid of cocaine or other local anaesthetic but it is preferable to confine the patient in laternal recumbency and anaesthetize.

The operation is made at the same point as for phlebotomy and the same cutaneous wound, *a*. Fig. 25, may be used for this purpose. The incision should be at least 10 cm. long, extending through the skin, fleshly panniculus and subscapulo-hyoideus muscles and then a passage forced with the fingers to the trachea. At the region of the neck indicated, the carotid passes along the border between the lateral and dorsal surfaces of the trachea, accompanied dorsally by the vagus and sympathetic nerves and ventrally by the recurrent. (In Fig. 25, the vagus and sympathetic nerves, *v* and *s*, are pushed out of their normal position and appear ventrally to the carotid.) Pass the index finger over and behind the carotid until the trachea is reached, and encircling the inner and lower sides of the artery, force a way through the surrounding areolar tissue and draw the vessel out through the wound. As a rule the carotid is still loosely surrounded by connective tissue, which comes from the deep fascia of the neck and in which also the three above-mentioned nerves are found. These nerves must be carefully separated from the carotid and must on no account be included in the ligature. If it is desired to permanently destroy the vessel, ligate the carotid twice with an interval of about 2 cm. between the two ligatures and

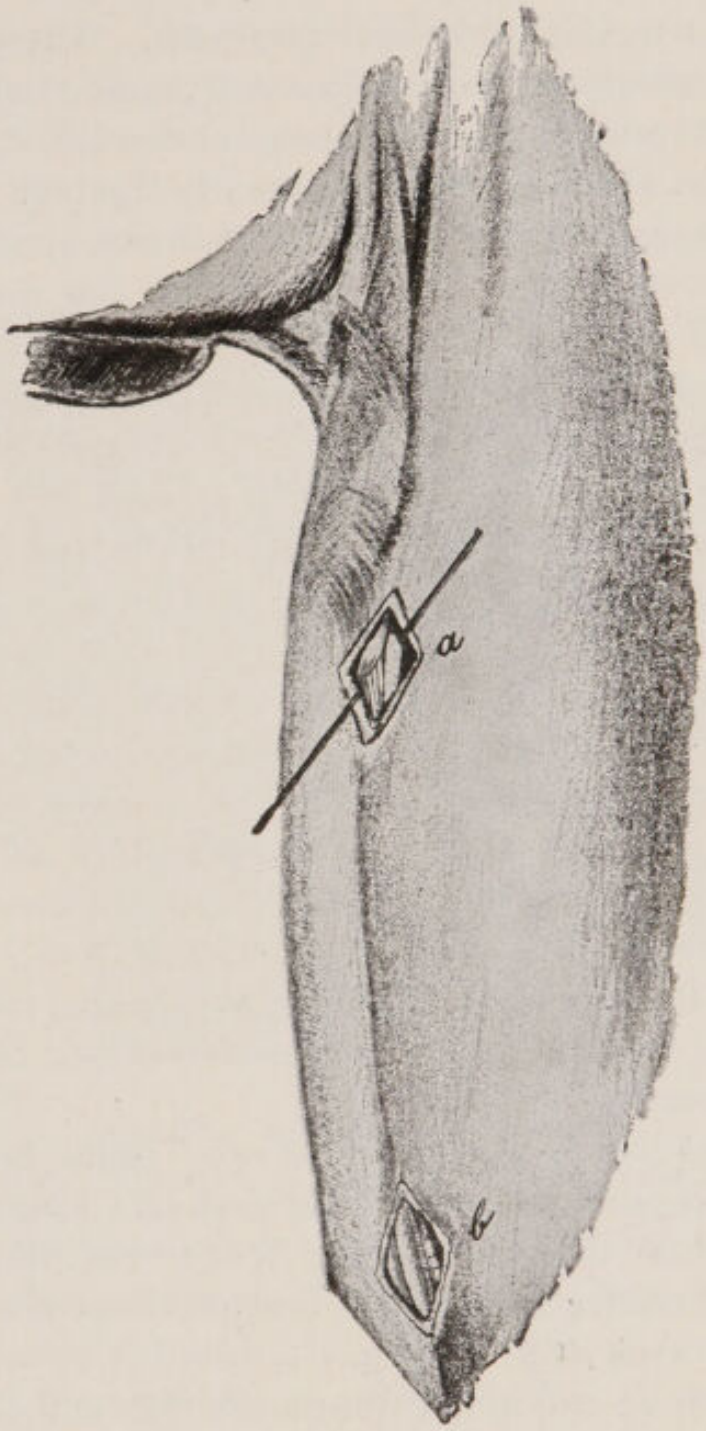

FIG. 25

a, Ligation of the common carotid artery ; *b*, Esophagotomy.

divide the artery midway between them. The second ligature is necessary in order to prevent hemorrhage from the distal end through collateral anastomoses and it is essential to sever the artery when permanently ligated, in order to avoid its rupture by the stretching of the undivided carotid, during movements of the neck, where the nutrition has been cut off at the point of ligation. Provide drainage for the wound and suture the muscle and skin.

19. ESOPHAGOTOMY

Fig. 25, 27

Instruments. Razor, scissors, convex scalpel, straight probe-pointed bistoury, tenacula, artery forceps, absorbent cotton, suture material.

Technic. The operation can be carried out on the standing or the recumbent animal. At its origin the œsophagus lies above the trachea somewhat to the left of the median line, and as it descends it gradually deviates to the left until in the lower cervical region it lies down along the left side of the trachea.

The operation is performed at any point between the pharynx and chest where the lodgment of a foreign body or other condition may demand. When the esophagus is empty, the practice operation is best performed in the lower third of the neck at *b*, Fig. 25.

An incision 10 cm. long through the skin and skin muscle is made on the left side between the anterior border of the mastoido-humeralis muscle and the jugular vein. With the two index fingers divide the loose connective tissue down to the esophagus, which lies between the left scalenus muscle, trachea and jugular vein. Along the supero-external border of the trachea runs the carotid artery, accompanied dorsally by the vagus and sympathetic and ventrally by the

recurrent nerves. The esophagus feels like a round muscle within which one can distinguish a firmer cord, the mucous membrane. When brought into view the organ has a pale red color, and it, with the trachea, is surrounded by the deep fascia of the neck. Pass one finger around the

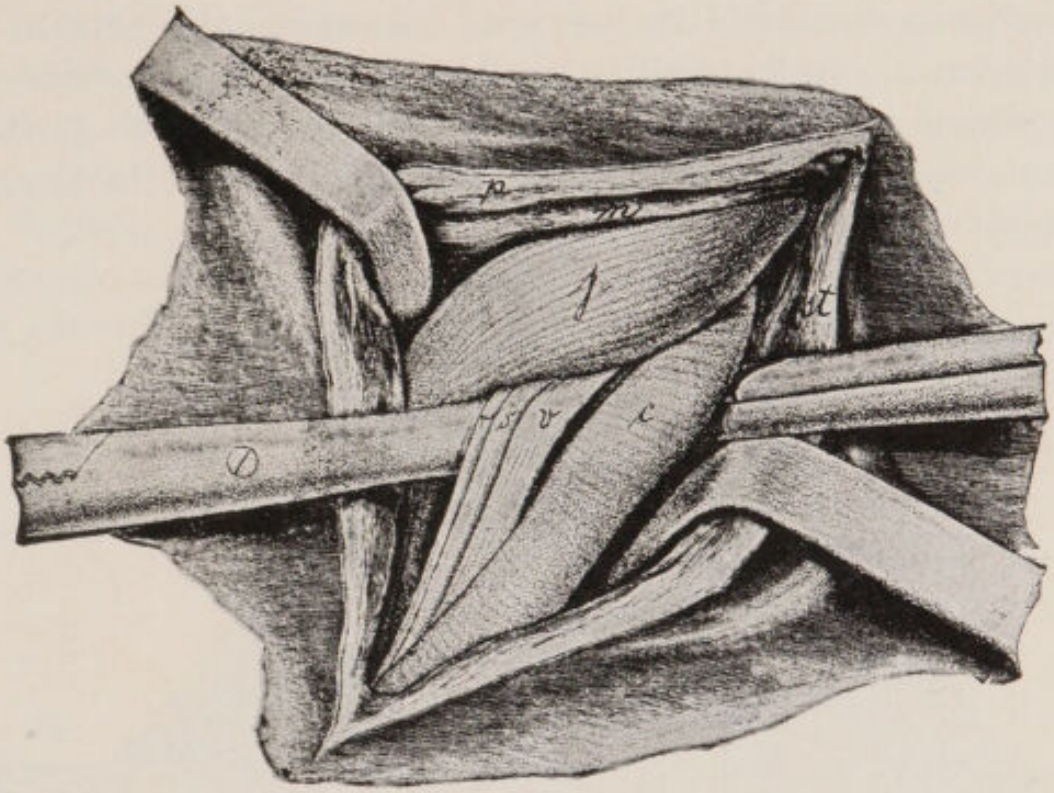

FIG. 26

Ligation of the common carotid artery

c, Common carotid artery; *j*, jugular vein; *v*, vagus nerve; *s*, sympathetic nerve; *r*, recurrent nerve; *p*, cervical panniculus carnosus muscle; *m*, sterno-maxillaris muscle; *st*, levator humeri muscle.

esophagus from behind, draw it away from the trachea, force a passage through the deep fascia of the neck and draw it out through the external wound. After making an incision through the esophageal muscle and mucous membrane, introduce a probe-pointed bistoury or a scissors blade into the lumen of the esophagus and split its wall. The mucous membrane is white and lies in thick longitudinal folds.

When there is a foreign body in the esophagus, the operation is performed at the point where it is lodged, in

the manner described, and the incision should be made only large enough to permit its removal. In diverticuli of the esophagus, an elliptical piece of the mucous membrane which has been overstretched is cut out. The esophageal wound is closed by a laminated suture, that is, the mucous membrane is united by means of an intestinal suture and the muscular wall closed over this. The skin and muscular wound may either be left open or closed with the Bayer suture and bandaged, with a drainage tube in the lower angle.

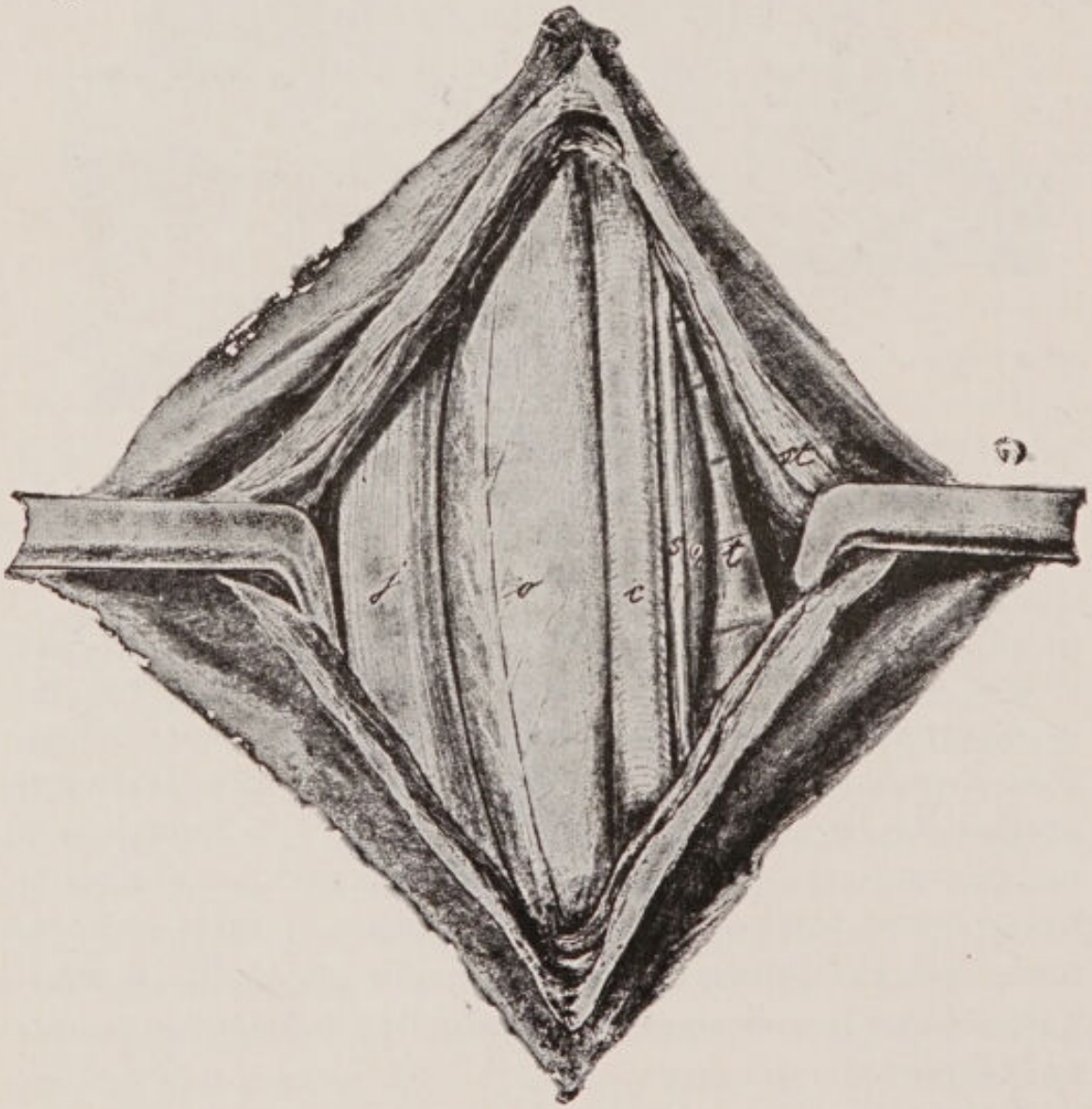

FIG. 27
Esophagotomy

c, Common carotid artery; *j*, jugular vein; *o*, *o'*, esophagus; *s*, sympathetic nerve; *t*, trachea; *st*, mastoido-humeralis (levator humeri) muscle.

III. OPERATIONS ON THE TRUNK, ABDOMINAL AND GENITAL ORGANS

19. PUNCTURE OF THE CHEST

Fig. 28

Object. The relief of hydrothorax or pyothorax.

Instruments. Razor, scissors, trocar, 1 m. of rubber tubing of the same size as the trocar, vessel for receiving the escaping fluid, dressing material.

Technic. Operate upon the standing animal, the point of operation in the horse being the seventh intercostal space on the left side, and the sixth on the right. Dogs may be

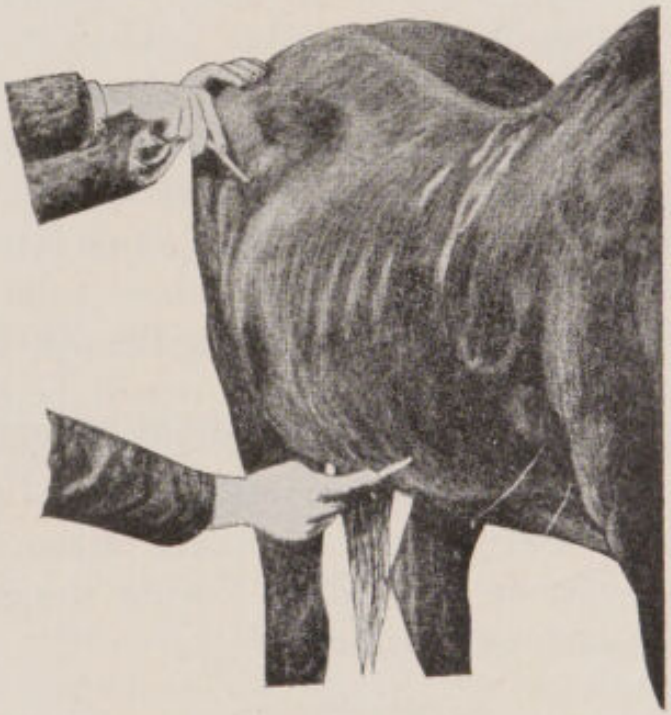

FIG. 28

Puncture of the chest; puncture of the intestine.

laid upon the table. The anterior ribs are so covered by the shoulder that they cannot be counted from before backward and must be enumerated from behind forward. In the horse there are usually eighteen ribs and in the dog fourteen. Counting 11 or 12 intercostal spaces from behind,

one reaches in the horse the point of operation on the left and right sides respectively. Clip or shave the designated intercostal area immediately above the thoracic vein. Grasp the trocar firmly with the thumb and index finger of one hand at such a distance from the point as will permit the canula to enter the chest. After the skin over the seat of operation has been drawn aside by the hand, place the trocar at the anterior border of the rib with the point inclined slightly forward and with a sharp blow with the palm of the other hand drive the instrument through the skin, cutaneous and intercostal muscles, internal thoracic fascia and pleura into the pleural sac. When the resistance ceases, the thoracic cavity has been entered. Remove the stilette and permit the pus, lymph, or other fluid to escape. This flow is at first continuous, but later becomes rythmic, synchronous with respiration. The intermission of the flow during inspiration permits air to enter the pleural cavity unless precautions are taken against it; this is most readily obviated by slipping one end of the rubber tubing over the exposed part of the canula and placing the other extremity in the receptacle for the fluid where it will be submerged. This will not only prevent aspiration of air into the chest but will act as a siphon to aid in the withdrawal of the fluid from the pleural cavity. In the absence of the tubing the entrance of air may be avoided by closing the canula with the finger after each expiration.

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20. PUNCTURE OF THE INTESTINES

Figs. 28, 29

Object. The relief of intestinal tympany.

Instruments. Razor, scissors, trocar.

Technic. Puncture of the intestine is preferably performed on the standing horse but may be carried out on the

recumbent animal. The point of operation is in the right flank about equidistant from the last rib, the extremities of the transverse processes of the lumbar vertebrae and the external angle of the ilium in the standing horse ; at the uppermost point of the abdomen in the recumbent animal, that is, at the most prominent part of the distension. After the skin at this place has been clipped or shaved and disinfected, grasp the trocar with the index finger and the thumb of the left hand and holding the instrument perpendicular to the body surface, give it a firm, quick blow with the palm of the right hand and drive it through the abdominal wall into the intestine.

With a properly constructed trocar of the dimensions suggested in Figure 29, no preliminary skin puncture with the lancet is required or advisable. The cutting end of the stilette should be very long, tapering and sharp so that it will cut as freely as a lancet. By performing the operation as directed, the trocar ordinarily punctures the caecum.

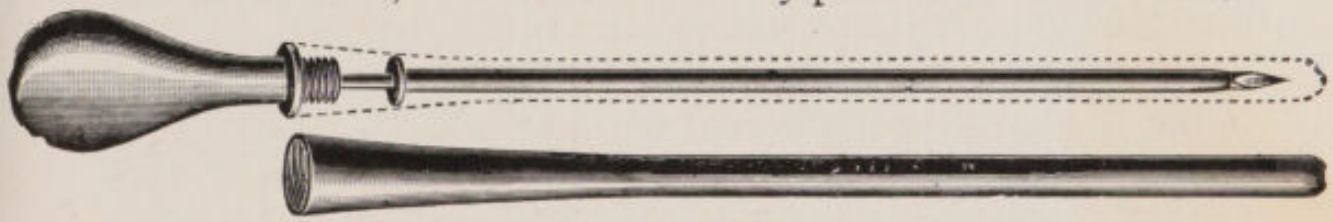

FIG 29.
Intestine trocar with sheath. Outside diameter of canula, 3 mm., length of canula, 16 cm.

Withdraw the stilette and permit the gas to escape through the canula. The canula may become occluded by particles of ingesta entering it. These should be removed by reïnserting the stilette. The intestine first punctured may collapse and the flow of gas cease while the tympany continues in other parts ; this may be overcome by reintroducing the stilette and pushing the trocar through the distal wall of the bowel into the intestine beyond. If this does not succeed, the trocar may be withdrawn and reïnserted in a neighboring area or, if need be, on the opposite side of the animal.

In withdrawing the canula, replace the stilette and press the skin against the abdomen with the thumb and finger of one hand while the trocar is drawn out with the other. This tends to prevent particles of ingesta from following the canula out of the intestine and becoming lodged at some point in the track of the wound to set up inflammatory processes there.

Before introduction, the trocar should always be rendered sterile but should not bear irritant antiseptics, which becoming lodged in the wound tend to irritate the tissues and produce abscesses. Puncture of the intestine is so often extremely urgent that deliberate aseptic precautions are not always practicable and trocarization only too frequently results in abscesses in the abdominal wall. Its prevention must depend chiefly upon the disinfection of the skin and instrument. It becomes important to use an instrument which is clean in advance. If the one shown in Fig. 29 is well disinfected after using and the sheath is filled with alcohol before it is screwed on, the instrument will remain sterile until it is again unsheathed when the alcohol will quickly evaporate and leave the trocar aseptic.

21. RUMENOTOMY

Objects. The surgical evacuation of the rumen when overfilled and not subject to relief by medication ; an exploratory operation for aid in diagnosis ; the removal of foreign bodies from the rumen and reticulum.

Instruments, etc. Clippers, razor, local anaesthetics, hypodermic syringe, scalpels, heavy curved artery or dressing forceps (6 to 8 pairs), scissors, assorted needles suitable for suturing rumen, peritoneum, muscles and skin, assorted catgut, and silk or linen sutures, needle forceps, sterile gauze.

Control of Patient. In many cases of overfilling of the rumen, the patient is unconscious and paralyzed so that neither restraint nor anaesthesia is indicated. In most other cases, rumenotomy may be performed on the standing animal, in stocks or restrained with leading ring in the nose. Very resistant animals may require confinement in lateral recumbency on the right side with the fore feet stretched forward and the hind ones backward.

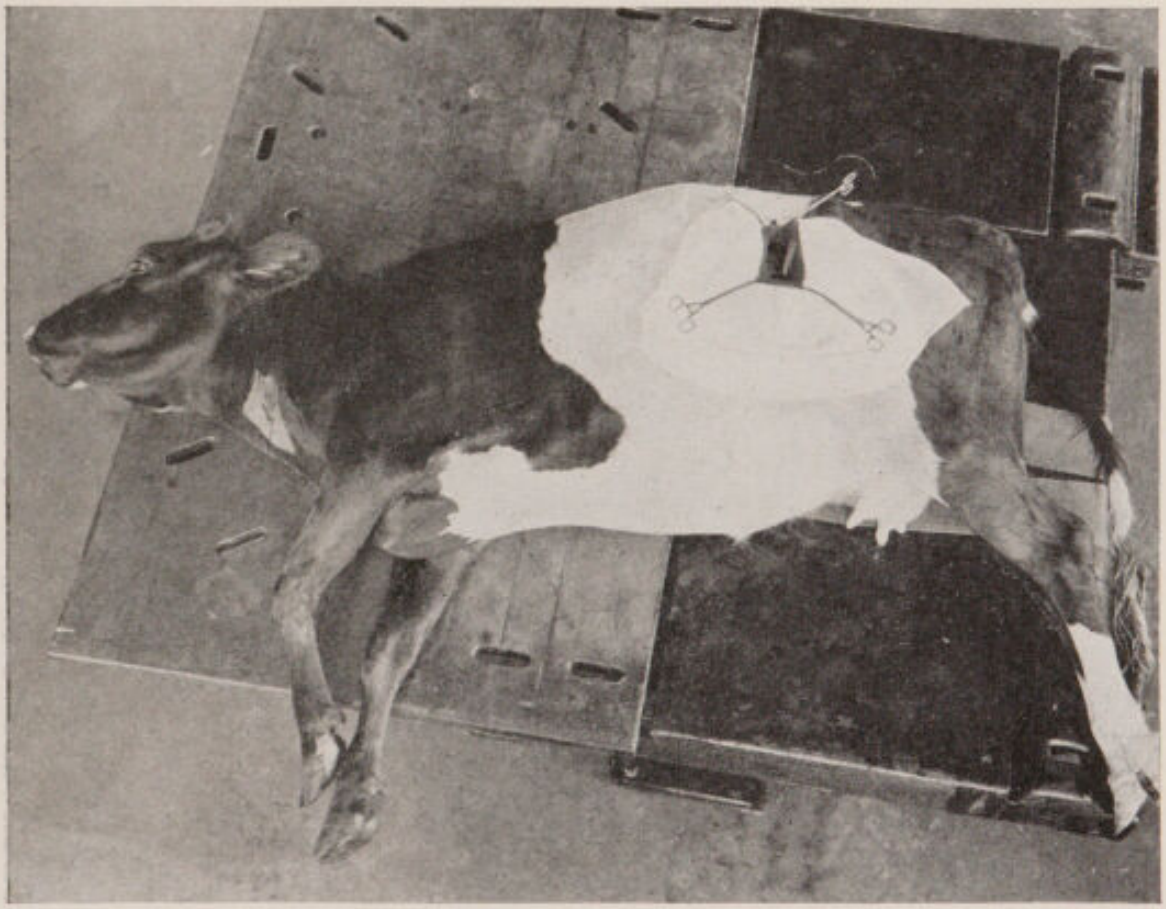

FIG. 30.

Rumenotomy showing location of incision, with incised walls of rumen drawn out through laparotomy incision over the protective gauze and held by forceps.

The operative area should be clipped, shaved and disinfected. Local cutaneous anaethesia should be induced by subcutaneous injections at short distances along the line of intended incision. The muscular walls should later be

anaesthetized. They are almost without sensation except where the larger sensory trunks of the part are encountered. The needle for hypodermic injection needs to be very sharp in order to penetrate the dense, thick skin. A small, short, reinforced needle is best suited for the purpose. General anaesthesia is not usually prudent for rumenotomy because when the rumen is distended with food or gas, or has for any reason lost its tone, passive regurgitation of food occurs, with inhalation when it reaches the pharynx. Later, inhalation pneumonia occurs.

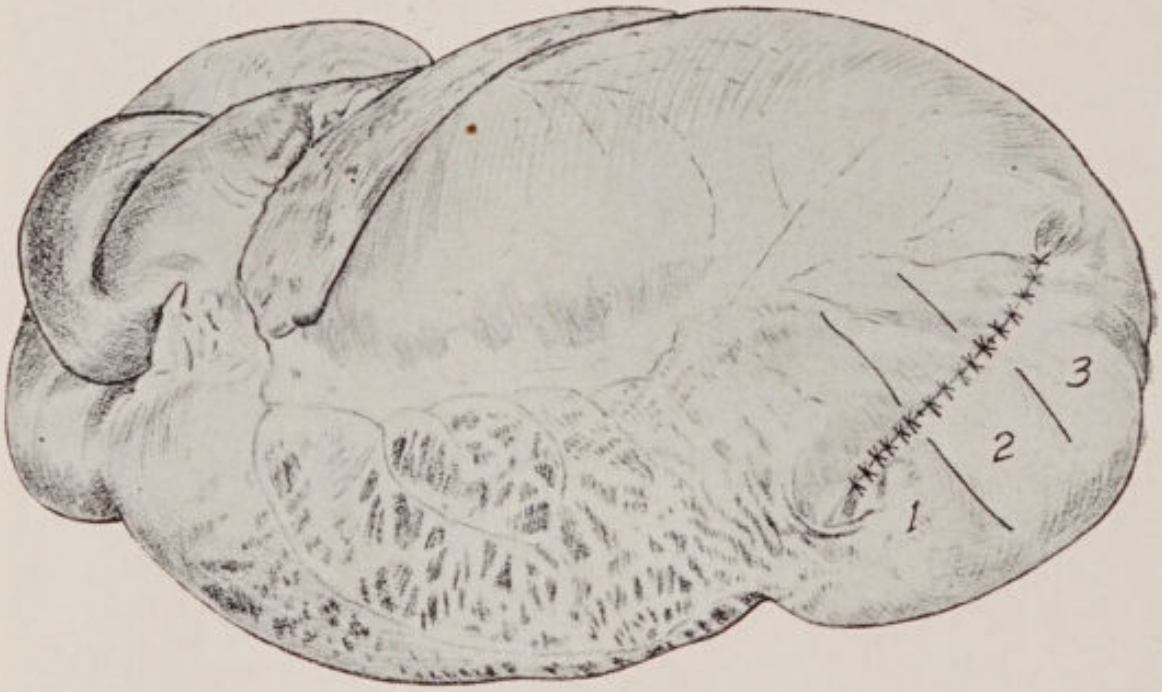

FIG. 31. Sutures in the Rumen illustrating 3 Layers

1. Third layer of sutures burying the second, the last one laid but not tied; 2, second layer burying the third layer, 3.

When satisfactory local anaesthesia has been induced, make a cutaneous incision in the left flank 7 to 10 inches long, beginning at a point about equidistant from the lateral processes of the lumbar vertebrae, the external tuberosity of the ilium, and the last rib, and carried downward perpendicular to the spinal column as indicated in Fig. 30. Following this, a second incision of the same length should be made on the central line of the gaping cutaneous wound

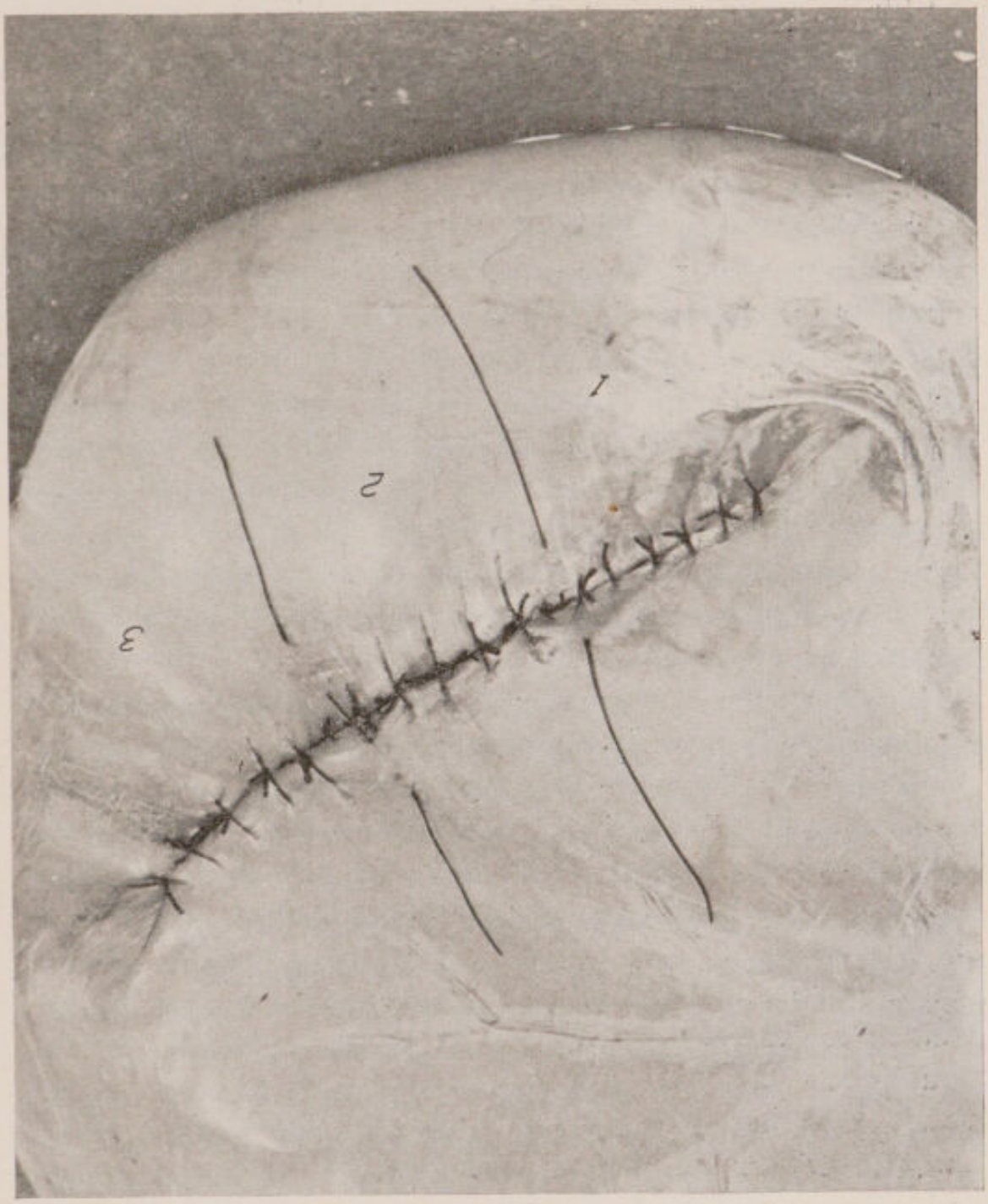

FIG. 32. Detail of Sutures in Rumen

1. Third layer of sutures burying the second, the last suture remaining untied; 2, second layer of sutures burying the first layer, 3.

through the oblique muscles of the abdomen. It should begin at the upper commissure of the gaping skin wound and follow a line equidistant from the wound margins to the lower commissure. Finally the peritoneum is to be picked up with forceps, punctured carefully with a scalpel, and the opening sufficiently enlarged.

Another and probably preferable plan for making the laparotomy wound is to incise the skin as directed in the preceding paragraph, and then separate the external oblique muscle obliquely downward and forward between its muscular bundles, and the internal oblique in a corresponding manner obliquely downward and backward, the two penetrations crossing in their middle, X-formed. The peritoneum is then incised as in the preceding plan. By this technic, suturing of the peritoneum and muscles after completing the operation is quite unnecessary. Only cutaneous sutures are advisable.

If the rumen is distended with gases, liquids, or solids, it immediately prolapses somewhat through the laparotomy incision. The margins of two or more thicknesses of sterile gauze should now be introduced between the rumen and the wound margins as illustrated in Fig. 30. Make an incision through the walls of the rumen 6 to 8 inches long, immediately beneath, and parallel to, the laparotomy wound. Seize the lips of the wound in the rumen promptly with four heavy artery or dressing forceps, one upon either lip at the lower commissure, the other two at the upper angle. By drawing steadily upon the forceps, assistants may draw the invaded portion well out of the wound as shown, and can hold the walls of the rumen backward, forward and downward in such a manner that no aliment can readily escape and drop into the peritoneal cavity. In default of needed assistants, the operator may make a heavy fixing suture in the adjacent skin, pass the free ends of the suture through the forceps' handles, and tie them

securely in a manner to retain the lips of the rumenal wound in the position designated in the figure.

The operator may now introduce his hand and arm freely into the rumen, can remove part or all of the ingesta as may be desired, and search the interior of the rumen and reticulum for foreign bodies or other evidences of disease.

Having completed the examination and applied any therapeutic agent advisable, carefully wash away any ingesta which has escaped from the rumen. The wound in the rumen is then to be sutured, using the Lembert type as shown in Figs. 31, 32. Heavy silk or linen should be used and care taken not to pass the suture into the rumenal cavity but only through the serosa and musculosa. If they penetrate the rumenal cavity, the digestive juices act quickly, destroy them and permit the wound to reopen. The closing of the wound in the rumen should not be intrusted to a single row of sutures, but instead should have three separate sets of the same material applied in the same manner, the second set burying the first, and the third burying the second, as indicated in Fig. 32. The third row of sutures may be of catgut having an absorbable period of 20 days if preferred. The lips of the rumenal wound may be conveniently held with the aid of heavy fixation sutures below and above the lower and upper wound commissures respectively, similar to the plan for fixing the intestine as shown in Fig. 34a, page 86, and by having an assistant hold these firmly.

The suture area may now be carefully wiped clean and permitted to drop away into the abdomen.

The margins of the peritoneal wound are next to be grasped with forceps and sutured with heavy, slow-absorbing catgut. The muscle layer is best closed by means of very deep and quite heavy interrupted sutures, carried through the skin. These should be carefully laid and left untied until the skin wound is carefully closed by shallow,

continuous or interrupted sutures. The muscle sutures are then to be tied over the skin sutures. By this plan the retaining sutures of the muscle, like those of the skin, are readily removed. The sutures should be left in position for 10 days. An antiseptic powder may be dusted over the wound, or in fly time, deterrent dressings containing camphor may be used with benefit.

If the preferable plan for laparotomy, involing the x-formed division of the oblique muscles is used, only the skin sutures are to be employed.

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22. RESECTION OF INTESTINE

Object. In cases of adhesion, ulcer, perforation, strangulated hernia, or intussusception of the intestine.

Instruments. Razor, scalpels, scissors, artery forceps, two long jaw compression forceps, with four pieces of rubber tubing to cover the jaws of the forceps.

Technic. The animal may be operated upon, standing or cast, and under either local or general anaesthesia. Cover the operative field with antiseptic or aseptic gauze. Make the laparotomy incision as directed for rumenotomy except that generally it should be in the right flank, whenever the lesion can be handled from that point.

In case of adhesion and strangulated hernia, the incision may be made over any part of the abdominal cavity. Draw the involved portion of the intestine out through the incision and let it rest upon the surrounding gauze. Remove as far as possible all intestine which may be so diseased that it will imperil recovery, and take care that at the points of division there shall be a good blood supply.

The normal intestine is clamped with the compression forceps, the jaws of which have been covered with rubber tubing to prevent injury, one pair being placed on each

side of the diseased tissue. The intestine is then severed with scissors about 1 cm. from the forceps toward the diseased part, care being taken not to let the intestinal contents enter the abdominal cavity or soil the healthy tissues. The incisions are carried in a v-shape, as shown in Fig. 33, into the mesentery for 10 or 12 cm. The mesenteric vessels may now be compressed with artery forceps and ligated.

FIG. 33. Resection of Intestines

1. Area of intestine to be excised isolated by two compression forceps, 2; 3, dotted line indicating triangular portion of mesentery to be removed.

After thoroughly washing the cut ends of the intestine with warm, normal salt solution, the two pairs of forceps are brought together. One suture, with long ends, may now be passed through the cut edges of the mesentery close to the intestine and another through the edges of the convex border of the intestines, as shown at 1, 1 *a* in Fig. 34. These are to serve as stays to keep the edges of the intestine tense while being sutured.

Two rows of sutures are used, the second burying the first. The first half of the intestine may be united with a

continuous suture as shown at 2 *a* in Fig. 34, by bringing the two edges of serosa in apposition, and applying the sutures from the lumen of the intestine. The remaining half may be united with interrupted Lembert sutures placed from the outside, as in *b* Fig. 34.

After the two ends of the intestine have been firmly united, the cut edges of the mesentery are brought together, either with a continuous or interrupted suture.

FIG. 34. Resection of the Intestines.

a. Application of first group of sutures uniting the intestine ends. 1, 1. Tension sutures for holding ends of intestine while applying first sutures; 2, continuous sutures applied from within the gut, seen between the non-sutured portions.

b. Completion of the union of the intestine. 1. First layer of Lembert sutures uniting that portion of the cut ends of intestine remaining open in *a*; 2, second layer of sutures burying the first.

c Completed operation. 1. Sutures closing the mesenteric wound; 2, second layer of sutures burying the first.

Then a large supply of warm, normal salt solution is allowed to flow over the intestine until healthy contractions have been stimulated and a normal blood flow established. Should any intestinal contents have escaped into the peritoneal, cavity these should be washed out by the free use of the salt solution. The intestine is then ready to be replaced in the abdominal cavity and the laparotomy wound sutured as described on page 78 for rumenotomy.

23. SUBCUTANEOUS CAUDAL MYOTOMY

Fig. 35.

Object. The correction of curved tail.

Instruments. Sharp straight tenotome, bandage.

Technic. The point or points of curvature and their extent are to be carefully noted by having the animal trotted away from the operator. The curvature is generally due to unequal development of the two levator or extensor muscles, Fig. 35, *e*, though quite rarely the depressors, *f*, may be implicated.

Confine the animal in stocks, or in default of these, control by means of a twitch and sideline. Cleanse and disinfect the tail and have it sharply bent by an assistant in the opposite direction to the curvature. Locate the longitudinal furrow between the levator and depressor muscles on what has now become the convex side and at the lower margin of the levator and just above *v*, Fig. 35, insert the tenotome at the most prominent part of curvature, the incision being parallel with the muscle fibers, and push the instrument entirely through the muscle to the vertebra, then turning the cutting edge upwards, at the same time advancing the point toward the median line, sever the entire muscle.

The superior lateral caudal artery, *s*, Fig. 35, bleeds profusely if severed, and wounding of it may usually be avoided by withdrawing the tenotome a trifle in passing that point.

Wounding the skin over the muscular incision is avoided by placing the thumb of the left hand over the line of incision so the knife will be recognized as soon as the muscle and caudal fascia are cut through. Remove the knife in the same manner as introduced. Release the horse and have him trotted again. *If the operation is sufficient, the tail should curve in about the same degree as before, but in the*

opposite direction. If this has not been attained, examine carefully and sever any remaining bundles of muscle, and this not sufficing, repeat the operation as before at another point 5 or 6 cm. above or below the first, severing the muscle again. Or if the depressor appears implicated, sever it in a similar manner. In extreme cases the entire lateral half of the caudal muscles, tendons and aponeurosis may be severed.

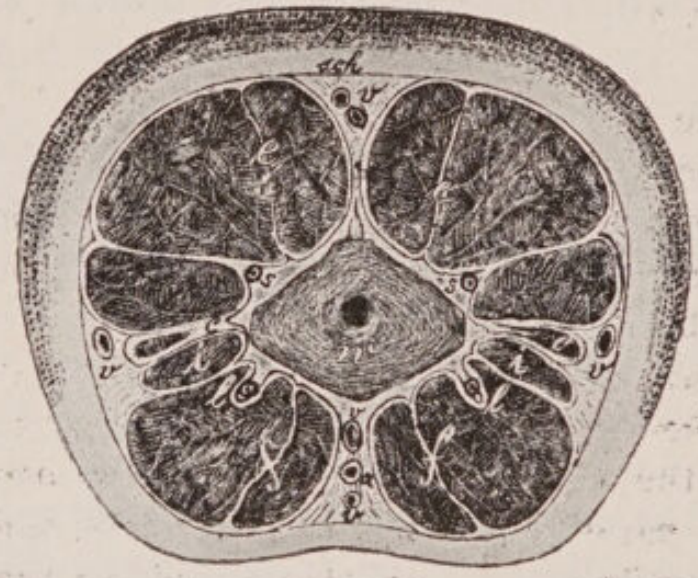

FIG. 35

Transverse section of the tail. *n*, Caudal vertebra; *c*, sacro-coccygeus lateralis muscle; *e*, sacro-coccygeus superior; *f*, depressor longus and brevis muscles (sacro-coccygeus inferior;) *i*, intertransversales muscles; *a*, coccygeal artery; *s*, supero-lateral coccygeal artery; *l*, infero-lateral coccygeal artery; *v*, caudal veins (dorsal, ventral, lateral); *sch*, caudal fascia; *h*, skin.

Apply an antiseptic pad to the wound and retain it by a moderately firm bandage, which serves at once as an occlusive dressing and effective hemostatic. Remove the bandage after 24 hours. By this plan of operation it is not intended to tie the tail to the side of the animal during the time of healing but when bandaging immediately after the operation, the tail should be held away from the side toward which it formerly curved so that the bandage may tend to prevent the return of the organ to its former position.

24. CAUDAL MYECTOMY

Figs. 35, 36

Objects. For the prevention of the gripping of the reins by the tail.

Instruments. Elastic ligature, straight bistoury, tenacula, absorbent cotton, bandages.

Technic. Confine the animal in lateral decubitis or in stocks, cleanse and disinfect the parts and apply the elastic ligature as close as possible to the root of the tail. Have an assistant hold the tail upward, *i. e.*, dorsalward, and tightly stretched. Make an incision 15 to 20 cm. long, over the middle of the inferior surface of each depressor longus muscle, beginning close against the elastic ligature and extending toward the apex, severing at once the skin and caudal fascia down to the muscle. Let an assistant retract the lips of the incision with tenacula while the operator dissects the depressor longus muscle, DC, Fig. 36, from the adjacent tissues at either side, sever it by a transverse incision close against the ligature and dissect away the entire muscle to the distal end of the wound and there excise it. Repeat the operation on the opposite side.

Make two elongated tampons of absorbent cotton, of the size and form of the muscles removed, saturate these with 1-1000 sublimate solution, insert neatly in the wounds and over this, to aid in securing antisepsis and to equalize the pressure, apply a pad of absorbent cotton, saturated with sublimate solution, covering the wounds and encircling the tail and secure by a moderately firm bandage as closely as possible to the elastic ligature. Remove the ligature, when hemorrhage may ensue, which is to be controlled by the application of a second bandage extending higher up on the tail. Remove the bandage in 24 hours and dress as before for a second day, after which treat as an open wound. Care

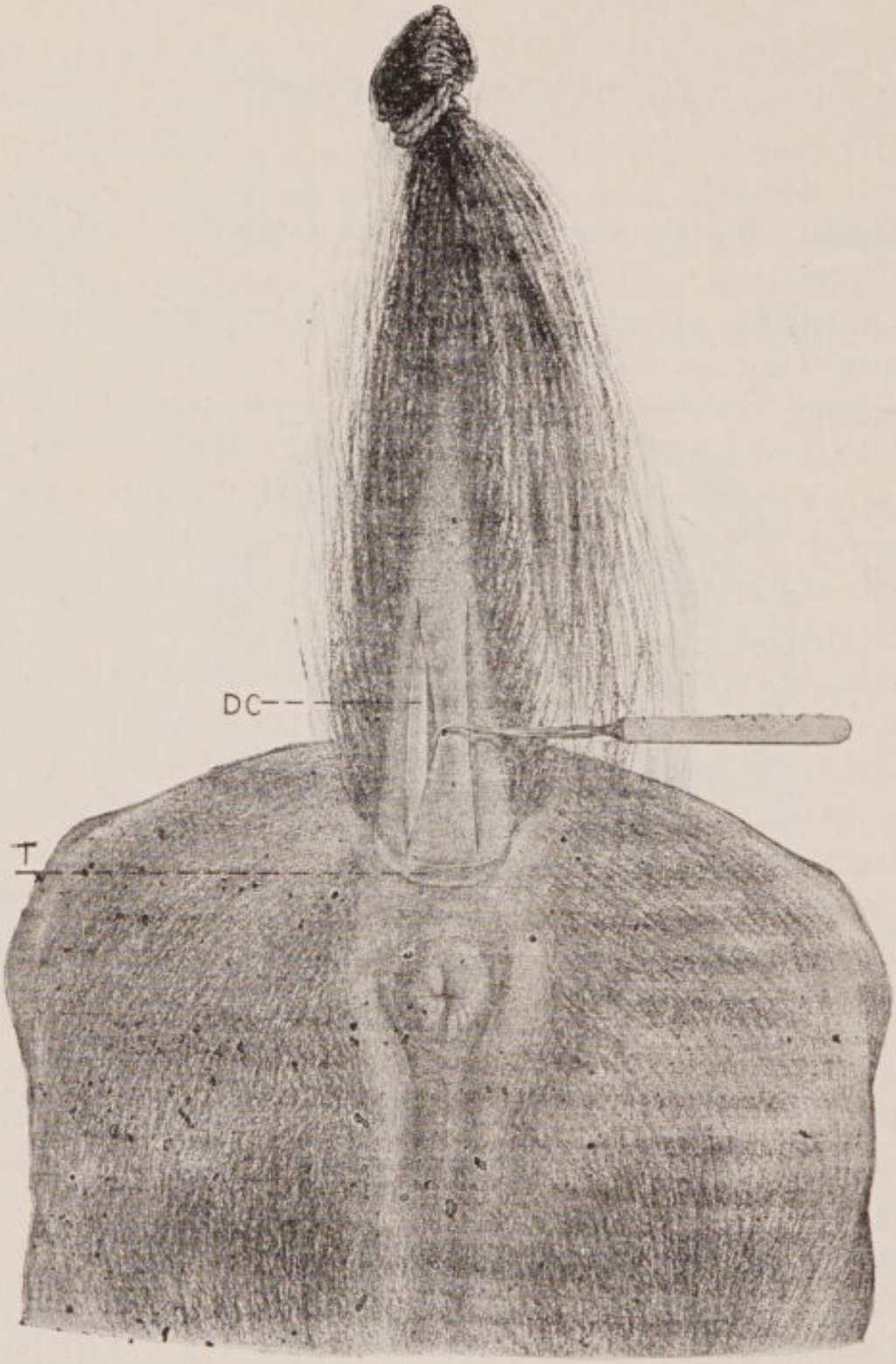

FIG. 36

Caudal Myectomy To Prevent Gripping of the Reins

DC, Depressor coccygeus longus muscle ; T, tourniquet.

should be taken not to apply the bandage too tightly or leave it in place for more than 24 hours, since otherwise necrosis of the tail is liable to occur and necessitate amputation.

25. AMPUTATION OF THE TAIL

Figs. 37, 38

Objects. The treatment of malignant, or incurable diseases of the tail.

Instruments. Elastic bandage, scalpel, razor, artery forceps, bone cutting forceps, suture material.

Technic. The animal may generally be operated upon in a standing position secured in the stocks or with the aid of the side line. Local anaesthesia may be applied by injecting cocaine or other drug deeply upon the nerve trunks as well as just beneath the skin. The animal's attention may be attracted by means of the twitch if found necessary. The point of amputation is determined by the location of the disease. Over the area of operation clip the hair, shave and thoroughly disinfect. Apply the tourniquet or elastic bandage at the base of the tail so as to render the operation bloodless.

Above the seat of operation turn the hair upward toward the root of the tail and secure it there by means of the bandage, B, Fig. 37. Locate as accurately as possible the position of a joint at the point where it is desired to operate, and with the scalpel begin an incision on the median line on the upper side of the organ about 1 cm. above the articulation and carry this obliquely outward for a distance of 4 to 6 cm. according to the size of the tail and then continue it downward, backward and inward along the side and inferior surface until directly opposite to the place of beginning. Make a similar incision upon the opposite side of the tail, cut through all the connective tissue and muscles down

FIG. 37. Amputation of the Tail
Tail amputated showing flaps unsutured; B, Bandage securing hairs turned upward out of operators way.

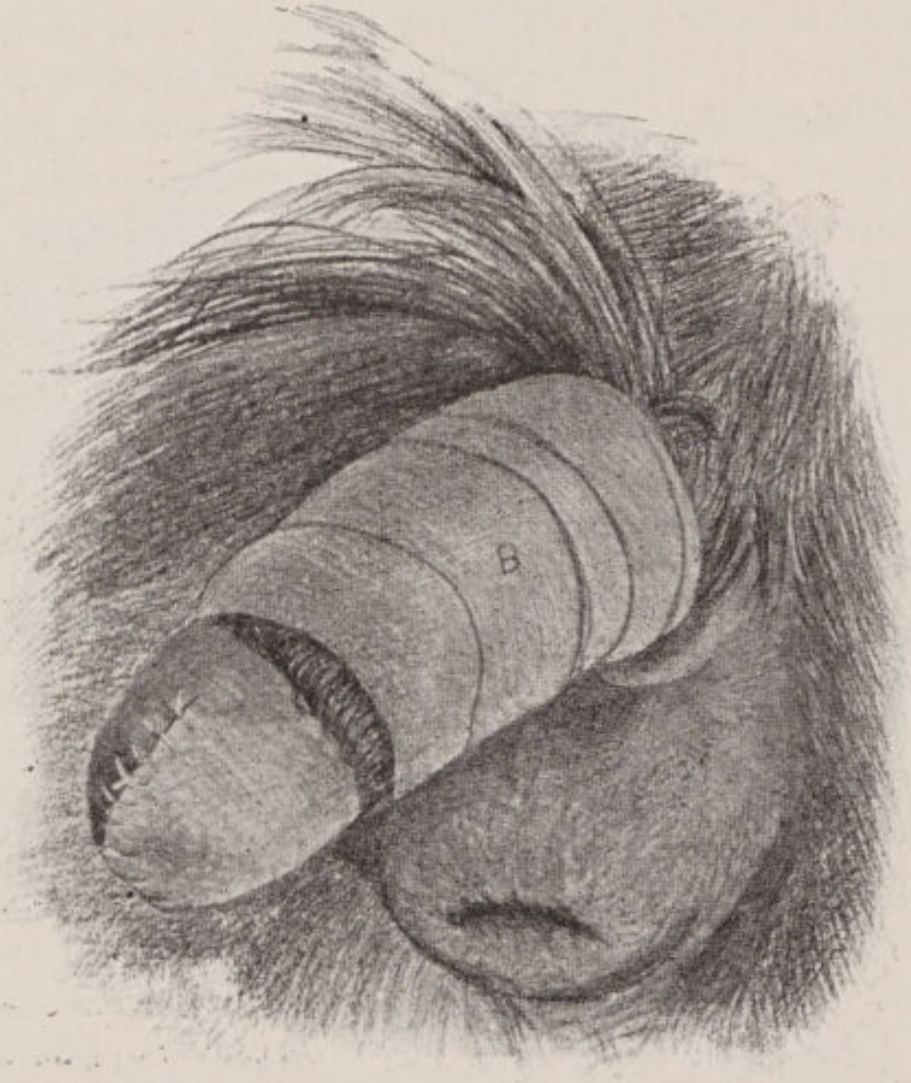

FIG. 38. Amputation of the Tail
Operation completed showing sutures; B, Bandage applied to secure hairs of tail upward out of operator's way.

to the bone and then disarticulate with the aid of the scalpel. Search for the arteries and control the hemorrhage by torsion or ligation. The vessels will be more readily found by loosening the tourniquet so as to permit the blood to flow.

Some operators prefer to begin the incision at the side of the tail instead of upon the dorsal surface and in that way have a dorsal and ventral flap instead of right and left as indicated in Fig. 37. The excision having been completed, the flaps are brought together by means of strong silk or silk worm gut sutures as shown in Fig. 38. The sutures should be begun at the apex of the two flaps and comparatively deep.

Disinfect the stump thoroughly and if the hair is sufficiently long it is well to draw it down over the wound, to which an antiseptic covering has been applied, and retain the dressing in position by tying a cord around the hair just beyond the point of amputation.

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26. URETHROTOMY. LITHOTOMY.

Figs. 39, 40.

Objects. For the removal of calculi from the bladder or urethra or performing other operations on these parts.

Instruments. Catheter, convex scalpel, scissors, artery and compression forceps, tenacula, lithotome, lithotomy forceps, lithotrite, absorbent cotton, drainage tube, suture material.

Technic. Urethrotomy may be performed on horses in the standing position, the hind feet being secured with hobbles.

It is best however, to operate under anaesthesia with the patient in lateral or dorsal recumbency, either on the operating table or cast, being careful to secure as gently as

possible, having first emptied the bladder if practicable, since rupture of an over distended viscus may readily occur during violent struggles by the animal.

The point of operation will depend upon the location of the calculus or other obstacle. If it is found in the pelvic portion of the urethra or in the bladder, the operation is made at the ischial notch, Fig. 39. First the penis is drawn out from the prepuce and the catheter introduced into the

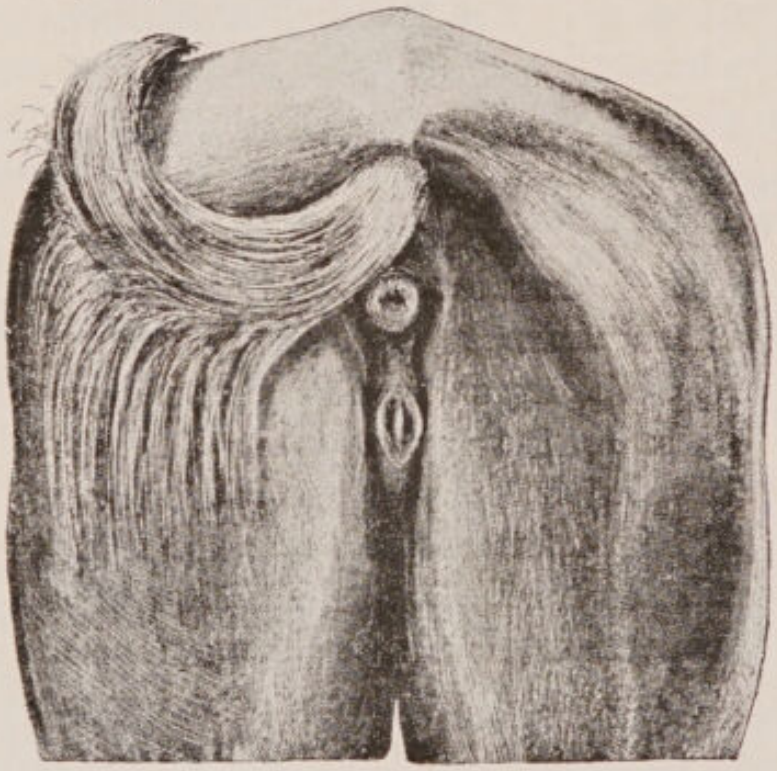

FIG. 39

Urethrotomy at the ischial notch.

urethra and pushed upward until it has passed the ischial notch. After disinfection of the skin, render it tense and make a 5 cm. long incision on the median line at the ischial arch through the skin, bulbo-cavernosus muscle, spongy portion of the urethra, and the urethral mucous membrane down to the catheter, Fig. 40, k. In order to prevent infiltration of urine after the operation, special care is to be taken to make the lower end of the wound slanting in such a manner that the deeper margin is higher than the superficial.

After the catheter has been drawn back away from the ischial arch, introduce the lithotomy forceps into the urethra or bladder, grasp the stone and draw it outward in its natural direction. The grasping of the stone with the forceps is materially aided by means of the left hand introduced into the rectum. One must avoid grasping, along with the stone, the mucous membrane of the bladder. Partial filling

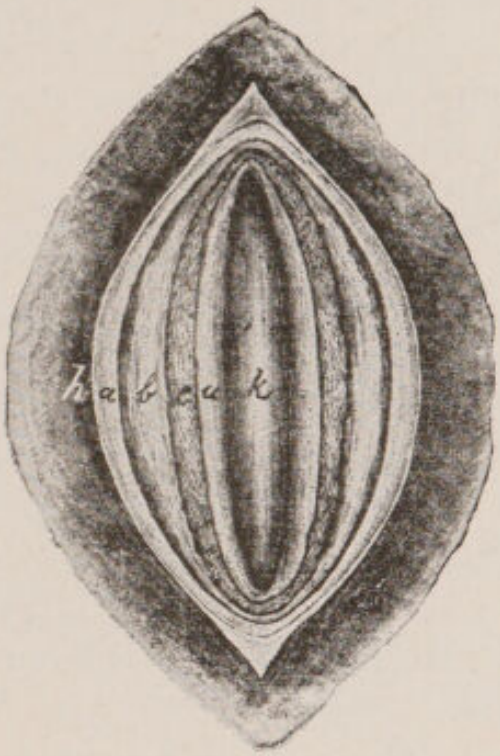

FIG. 40

Urethrotomy (life size). *h*, Skin ; *a*, retractor penis muscle ; *b*, bulbo-cavernosus muscle ; *c*, spongy urethra ; *u*, urethra ; *k*, catheter.

of the bladder with a tepid aseptic solution will aid in grasping the calculus and in avoiding the implication of the bladder walls. By careful rotary movement and pushing the forceps backward and forward, the operator can determine before traction is exerted if the forceps can be withdrawn easily and without much resistance through the neck of the bladder.

If the stone is so large that it cannot pass the neck of the bladder, lithotripsy may be performed. This operation re-

quires time and patience, since as a rule it is not possible to encompass the entire calculus with the forceps. That is, the narrowness of the neck of the bladder prevents the sufficiently wide opening of the forceps. The stone consequently must be gradually broken off at its periphery and the individual pieces of calculus removed. The character of the surface of the stone has an evident bearing upon the practicability of lithotripsy.

The surgical dilation of the pelvic urethra with the lithotome is usually far more practical than the crushing of the stone. Introduce the instrument and divide the urethra upward on the median line as the instrument is withdrawn. In order to prevent injury to the rectum, it should be emptied of feces before the operation is undertaken. After the removal of the stone, the operator may push the catheter again over the ischial arch and unite the lips of the wound in the urethral mucous membrane by means of intestinal sutures. Flush the bladder and urethra by means of a warm, 3 per cent. boric acid solution injected through the catheter and then withdraw the latter. Finally, suture the skin wound and insert a drainage tube or antiseptic gauze in the lower angle.

Or the whole wound may be left entirely open and dressed daily with antiseptics. In case the pelvic urethra has been divided, the suturing of the external wound is of questionable utility.

(For student practice on an anaesthetized horse, introduce a stone into the bladder through the urethral wound and practice grasping and removing it with the lithotomy forceps.)

27. AMPUTATION OF THE PENIS

Figs. 41, 42, 43

Instruments. Scalpel, elastic ligature, strong silk suture, strong piece of tape 1 m. long, artery and compression forceps.

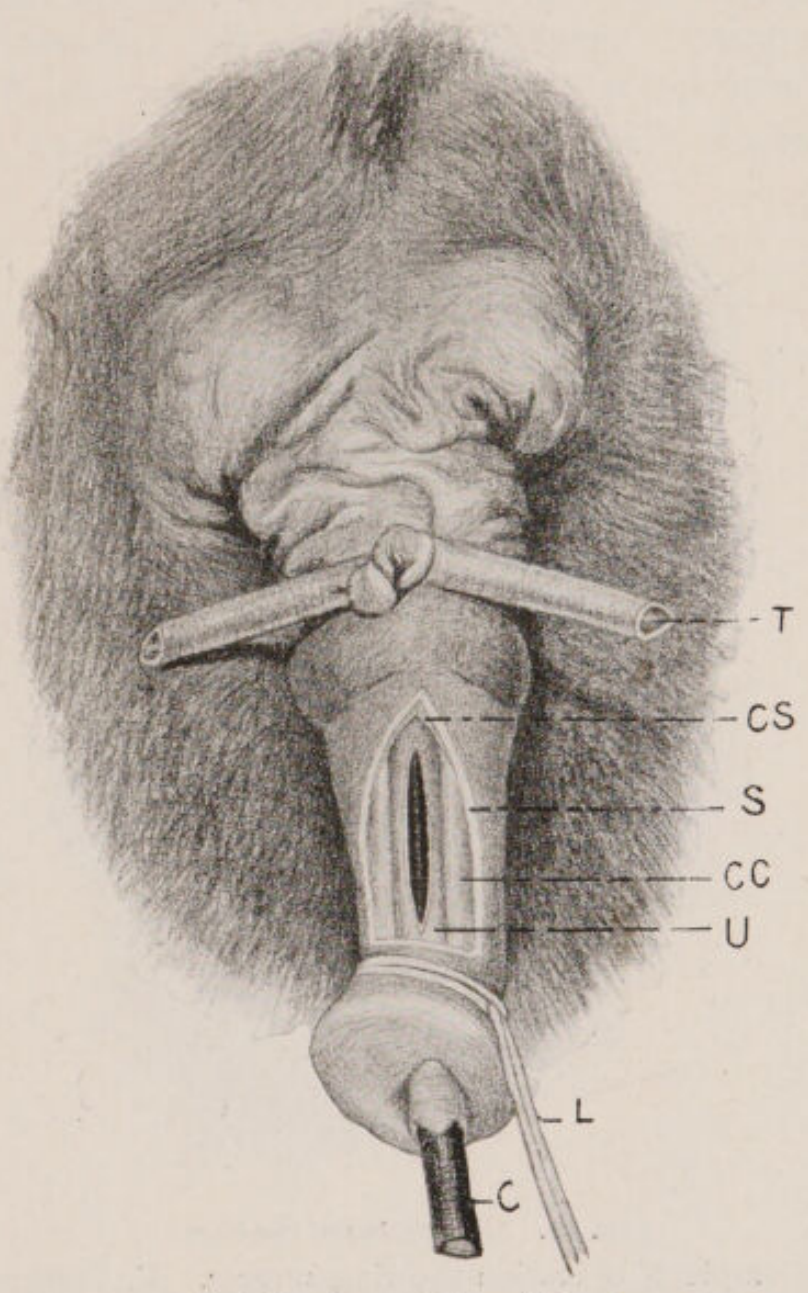

FIG. 41. Amputation of Penis

First stage of operation. T, Elastic ligature used as tourniquet; CS, Corpus spongiosum of urethra; S, Skin; CC, Corpus cavernosum; U, Urethra; L, Ligature; C, Catheter.

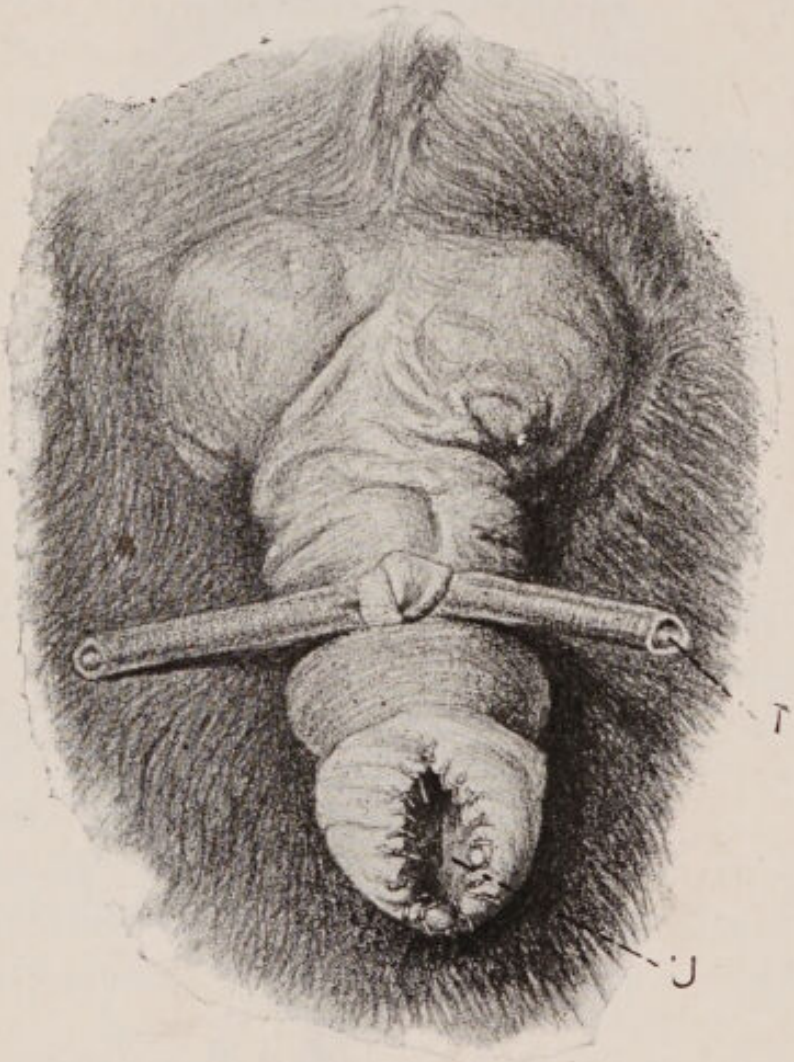

FIG. 42. Amputation of the Penis.
Completed operation showing sutures. U, Urethra

Technic. The operation is carried out on the recumbent animal under local or general anaesthesia, the upper hind foot being drawn backward or upward or otherwise so fixed as not to obstruct the field of operation. The point of operation is determined by the character of the disease and the object to be attained. It may be made at any point

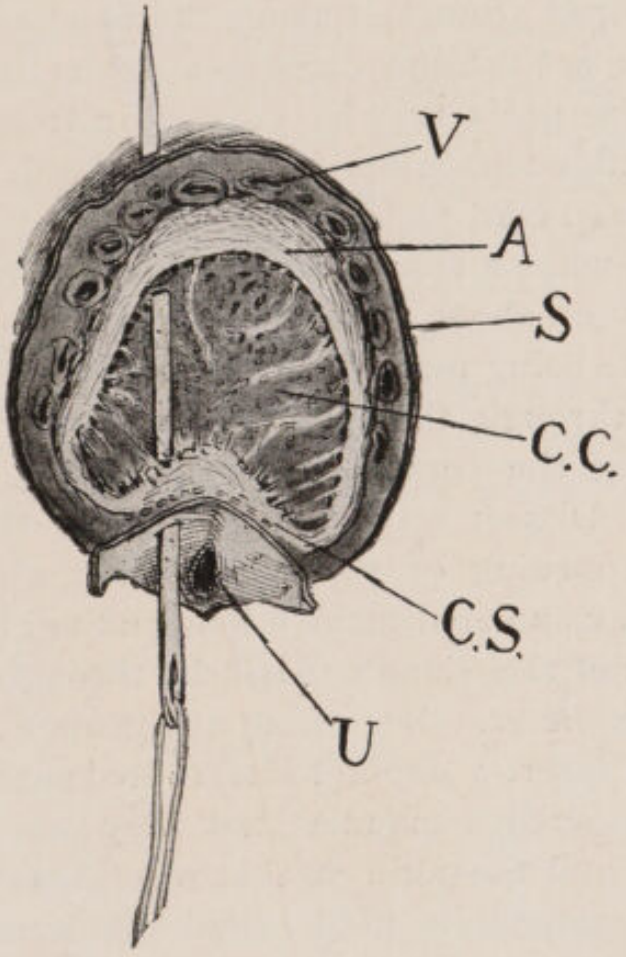

FIG. 43.

Amputation of the penis, showing needle inserted for a suture. V, Dorsal vessels of penis; A, fibrous tunic of the corpus cavernosum; S, skin; CC, corpus cavernosum; CS, corpus spongiosum of urethra; U, urethra.

from the glans penis to the attachment of the corpus cavernosum to the ischium. If possible, amputate in front of the preputial ring.

After the penis has been drawn out, and the preputial region carefully cleansed and disinfected, an assistant grasps the organ just behind the preputial ring and holds it firmly, A catheter is then introduced into the urethra and pushed upwards beyond the point where it is designed to amputate the organ and a temporary elastic ligature, T, is then applied above the assistant's hand around the penis, or a piece of tape is looped around it above the hand and is made to serve both as a tourniquet and as a means for holding the penis. Or the penis may be grasped in front of the ligature with double tenaculum forceps and held.

Apply a small cord just behind the glans penis, L., Fig. 41, and then make a triangular incision on the ventral surface of the organ about 4 cm. long by 3 cm. wide, the base of the triangle being forward as shown in the figure ; carry this incision through the skin, S, the corpus spongiosum, CS, and along the corpus cavernosum, CC, down to the urethra, U. Dissect away the tissues in the triangular area without opening or wounding the urethra and when this has been completed make a longitudinal incision from near the apex of the triangle to its base through the urethral walls to the catheter. Beginning at the apex of the triangular wound, insert a series of interrupted sutures as shown in Fig. 42, in such a manner that they pass through the urethral wall and the skin so that when tied the wounded surfaces are completely hidden and the urethral mucous membrane is brought into apposition with the integument. Continue these sutures down to the base of the triangle, after which remove the catherer and excise the organ by a cut extending in a slightly oblique direction from below upward and forward. Take a straight needle armed with a silk suture and passing it through the margin of the urethral wound, the adjacent fibrous capsule of the corpus cavernosum and across but not through the erectile tissue, insert it again into the superior portion of the fibrous cap-

sule and carry it out through the adjacent dorsal vessels and the skin as shown in Fig 43, and, bringing the ends of the sutures together, tie in such a way that the urethral mucous membrane and the margin of the skin are brought into immediate contact and the blood vessels securely closed in such a manner as to guard against hemorrhage. By this plan when the sutures are tied, the cut borders of the fibrous envelope are brought together over the erectile tissue, thus preventing hemorrhage from that tissue also. Insert as many sutures as may be required to completely and securely close the wound, and finally leave every part wholly covered with epithelium. By this plan stricture of the urethra in the process of healing is avoided. Remove the tourniquet and release the patient.

The principles here laid down are applicable and advisable in the amputation of the penis in all domestic animals. In the dog, the point of amputation should be above the penial bone.

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28. VAGINAL OVARIOTOMY IN THE MARE

Figs. 44, 45.

Objects. The alleviation of vice when related to ovarian irritation or disease.

Instruments. Colin's scalpel, ratchet ecraseur, 55 cm. long, vaginal tensor.

Preparation of patient. It is best to keep the animal on a scant laxative diet for at least 24 hours and preferably longer, prior to the operation, so that the alimentary canal shall be somewhat empty and thus decrease the intra-abdominal tension and relieve the operator from much annoyance due to the pressure of the viscera. Before commencing the operation, it is best to have an assistant empty the rectum manually. Do not use enema because there is dan-

ger from the expulsion of liquid feces during the operation. It is best, also, to empty the bladder before operating, otherwise the animal is quite sure to urinate during the operation.

Technic. The introduction of the hand into the vagina of the mare causes the admission of air along the side of the hand and arm. The vulvar lips fail to envelop the hand and arm closely and the irritation or shock causes the animal to draw air into the vagina alongside the arm, and fully balloon it. The movements of the diaphragm in respiration tend to cause a vacuum of both chest and abdomen during

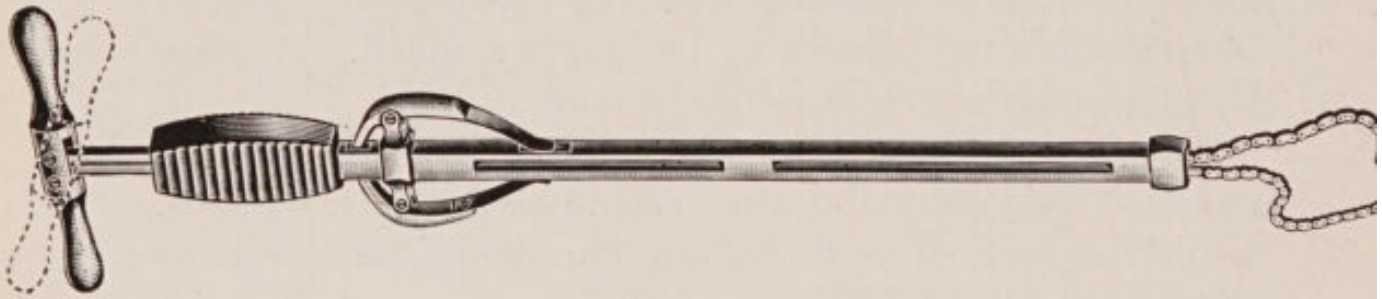

FIG. 44.

Special spaying ecraseur, 55 cm. long.

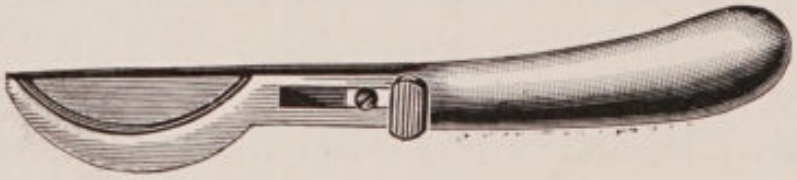

FIG. 45.

Colin's scalpel.

inspiration, and if the vulva is partly propped open and the abdominal walls are fixed, air rushes in. The vagina may also be distended by filling it with warm water. Under these conditions the vaginal walls become hard, and stand apart from each other, closely applied against the pelvic walls at every part except that at the points where the bladder and rectum intervene, and these organs are pressed out flat and occupy a minimum amount of space. In the

quiescent state the vaginal walls are in contact. From the perinaeum forward to within about 10 cm. of the uterine os, the vulva and vagina are connected above with the rectum by the pelvic connective tissue, while anterior to this point the vagina is covered by peritoneum. It is in this area that the incision needs to be made in the operation. The ballooning of the vagina profoundly alters the relation of this operative area, and changes it from the horizontal in the quiescent organ to the perpendicular in the ballooned condition. These variations permit of two methods of operating : I. On the ballooned organ without anaesthesia and with the animal confined in the standing position. II. On the quiescent organ in the recumbent position under anaesthesia :

I. *Without anaesthesia.* Secure in the stocks with the head elevated, a rope over the back to prevent rearing, straps beneath the body to prevent lying down, straps or ropes before and behind the animal to prevent backward and forward movements, all four feet pinioned to the floor, and the tail firmly secured and stretched to a beam above. Apply a bandage to the tail extending for a distance of 12 to 15 inches from its base in order to secure the tail hairs out of the way of the operator.

With soap, water and brush cleanse the tail, perineum and vulva thoroughly, being especially careful to remove all detachable masses of sebum ; 50 per cent. alchohol or gasoline may be used sparingly to aid in removing this. Too free a use of alcohol excoriates the delicate skin. Cleanse the clitoris carefully. Follow the washing with a free application of 1:1000 aqueous sublimate solution to the external parts and for a short distance inside the vulvar lips and to the clitoris. Do not introduce irritant disinfectants into the healthy vagina nor deeply into the vulva as it may cause severe straining during and subsequent to the operation and by injuring the vulvo-vaginal mucosa favor subse-

quent infection of the vaginal wound. The vagina may with benefit be flushed out mechanically with 0.6% salt or soda solution.

Wash away the sublimate solution with a tepid 0.6 per cent soda bicarbonate solution, and fill the vulvo-vaginal canal with the same. After thorough disinfection of the hands and arms, remove the disinfectants by washing in sterile soda solution, which at the same time renders the hand unctuous and readily introduced through the vulva. Armed with the guarded sterilized scalpel, Fig. 45, introduce the right hand into the vagina promptly and when it is well "ballooned," unsheath the knife. Place it just above the os uteri parallel to the long axis of the uterus, a few mm. to the right or left of the median line in order to avoid a loose fold of mucous membrane generally existing there. Hold the blade vertical, that is, with the cutting surface parallel to the longitudinal muscular fibers of the vagina, and guarding the possible extent of its introduction with the thumb and fingers, push it directly forward in a straight line with a quick thrust through vaginal mucosa, the muscular walls and the peritoneum, until the disappearance of resistance indicates that the latter has been penetrated. This is the most critical step in the operation.

If the hand is introduced into the vagina immediately after the injection of the sterile saline solution, the vagina will generally be found " ballooned " or will quickly become inflated under manual movements. If the solution is thrown out, the vagina may collapse and closely invest the hand, in which case more of the liquid should be injected when it will again dilate. If the hand is introduced without the knife, withdrawn, and then introduced with it, it will be frequently found that the vagina has collapsed and needs a second filling with the fluid. Patience until dilation is accomplished and promptness to act when attained are prime requisites to success.

The knife should be pushed through the vagina quickly, making a clean wound the width of the blade, when the latter is to be withdrawn and laid aside. It should be remembered that in this "ballooned" state, the anterior wall of the vagina is but 2 or 3 mm. thick and easily penetrated. Introduce the hand again, push one finger into the incision, then a second and third, and eventually holding all the fingers in the form of a cone, push the entire hand into the peritoneal cavity. Immediately below the incision and continuous with the tissues involved in the wound, lies the uterus with a transverse diameter of 4 to 6 cm. With the palm of the hand downward, trace the uterus forward a distance of 15 to 18 cm., where it ends abruptly in two cornua of about the same size as the body, which are given off horizontally at almost right angles. Trace these to the right and left for a distance of 14 or 15 cm., where they end obtusely, and 3 or 4 cm. beyond this in a direct line, resting upon the anterior border of the broad ligament is the dense oval ovary varying in size from 2.5 to 7 cm. in diameter.

Prepare the ecraseur for use by withdrawing the chain until the loop is of barely sufficient size to admit of its being readily slipped over the ovary. Grasp this loop and the end of the ecraseur tube in the hand, carry the instrument to the ovary and drop the loop over it from above. Pass some of the fingers beneath the ovary and push it up through the chain loop and grasp it there with the thumb and index finger. Holding the ovary with one hand, tighten the chain quickly with the other, examine to make sure that a loop of intestine is not caught, draw the ovary well through and get a large portion of the oviduct, and crush off promptly, holding to the gland until carried out through the vulva. Remove the other ovary in the same way. Generally it is most convenient to remove the left ovary with the right hand and vice-versa, but each may be removed with either hand. Wash away any blood from the

external parts, apply sublimate solution freely to the vulva, perineum and tail. Keep the patient quiet for five or six days, and feed lightly on a laxative diet.

II. In operating under anaesthesia, the animal should be cast or confined upon the operating table in lateral recumbency preferably with the posterior part of the body somewhat higher than the anterior in order to avoid visceral pressure in the pelvic cavity. Place the animal under complete anaethesia. Prepare the parts in the same manner as already described. Carry the knife into the vagina in the manner previously described and render the roof of that organ tense by pushing the os uteri downward and forward with the hand or by means of a vaginal tensor or speculum. It is important that the vagina be held well down toward the floor of the pelvis, so as to carry it away from the rectum, posterior aorta and iliac arteries while the incision is being made. The incision is now to be made just above and behind and a trifle to one side of the os uteri in essentially the same manner as under I, except that when the vaginal tensor is used, the cut is made upward and backward instead of directly forward. The remainder of the operation is identical with what we have described under I. Under anaesthesia the vagina is flaccid and cannot be made to "balloon" but may be distended with sterile soda or salt solution.

Dangers. Wounding of the rectum is scarcely possible under the first method if it has been emptied as advised on page 101 and care is taken not to attempt the incision until the vagina is well "ballooned," and then making the stab wound directly forward. If made upward when the organ is so tensed, the accident is highly probable, and with the undilated vagina, where it is necessary to cut upward, the danger is ever present. Its prevention demands that in the first method, the operator await the complete "ballooning" and then make his incision as directed. In the second

method, the accident is to be prevented by being careful to push the vagina down away from the rectum and hold it away while the incision is being made. If the wound in the rectum passes through the pelvic connective tissue behind the peritoneum, it is of little consequence, but the operation should be abandoned ; if the bowel is opened into the peritoneal cavity, the accident is generally fatal. The accident is not necessarily fatal. The vaginal incision may be enlarged and the wounded portion of the rectum drawn out through the vulva. The wound may then be closed by sutures.

Wounding of the iliac arteries, which generally produces prompt death from hemorrhage, results from the incision being made upward instead of forward when the vagina is "ballooned" or from a failure to hold the roof of the vagina down and away from the part while makiug the incision in the flaccid organ as is the case with the recumbent animal under anaesthesia, It is most likely to occur with timid operators who become nervous, especially when the vagina does not "balloon" promptly or the mare is not well secured. The accident is wholly unnecessary if the operator will await the "ballooning" in the first operation, while by the second method it is prevented by proper care in holding the vagina downward and forward during the incision. When it has occurred, it is generally beyond remedy though in some cases the prompt intravenous injection of adrenalin chloride may stay the hemorrhage and save the life of the patient.

Wounding of the uterus may occur when the incision is directed downward and may greatly embarrass the operator and confuse him because his fingers or hand may pass through the incision into the uterine cavity. It is to be avoided in the first operation (without anaesthesia) by carefully directing the incision straight forward. When the accident occurs it is of little consequence beyond the em-

barrassment and may be overcome by again dilating the vagina with fresh injections of the soda solution and making a new incision, or if preferred, the first cut may be corrected by placing an index finger against the peritoneum at the upper part of the wound, and with a sudden and vigorous thrust, breaking through into the peritoneal cavity, or the error may be corrected by again using the scalpel and directing the incision properly. If it is attempted to rupture the peritoneum with the finger, it must be done by a sharp thrust since otherwise a large section of the membrane will be pushed away from the subjacent tissues.

Incomplete penetration of the vaginal wall is liable to occur if the scalpel is *dull* or the vagina imperfectly "ballooned" and flaccid, or the operator is unduly timid. It is best prevented by avoiding the causes as related, and once it has occurred, it is generally best to again "balloon" the organ in the operation without anaesthesia and make a new incision either to the right or left of the first. It may be overcome also by thrusting the index finger through the peritoneum as described in the preceding paragraph or by completing the cut with the scalpel.

The mistaking of a ball of feces for the ovary has occurred to inexperienced operators and the fatal error of removing the portion of the rectum surrounding the fecal pellet committed. The blunder is uncalled for; the fecal ball is movable in the bowel, the intestine is far more massive than the broad ligament, and the ovary is to be definitely identified by its being lodged in the broad ligament just beyond the end of the cornua, which is continuous with the uterus. If, therefore, one traces the uterus forward to the cornua, thence along each of these to their extremeties and along the borders of the broad ligament to the ovary, as above directed, the error will not occur.

The vaginal incision may be made too low and pass beneath the broad ligament. It is to be avoided by being careful to

keep close to the median line and above the os uteri. If it occurs, the operation may be completed from beneath without very great difficulty, only that the ovary now lies above the hand and must be drawn down from on top the broad ligament in order to fix the ecraseur upon it.

Infection always constitutes the most serious danger and is to be avoided by properly securing the animal, by the avoidance of irritant antiseptics in the vagina, by rigid asepsis at every stage, and by carrying out the mechanical parts of the operation deliberately, vigorously and neatly. If infection should occur, it will generally take the form of pelvic cellulitis with abscesses and rectal stricture. Enemas of normal salt or soda solution afford the surest relief of the stricture and impaction in front of it. The abscesses must be watched and opened early into the vagina or rectum, and the case treated internally and locally according to general surgical principles.

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30. VAGINAL OVARIOTOMY IN THE COW

Objects. Vaginal ovariotomy has been alleged to increase the yield of milk and butter fat, but the evidence is not good. It serves a useful purpose in cases of nymphomania and other ovarian disease. In some cases of sterility, disease of one ovary may inhibit ovulation by the healthy ovary and the removal of the diseased gland may be advisable in order to permit the healthy gland to function.

Instruments. Colin's scalpel, vaginal dilator, spaying ecraseur, or emasculator.

Technic. Confine the cow in the standing position in the stocks, secure the head firmly and pass two boards beneath the abdomen and sternum to prevent lying down, and a rope over the middle of the back to prevent arching of the spinal column and straining.

Wash and disinfect the tail and the perineum and flush out the vagina with a 0.5 % solution of carbolic acid or lysol at a temperature of about 100° F. Insert the vaginal dilator with one hand and push the prolongation at the anterior end into the os uteri. With the other hand, elevate the handle of the dilator and depress and push forward the uterus, thus rendering the roof of the vagina tense and pushing it downward away from the rectum. Carry the scalpel into the vagina with the right hand and resting it in the oval of the dilator, make an incision through the roof of the vagina, beginning at a point 8 to 10 cm. posterior to the os uteri and extending backward on the median line for a distance of 2 or 3 cm. Be careful to make the incision entirely through the mucosa, muscle and peritoneum at the first cut, since any failure to complete it tends to cause the peritoneum to separate from the muscular coat and form a pocket between them, while the serous membrane being very elastic, renders it difficult to complete the incision. Introduce two fingers through the incision, and reaching over the side of the vagina to the right or the left, the right or left ovary respectively is recognized lying immediately against the lower part of the base of the uterine horn, just at the anterior border of the pubis, in a mass consisting of the cord-like Fallopian tube and the fimbriæ of its pavilion. The ovary may be distinguished as a firm oval mass 2 to 4 cm. in length and 1 to 2 cm. in its lesser diameter attached to the broad ligament. If not promptly recognized by the sense of touch, trace the vagina and uterus forward with the fingers from the vaginal incision to the cornua and follow them as they bend forward and downward, and then backward and upward to the oviducts, until the ovary is reached where it is attached to the broad ligament, just beyond the fimbriated end.

Grasp the ovary between the fingers and draw it through the incision into the vagina. Introduce the emasculator

with the other hand, and when the ovary is reached, open the instrument far enough to admit the ovarian attachments between the jaws, push the ligament between the jaws, close the forceps and sever the ovary. Or introduce the ecraseur, draw the ovary through the loop of the chain and holding it securely until the instrument is tightened, crush it off.

It is essential that plenty of the broad ligament and oviduct be excised with the ovary to insure the entire removal of the gland, because the accidental leaving of the smallest particle of ovarian tissue may cause a development of this into abnormally large cystic ovisacs, and will tend to increase, instead of decrease nymphomania. Should the animal be pregnant, the ovary on the gravid side is dragged downward and forward out of reach of the operator's fingers, and if it is desired to complete the operation, it may be necessary to enlarge the vaginal wound and introduce the entire hand, when the ovary can be reached and removed. Generally no after care is necessary.

The Dangers are similar to those of the mare. The iliac arteries may be wounded in the same manner as in the mare. The accident is preventable by being careful to push the vaginal roof well downward away from the rectum and sacrum. In rare instances fatal hemorrhage occurs from the severed ovarian arteries, especially in badly diseased ovaries accompanied by a want of tone. For this reason it is safer in cows sterile from diseased ovaries to use the ecraseur but even this instrument is not wholly proof against fatal hemorrhage, consequently some veterinarians have advised ligation of the arteries. This is especially necessary in highly vascular diseased ovaries. The gland is then to be cautiously drawn into the vagina and a silk ligature in the form of a running noose with two long ends, applied. After the noose has been tightened, a second tie may be begun outside the vulva and the knot tied by following one of the

threads into the vagina with the hand. Another danger appears in the presence of the rumen, the supero-posterior portion of which when filled with food projects into the pelvic cavity and if the cut is directed forward, a stab wound readily penetrates its walls with fatal results. Make the cut upward and backward.

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31. OVARIOTOMY IN THE COW BY THE FLANK

Instruments. Clipping shears, convex scalpel, spaying emasculator, or ecraseur, heavy needle and thread.

Uses. Same as the preceding, applicable to heifers or to cows in which the vulva is too small to admit the operator's hand or in case of diseased vagina or uterus.

The animal may be secured as in the preceding or confined in lateral recumbency with the hind legs extended backward and the anterior limbs forward. To accomplish this, loop a rope about the two fore feet, another about the two hind feet, and drawing upon these, cast the animal and secure it in recumbency with the legs extended and body stretched by fastening the ropes to two strong posts about 8 to 10 m. apart. The operation may be performed in either flank.

Clip the hair from the upper part of the flank, disinfect an area 15 to 25 cm. square and make an incision about 12 cm. long beginning at a point equidistant from the anterior tuberosity of the ilium, the ends of the transverse processes of the lumbar vertebrae and the last rib, and extend it downward perpendicularly, severing the skin and subcutaneous muscle. Divide the external oblique muscle in the direction of its fibres by means of the scalpel handle or the fingers and repeat the process upon the internal oblique, after which puncture the peritoneum with the scalpel. When operating upon large numbers of animals, and greater rapidity is desired, the entire abdominal wall is cut directly through at a single stroke.

Force one hand through the opening into the peritoneal cavity and search for the ovaries at the same point and by the same method as in the preceding operation, that is, locate the uterus within the pelvic cavity, between the rectum and bladder and trace it, the cornu, and broad ligament to the ovary. The uppermost ovary can be drawn out through the wound and cut off; the lower one must be held with one hand, the instrument introduced along the arm and when the ovary is reached, apply the emasculator or ecraseur to the ovarian attachments and closing the instrument cut or crush off the gland. The beginner must always remember that the positive means for identifying the ovary is by tracing the uterus from the vagina along the cornu to the oviduct and thence to the organ in the broad ligament. Cleanse the wound and close the skin incision with continuous sutures.

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32. OVARIOTOMY IN THE BITCH BY THE FLANK

Fig. 46

Instruments. Spaying knife, canine emasculator, scissors, 3 or 4 pairs of artery forceps, suture material.

Technic. Confine the animal in lateral recumbency, preferably upon the right side for a right-handed operator, the head somewhat depressed, the limbs extended and the body well stretched. Clip, shave and disinfect a sufficient area in the exposed flank at a point just anterior to and beneath the external angle of the ilium. Before cutting through the abdominal wall, the urinary bladder should be emptied if distended. With one hand grasp the skin fold of the flank and render the skin of the region tense, while with the other, holding the spaying knife like a pen, make at first a drawing incision from below upward about 2 to 3 cm. long, ending above at a point slightly below the external angle of the ilium, the incision extending through the skin

and subcutaneous tissues; without removing the knife from the wound, elevate the handle and with a quick thrust make a stab wound extending through the external and internal oblique muscles and peritoneum at a single cut. The operator can determine when the peritoneal cavity has been entered by the disappearance of resistance.

Introduce an index finger into the peritoneal cavity, and as soon as this has been entered, follow directly along the peritoneum upward and backward toward the angle of the ilium where the uterine cornua lie covered over by the broad ligament. The internal generative organs of the bitch are unique among domestic animals. The uterus, U, Fig. 46, is small and physiologically unimportant, the cornua, RUC and LUC, are ample in size and constitute physiologically the uterus. The distance from the cornual extremity, LUC, to the ovary, O, which is occupied by the Fallopian tube, is very brief so that the cornu and ovary are well nigh in contact. The ovary, O, O, is very small, smooth and completely hidden in the pavilion which here constitutes a sac having a very small longitudinal opening of 2 to 5 mm. The most remarkable feature of the apparatus from a surgical standpoint is the great development of the broad ligament which is broader than the distance from the lumbar region to the abdominal floor, while the uterus and uterine cornua are stretched between the vagina, V, and the ovary, O, so that they are suspended in the sub-lumbar region, resulting in a double fold of the broad ligament hanging down like a curtain between the parietal peritoneum and the uterus and cornua on either side. The broad ligament of the bitch is consequently suspended at one end from the sub-lumbar region, at the other from the uterus, so that, instead of being suspended by the ligament, the relation is reversed and the ligament is suspended from the uterus, or rather uterine cornu.

In Fig. 46, the right broad ligament, BL′, is laid out upon the side exposing the right uterine cornu, RUC, while on the left side the ligament is divided at about its center and the posterior portion, BL′, is laid out on the flank, while the anterior, BL, is left in its normal position concealing a portion of the cornu, LUC. Unlike other domesticated animals, the broad ligament is heavily loaded with fat which gives it an appearance very similar to the omentum, but the net-work is far less conspicuous or wanting. The omentum extends back into this region and is in contact with the uterine ligament.

The ovary is indistinct and hidden which renders it difficult to identify directly, and the cornu being covered over by the duplication of the broad ligament, is not readily reached, so that the finger generally comes in contact first with the broad ligament of the uppermost cornu hanging loose in the peritoneal cavity ; engage this between the end of the finger and the abdominal wall and draw it out through the wound, grasp it and continue drawing upon the folds of the ligament, especially upon the median or undermost portion until the naked cornu appears through the opening, seize it and draw out the anterior portion until the ovary follows, then grasp the latter with the thumb and index finger of one hand and the ovarian ligament with the same members of the other and tear the ligament through between them by linear tension. Extend the tear through the broad ligament as high toward its lumbar attachment as is convenient and backward to the neighborhood of the uterine bifurcation. Draw upon the exposed cornu until the point of bifurcation appears, when the other cornu is to be grasped and drawn out through the opening. In young puppies the securing of the second cornu is very difficult and requires great care to prevent the rupture of the first. The object may be facilitated by pressing the upper flank of the bitch downward, thereby greatly diminishing the transverse diameter of the abdomen.

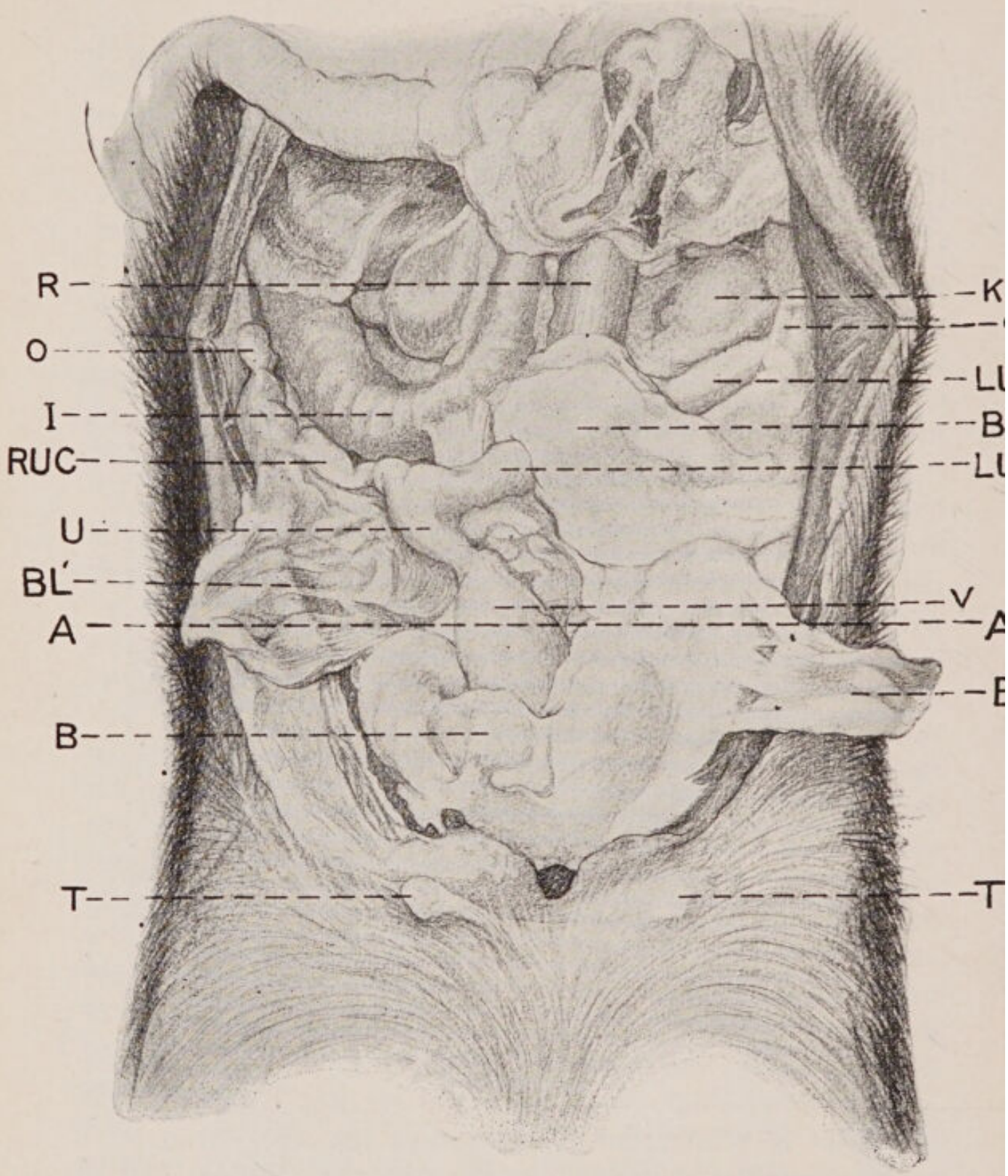

FIG. 46

Ovariotomy in the Bitch

Abdomen of a non-pregnant bitch lying on the back with the abdominal floor removed and the omentum pushed away. TT, The two posterior teats; B, bladder; V, vagina; U, uterus; LUC, LUC, left uterine cornu with a portion of its broad ligament, BL, lying across it; RUC, right uterine cornu with its broad ligament, BL′, turned outwards exposing the full length of the cornu. On the left side the ligament is divided so that the anterior half rests in its normal position while the posterior half, BL′, is turned back. O, O, ovaries; R, rectum; K, left kidney; AA, a line indicating the level of the external tuberosities of the ilia.

The succeeding operation avoids this difficulty in a large measure. Should the distal cornu be ruptured and with its ovary drop away from the operator, it becomes necessary to turn the animal over and make a second incision on the opposite side, somewhat farther forward. When the second cornu has been secured, draw it out as far as practicable and holding it tense, insert an index finger along it until the ovary is reached. This is recognized by its slightly greater size and density succeeding the brief neck representing the Fallopian tube between the end of the cornu and ovary. Beyond the ovary can be felt the ovarian ligament. Engage the ligament between the end of the index finger and the abdominal wall, and with a firm and vigorous movement, using the finger end and nail as a curette, rupture the ovarian ligament by drawing the finger toward the incision, and with the aid of tension upon the cornu, draw the ovary out through the abdominal incision and divide the broad ligament as before. Remove the cornua with the attached ovaries by rupturing them transversely near the bifurcation by means of linear tension.

If the bitch be pregnant, and especially if far advanced, the uterine cornua will lie upon the abdominal floor, much enlarged and very much more flaccid than the non-gravid uterus and feeling like intestines. The change in the position of the uterus has caused the unfolding of the duplicature of the broad ligament so that it no longer covers the cornu. In such cases the operation is performed in the same way except that rupturing the blood vessels by linear tension does not insure against hemorrhage and it is necessary to ligate the ovarian and uterine arteries with catgut or silk. Or the ovary may be removed with the bitch emasculator. In cases of pregnancy, the entire cornua should be drawn out and a strong ligature placed around the uterus or vagina, and the ovaries, uterine cornua and their contents be removed *en masse*. Release the upper

posterior limb and close the cutaneous wound by a continuous suture.

Dangers. Rupture of the uterine cornu alluded to above. It is always to be remembered that the leaving of one ovary in position even though the other gland with the two cornua and uterus are removed, induces intense estrum and renders the animal if anything more disagreeable than before the operation.

The ureter may rarely be mistaken for the cornu but is smaller, is closely attached to the abdominal walls, and does not have the broad ligament with its large deposit of fat. The kidney is far larger than the ovary, more exposed, and located more anteriorly.

The iliac arteries are at times caught and ruptured by the finger but the blunder is uncalled for except through nervousness of the operator.

Instances of puncturing the bladder in making the incision have been reported. If the bitch has been led out and caused to urinate prior to operating, the accident is made practically impossible.

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33. OVARIOTOMY IN THE BITCH BY THE LINEA ALBA

Instruments. Same as in the preceding.

Technic. Confine in the dorsal position with the head sharply declined. Shave and disinfect an area on the median line about 6 cm. square, extending forward from the public brim. Make an incision on the median line about 4 cm. long beginning just in front of the public brim and extending forward, cutting entirely through the skin, the linea alba and peritoneum. Insert an index finger and identify the uterus or broad ligament by its location and form. The finger usually comes in contact first with the urinary bladder which may more or less obstruct the passage to the

uterus according to its degree of distension. When empty as shown at B, it offers practically no obstruction. When very much distended, it may be evacuated by gentle pressure with the fingers. The operator should be careful not to draw the bladder out through the incision as its replacement may prove difficult and its puncture with a hypodermic needle or an enlargement of the abdominal incision may be necessary in order to bring about its return. Push the bladder aside if necessary and just above it and below the rectum, the uterus should be readily distinguished and either it or the broad ligament caught by the finger and brought out through the incision, after which the operation proceeds in the same manner as by the flank method. By passing an index finger forward to reach the lower surface of the rectum in front of the uterus and then drawing it backward, the finger passes between the former and the cornua and the latter are picked up. This operation has a distinct advantage over the flank method in that in puppies there is not so much difficulty in bringing out the ovaries, nor the danger of the rupture of the cornu and the ovary's being retained.

By the use of retractors in the abdominal incision, the operator is enabled to see every part of the uterus, grasp it by means of forceps, and perform all intra-abdominal portions of the operation with instruments and avoid the necessity for introducing the finger into the peritoneal cavity.

The sutures must extend entirely through the abdominal wall and be carefully placed in order to prevent hernia. The sutures should be in laminae, the peritoneal of catgut, that in the linea alba of slow dissolving catgut, and those in the skin, of silk or linen. These latter may extend down into the linea alba and include the wound in that structure in a second suture. Interrupted sutures are preferable. If the operation has been properly performed, no bandage is neces-

sary and the patient will not disturb the sutures. If asepsis has not been strictly followed, infection may occur and the consequent irritation cause the patient to tear the sutures out, which may lead to protrusion of the intestines or other abdominal viscera. If the sutures do not include the deeper layers of the abdominal wall, hernia is liable to occur and require a second operation. The silk or linen sutures should be removed in seven to ten days.

34. OVARIOTOMY IN THE CAT

Instruments. Same as for the bitch.

Technic. The cat may be spayed either by the flank method or through the linea alba. The point of incision in either case is the same as in the bitch but owing to the smaller size of the animal it is necessary to make the wound quite small. The abundance of fur renders it essential that an ample area be shaved and the surrounding hair be saturated with a disinfectant and carefully brushed away from the operative area. The cat being more subject to infection than the bitch, the aseptic precautions must be of the strictest possible character. The operative area must be thoroughly disinfected and cleansed and great care must be taken not to introduce irritant disinfectants into the wound. A great danger also exits in the tendency of the muscle layers of the abdomen to readily become separated by pressure from the finger and form a pocket in which wound discharges accumulate and constitute a dangerous seat for infection. Great care must therefore be taken to make a clean incision directly into the peritoneal cavity and to avoid separating the peritoneum from the muscles or the muscular layers from each other. The uterus and ovaries of the cat are naked and far more easily distinguished than in the bitch, there being no extra deposit of fat in the broad ligament. The sutures are to be applied to the wound in the same manner as in the bitch.

35. CASTRATION OF CRYPTORCHID HORSES

Figs. 47, 48

Instruments. Scalpel, emasculator.

Technic. Prior to attempting the operation, it is well to make a rectal exploration and determine as far as may be, the location of the testicle, whether it be on the right or left side, and its character, should it be in any way pathologic. Confine the animal by casting in the dorsal position with the hocks well flexed and both posterior limbs completely abducted so as to fully expose the inguinal region. Or secure upon the operating table on the side opposite to the retained gland and abduct the upper posterior limb by drawing it upward by means of a pulley. Cleanse and disinfect the inguinal region. Anaesthetize. Make an incision about 10 to 12 cm. long through the skin and dartos directly over the normal position of the scrotum, parallel to the median raphe and about 4 or 5 cm. distant from it. Insert the two index fingers in the wound, press them into the areolar tissue toward the external inguinal ring and drawing them apart, separate the tissues sufficiently to permit the entrance of the hand into the inguinal space. With the fingers held in the shape of a cone, bore a passage in the areolar tissue through the external abdominal ring and continue in a direction approximately toward the external angle of the ilium until the aponeurosis of the small oblique muscle near the crural arch is reached. Unless rectal exploration has shown that the testicle is within the abdomen, take care in traversing the inguinal space between the external and internal rings that the gland is not passed by unrecognized (inguinal cryptorchidy), lying in this region covered by peritoneum and the cremasteric fascia. Sometimes the epididymis has descended to the scrotal region while the testicle remains within the abdomen, thus resulting in a narrow inguinal canal, containing the epididymis only.

Pass the hand upward, outward and forward along the aponeurosis of the small oblique until the crural arch is reached, slightly anterior to the crural ring in which the pulsating femoral artery can be felt, and palpate at this point in the muscular wall for the internal inguinal ring which varies greatly in different individuals but usually reveals itself to the fingers as an oblong slit or ring about one inch in length covered only by peritoneum. Through this usually extends a portion of the gubernaculum testis or of the vas deferens.

Examining Fig. 47, the peritoneal view of the internal ring is shown crossed by the dotted line, V, of the upper or right testicle, into which the tail of the epididymis extends for a short distance. In the lower or left testicle the ring has been opened and the gland lies in a position corresponding to the right, showing the epididymis and vas deferens lying in the processus vaginalis, P. The surgical relation of the parts is further illustrated in Fig. 48, where the testicle is completely withdrawn into the peritoneal cavity and spread out over the right flank. The processus vaginalis, P, is outlined by a dotted line into which is introduced a curved sound, S, along side of which lies the gubernaculum, G. The gubernaculum, it will be observed, is divisible into three sections, a slender one, G, which by passing along behind the peritoneum escapes from the abdominal cavity at the postero-external commissure of the ring to extend to the scrotum. The second portion of this organ, G′, is much thicker and extends from G to the epididymis at E, while the third division, G″, extends from the epididymis to the testicle.

In Fig. 48, it is shown that the testicle under all ordinary conditions is inevitably attached through its gubernaculum testis to the postero-external commissure of the ring, that it has a second definite attachment to the seminal bladder through the medium of the vas deferens, V, and a

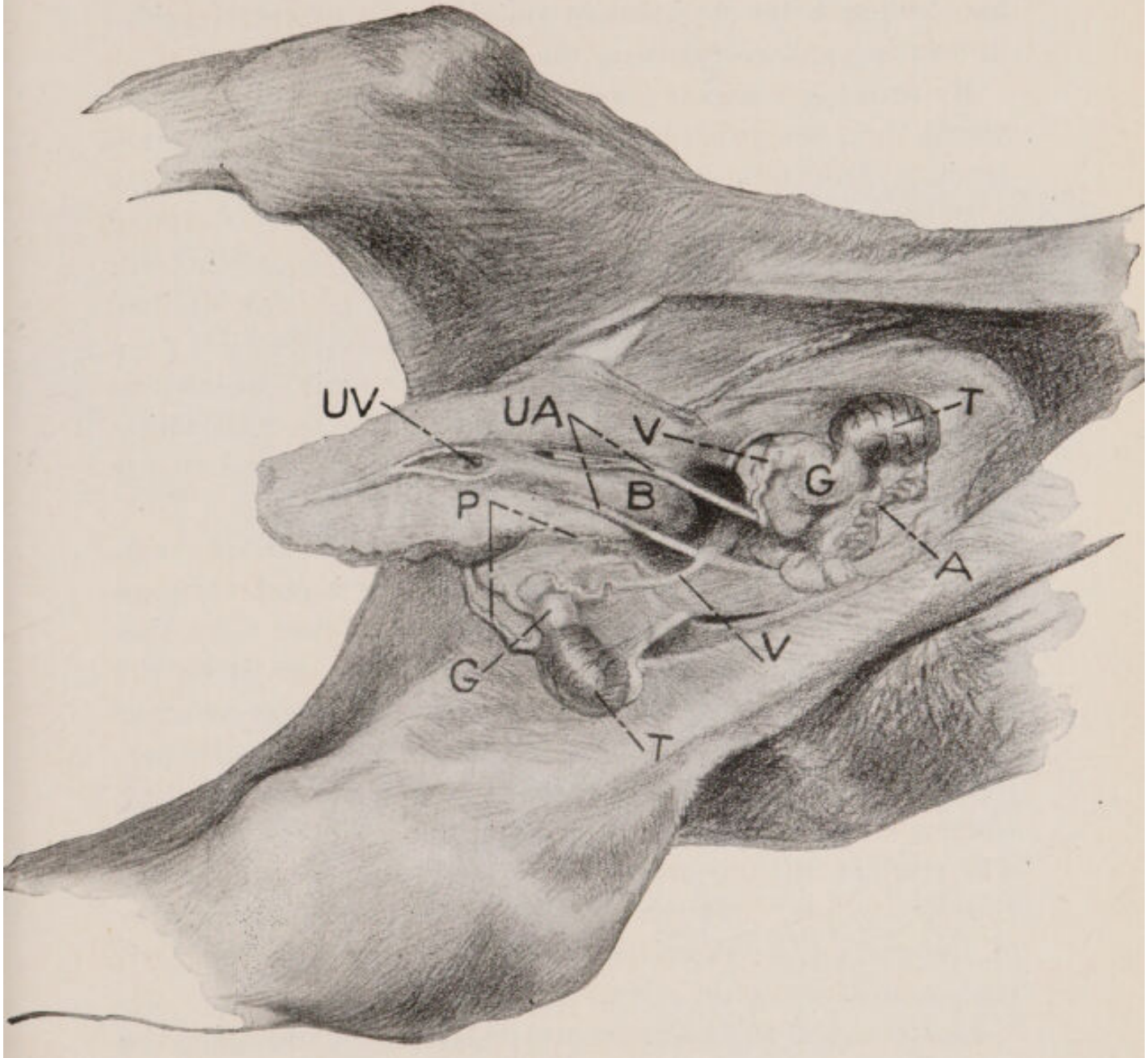

FIG 47

Castration of Cryptorchid Horse

Urino-genital apparatus of 24 hr. colt. T, T, Testicle ; A, testicular artery ; G, gubernaculum testis ; V, V, vas deferens ; B, urinary bladder ; UA, umbilical arteries retracted within abdomen ; P, processus vaginalis ; UV, umbilical vein.

third by means of the testicular artery, A. The gubernaculum and the vas deferens constitute the essential guides in locating and recognizing the testicle.

By forming a hollow cone with the fingers about the internal ring, the gubernaculum, epididymis, and vas deferens tend to drop out into the processus vaginalis where they may be grasped with the fingers without having ruptured the peritoneum. The vas deferens and epididymis present characteristics which are unmistakable to the trained touch, consisting of a small firm cord (vas deferens) or a small mass of fine threads (tail of epididymis) which roll freely between the thumb and finger and give a sensation which is unlike that produced by any other tissue in the body.

Grasp the part firmly and tearing through the peritoneum, seize the vas deferens and carefully draw it out through the external wound. (In teaching cryptorchid castration to the beginner, it is best for the instructor to make the opening down to the internal ring, grasp the vas deferens between the thumb and finger without penetrating the peritioneal cavity and passing a pair of long uterine dressing forceps along the hand, fasten them upon the vas deferens. The student then completes the operation, using the forceps as a guide. He thus learns the relations and character of the parts and recognizes the internal ring with the peritoneum still stretched across it, intact.)

In case the vas deferens can not be felt before rupturing the peritoneum, that membrane may be broken through with the index finger, and inserting the finger into the cavity, the gubernaculum is to be found attached to the postero-external border of the ring, and but a short distance therefrom the finger comes in contact with the vas deferens or with the tail of the epididymis where the gubernaculum crosses it at E, in Fig. 48. Having reached the vas deferens, the operation is proceeded with as above. Thus far the operator has not

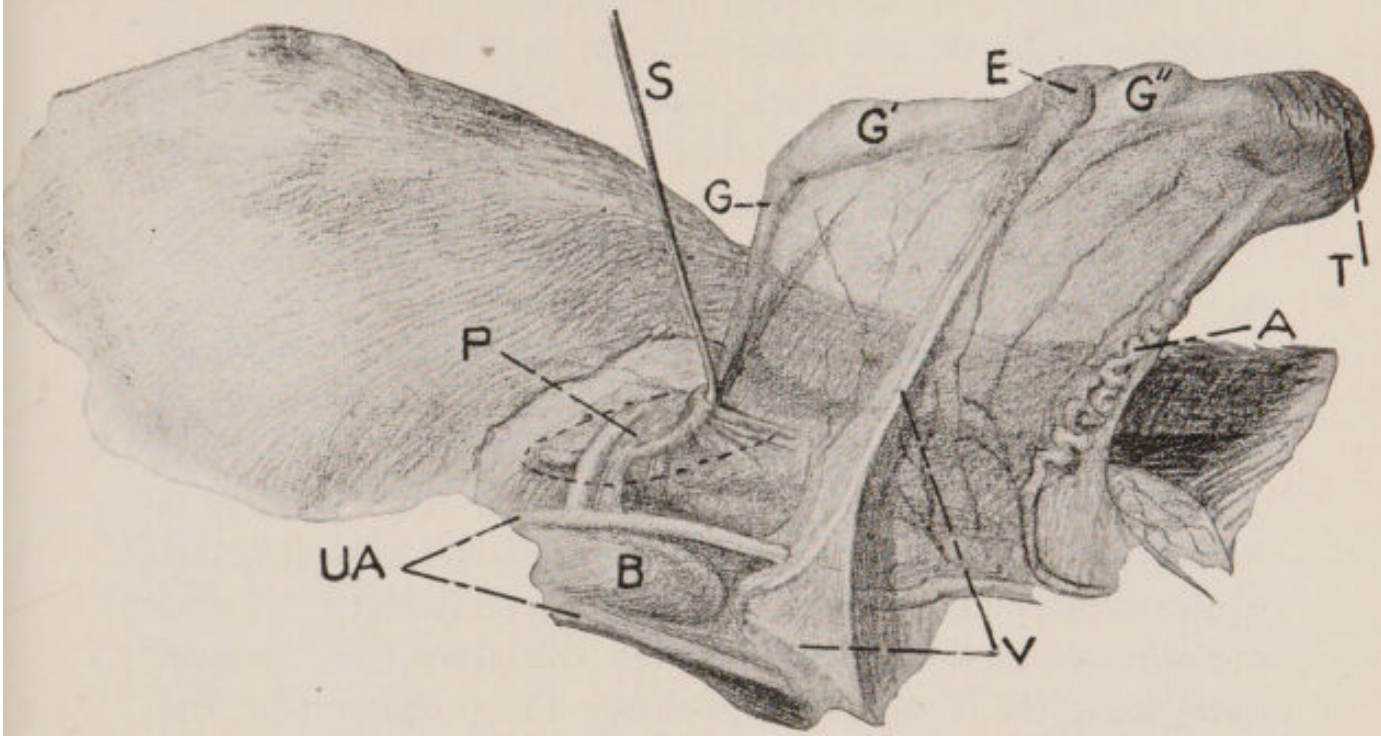

FIG. 48

Castration of Cryptorchid Horse

Right inguinal region and testicle of 24 hrs. colt. P, Processus vaginalis surrounded by a dotted line and containing a curved sound, S; G, first portion of gubernaculum testis; G′, second portion of gubernaculum testis extending to the epididymis, E; E, epididymis; G″, gubernaculum extending from epididymis (globus minor) to the testicle; T, testicle; A, testicular artery; V, V, vasa deferentia; B, urinary bladder; UA, umbilical arteries.

concerned himself with the location of the testicle but relies wholly upon the vas deferens or gubernaculum, since when either of these is recognized, the testicle is virtually within his power.

He thus proceeds upon the basis that he is not to *find* the testicle for the reason that it is not *lost* but that it has definite relations and attachments which permit of certain displacements of the organ itself but not of its attachments.

Having drawn the vas deferens out through the wound, tension is exerted upon it which tends to cause the testicle to follow, but sometimes the gland is too large to pass the internal ring and the latter needs to be dilated by inserting an index finger in it or the testicle needs to be guided through the opening.

We have described herein one method of castrating a cryptorchid horse where the cryptorchidy is due to an arrest in the development of the gland and of its descent. There are other methods employed which introduce variations at each step, many operators making the incision over the external ring instead of near the median line. Other operators avoid opening the internal ring and penetrate the peritoneal cavity somewhat in front of and above the ring through the small oblique muscle. When one plan has been learned, the variations are easily applied.

There are other causes of cryptorchidy which in rare cases require a different procedure in order to extract the gland, varying with individual cases, but the essentials for the tracing and recognition of the testicle are the same.

After the testicle is brought to the surface, it may be removed with the emasculator or by such means as the operator may prefer. Cryptorchid testicles when due to arrest in development are not vascular and there is little tendency to hemorrhage after excision. Place an antiseptic tampon in the wound, pushing it well up against the internal ring

and retain it in position by means of sutures for a period of 24 to 48 hours when it is removed and the wound dressed antiseptically.

36. CASTRATION OF CRYPTORCHID BOARS

Instruments. Razor, convex scalpel, emasculator, artery forceps, suture material.

Purpose. The retention of a testicle by adult boars taints the flesh extremely and renders it unfit for human food. In some states the law regards as a misdemeanor the sale of boar's flesh. The boar must, therefore, be castrated, whether normal or cryptorchid, and kept for a considerable period thereafter before his flesh becomes fit for food.

The animal is to be secured in lateral recumbency on the normal side, the posterior parts being elevated. The hair is clipped or shaved in the upper flank region and the area washed and disinfected. A flank incision is then to be made as described on page 113 for spaying the bitch. The incision should ordinarily suffice for passing two fingers into the abdominal cavity. If the operation has been too long deferred and the animal is large and fat, the operator, especially with short fingers, may be unable to reach sufficiently into the abdominal cavity, in which case the incision needs to be extended to admit the hand.

With the fingers (or the hand) passed into the peritoneal cavity, the testicle is to be located upon the same principles as laid down for cryptorchid horses ; the testicle is attached to the posterior commissure of the internal inguinal ring by the gubernaculum, and to the seminal bladder, just above the neck of the urinary bladder, by the vas deferens. The gland itself may be anywhere, its size, form, and consistency so modified as to be unrecognizable, or the gland may be hidden amongst adherent viscera but the gubernaculum and vas deferens still constitute the reliable means for identification.

The vas deferens, gubernaculum, or epididymis having been recognized, it is grasped and, with the testicle following, drawn through the flank incision and detached by means of the emasculator or by other hemostatic method.

If one testicle has been removed and the operator erroneously performs laparatomy on the wrong side, he may reach across to the opposite side and complete the operation. If both testicles be cryptorchid, and the uppermost gland has been removed, the fingers or hand may be passed across the floor of the belly to the opposite side and the distal gland located, withdrawn and removed through the opening already made.

When the laparotomy incision is made well up in the flank, only cutaneous sutures are required. They are made of strong linen.

The technic here described answers for cryptorchidy in dogs and cats. Cryptorchidy in ruminants is rarely submitted to surgical procedure because the presence of testicles does not taint the meat and up to sex maturity does not interfere with growth. They are, therefore, usually slaughtered early. In exceptional cases where surgical interference is demanded, the technic described for the boar suffices.

IV. OPERATIONS ON THE EXTREMITIES

37. TENOTOMY OF THE FLEXORS OF THE PHALANGES

Fig. 49

Objects. The relief of contraction of the flexor tendons of the foot.

Instruments. Razor, scissors, sharp tenotome, bandage material.

Technic. Tenotomy is generally performed on the flexor of the third phalanx, seldom on the superficial flexor or flexor of the second phalanx.

Quiet horses may be operated upon in the standing position with local anaesthesia. Otherwise secure upon the operating table with the affected member undermost and the foot fully extended, or in default of a table, confine in lateral recumbency and apply an extension splint to the foot as shown in Fig. 49.

On the median side at the middle of the metacarpus or metatarsus, the skin is shaved and disinfected over the tendon of the flexor pedis muscle. The location named lies between the lower extremity of the great carpal or tarsal sheath above and the superior extremity of the tendonous sheath of the fetlock below, so that neither of these is wounded during the operation, but the tendon is severed at a point where it is invested by loose connective tissue which retains the divided ends in their normal line of direction, somewhat fixed, and favors their ultimate reunion.

Grasp the metacarpus or metatarsus in this area from above and behind in such a manner that the thumb rests upon the median or upper surface, and the index and second fingers on the lateral or under side of the flexor pedis tendon. While the left thumb pushes the skin toward the bone, that is, forward, a sharp-pointed tenotome held perpendicularly in the right hand is introduced with the cutting edge toward the body through the skin, subcutem and fascia down to the flexor pedis tendon. Immediately on the anterior border of the tendon, insert the tenotome so far

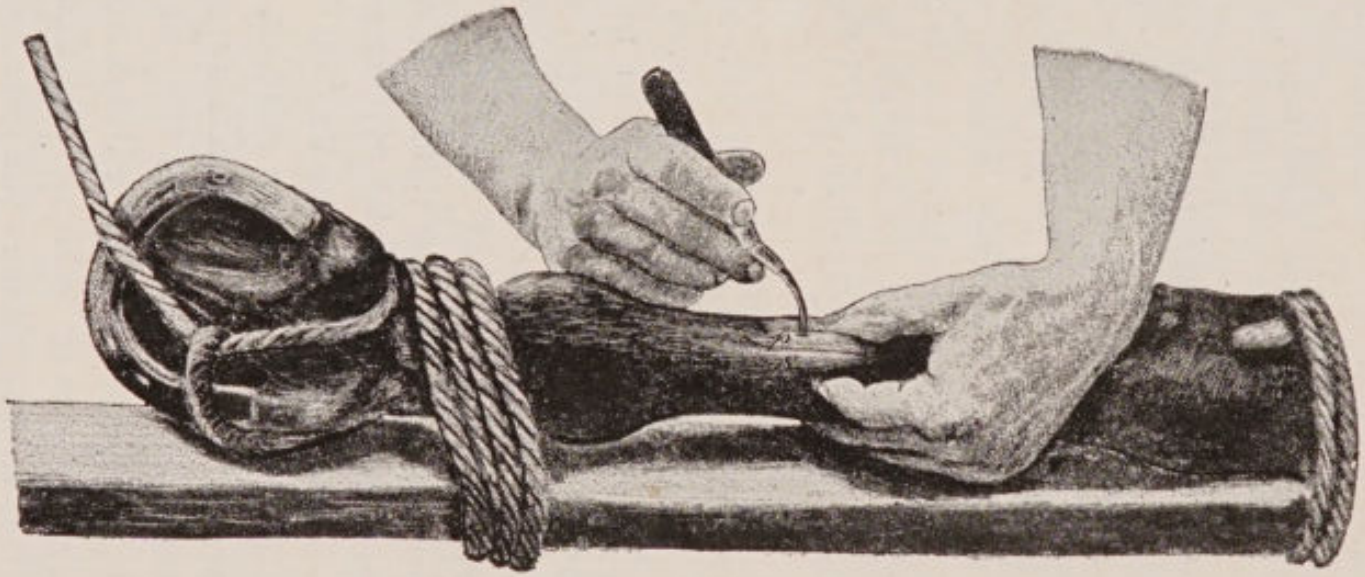

FIG. 49

Tenotomy of the Flexor Pedis Tendons

Right fore foot of horse bound upon the extension splint.

s, Tendon of the superficial flexor muscle ; *p*, deep floor tendon.

that the point of it can be felt on the lateral or outer side through the skin with the left hand.

Care is to be exercised in making this invading incision not to include the metacarpal, or metatarsal, arteries, veins and nerves. The vascular bundle lies immediately against the anterior border of the flexor of the third phalanx and it is easy to err by inserting the tenotome in front of the vessels, that is, between the suspensory ligament and vessels instead of between the flexor of the third phalanx and vessels. It is best to make the skin incision far enough posteriorly to insure safety to the vessels. First cut down upon the tendon, then incline the handle of the tenotome backward, push the point obliquely forward and downward behind and beneath the vascular bundle and then carrying the handle forward, bring the instrument to a perpendicular position, and force it down along the anterior surface of the tendon until it nears the inferior border. Then carry the tenotome handle yet farther forward so that the point is directed obliquely backward, to facilitate its passing between the vessel bundle and the tendon out to the skin. The invading incision thus describes the segment of a circle, with its concavity backward toward the tendon.

The cutting edge of the instrument is then turned against the tendon, that is, it is directed backward, the foot is extended by an assistant with the aid of a rope bound around the pastern and looped over the hoof, and the tendon is cut through under light pressure, the operator pressing the handle of the knife forward and downward, using the metacarpus or suspensory ligament as a fulcrum upon which the back of the tenotome rests as a lever. A loud cracking, as well as the disappearance of resistance to extension, shows that the tendon has been severed.

After removing the knife and seeing that there is a wide space between the ends of the tendon, the foot is unbound

from the splint and a bandage, which rests upon the fetlock joint, applied to the metacarpus, and allowed to remain in position for eight days. The cutaneous wound should heal by primary union.

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38. PERONEAL TENOTOMY

Fig. 50

Object. The relief of Stringhalt.

Instruments. Razor, scissors, sharp tenotome.

Technic. On the lateral side of the metatarsus a triangle, *d*, opening toward the tarsus is formed by the tendons of the extensor pendis longus muscle, *l*, and the lateral extensor of the foot, *e*, which unite on the anterior surface of the middle of the metatarsus. The synovial sheath of the extensor pedis longus muscle extends inferiorly to near the point of juncture of the two tendons; the sheath of the lateral extensor ends below, 3 to 4 cm. above the point of union. In the middle of this space without a sheath, which is 3 to 4 cm. long, and below the annular ligament of the hock, the operation is carried out. After the skin has been shaved and disinfected, confine in the stocks or operate upon the standing horse, with the aid of local anaesthesia, a twitch being applied to the nose and the opposite hind foot held up with the side-line. The tendon of the lateral extensor is easily felt under the skin as a hard cord about 0.7 to 1 cm, in diameter. Stretch the skin and with the back of the hand toward the hock, grasp and compress the tendon with the thumb and index finger of one hand, insert the tenotome with the cutting edge toward the body perpendicularly upon the tendon through the skin, subcutem and aponeurosis derived from the crural fascia; push it from before backward under the tendon, turn the cutting edge against it, and with the hock extended, sever the tendon as

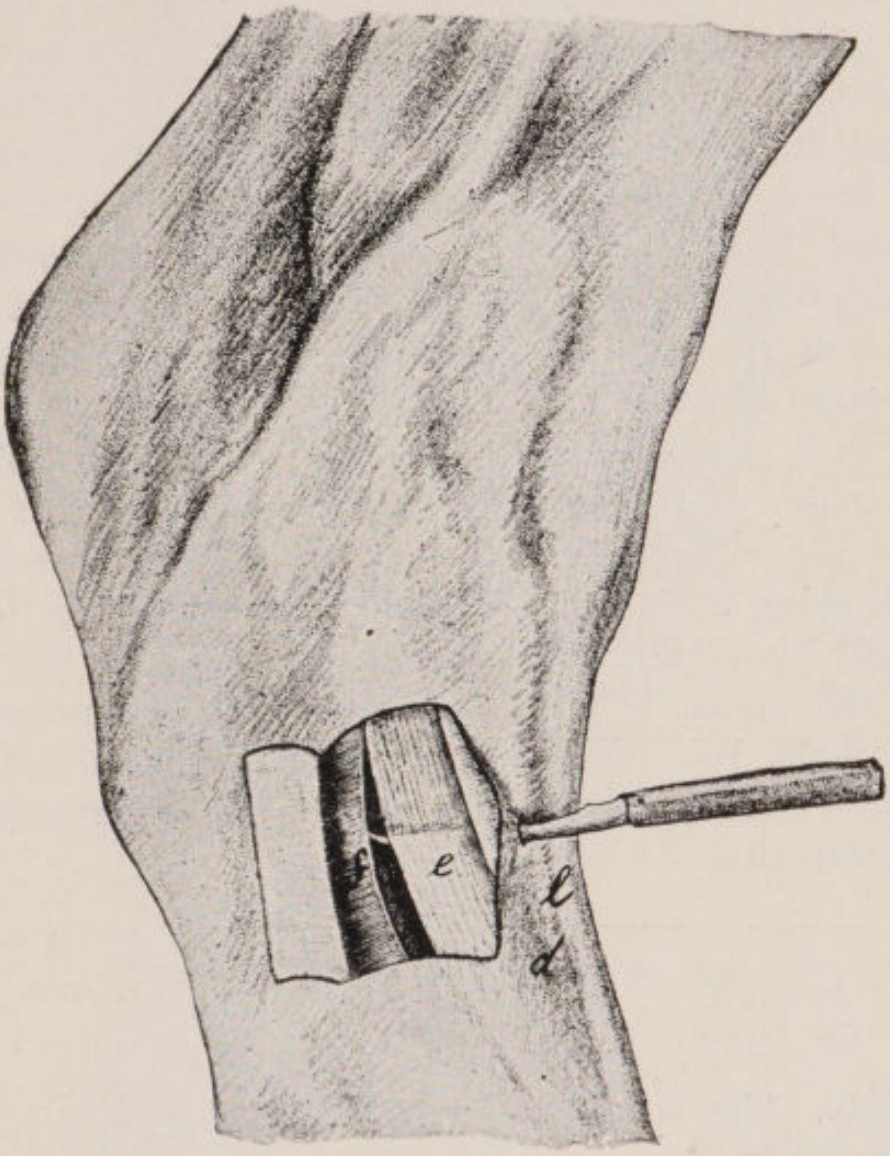

Fig. 50

Peroneal Tenotomy for Stringhalt

Right hind foot seen from the external side. The skin covering the lateral extensor of the foot is laid back in the form of a flap, the crural fascia divided. *e*, Peroneal tendon ; *f*, crural fascia ; *l*, tendon of the anterior extensor pedis muscle ; *d*, the triangle formed by *l* and *e*.

well as the fascia through to the skin. In accomplishing the section of the tendon, the knife is to be used as a lever of the first class with the anterior border of the metatarsus acting as a fulcrum. If the tendon has been completely severed, its retracted ends may be felt under the skin 1 to 2 cm. above and below the wound. After the operation an antiseptic bandage is applied, resting upon the fetlock. The bandage should remain eight days and the cutaneous wound heal by first intention. Care should be taken not to wound the tendon of the extensor pedis longus muscle.

Recently it has been proposed to permanently obliterate the function of the peroneus muscle by severing it's tendon within it's tarsal sheath above and below the tarsus and withdrawing the isolated section. The same object may be attained by merely severing the tendon within it's sheath below the tarsus, if the operation be carried out under aseptic precautions, because when thus performed the epithelium advances over the retracted cut ends and leaves them free in the sheath.

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39. CUNEAN TENOTOMY

FIG. 50

Objects. The relief of spavin lameness.

Instruments. Razors, scissors, straight scalpel, Peters' spavin knife.

Technic. Most horses can be operated on standing, under local anaesthesia; otherwise the horse should be cast, or secured on the operating table, on the affected side and the tarsus extended. Shave and disinfect an area 5 to 6 cm. square on the inferior median surface of the hock, over the course of the cunean tendon of the chief flexor of the metatarsus, as indicated in Fig. 51. Locate the tendon, CT, by palpation as it passes obliquely downward and backward and make a transverse incision with a straight scalpel

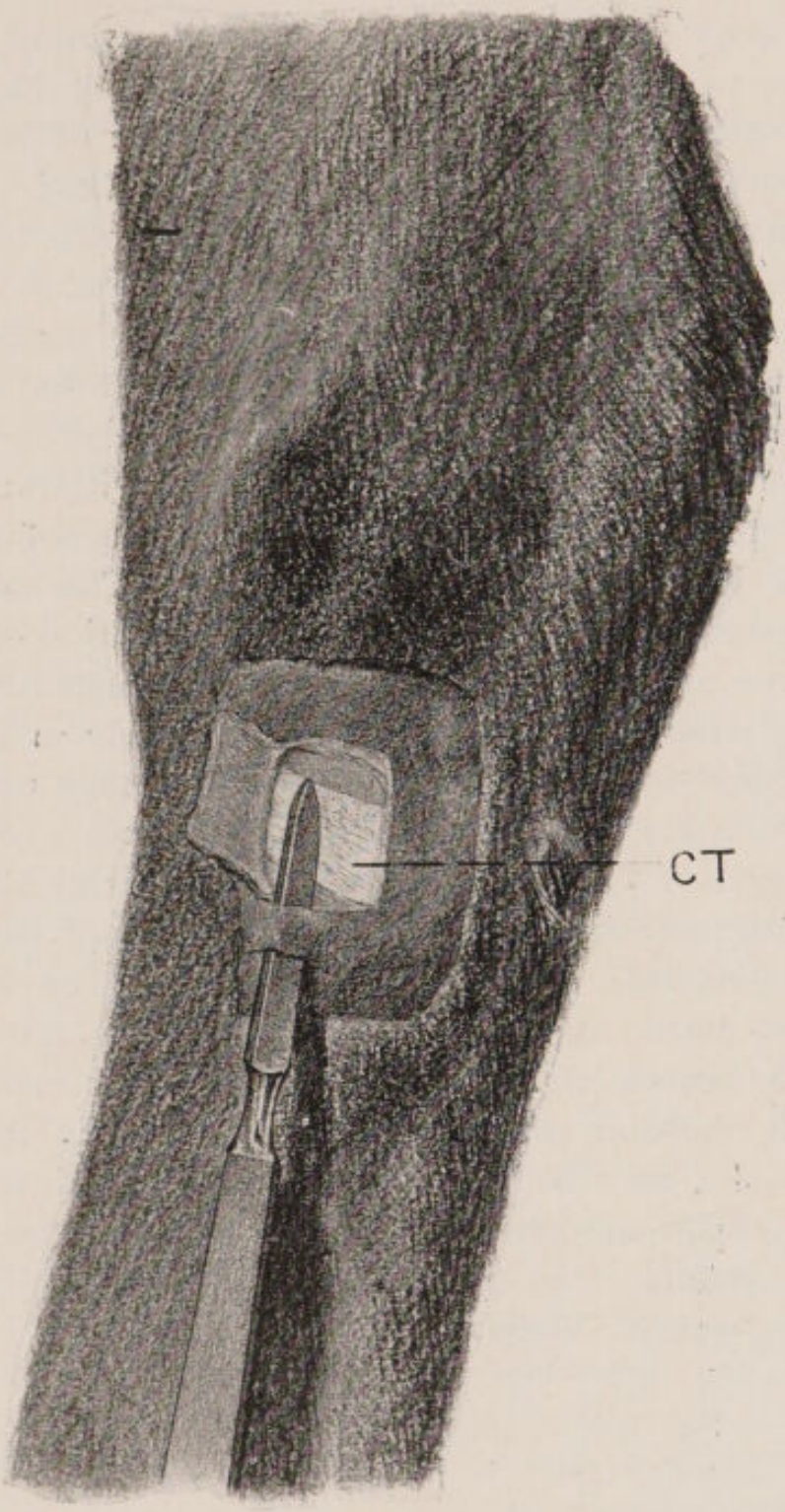

FIG. 51

Cunean Tenotomy

For the relief of spavin lameness. CT, Cunean tendon. The dotted line crosses the ergot.

or tenotome, in the form of a stab wound, merely sufficient to afford passage for the blade of the instrument, about 1 cm. below the inferior border of the tendon at a point midway between the anterior and posterior borders of the hock, or slightly anterior thereto. Push the tenotome flatwise between the skin and tendon, as shown in the figure, force it upward to the superior border of the tendon, then turn the cutting edge toward it and elevating the handle, using the superior border of the skin wound as a fulcrum, cut the tendon through from without inward. By firm pressure upon the skin over the tenotome, periosteotomy is simultaneously accomplished. The completion of the operation is evidenced by the separation of the cut ends of the tendon leaving a well-marked depression at the point of division. Disinfect the wound, apply an antiseptic pack covered by a tarred bandage resting upon the fetlock and including the hock, and allow to remain undisturbed for six days. A common, and perhaps better plan, is to follow the tenotomy with point firing, applying a cantharides-biniodide of mercury blister. Cover with dry absorbent cotton and over this a tarred bandage which is allowed to remain eight days. Healing by primary union. After the incision through the skin has been made, the Peters' knife may be used instead of the straight scalpel, and the tendon and periosteum cut through at two or three different points, the cuts diverging upwards from the cutaneous wound, V-shaped.

NEURECTOMY

General Remarks. Neurectomy is performed for a variety of objects, such as the relief of pain in a sensitive nerve itself, as in trifacial neurectomy, p. 64 ; the relief of pain or lameness in a part supplied by a sensory nerve ; or the inhibition of motor power, as in the "cribbing" operation by severing the spinal accessory where it passes into the sterno-maxillaris muscle.

The following neurectomies are designed to relieve pain and the consequent lameness dependent upon a pathologic condition of some structure, on the distal side of the point of operation and to which the divided sensory nerve is destined.

Neurectomy of a sensory nerve is always a painful operation, and it's performance without anaesthesia is unjustifiable from a humane standpoint, and cannot be so well done either from a view of mechanical correctness or the carrying out of antiseptic standards. Some neurectomies can be well performed on the standing animal if it is quiet and the operator is experienced, the parts being rendered insensitive by means of local anaesthesia ; in the greater neurectomies, general anaesthesia may be desirable or necessary from the humane or operative standpoint.

The confinement of animals for neurectomy on the sensory nerves of the extremities for the relief of lameness, is always to be viewed as a critical procedure for the reason that the operation is generally made because of the local manifestation of a more or less general disease which may be accompanied by general fragility of the skeleton, and as a result most casting accidents occur in cases of confining for neurectomy or firing in cases of lameness belonging to the great group of dry arthritis or spavin family. Casting must, therefore, be done with the greatest possible care, and the operating table is to be greatly preferred.

Neurectomy is properly a last resort in lameness and should not otherwise be performed. It has two great and ever present dangers. If the part deprived of sensation is too badly diseased to bear the weight and resist the insult resultant upon its being called upon to do its normal or even an extra amount of work, it must ultimately give way, the bones become fractured, the tendons separate from the bone, the intra-ungular tissues lose their integrity, and the hoofs become detached (exungulation) or other degenerative changes take place as a result of causing a part to do a work for which its condition unfits it.

The second great danger occurs from wounds or other traumatisms to the tissues distal to the operation when the unnerved parts are not rested as they would be in natural conditions when injured, and as a result reparative changes are prevented and supplanted by retrograde processes with ultimate death of the part and of the animal.

In other words, sensory neurectomy robs an organ or tissue of the enormously conservative force of pain. Pain causes the animal to rest the affected part, protects the painful tissues against disintegrating and destructive insults and favors restorative processes ; robbed of this protective influence of pain by the severance of the sensory nerves, the diseased tissues are without their natural protection.

Nerves are generally accompanied by satellite arteries and veins which are always liable to be wounded during the neurectomy and are more embarrassing because of the hemorrhage clouding the operation field and inviting error than dangerous because of the loss of the blood itself. It is essential to a good operation that the hemorrhage be kept under control throughout so that each tissue will stand out in relief and the nerve reveal it's identity in addition to its location, size and relations, by it's intensely white, nacrous, striated character. The test of compressing the nerve in order to identify it by the resultant pain is unsurgical and unnecessarily cruel.

Sepsis holds an important place in considering the dangers of neurectomy because the infection of a sensitive nerve causes very great pain and if considerable, tends to cause a false neuroma or fibroma in the connective tissue of the nerve trunk, calling for a second operation in order to remove the tumor, and resultant lameness.

Neurectomies should consequently be performed only in properly selected cases, the smallest possible trunk that will sufficiently relieve the pain should be selected for the operation, it should be performed with due regard for suffering and for asepsis, should be performed quickly and neatly, the incisions being free, laying the nerve trunk bare without tearing up the tissues and clouding them and at every point the operator should aim at celerity, accuracy and neatness. Neurectomy is frequently unethical and the veterinarian who values his good name, will be careful in selecting his clients as well as his patients. Some owners of lame horses have scant honor and ask the veterinarian to perform neurectomy for the fundamental purpose of masking serious disease until the animal may be sold. The veterinarian consciously or unconsciously becomes a party to the deceit. He should, therefore, operate only upon animals which he has ample assurance will not be fraudulently sold. In case of any question of the intent of the owner, he should be given clearly to understand that no rule of professional secrecy is binding upon the veterinarian and that under no avoidable circumstances will he become a partner in the fraud.

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40. DIGITAL NEURECTOMY

Fig. 52

Objects. The relief of navicular lameness in cases where plantar neurectomy is not deemed necessary or advisable.

Instruments. Razor, scissors, scalpel, probe-pointed bistoury, tenacula, aneurism needles, bandages,

Technic. Digital neurectomy may generally be performed on the standing animal, the operative area having first bee n fully anaesthetized and adrenalin solution added to the local anaesthetic in order to control hemorrhage, a twitch applied to the upper lip and the affected foot held up by an assistant. If necessary because of restlessness of the animal or inexperience of the operator, confine on the operating table or cast the animal and apply the extension splint to the foot to be operated on as shown in Fig. 49, page 130, except that the lower binding cords rest on the metacarpus instead of the pastern.

Extending downward from the fetlock joint toward the coronet, between the posterior border of the first phalanx and the anterior border of the flexor tendons, there is a slight furrow, at the posterior part of which, close to the external margin of the tendon, lies the median or principal digital nerve accompanied in front by the digital artery, A, anterior to which lies the digital vein, V. Immediately behind the nerve and generally lying a trifle deeper, is quite commonly found a second venous trunk of considerable size. Near the middle of the first phalanx the nerve is crossed externally in an oblique direction from above to below and from behind to before by a white ligamentous band, L, slightly broader than the nerve extending from the base of the ergot of the fetlock to the retrossal process of the pedal bone. This must not be mistaken for the nerve, N, and need not be if it is remembered that the latter is accompanied on the same plane and in a like direction by the satellite artery, A, and vein, V, enclosed with it in a fibrous sheath. At the uppermost part of the first phalanx the nerve lies in front of this ligament, a short distance inferiorly it passes beneath it, while from the middle of the pastern downward the nerve lies behind the ligament.

The operation is practicable at any point over the line of the nerve from the top to the bottom of the shaved area in

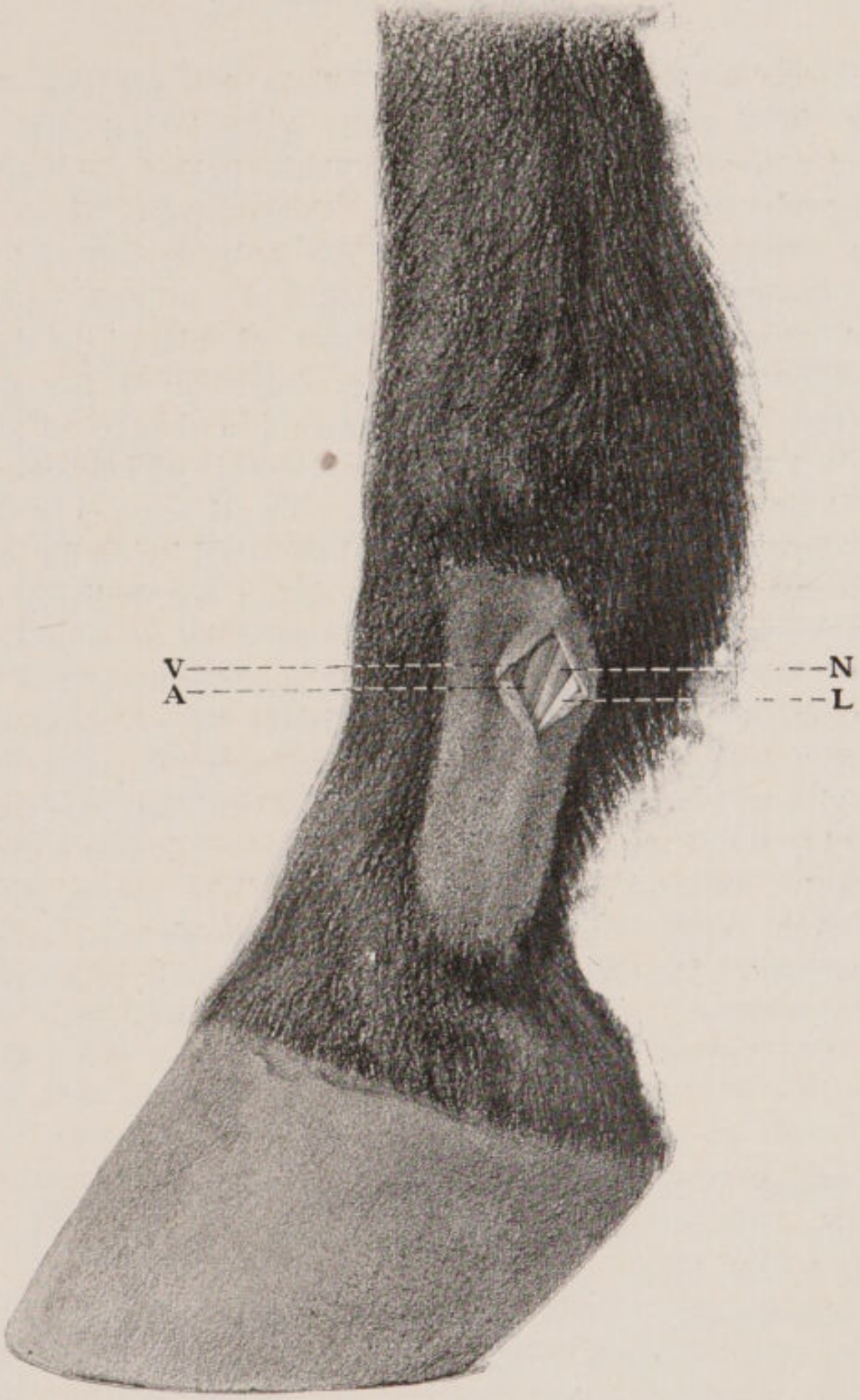

FIG. 52

Digital Neurectomy

V. Digital vein ; A, digital artery ; N, principal digital nerve ; L, ligament.

Fig. 52 or from the superior end of the first phalanx down to a level with the superior border of the lateral cartilage, but preferably at about the point shown in Fig. 52, near the superior end of the first phalanx. At the desired point and over the groove between the flexor pedis tendon and the phalanges, shave and disinfect an area 4 to 5 cm. square. In the center of this area at the anterior border of the flexor tendon, with the scalpel held perpendicular to the skin, make an incision from above downward, a distance of from 2 to 3 cm., cutting cleanly through the skin and subcutaneous fascia down upon the nerve. The incision is favored by tensing the skin between the thumb and index finger of the left hand, but care should be taken not to displace it backward or forward. Dilate the wound by pressure upon the skin with the thumb and index finger or otherwise and carefully incise longitudinally the fibrous sheath enveloping the nerve and artery. Pass an aneurism needle beneath the nerve, and forcing it upward and downward, separate thereby the nerve from the surrounding tissues. Insert a probe-pointed bistoury or scissors beneath the nerve, divide it at the upper angle of the wound and excise a section 3 cm. long. Disinfect and bandage with or without suturing the wounds. Leave the bandage in place 6 to 8 days.

41. PLANTAR NEURECTOMY

Fig. 53

Object. The relief of navicular or ringbone lameness or other painful, non-suppurating disease of any parts below the fetlock joint,

Instruments. Razor, scissors, convex scalpel, compression artery forceps, tenacula, aneurism needles, suture material, elastic ligature.

Technic. It is well to shave the site of operation and thoroughly disinfect the region of the metacarpus and fetlock with soap, brush, and sublimate or creolin solution and

50% alcohol, and apply a bandage saturated with sublimate or creolin solution to the fetlock joint 24 hrs. before the operation in order to secure an aseptic field.

Confine the animal and fix the limb as in the preceding operation. After removing the disinfecting bandage, producing local anaesthesia and causing constriction of the arteries by adrenalin, pass the fingers from before to behind with light pressure over the region just above the fetlock joint, where there is felt immediately in front of the flexor pedis tendon a channel-like depression extending from above the fetlock downward over it. Just at the anterior margin of the flexor pedis tendon and at the posterior part of the groove, lies the cordlike vascular bundle, consisting from behind to before, of the nerve, *n*, 3 mm. thick, and of the plantar arteryand the vein *v*, which glides away from underneath the fingers with a distinct recoil. The site of operation lies immediately above the fetlock in the posterior third of the metacarpus. In special cases one may operate at any point higher up as far as beyond the middle of the metacarpus or metatarsus, so long as care is taken to include the anastomosing branch given off by the median plantar nerve at about the middle of the metacarpus and bending obliquely around behind the tendons to join the lateral nerve somewhat lower down. At the point designated stretch the skin between the thumb and index finger of one hand and make an incision 3 to 5 cm. long, the lower angle of which is usually just above the fetlock joint, cutting directly through the skin, subcutem and connective tissue sheath down onto the nerve, laying it bare. The borders of the cutaneous wound are held apart with tenacula and by palpation with the fingers or by vision it is determined if the nerve lies in the middle of the wound. If necessary continue the dissection with the scalpel until the nerve is clearly revealed ; it is distinguished by its nacrous white color, its fine longitudinal striæ and its location immediately behind the metacarpal artery.

FIG. 53.

Plantar Neurectomy

a, Lateral digital artery ; *v*, lateral digital vein ; *n*, common lateral digital nerve ; *d*, anterior branch ; *o*, posterior branch ; *s*, superficial flexor tendon ; *p*, perforans tendon ; *i*, suspensory ligament of fetlock ; *m*, metacarpus.

Immediately above the fetlock joint the median metacarpal or metatarsal nerve divides into an anterior smaller, *d*, and posterior larger branch, *o*. This division should be laid bare in order that the operator may not erroneously cut one branch only. Immediately above this point of division the aneurism needle is passed under the nerve, pushed well through and forced up and down, separating the nerve from the adjacent tissues, the scissors or a small probe-pointed bistoury is passed beneath and it is cut through quickly at the superior angle of the wound. The distal end of the nerve is then dissected free downward and excised at the lower angle of the wound so that a section 3 to 5 cm. long is removed. The cutaneous wound is united by a suture and a temporary bandage applied. If the horse has been secured by casting, the extension splint, if it has been used, is then removed, the foot replaced in the hobble and the horse turned to the other side. The operation on the opposite metacarpal nerve is carried out in the same way after which a sterile bandage is applied and allowed to remain eight days. Healing by primary union.

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42. MEDIAN NEURECTOMY

Fig. 54

Objects. The relief of lameness due to disease so located in the anterior limb that it cannot be overcome by plantar neurectomy.

Instruments. Razor, scissors, convex scalpel, artery and compression forceps, tenacula, aneurism needles, suture material.

Technic. The operation is performed on the median surface of the anterior limb immediately below the humero-radial articulation on the recumbent horse after the affected foot has been fully extended on the operating table, or in de-

fault of this, removed from the hobbles and bound upon the extension splint as shown in Fig. 54. Apply a local anaesthetic with adrenalin.

The foot is drawn out firmly from the shoulder, inclined somewhat forward. The operator places himself between the neck and the forearm of the patient and, after the median region of the elbow joint has been washed with soap and water, searches for the median nerve where it glides over the posterior part of the joint to disappear behind the radius. Shave the skin at and below this point, disinfect it with sublimate or creolin solution and 50% alcohol. The nerve, *n*, lies as a rule somewhat in front of the middle of the median side of the forearm against the postero-internal margin of the radius and can be felt, about 5 to 6 mm. in diameter, lying somewhat deeply. The position of the nerve varies with the different attitudes of the forearm. In fat and fleshy horses the identification of the nerve is more difficult. It may be felt upon the standing animal.

With the thumb and index finger, stretch the skin over the nerve at the point where it begins to disappear behind the radius after having passed over the humero-radial articulation. Make an incision 5 cm. long, first through the skin, then through the expansion of the sterno-aponeuroticus muscle down upon the nerve. Check any hemorrhage from the skin, subcutis, or muscle. The tenacula are inserted cautiously in the lips of the wound, and these being drawn apart, the white anti-brachial fascia is brought into view and a search is made with the index finger to determine the exact location of the nerve, the fascia is divided with the scalpel and an oval piece immediately over the nerve excised with the scissors. If much fatty tissue is found beneath the fascia, it may be dissected away carefully with the scalpel or cut away with the scissors. There now comes into view a delicate reddish colored fascia-like membrane, the nerve sheath, behind which a dark cord,

the brachial vein, V, is visible, the latter being intimately connected with the nerve sheath. The vein lies mostly behind and beneath the nerve and may project out from beneath the border of the same. *The operator needs to be careful not to prick this vein with the tenacula, as the hemorrhage*

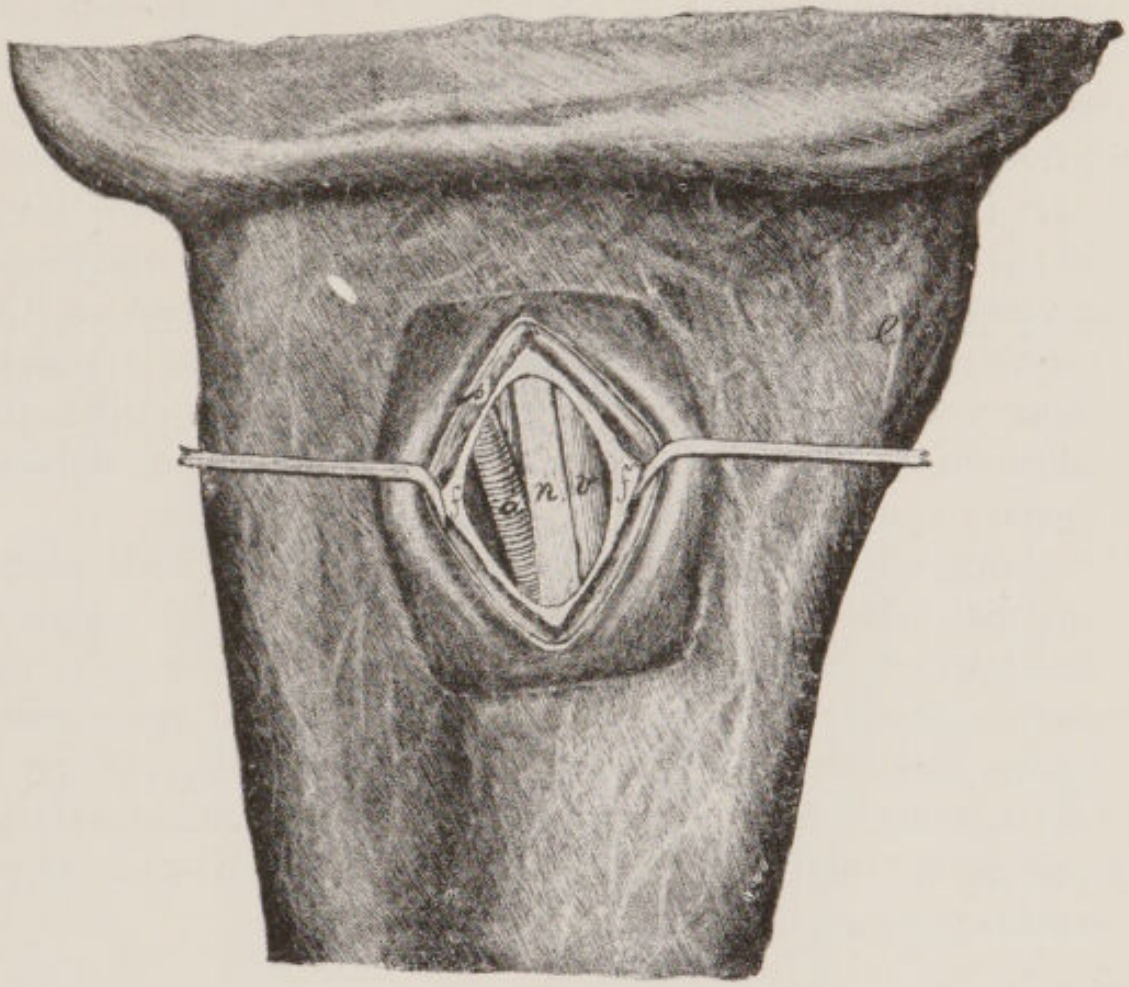

FIG. 54

Median Neurectomy

Median surface of the right humero-radial articulation, *a*, Brachial artery; *n*, median nerve; *v*, brachial vein; *f*, antibrachial fascia; *p*, sterno-aponeuroticus muscle.

therefrom is exceedingly annoying during the operation. Avoid the use of tenacula after penetrating the fascia and retract the wound lips cautiously with aneurism needles instead. Still further forward and deeper may be felt the pulsating brachial artery. Incise the nerve sheath carefully and divide it upward and downward with the scalpel or scissors,

whereupon the yellowish and distinctly striated nerve comes into plain view. Pass an aneurism needle beneath the nerve, pushing it so far through that the distal end is readily grasped and drawing it up and down with the two hands, separate the nerve from the adjacent tissues throughout the length of the wound. *Be careful not to cut the nerve too high and erroneously include the motor nerve of the flexor of the metacarpus and the flexors of the foot, which is generally given off posteriorly just below the humero-radial articulation.* Lift the nerve up and cut it through at the superior angle of the wound by a sulden clip with the scissors or with the probe-pointed bistoury. Lay the peripheral end of the nerve bare to the lower angle of the wound, and excise at least 3 cm. of it. Disinfect the wound and approximate the skin with a continuous suture. The tampon and sutures remain 1 to 2 days.

Since sensation of the lower part of the limb is partly maintained by the deep branch of the ulnar nerve which at the lower part of the carpus, covered by the tendon of the oblique flexor, becomes the lateral plantar nerve, neurectomy of the median nerve does not always completely effect the desired end. In order to produce complete anaesthesia of the foot, therefore, it is necessary to perform ulnar neurectomy also.

43. ULNAR NEURECTOMY

Figs. 55, 56

Object. An adjunct operation of the preceding by which the enervation of the carpus and foot is completed,

Instruments. Same as the preceding.

Technic. Above and behind the carpus there may be felt a groove between its external and middle flexors, EF and OF, Fig. 55. At this point, 10 cm. above the pisiform

FIG. 55.

Ulnar Neurectomy

Right forearm seen from behind. *e*, External flexor of the carpus; *f*, oblique (middle) flexor of the carpus; *a*, collateral ulnar artery; *b*, antibrachial fascia; *n*, ulnar nerve..

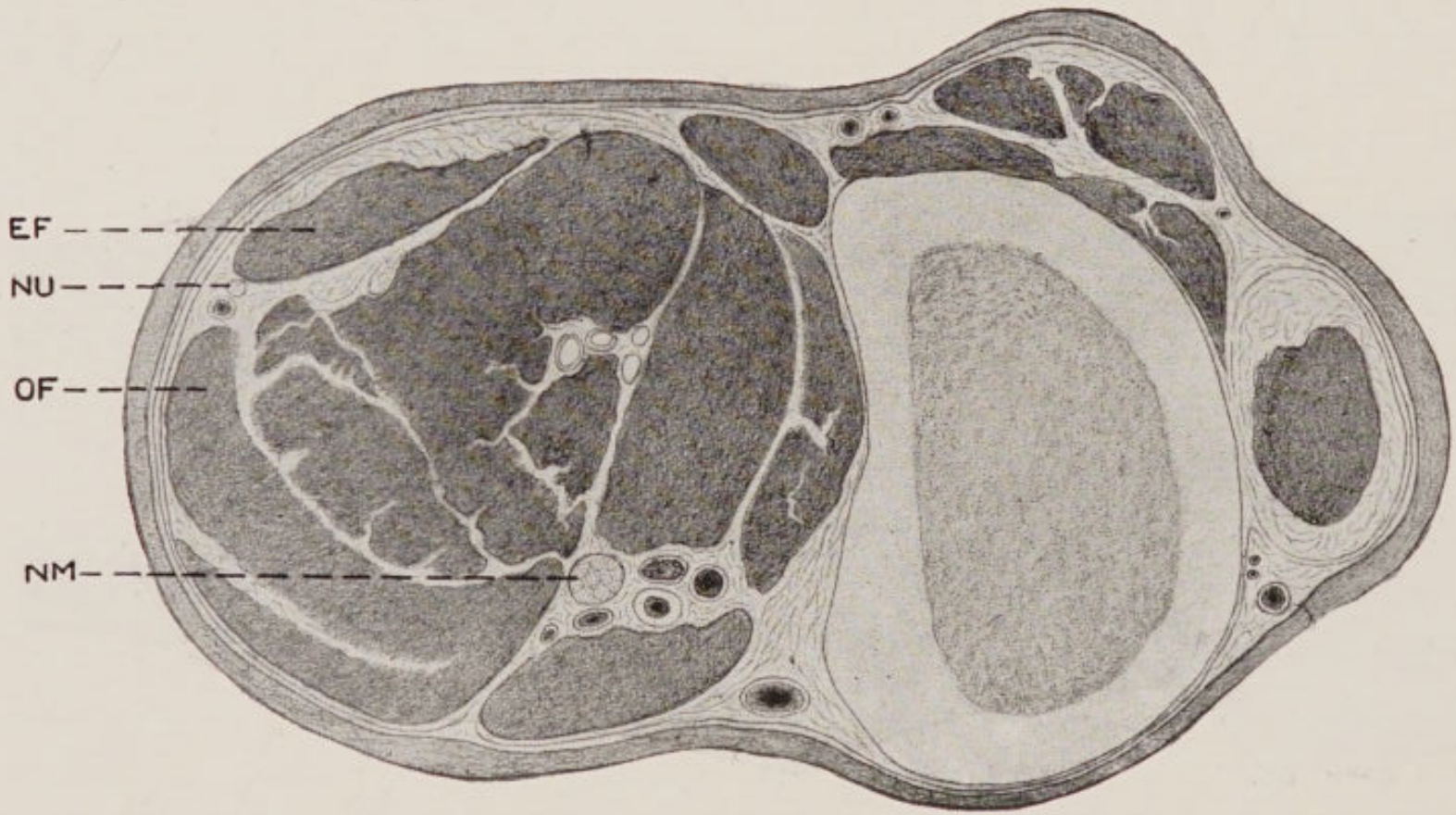

FIG. 56

FIG. 56

Ulnar Neurectomy

Cross section through the forearm, about 10 cm. above the pisiform bone, viewed from below. EF, External flexor of the carpus; OF, oblique flexor of the carpus; NU, ulnar nerve; NM, median nerve. Lying on its median side is the ulnar artery, the satellite vein of which is not shown.

bone, the skin is shaved and disinfected and an incision 6 cm. long made through the skin and antibrachial fascia. This incision extends just outside the median line of the posterior surface of the radius in such a way that the superior angle of the wound is about 1 cm. farther outward than the lower. Beneath the fascia between the aforesaid muscles is seen the ulnar nerve, Fig. 55, *n*, Fig. 56, NU, on the median or inner side of it, the collateral ulnar vein, Fig. 55, *v*, and between the two and somewhat deeper, the collateral ulnar artery, *a*. The nerve, about 3 mm. in diameter, is picked up with the aneurism needle, severed at the upper and lower angles of the wound, the lips of the wound united by a continuous suture and a bandage applied. Healing takes place by first intention.

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44. SCIATIC NEURECTOMY

Figs. 57, 58

Objects. The destruction of sensation in the tarsus and parts beyond for the relief of otherwise incurable spavin lameness, diseases of the tendons, etc.

Instruments. Same as in the preceding.

Technic. Expert surgeons may operate on the standing animal under local anaesthesia and adrenalin. The average operator should place the animal on the operating table on the diseased side, extend the affected limb and draw the upper leg forward or backward and secure it out of the way. Produce complete general or local anaesthesia. The posterior tibial or sciatic nerve, *n*, Fig. 57 and NS, Fig. 58, is then sought by grasping the leg with the left hand from behind in such a manner that the thumb rests above and the fingertips below it. Reaching forward with the fingers to the deep flexor of the foot, grasp the leg with moderate firmness and draw the hand slowly backward. Immediately behind the

perforans muscle and between this and the tendo-Achilles the nerve, nearly 1 cm. in diameter, glides away forward from between the fingers with a distinct recoil. If the nerve cannot be recognized in this manner, the hock should be more strongly extended, by which means it may be caused to

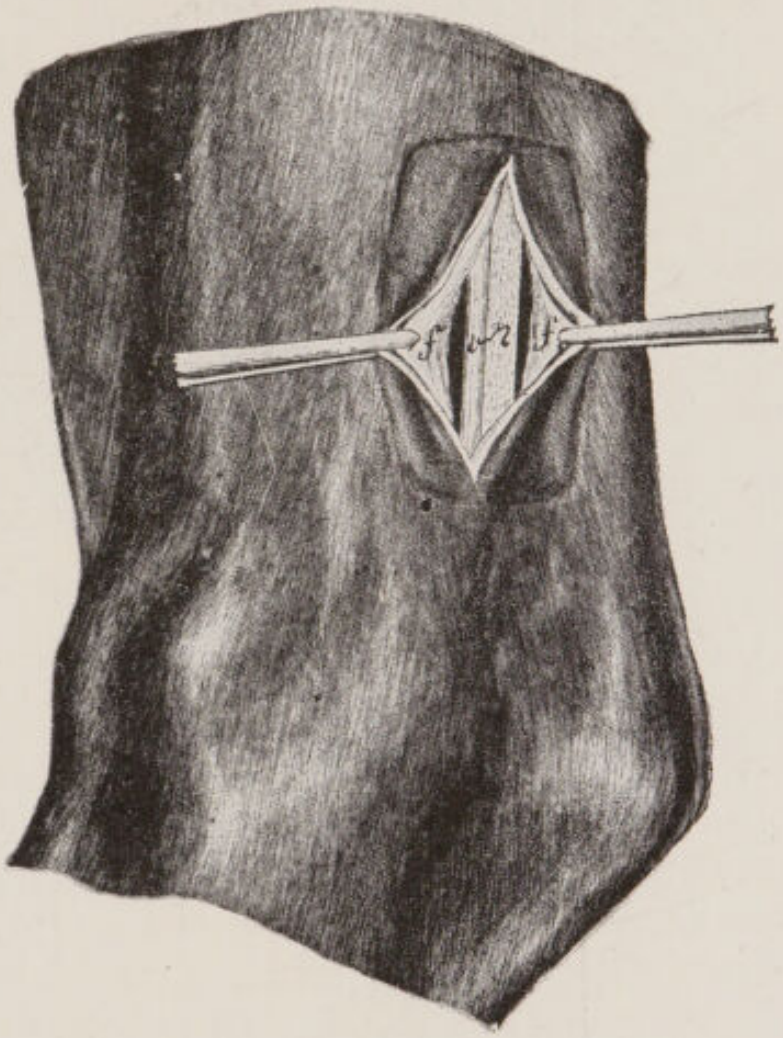

FIG. 57

Sciatic Neurectomy

Right hind leg viewed from the median side, *f*, Crural fascia; *n*, sciatic (tibial) nerve; *v*, plantar vein.

recede from the perforans muscle, so that it can more readily be felt near the middle of the groove extending between it and the tendo-Achilles.

At this point on the median side of the leg the skin is shaved, disinfected and an incision made through it, 5 cm.

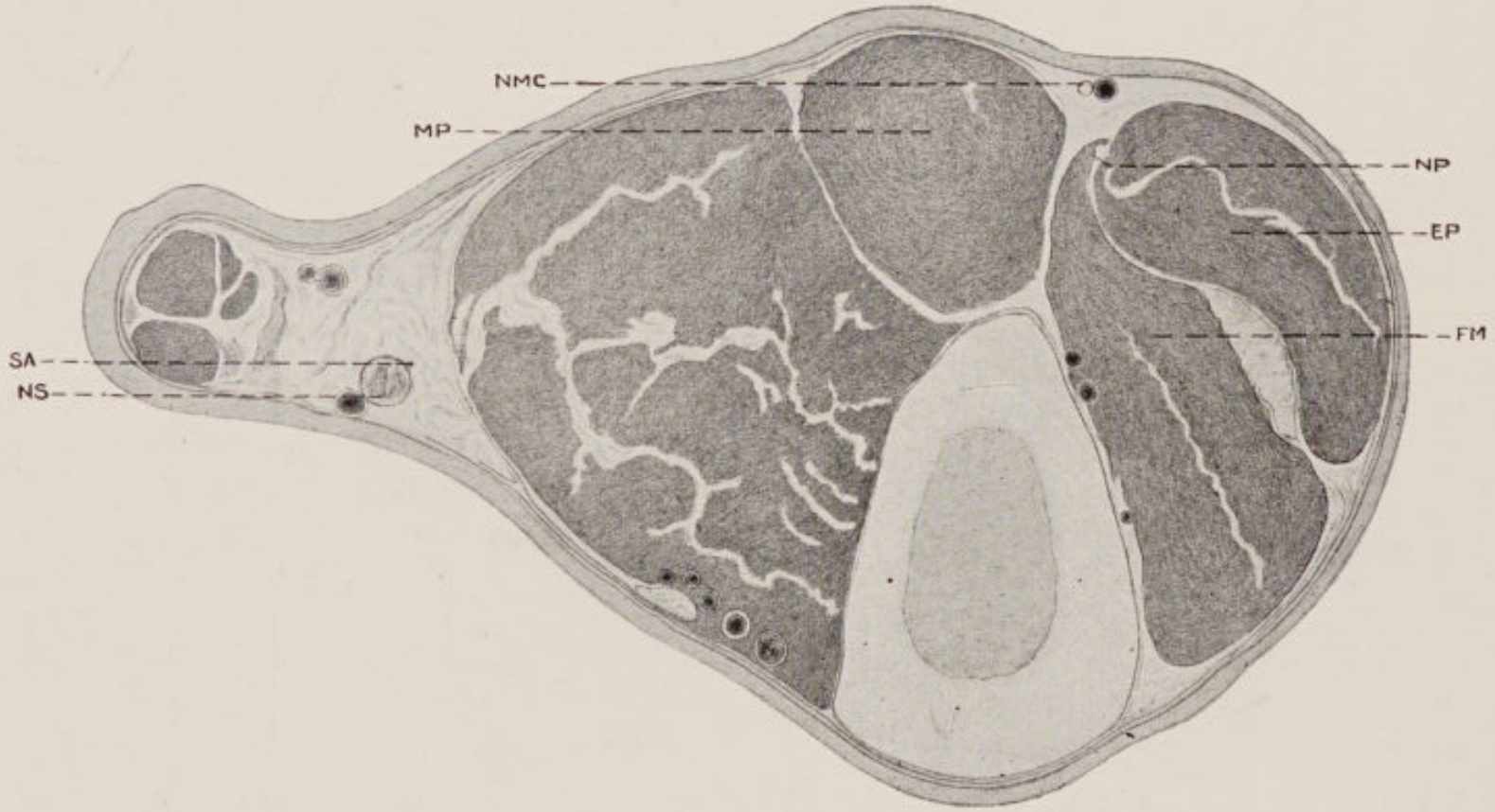

FIG. 58

FIG. 58

Tibio-Peroneal Neurectomy

Cross section through the tibia at about 10 c. m. above the tibio-astragaloid articulation. SA, Recurrent tibial artery; NS, sciatic nerve; NMC, musculo-cutaneous branch of anterior tibial nerve; NP, deep or sensory branch of anterior tibial or peroneal nerve; EP, extensor pedis muscle; MP, peroneus muscle; FM, flexor metatarsi muscle.

long, parallel to the tendo-Achilles. The white, rigidly-stretched crural fascia is now divided in the same direction, after which the precise location of the nerve should be determined by palpation. Excise with the scissors an elliptic or oval piece of the fascia directly over the nerve, or hold it apart along with the lips of the cutaneous wound by means of the tenacula. In poor horses the contour of the nerve, covered only by loose connective tissue, stands out prominently; in fat horses it is surrounded by a large amount of adipose tissue. Cut through this fat and connective tissue and expose the tibial nerve, *n*, Fig. 57, and NS, Fig. 58, to view; immediately before it, lies the plantar vein and on the lateral side is situated the recurrent tibial artery, SA, Fig. 58. The cross section in Fig. 58 is located somewhat below the point for operation and the vein has crossed obliquely over the nerve so that it appears *behind* instead of *in front* of it, as is the case generally at the point where the operation is performed. Separate the vessels completely from the nerve with the handle of the scalpel, pass an aneurism needle from before backward beneath it through to the handle and grasping both ends, force the instrument upward and downward in order to separate the nerve trunk from the adjacent tissues. Cut the nerve off at the upper and lower angles of the wound, removing a section at least 5 cm. long. Suture the cutaneous wound and apply a bandage allowing it to remain eight days, Healing should occur by first intention.

45. ANTERIOR TIBIAL NEURECTOMY

Neurectomy of the Deep Branch of the Peroneal Nerve

Figs. 58, 59

Object. An adjunct operation to the preceding, since this nerve supplies sensation to the tarsus in common with the sciatic. The two constitute what is known as Bossi's double neurectomy for spavin.

Instruments. Same as in the preceding.

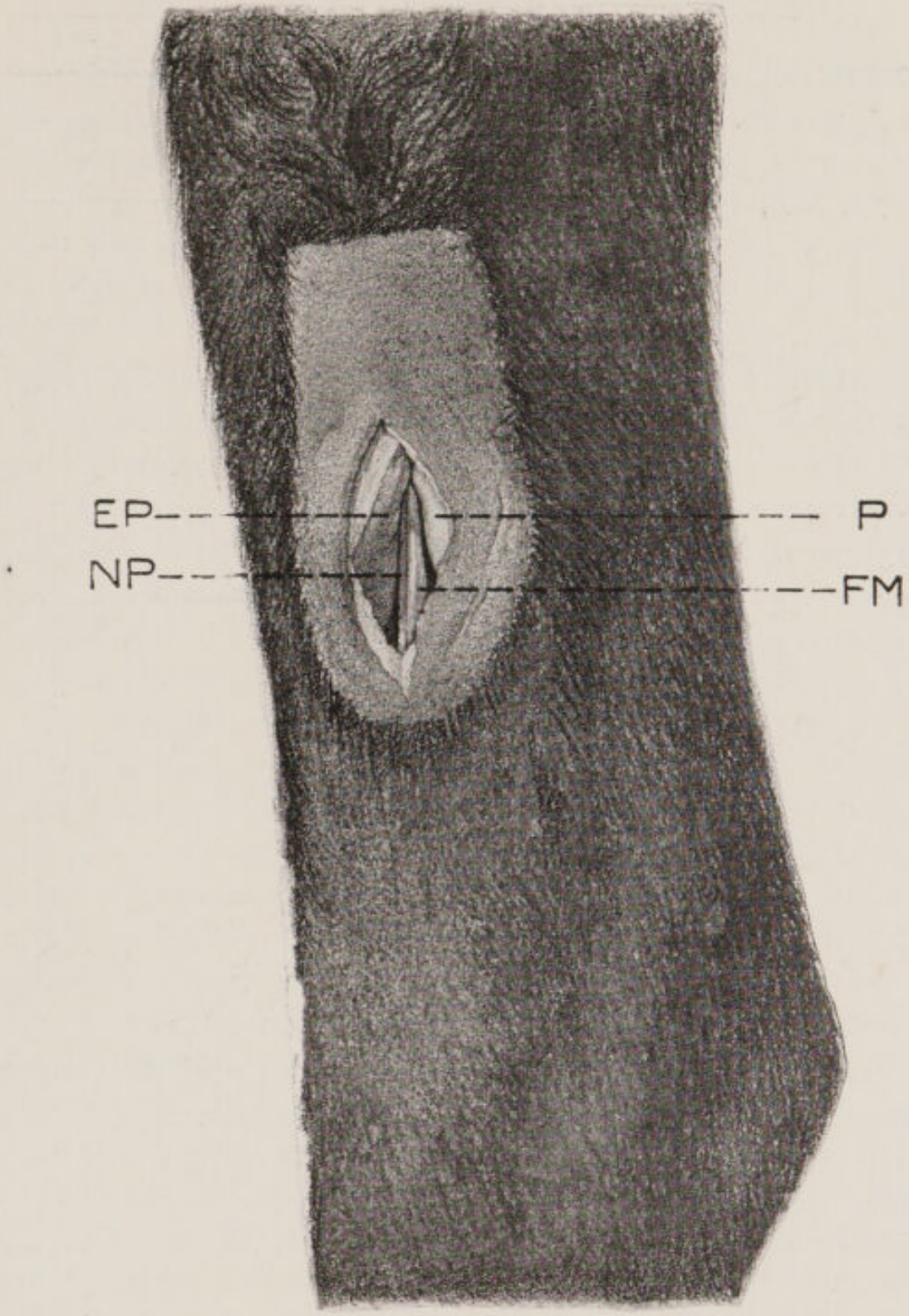

FIG. 59

Anterior Tibial Neurectomy

EP, Extensor pedis muscle; P, peroneus muscle; NP, deep branch of the peroneal or anterior tibial nerve; PM, flexor metatarsi muscle.

Technic. Confine as in the preceding but with the affected leg uppermost. Locate the furrow dividing the extensor pedis longus, EP, Figs. 58, 59, and the peroneus muscles, P, Fig. 58, MP, Fig. 59, and shave and disinfect an area 6 cm. long by 3 cm. wide directly over this depression and extending upward from a point 6 to 7 cm. above the tibio-astragaloid articulation.

At a point 8 to 10 cm. above the flexure of the hock, make an incision through the skin and subcutis 5 or 6 cm. long over the line of division between the two extensors of the foot. Superficially the operator passes near by the musculocutaneous division of the anterior tibial nerve, NMC, Fig. 58, which must not be mistaken for the deep branch.

The peroneus muscle, MP, Fig. 58, and P, Fig. 59, is separated from the extensor pedis longus, EP, Figs. 58, 59, by a strong aponeurotic sheath continuous with the tibial aponeurosis. Penetrate the tibial aponeurosis *anterior* to the aponeurotic partition directly against the extensor pedis, EP. Passing along the posterior border of this muscle to a depth of 2 to 4 cm., there appears the thin margin of the flexor metatarsi magnus, FM, Figs. 58, 59, which lies immediately against the extensor pedis without a visible connective tissue partition but reveals itself by a markedly lighter shade of color and its ready separation from the extensor with the scalpel. The deep branch of the peroneal nerve, NP, Figs. 58 and 59, lies loosely imbedded on the anterior side of the margin of the flexor metatarsi facing the extensor pedis, at times visible at the margin, at others placed more deeply, reaching in some cases a distance from the margin of 4 or 5 mm. Within this range is seen the slender nerve trunk almost devoid of surrounding connective tissue and measuring about 2 mm. in diameter. Pass the aneurism needle beneath it and remove a piece 3 to 4 cm. long. Close the cutaneous wound with interrupted sutures and dress antiseptically without a bandage.

46. RESECTION OF THE LATERAL CARTILAGE

The Bayer Quittor Operation

Figs. 60, 61

Object. The cure of quittor or necrosis of the lateral cartilage.

Instruments. Elastic ligature, drawing knife, scissors, razor, hoof rasp, hoof plane, craniotomy or other heavy forceps for the removal of the horn, artery forceps, elevator or long bone chisel, right and left sage knives, curette, needle holder, thread, needles, antiseptic gauze, tampons, absorbent cotton, bandages.

Technic. For a few hours before the operation place the affected foot in a bath of creolin or other antiseptic solution, after having first rasped the diseased quarter *lightly* and having made a semicircular groove in the horn of the lateral wall and quarter down to the horny lamina, as shown at *s* in Fig. 60. It is essential not to materially thin the horn on the quarter with the rasp since by weakening it, it yields and breaks and cannot be properly detached from the sensitive laminae. The rasping of the wall should merely suffice to remove the very hard external layer and facilitate the cutting of the groove with the hoof knife.

The operation is performed upon the recumbent, anaesthetized animal, in such a position that the diseased cartilage of the affected foot lies upward. The operating table constitutes incomparably the best means of confinement in every respect.

The hair on the coronary band is clipped or shaved and the entire foot up to the fetlock joint thoroughly cleansed with brush, soap, creolin or sublimate solution and 50 per cent. alcohol. The fetlock and pastern are carefully wrapped in a towel saturated with sublimate solution or other disinfectant. The hoof should be similarly wrapped

except the operative area and every precaution taken against the transfer of infecting material from neighboring parts into the wound.

After the application of the elastic ligature in the metacarpal or metatarsal region, the groove in the horn is deepened with the drawing knife down to the sensitive laminae without injuring them. The groove must be so located that it extends beyond the anterior and posterior borders of the lateral cartilage, and downward to within 1 or 2 cm. of the margin of the os pedis and approximately perpendicular to the surface of the horn wall so that it will form a secure support for the dressing to be later applied.

The elevator or long bone chisel is then inserted beneath the lowest part of the semi-circular piece of horn which has been isolated, the horn is elevated from the sensitive structures somewhat, grasped with the heavy forceps and carefully loosened from the sensitive parts by drawing upward parallel to the laminae until the coronary band is reached. The traction is then directed backward toward the heel, separating the wall from the coronary papillæ and keraphyllous tissue. Care is to be taken here to avoid lacerating the underlying tissues, especially when the traction is first directed backward. If the soft tissues threaten to tear, the danger should be avoided by the timely use of the scalpel or sage knife as conditions may suggest.

After the coronary band has been smoothed with the scissors, make two perpendicular incisions through the skin and coronary band, one behind the anterior and the other in front of the posterior border of the groove in the horn, and connect the two by means of a semi-circular incision in the sensitive laminae. The U-shaped incision should be so made that between it and the horny wall there is left an area of sensitive laminae 1 to 2 cm. wide, in order that there may be sufficient room in the soft tissues for the application of the sutures, as shown in Fig. 61. The lines of incision

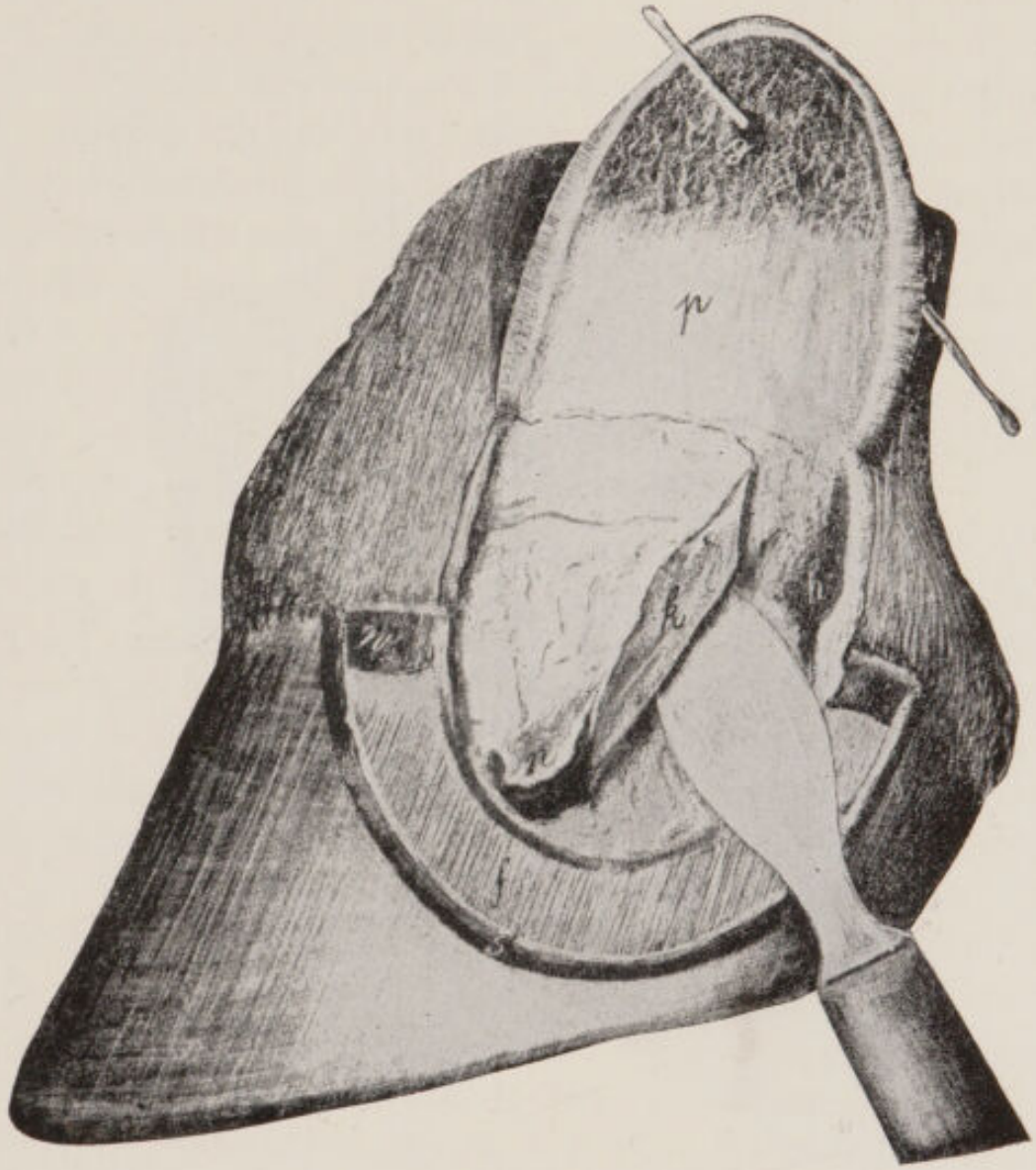

FIG. 60

Resection of the Lateral Cartilages of the Os Pedis

Horny wall removed, sensitive laminæ and cutaneous flap held upward Posterior half of the cartilage excised. *f*, Sensitive laminæ ; *w*, coronary band ; *k*, anterior half of cartilage ; *h*, cavity caused by the removal of the posterior half of the cartilage ; *n*, necrotic cartilage ; *p*, parachondral surface of the skin and sensitive laminæ ; *s*, perpendicular, crescent-shaped incision in the horny wall ; *g*, fistula.

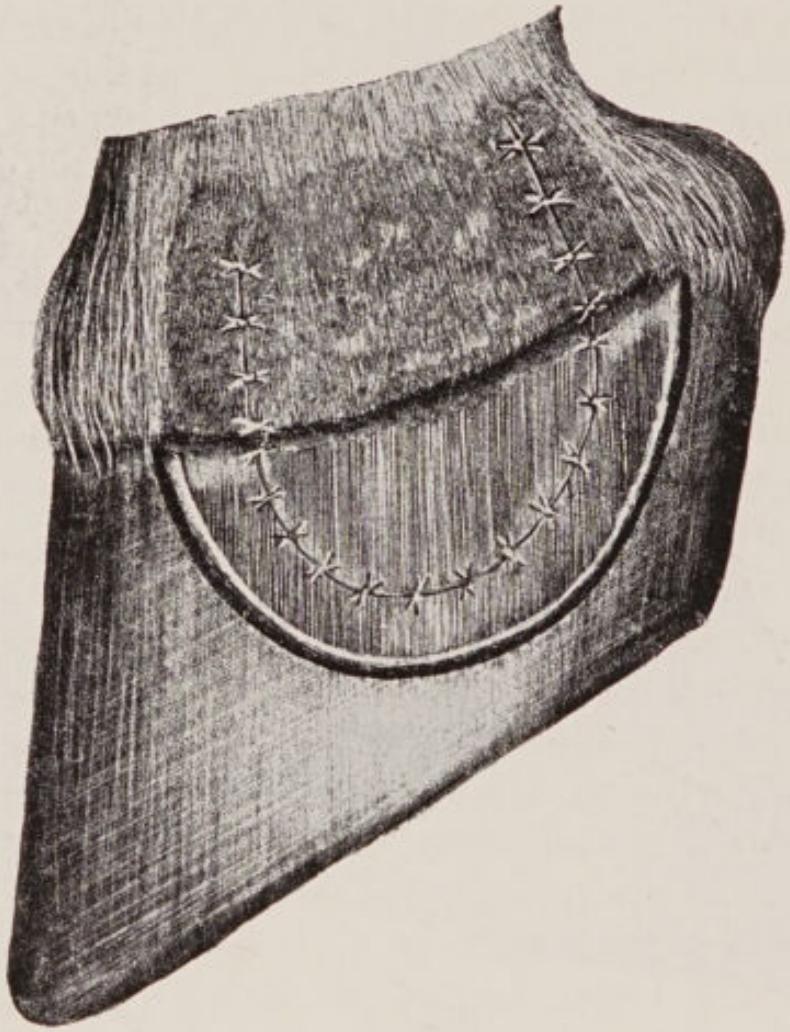

FIG. 61

Resection of the Lateral Cartilages of the Os Pedis

Completed operation showing the sutures in place and the parts ready for the application of dressings.

through the coronary band should be so located as to include between them the entire lateral cartilage.

The isolated flap is now dissected closely against the os pedis and its ala and from the lateral surface of the cartilage, the operator lifting the flap with forceps or tenaculum. Above the cartilage toward the fetlock the operator must keep the fingers of one hand against the external skin in order to avoid cutting through it or thinning it too much. The flap is held turned upward by an assistant or a strong suture is passed through it and turning it upward, the suture ends are carried around the pastern and tied.

As a rule there is now seen a prominent, greenish colored, necrotic piece of cartilage surrounded by brownish red masses of granulations. By means of an incision through the cartilage parallel to the long axis of the foot, divide it into anterior and posterior halves and extirpate the latter first by dissecting it out on the inner side from the parachondral tissue with the sage knife. Begin the excision of the cartilage by engaging the supero-anterior angle of the posterior half with the tenaculum and, exerting moderate traction, dissect it away from the underlying tissues first along the line of the dividing incision down to the base and then cut backward toward the heel cutting the cartilage away from the bone with which it is continuous. *The point of the knife must be constantly directed against the cartilage.*

Since the inner surface of the anterior half of the cartilage lies immediately against the capsular ligament of the corono-pedal articulation, the joint should be sharply extended by having an assistant seize the toe and force it forward. By this means the capsular ligament is drawn away from the cartilage during its extirpation.

The anterior half of the cartilage, *k*, is then removed in the same way, except with the greatest possible care to avoid puncturing the corono-pedal articulation. The chief precaution is to dissect only with the point of the sage knife,

using at all times that knife, right or left, which will result in its concave surface being presented toward the cartilage; then by carefully keeping the line of excision *immediately against* the cartilage, material danger of penetrating the joint is avoided. Remnants of cartilage at its juncture with the retrossal process of the os pedis, and any granulations present are to be removed with the curette. Cut away with the scissors and knife any remnants of cartilage adherent to the flap, *p*, thin if necessary the entire flap and excise the fistulous openings, *g*. After thorough disinfection of the entire field of operation, return the flap to its former position and retain it there by a sufficient number of interrupted sutures as shown in Fig. 61. The first sutures to be applied should be at the border line between the skin and coronary band in order to insure accurate apposition at this point. Disinfect the wound surface with two per cent. chlorazene solution. Pack the cavity remaining after the removal of the cartilage with powdered boric acid. Cover the entire surface with gauze saturated with two per cent. chlorazene, cover with dry cotton to prevent evaporation and over this apply a tar bandage. Remove the elastic ligature. If the animal is free from fever, feels and eats well, the bandage is left in position from 12 to 14 days. Healing by first intention.

The two chief dangers in the operation are the opening of the corono-pedal articulation and the persistence of a scar in the coronary band resulting in a quarter crack.

If the operation has been kept thoroughly antiseptic, the opening of the articulation is not necessarily serious.

The question of preventing a weakening scar at the coronary incision is one of strict antisepsis and accurate suturing. The operation frequently fails under indifferent technic. It is an operation for the careful surgeon only. In the succeeding modification of the quittor operation, the danger from a weak scar or a fissure in the coronary band is obviated and in this respect is to be preferred.

47. MODIFIED QUITTOR OPERATION

A section of the horny wall is removed as in the Bayer operation.

A semicircular incision is made through the sensitive laminae up to the coronary band, care being taken not to injure the latter. This incision should be so made that

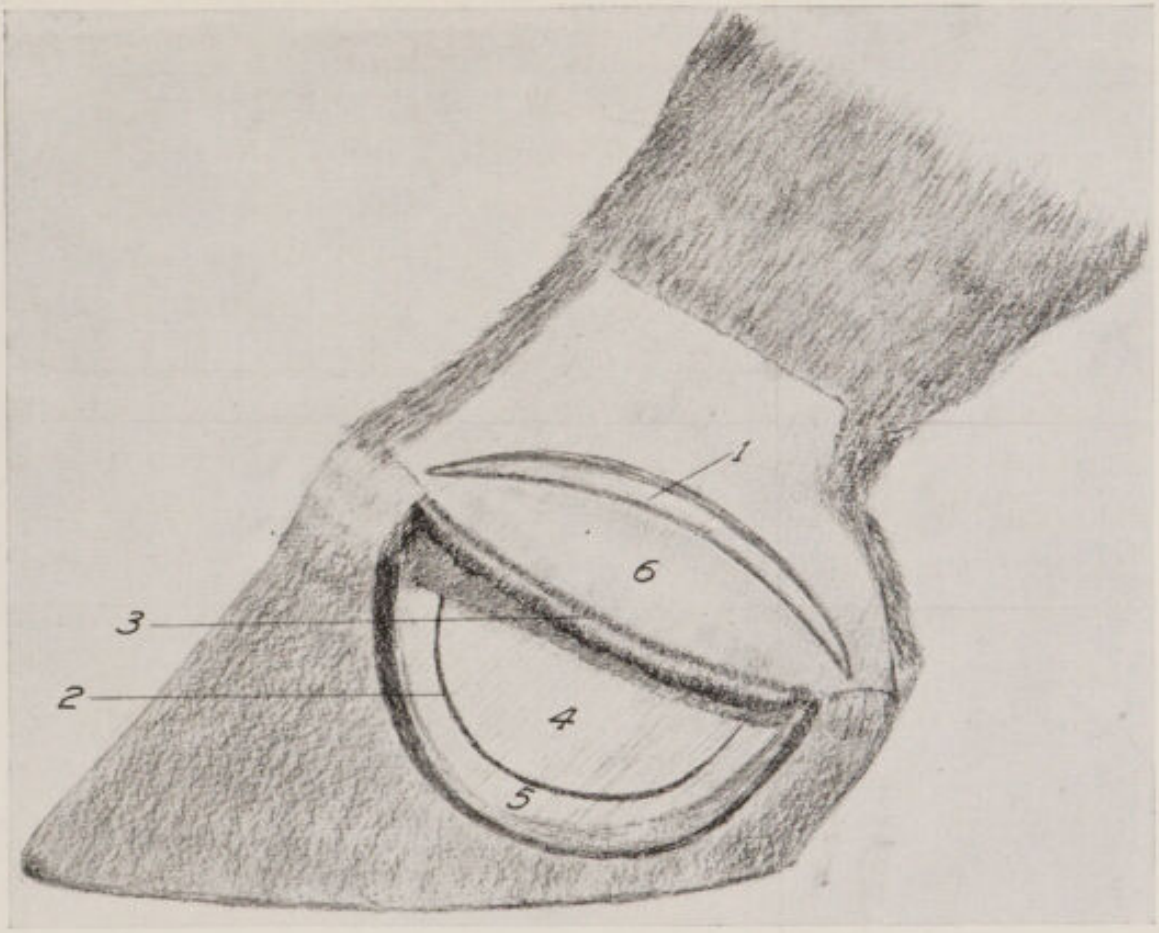

FIG. 62. Modified Quittor Operation

1. Cutaneous incision; 2, incision through sensitive laminae; 3, coronary band; 4, sensitive laminae flap; 5, sensitive lamina border to which flap is to be sutured; 6, skin flap.

there is left sufficient room between it and the horny wall for the application of sutures in the sensitive laminae.

The flap thus formed is then dissected away from the os pedis and the lateral surface of the cartilage. By working beneath this loosened flap, the coronary band may be sepa-

rated from its attachments for a distance equal, and corresponding to, the width of the flap.

Another semicircular incision is then made through the skin over the upper border of the lateral cartilage beginning at the coronary band, 1 or 2 cm. in front of the anterior incision in the sensitive laminae. The incision is carried back about the same distance beyond the posterior incision in the laminae.

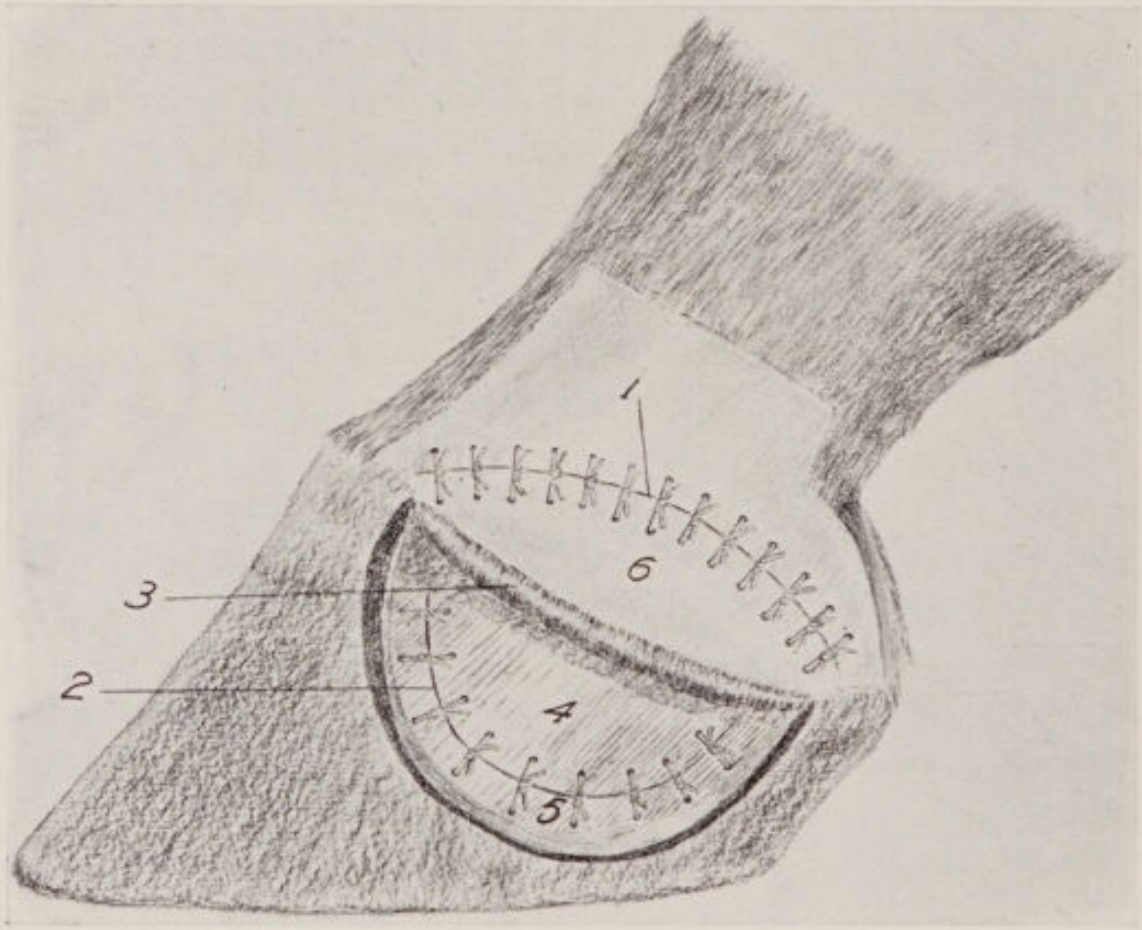

FIG. 63. Modified Quittor Operation

Figures same as in preceding.

The upper flap is then dissected away from the surface of the cartilage, making a communication between the upper and lower incisions and leaving the cartilage exposed.

The operation is then continued as in the Bayer method. The sutures are applied first to the sensitive laminae and then to the incision through the skin.

48. RESECTION OF THE FLEXOR PEDIS TENDON

Fig. 64

Object. The removal of necrotic tissues and disinfection of the parts in cases of infected wounds, chiefly of nail wounds of the navicular bursa.

Instruments. Elastic ligature, drawing knife, sage knives, scissors, tenaculum forceps, curette, scalpels, tenaculæ, bandage material.

Technic. Thin the horn of the sole, frog and bars until every part of the horny covering of the sole is thin, soft, and yielding. If opportunity offers, apply an antiseptic bandage for 24 hours. Secure the patient on the operating table or by casting in lateral recumbency with the affected foot extended. Anaesthetize. Cleanse and disinfect the entire foot with soap, brush, creolin or sublimate solution and 50% alcohol and apply the elastic tourniquet in the metacarpal or metatarsal region. Apply towels saturated with antiseptics as in preceding operation. Make a transverse incision through the base of the frog, 2 to 3 cm. from the balls, through the horny and sensitive portions and the fatty cushion down to the flexor pedis tendon. Follow this by two converging incisions extending forward and inward in an oblique direction corresponding to the semi-lunar crest of the os pedis, the lines of incision being in the bars about ½ cm. outward from the lateral groove of the frog and uniting at its apex. The triangular piece of frog which has been isolated by the incision is now grasped with the tenaculum and dissected away. The remnants of the fatty frog should be removed with the sage knife or scalpel by means of a horizontal incision. There is then revealed the flexor pedis tendon which may be greenish or yellowish colored and necrotic, or may be covered with reddish-colored granulations.

Should there be present also suppurative pododermatitis, the bars on the affected side must be excised along with the other portions.

The position and extent of the navicular bone can now be determined by palpating it through the flexor tendon. A transverse incision is then made over the middle of the navicular bone through the flexor pedis tendon into the navicular bursa, the distal end of the tendon grasped with the tenaculum forceps and lifted up from the navicular bone with the aid of two lateral curved incisions. Between the inferior or

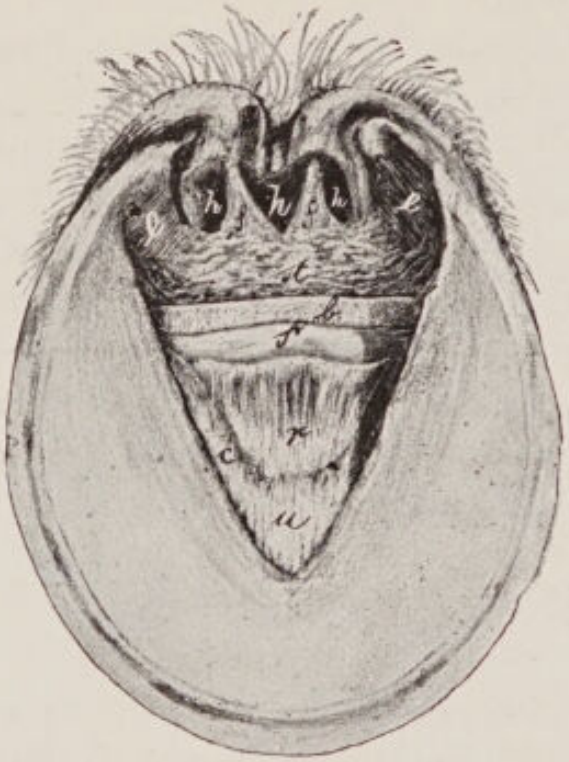

FIG. 64

Resection of the Flexor Pedis Tendon

Solar surface of the foot. *c*, Semi-lunar crest of os pedis; *u*, os pedis; *r*, navicular-pedal ligament; *s*, navicular bone; *b*, flexor pedis tendon; *e*, sensitive laminæ of the bars; *sf*, fatty frog; *f*, sensitive frog; *h*, horny frog.

anterior border of the navicular bone and the semi-lunar crest of the os pedis, stretches the capsular ligament of the corono-pedal articulation reinforced by dense fibrous bands. The flexor pedis tendon is united to this by a few bundles of fibres. Dissect the tendon carefully away from the capsular ligament, avoiding opening the articulation, and then cut it away from the semi-lunar crest of the os pedis. If necrotic

or discolored pieces of the fatty cushion or the tendon still remain, remove these with scissors, scalpel or curette. Curette away all the cartilage from the inferior surface of the navicular bone and remove any necrotic or inflamed, softened portions of the bone. In extensive necrosis of the suspensory ligaments of the heel and of the ligaments extending from the fetlock joint to the lateral cartilages, the necrotic portions as well as the neighboring fatty cushion with its numerous elastic fibres, must be resected. In case of purulent areas extending along the tendon and opening above in the heel, draw through the tract a large strip of gauze thoroughly saturated with tincture of iodine and allow it to remain. If the suppurating area extends well up into the heel without an opening, incise from above and handle as preceding. Dress the wound as advised for the quittor operation on page 164. In the absence of fever the bandage remains in position for 12 to 15 days.

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49. AMPUTATION OF THE CLAWS OF RUMINANTS

Figs. 65, 66

Uses. The cure of "foul in the foot" or panaritium when complicated with suppurative arthritis or ostitis.

Instruments. Half round rasp, sage knives, scissors, convex scalpel, artery forceps, drawing knife, elastic ligature, dressing materials.

Technic. Cast the animal and secure the foot to be operated upon in an extended position, apply the elastic ligature and after disinfecting the claws, rasp away the horn on the lateral side of the diseased claw, especially at the posterior part of it, until the horny wall becomes so thin that it can readily be pressed in with the fingers. Anaesthetize. The corono-pedal articulation can be felt, about 3 cm. below the coronary band, by grasping the claw with the left hand in such a manner that the thumb rests upon

the thinly rasped horn while with the other hand the claw is moved from side to side. At the lowest point of the articulation push the sage knife into the joint, the concavity of the knife being directed toward the leg, and make a curved incision at first forward and upward to the coronary band, then with strong flexion of the foot, a second curved incision backward and upward which, however, extends only to the navicular bone. By this in-

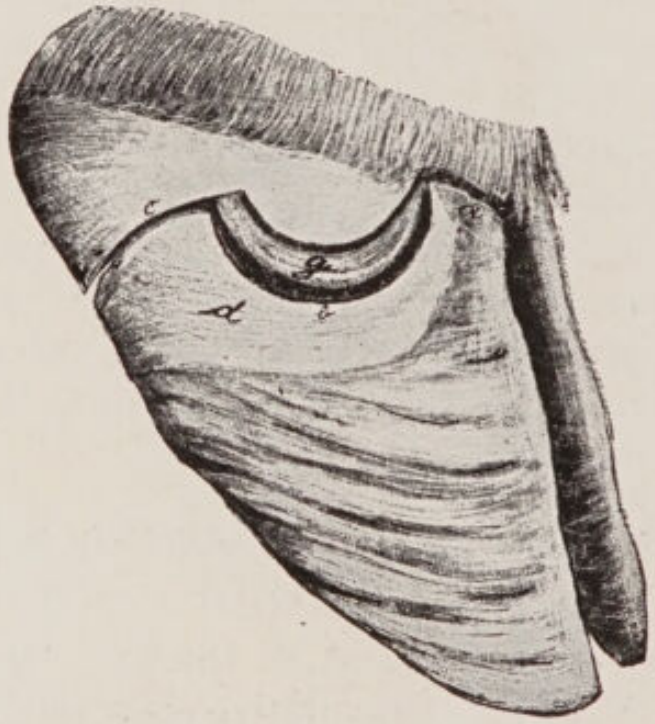

FIG. 65. Amputation of the Claws of Ruminants

d, Horny wall, rasped thin; *g*, articular condyle of 2nd phalanx; *a*, *b*, *c*, course of incision.

cision the operator divides the horn, the sensitive lamina, the external corono-pedal ligament and the capsular ligament of the corono-pedal articulation. Pass the knife between the navicular and pedal bones and extend the incision downward perpendicular to and, through the sole, separating the navicular bone from the os pedis. In this manner the navicular bone is preserved as well as the ball of the heel, the latter of which is of special significance in healing.

The inner wall of the claw with the powerfully developed corono-pedal ligament is divided from before backward. After the vessels which can be seen are ligated, the articular surfaces of the navicular and coronary bones curetted and the necrotic remnants of tendon removed, an antiseptic pack is applied and a tar bandage placed over it for protection. The bandage should remain for 12 or 14 days.

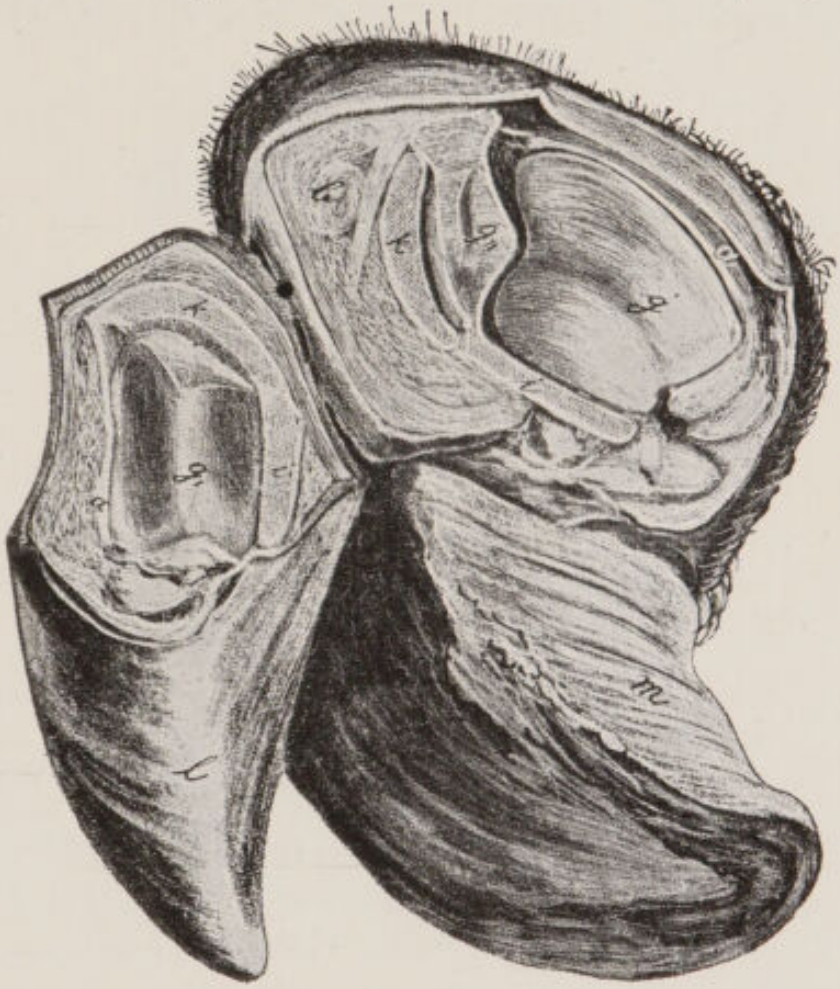

FIG. 66 Amputation of Claws.

Median claw preserved. Viewed from the solar surface outward. *a*, External corono-pedal ligament; *i*, internal do.; *k*, tendon of the flexor pedis muscle; *g*, distal articular surface of the 2nd digit; *g'* articular surface of 3rd digit; *g''*, navicular bone; *l*, lateral claw; *m*, median claw; *b*, bulb of the heel.

If the structures above this point of amputation be irremediably involved, the digit should be amputated higher up, at the articulation of the first and second phalanges or through the first phalanx. In these higher amputations a flap operation is generally practicable.

50. THE BAYER SUTURE

Fig. 67

Uses. The closure of large or penetrant wounds with convenient and secure means for applying and retaining antiseptic dressings.

Instruments. Large curved suture needle armed with strong silk thread, about 20 cm. long, which is doubled and

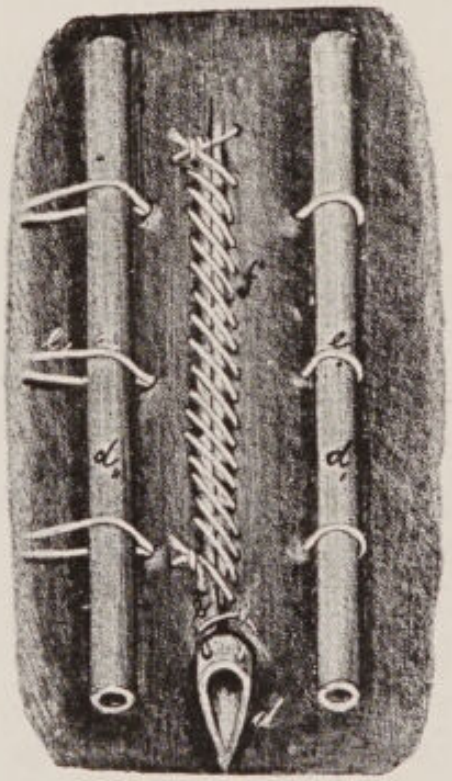

FIG. 67 Retention, and Continuous Approximation Sutures

d, *d'*, *d''*, Drainage tubes; *e*, retention suture (closed end); *e'*, open end; *b*, fixation suture for the drainage tube; *f*, continuous approximation suture.

passed through the needle eye in such a manner that the loop extends considerably beyond the cut ends; small needles and thread; needle forceps; rubber tubing, preferably two large pieces and one small with lateral openings; thin wooden splints 15 cm. long, 2 to 4 cm. wide, with rounded ends; antiseptic gauze; antiseptics.

Technic. After the skin has been shaved over an area having a radius of 5 to 6 cm. from the wound, the suture

needle is inserted 2 to 3 cm, from the lips through the skin and adjacent tissues, a piece of the rubber tubing, *d'*, passed through the closed end of the suture and the thread drawn tight. If before threading the needle, a clove hitch be made at the middle of the thread, or if threaded as above directed and the thread be thrown about the tube in a double noose, the two threads will be kept in contact as they leave the tube to enter the soft tissues and thus prevent to some

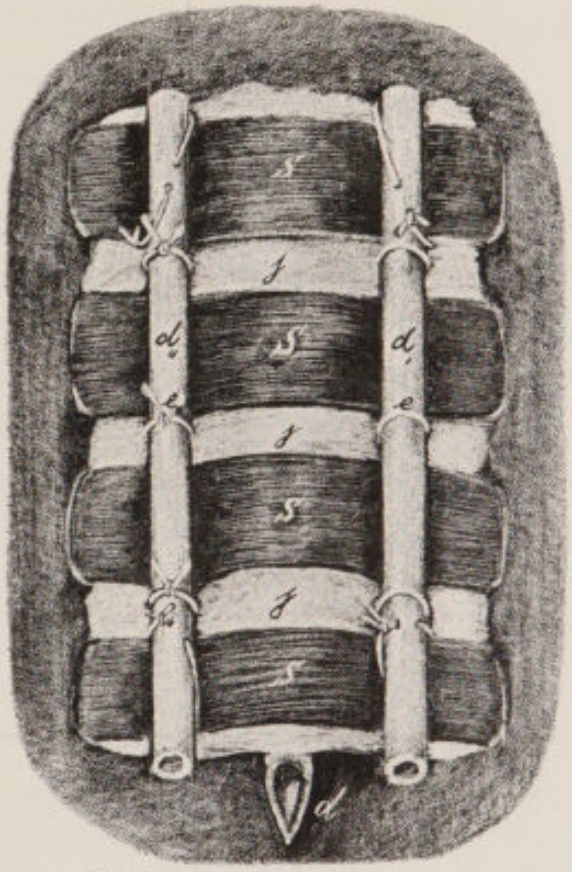

FIG. 68. Splint Bandage.

d, *d'*, *d''*, Drainage tubes; *e*, retention suture (closed ends); *e'*, do, open end; *j*, antiseptic gauze; *s*, splints.

degree, the pressure necrosis otherwise taking place, due to the tense threads of the suture separating from each other. The needle is then passed through the opposite lip of the wound from within to without at the same distance from the lips, the needle removed, the free ends drawn taut and a single knot tied against the skin to prevent the separation of the two threads for the reasons just stated above. The

second large tube, *d''*, is laid between the open ends of the double silk thread and these are tied upon it with a triple knot, after they have been drawn sufficiently tight that the approximated wound lips form a crest. If the lips of the wound can be grasped with the hand and held together in such a manner as to form a ridge 3 or 4 cm. deep, the suture needle may be passed through both simultaneously. The first suture should be located about 3 cm. beneath the upper angle of the wound, the other retention sutures follow at distances of about 5 cm. from each other and are applied in the same way.

The lips of the wound are then united by continuous approximation sutures like an overcasted seam. This suture ends at least 2 cm. above the lower angle of the wound. The third tube, for drainage, is introduced beneath the latter sutures and fixed by a separate suture.

The entire cutaneous surface lying between the drainage tubes is covered with antiseptic gauze, and between each two retention sutures there is laid over this gauze the wooden splints previously cut to the proper size, the ends of which are pushed under the tubing. The upper and lowermost splints should be secured to the tubing by means of sutures passed through them. The entire bandage is finally saturated with antiseptics. The bandage and retention sutures should remain eight days, the approximation sutures, fourteen.

B. EMBRYOTOMY OPERATIONS

Fig. 69.

The following exercises in embryotomy operations are designed to give to the student a general view of the subject by a simple plan as carried out through the aid of a skeleton provided with an artificial uterus into which are placed freshly killed, newly born calves in such a position as may be desired and the operations carried out by the student. At the same time it is hoped to offer to the veterinary obstetrist, through these descriptions, a simple and effective plan for performing embryotomy which has been fully tested by the author in an extensive obstetrical practice. In describing these operations the instruments to be used are purposely limited to the fewest number and simplest kinds, essential to their performance. The same instruments are designated for each operation.

They are, see Fig. 69: a hooked ring knife; a Colin's scalpel; an embryotomy chisel; long blunt hook; short blunt hook; repeller; probe-pointed sector; injection pump; mallet; several cotton ropes 1 cm. in diameter with a small, spliced loop at one end.

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51. CEPHALOTOMY

Object. The diminution of the size of the head on account of its oversize or the smallness of the maternal pelvis, so that it may pass through the pelvic canal.

Technic. In these cases the head is usually engaged in the canal sufficiently tight that no further fixation is necessary. Should further fixation be desired, fix the long blunt hook deeply in one orbit. After thoroughly washing and cleaning the parts inject into the vagina a copious amount of tepid emollient like suspensions of elm bark or linseed, or apply fats like lard, oil, or vaseline in order to facilitate manipulations. Carry the chisel, carefully guarded by one hand, into the passage and place it accurately upon

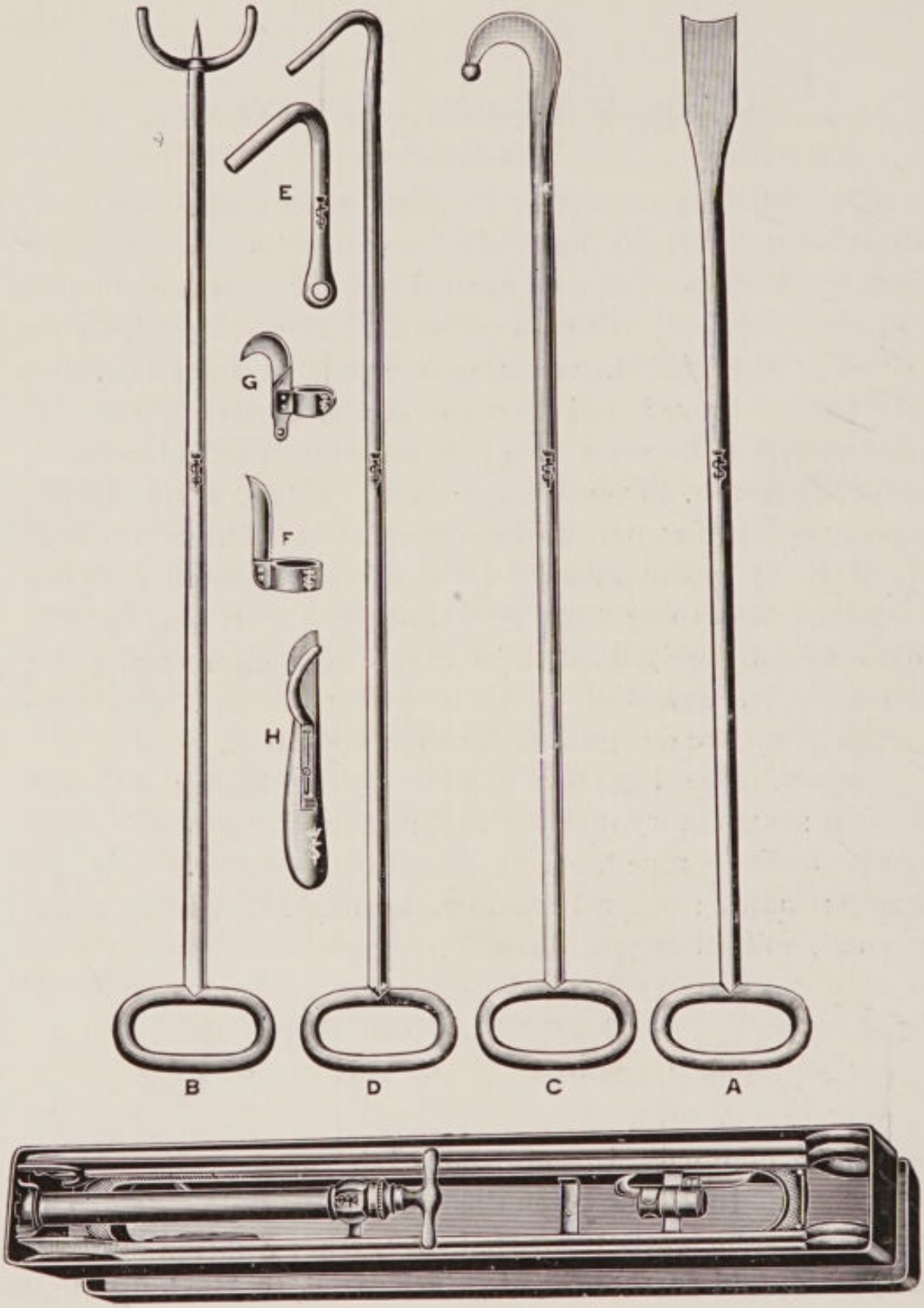

FIG. 69

Aseptible Embryotomy Outfit

A, Embryotomy chisel ; B, repeller ; C, sector ; D, long blunt hook ; E, short blunt hook ; F, ring knife ; G, hook knife ; H. Colin's scalpel The lower figure represents the entire set with injection pump arranged in aseptible metal case.

that part of the head of the fetus where it is desired to begin the operation ; generally on the median line of the nose with the blade of the chisel standing parallel to the septum nasi of the fetus. Holding the blade of the chisel firmly against the part with one hand in such a manner as to effectively guard the instrument from slipping aside and wounding the maternal organs, steady and direct the handle with the other hand and have an assistant drive the chisel by means of blows of proper vigor with the mallet into the bones of the face and head. Do not drive the chisel deeper than the length of the blade without stopping and forcibly revolving it upon its long axis and breaking the fetal bones apart. The partially detached pieces of bone may be torn away with the fingers or, in case the skin is quite adherent to them, the bone may be held with the fingers of one hand, the chisel introduced with the other and, using it as a spatula, the separation completed. The removal of the partially detached pieces of bone may in many cases be greatly facilitated by looping a cord over them and having an assistant apply traction sufficient to pull them away, the operator guarding the maternal organs by holding the piece of bone during its detachment and extraction, in the palm of his hand. Repeat the use of the chisel as often as may be necessary in order to bring about the required diminution of the head, care being taken at all times not to wound the maternal parts and to conserve as far as practicable the skin of the fetal face and head in order that it may protect the maternal parts from jagged bones during the passage of the remains of the head.

52. DECAPITATION

Objects. The facilitation of repulsion and correction of the deviation of fetal parts. The operation is generally carried out when the fetal head is far advanced in the pelvic canal or has passed beyond the vulva.

Technic. Attach a cord to the inferior maxilla of the fetus and have one or more assistants draw the head out as far as possible.

Some obstetrists have found difficulty in applying traction to the inferior maxilla by means of a cord. First make a perforating wound with the knife between the rami of the lower jaw, then carry the looped cord over the jaw and push it beyond the perforating incision with the loop resting within the mouth, and finally pass the free end of the cord through the perforation from the buccal cavity outward, and drawing upon this the inferior maxilla is so engaged that it will permit the application of powerful traction.

Make a circular incision at a convenient point through the integument encircling the head and separate the skin backward toward the occiput by forcing the hand between it and the bones or by using the chisel as a spatula or dissecting it away with the Colin's scalpel, continuing the separation over the occiput to the atloid region. Make a transverse incision below across the trachea and esophagus and surrounding muscles and above through the ligamentum nuchæ. Grasp the head firmly with both hands and twist it forcibly on its long axis rupturing the articular ligaments and the remaining muscles and other soft tissues, detaching the head at the occipito-atloid articulation. The removal of the head greatly diminishes the bulk of the fetus and it may now be repelled, or deviated parts brought into the desired position and other operations performed.

53. SUBCUTANEOUS AMPUTATION OF ANTERIOR LIMBS

Objects. Amputation of the anterior limbs is very frequently called for in equine obstetric practice, chiefly in cases of transverse presentation with all four feet presenting and the head retained where it may be impossible to safely correct the deviation, in cases of wry neck in the foal in the anterior presentation, when it is impossible to correct the deviation of the head, or in any case in the mare or cow

where deviation of the head cannot be corrected or is not so readily overcome as is the amputation of the limb.

Technic. Herbivorous animals being devoid of a clavicle, the anterior limb is attached to the thorax by means of the skin and muscles only and is therefore comparatively easily amputated. Attach a cord to the pastern of the limb, the shoulder of which lies most exposed or is most readily reached and have one or two assistants exert traction on it and draw it out as far as possible with safety to the mother. Insert one hand armed with the hooked embryotomy knife up to the top of the scapula or as nearly thereto as can be reached, the knife being well guarded in the palm of the hand which rests against the limb of the fetus; press the knife into the skin and subcutaneous tissues and drawing the hand downward slit them freely and deeply from the top of the scapula down to the pastern. Lay aside the knife and force the fingers between the skin and subjacent tissues of the limb and while an assistant maintains gentle traction, separate the skin upward by forcing the hand or the ball of the thumb through the loose connective tissue until the upper region of the scapula is reached. The separation of the skin from the subjacent parts may require at certain points, like the olecranon or carpus, the aid of the chisel or knife to divide firm bands of connective tissue. The separation of the skin from the subjacent parts has removed the chief source of resistance to the tearing of the limb away from the body. The skin is not to be severed from the foot until it has been completely detached from the leg and shoulder. The attachment of the skin to the foot gives it a neccessary fixation enabling the operator to detach it from the leg and shoulder by forcing the hand or other object upward between the skin and subjacent muscles. The next most important obstacle is the pectoral muscles which should be torn asunder by separating them into small bundles and tearing them through with the fingers between the sternum and limb, or the process may be aided by in-

cision with a knife or the chisel. When these are well divided, the remaining impediment to tearing the shoulder away consists largely of the trapezius and rhomboideus muscles at the top, the latissimus dorsi behind, and the great serratus and the angularis scapula which only come into action when the shoulder is nearly severed. It only remains, therefore, to separate the skin from the limb and divide the pectoral muscles in order to readily draw the leg away by traction. Divide the skin around the pastern. Have two or three assistants exert traction upon the limb while the operator places his hand against the sternum and pushes in the opposite direction. Or the operator may increase his repulsion by using the repeller and pushing upon the crutch with his hand while an assistant pushes upon the repeller handle. The impact upon the maternal organs due to the traction may be reduced to almost any desired degree by applying a corresponding amount of repelling force to the sternum of the fetus. If the repelling force applied to the fetal sternum equals the traction upon the limb, the impact of the fetus against the maternal organs becomes nil.

If traction does not bring the limb away promptly, the operator should attempt to extend the division of the muscles attaching it to the thorax while moderate traction is continued.

Further diminution of the size of the fetus may now be had by removal of the other limb in the same manner which is especially desirable in the transverse presentation with all four limbs in the passages, or the size of the trunk may be reduced by evisceration as described under 59.

This diminution suffices to permit the torso to be withdrawn with the head deviated to the side, because the total volume is then no greater than with the head normally presented. It also renders the fetal body very flaccid, and easy of repulsion and simplifies the correction of any deviations of parts.

54. AMPUTATION AT HUMERO-RADIAL ARTICULATION

Object. Amputation at this point is rarely desirable, but may at times be necessary in the mare in order to remove an anterior limb when it is impossible to reach the shoulder on account of the position.

Technic. Attach a cord to the pastern and have an assistant render the leg tense by exerting moderate traction, as in the preceding. Introduce the hand armed with the embryotomy knife, carefully concealed in the palm, and girdle the skin around the articulation. Passing above the head of the olecranon on the posterior side, divide the attachment of the anconean group of muscles with the knife by cutting from behind forward. Then divide transversely, as far as possible, the muscles and ligaments passing over the articulation. Rotate the limb forcibly on its long axis while strong traction is maintained, and rupture the principal ligaments until the limb is completely detached and comes away. In cases of limited room it may sometimes be easier to detach the skin of the limb from the pastern up to the articulation, as in the preceding chapter, rather than to girdle it.

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55. DETRUNCATION

Fig. 70

Object. In the mare a fetus in the anterior presentation and dorso-sacral position sometimes has one or both posterior limbs deviated forward and the feet engaged in or against the pelvis. It may then be necessary, or at least advisable, to divide the trunk of the fetus in order to bring about delivery without serious or fatal injury to the mother.

Technic. If possible, secure the two hind feet by means of cords, prior to other manipulations. Apply cords to the

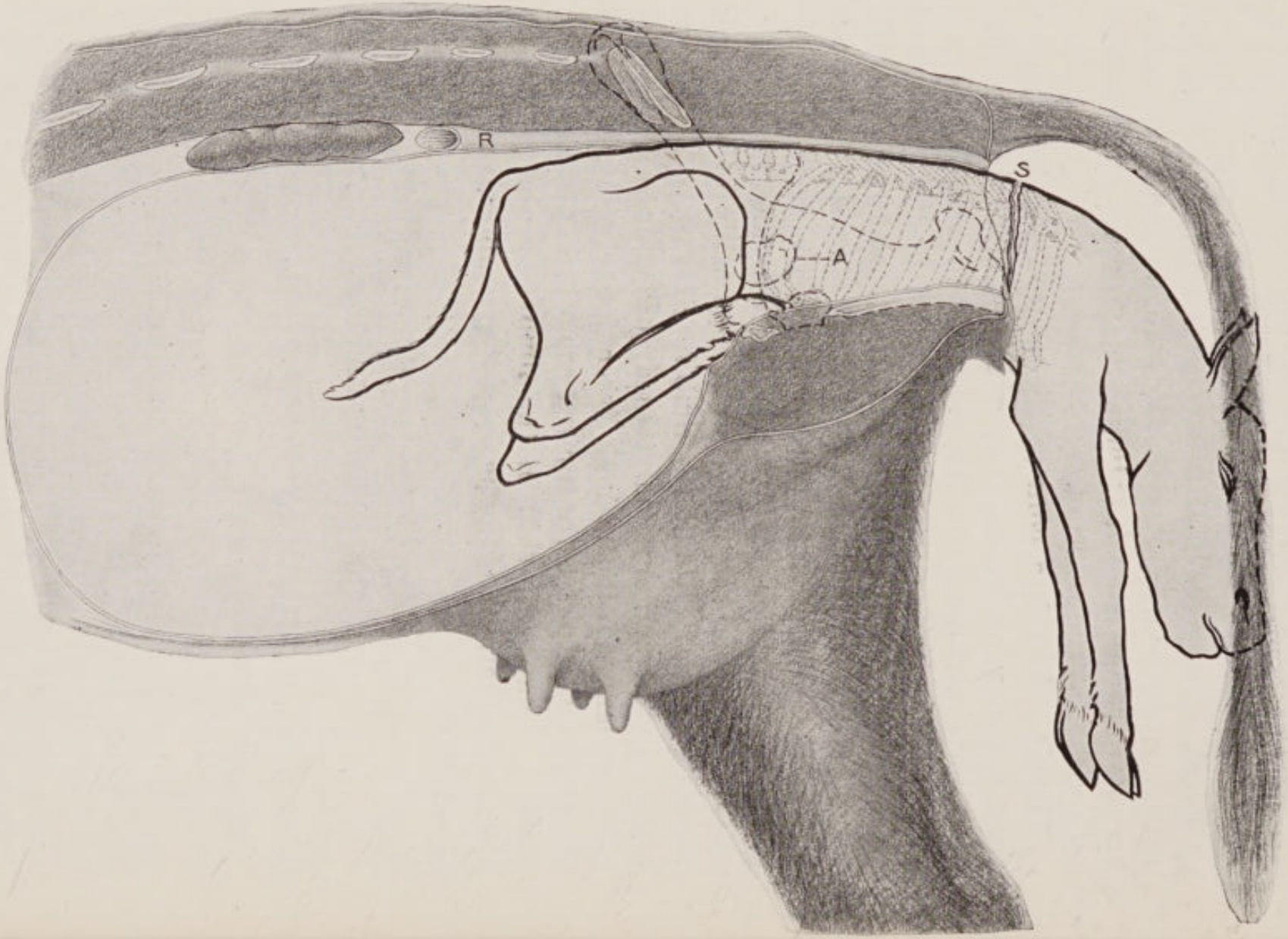

FIG. 70

FIG. 70

Detruncation

Embryotomy in anterior presentation; dorso-sacral position, the two hind feet engaged in the pelvis. S, Point of incision through the skin. The dotted line behind and parallel to the last fetal rib indicates point for severing the muscles and spinal column.

two anterior limbs and the head, have one or two assistants draw the anterior part of the fetus as far out as practicable and safe, and then girdle the fetal body immediately against the maternal vulva by making an incision through the skin and skin muscle. If practicable it is best at this point to remove one shoulder subcutaneously, and follow by evisceration, in order to give greater operative room and increased mobility of the fetus. Insinuate the hand between the skin and the deeper structures and forcibly separate the integument from the fetal body backward until the last rib is passed, as shown at the curved line in Fig. 70. Force the finger tips through the abdominal wall behind the last rib and passing along the entire border of each posterior rib, separate the abdominal walls from the ribs and sternum. After the abdominal muscles have been detached, and the fetus has been eviscerated, rotate the thorax upon its long axis which will cause a division of the vertebral column near the dorsal-lumbar articulation and the anterior portion of the fetus to fall away.

Secure the two posterior feet with cords, unless this has already been done, spread the detached skin, which has been pushed back from the thorax, carefully over the amputation stump of the lumbar vertebrae, repel these by means of the hand while an assistant draws upon the cords attached to the feet, push the remnant of the fetal trunk into the uterus and advance the feet along the genital passages, thus converting it into a posterior presentation. Ordinarily this would result in a dorso-pubic position. This should be converted into the dorso-sacral position, when its extraction can be readily brought about.

56. DESTRUCTION OF THE PELVIC GIRDLE IN THE ANTERIOR PRESENTATION

Fig. 71

Object. In somewhat rare instances, perhaps most frequently in the cow, the pelves of the mother and fetus become interlocked, the antero-external angle of the fetal ilium, I′, becoming locked with the shaft of the maternal ilium, I, at C in such a manner that any safe degree of traction fails to dislodge it.

The interlocking is generally, if not always, caused by traction wrongly applied. At the stage of expulsion or extraction of the fetus, when the interlocking occurs, any traction applied should be parallel to the long axes of the posterior limbs of the cow : the head of the fetus should be directed toward the hind feet of the cow.

Technic. Remove one anterior limb subcutaneously, (53) and eviscerate, (59) through an opening made by the removal of two or three of the exposed ribs. Introduce the chisel through this opening, carry it back with the hand, place it against the shaft of the fetal ilium, I′, and have an assistant drive it through the bone from before to behind. Revolve the chisel forcibly on its long axis to completely break down the ilium and its periosteum. Then withdraw the chisel, place it against the pubic brim either at the symphysis pubis or opposite the obturator foramen, and drive it through the pubis and ichium at either of these points. The coxo-femoral articulation is thus detached and isolated so that the entire limb may drop backward beyond its fellow, the remnant of the severed ilium, I′, can drop downward or move in any direction, the entire pelvis thus loses its rigidity and undergoes great diminution in size so that it can readily be withdrawn.

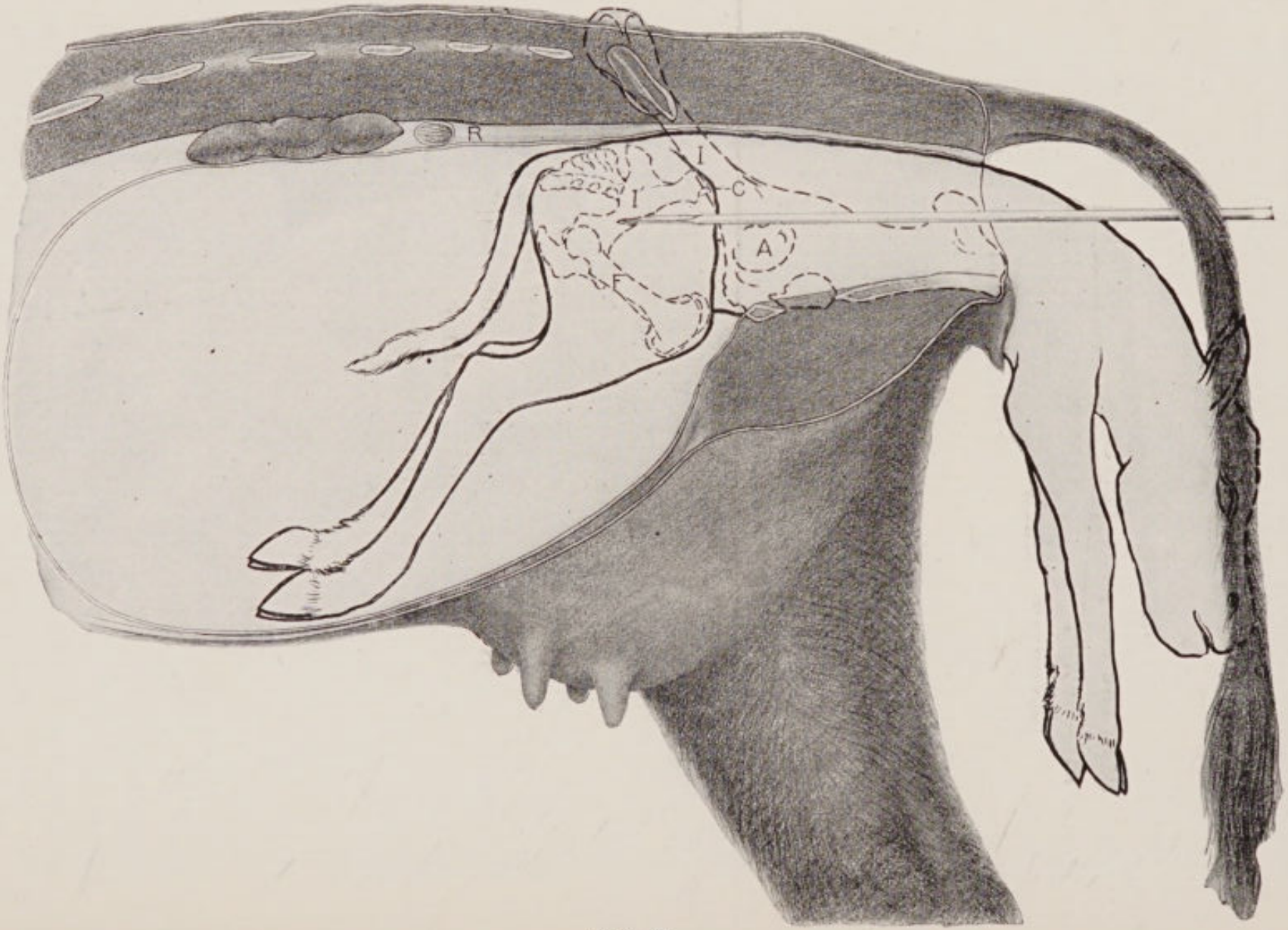

FIG. 71

Fig. 71

Destruction of the Pelvic Girdle

Embryotomy in anterior presentation ; dorso-sacral position, the fetal and maternal pelves interlocked. C, Chief point of impact between the two pelves ; I, maternal ilium ; I′, fetal ilium, showing chisel passing through its shaft ; R, rectum ; A, outline of maternal coxo-femoral articulation.

57. AMPUTATION OF THE LIMBS AT THE TARSUS

FIG. 72

Object. In the mare and cow, when the fetus presents posteriorly with the hind limbs retained at the hocks, it is sometimes impossible or imprudent to correct the deviation. This is especially true when the fetus is dead and emphysematous. In these cases it is sometimes easier for the obstetrist, and safer for the mother, to amputate the limb at the tarsus.

Technic. Pass a cord around the leg above the tarsus as indicated in Fig. 72, and have an assistant hold the leg steady by gentle traction. Introduce the chisel, carefully guarded in the palm of the hand, and place it against the lower part of the tarsus as shown between T, T. The chisel should be placed as nearly as possible perpendicular to the long axis of the metatarsus. The proper direction of the chisel may at times be greatly favored by placing the cord upon the metatarsus instead of the tibia, thus forcing the tarsus toward the sacrum of the mother and tending to throw the metatarsus straight across the pelvic cavity. When the fetus is in the dorso-sacral position and it is desired to amputate the left limb, the chisel should be held in the palm of the left hand with its dorsal surface against the vaginal walls and the instrument carefully guarded and guided during the entire operation. The amputation should preferably be through the lower section of the tarsus but may be made through the head of the metatarsus. Do not drive the chisel entirely through the hock without removal as it may become caught and clamped between the divided bones, but drive for a few inches along the lateral side, being sure that the skin at that point is severed along with the bone, then loosen the chisel by rotation and lateral motion and drive somewhat deeper into the tarsus until it is completely severed. Withdraw the severed metatarsus, re-

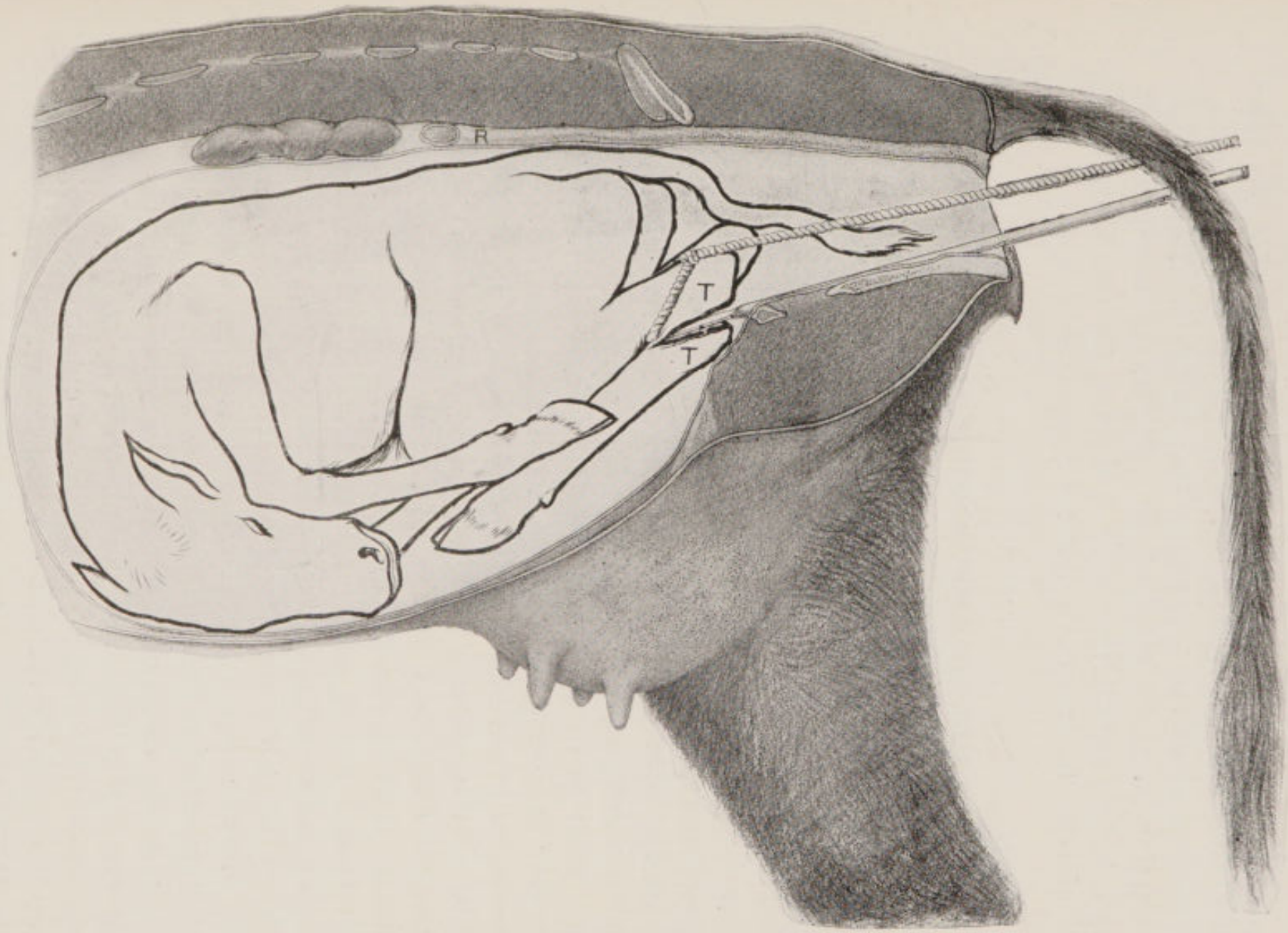

FIG. 72

Amputation of the Posterior Limbs at the Tarsus.

Embryotomy in the posterior presentation with irreducible retention of the posterior limbs. T, T, Tarsus in process of amputation by means of the chisel.

move any dangerous spicules of bone remaining on the stump and see that the latter is safely secured by a cord passing around the leg above the os calcis. Repeat the operation on the other hock in a similar manner using the right hand to guide the chisel. Extend the two limbs into the passage by traction and effect a posterior delivery.

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58. INTRA-PELVIC AMPUTATION OF THE POSTERIOR LIMBS, BREECH PRESENTATION

FIG. 73

Uses. The overcoming of dystocia due to a posterior presentation with the hind limbs completely retained in the uterus, the so-called breech presentation, in cases where the deviation can not be readily corrected.

Technic. Introduce one hand, armed with the embryotomy knife, through the maternal passages until the perineum of the fetus is reached, make a free incision through that region, involving the anus in the male fetus and the anus and vulva in the female, and enlarge the incision sufficiently to admit the operator's fingers into the fetal pelvis. Locate the great sciatic ligament and with the knife or chisel divide it from end to end, thus enlarging the pelvic cavity and giving ample operating room. When this has been severed and sufficient operating room attained, carry the chisel with the hand, place it against the shaft of the ilium as shown between I′ I′ in Fig. 73, as nearly perpendicular to the long axis of the iliac shaft as possible and keeping the hand in touch with the chisel blade, have an assistant drive it through the bone until it and its periosteum are completely severed. Revolve the chisel on its long axis and force the cut ends of the bone apart. Disengage the chisel and place it against the symphysis pubis or against the ischium opposite the obturator foramen and drive it

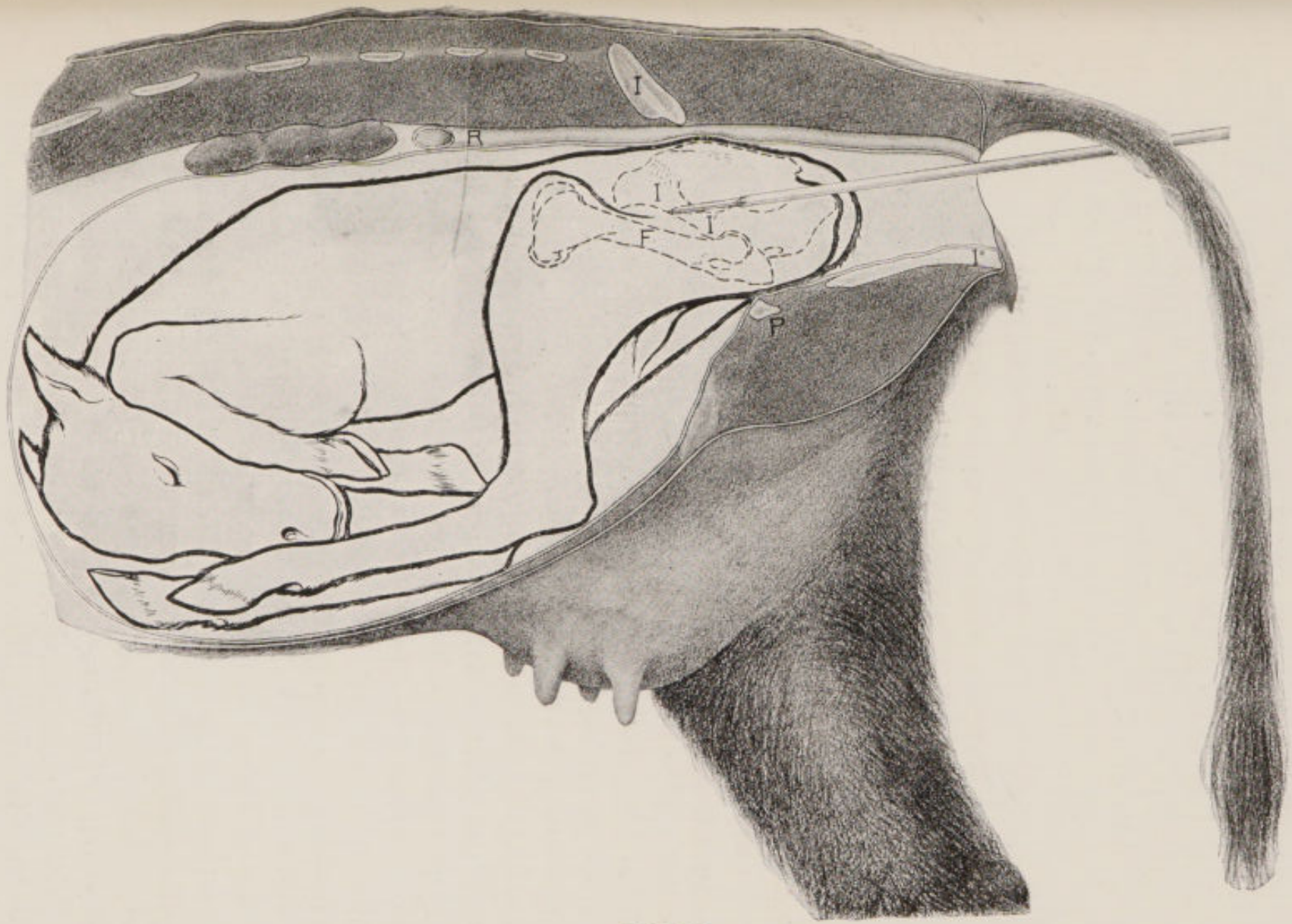

FIG. 73
Intra-pelvic Amputation of the Posterior Extremities

Embryotomy in the posterior presentation with the hind legs completely retained. Breech presentation I, Maternal ilium ; I′I′, fetal ilium ; I″, maternal ischium ; P, pubis ; F, fetal femur. The chisel is shown passing through the shaft of the fetal ilium.

through the ischium and pubis at this point. Revolve the chisel upon its long axis and separate the isolated portion of the pelvis as completely as practicable from the surrounding tissues. Separate the muscles with the fingers from the detached pelvic bone for a short distance from the severed ends on either side. The most important point of resistance is the attachment posteriorly of the skin, vulva and anus to the sciatic ligament and the ischium and anteriorly, chiefly on the median line, the prepubic tendon to the pubic brim; these are to be cut, if necessary, with the chisel or knife. The next most important obstacle to tearing away of the limb is the great gluteus muscle which should be sought for, identified and torn through with the fingers at a distance of 5 or 6 cm. from its attachment to the great trochanter. Carry a cord in, pass the loop over the ends of the severed section and, tightening it, secure the isolated portion of the pelvis and have one or more assistants exert traction as indicated in Fig. 74. Vigorous traction may be applied by means of the cord, the operator in the meantime guarding the most advanced end of the detached piece of pelvis with the palm of his hand in order to prevent injury to the maternal organs. Sometimes this detached piece of the pelvis tears away from the femur when traction is applied, and comes away alone. In such a case the cord is to be applied over the head and trochanter of the femur and traction again applied drawing the limb away in a reversed position, the skin being turned back or everted as it advances, until the region of the hock is reached where the integument does not so readily separate and only requires to be cut loose and the member allowed to come away. During the removal of the limb the operator is to constantly note the progress with his hand and sever by tearing or cutting any tendons or muscles which offer special obstruction to the operation. Repeat the operation upon the opposite limb in the same manner except that but one incision need be made through the bone, that is, through

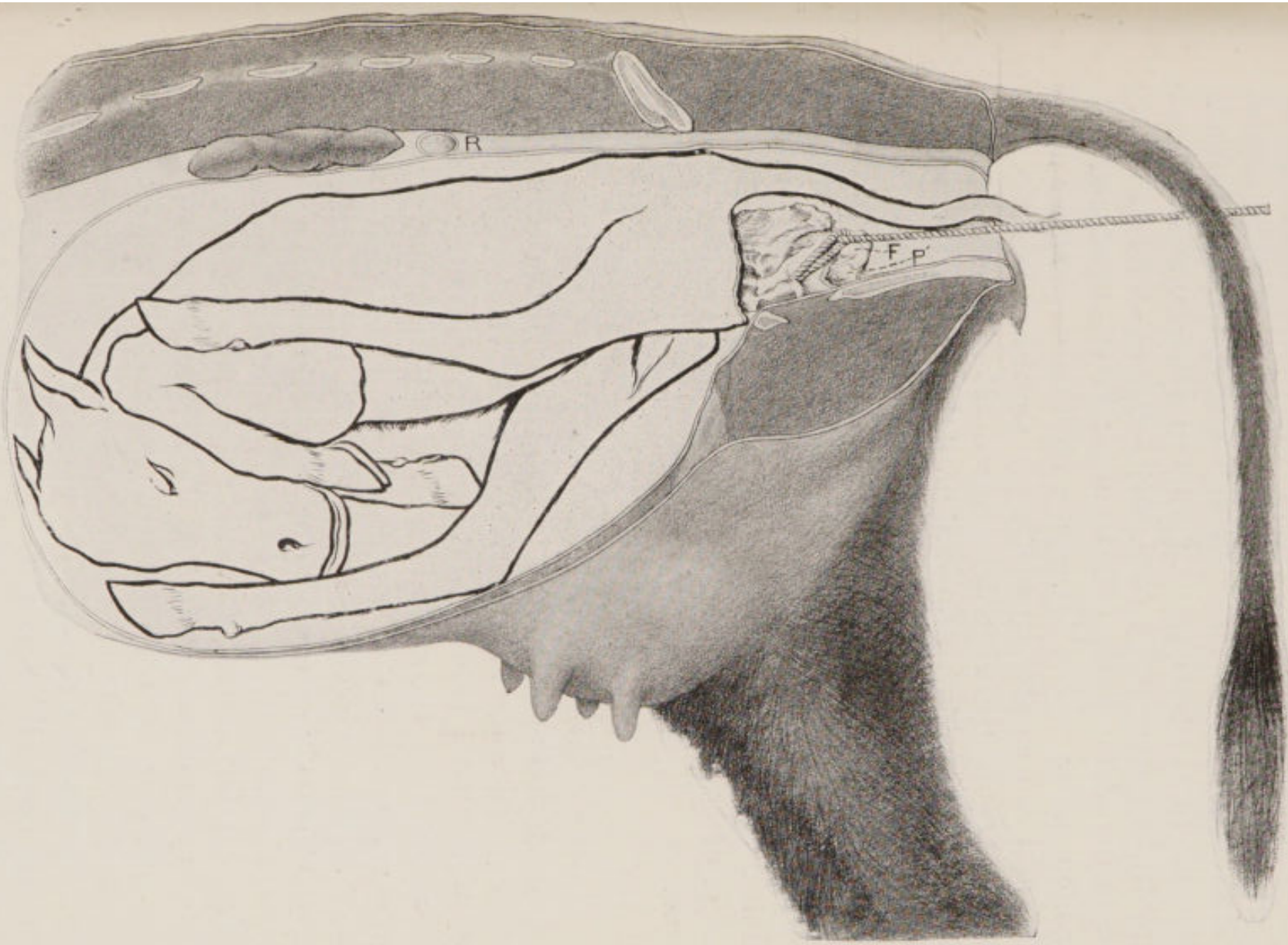

FIG. 74

Intra-Pelvic Amputation of the Porterior Extremities

Embryotomy in the posterior presentation with the hind legs completely retained. Breech presentation. F, Trochanter of the fetal femur; P′, the fetal pubis. The rope is looped over the isolated coxo-femoral articulation including portions of ilium, pubis and ischium.

the shaft of the ilium. During the entire work the operation is carried out subcutaneously or rather intra-fetally and the maternal parts are amply guarded against injury. The size of the fetal trunk may be further reduced if desirable, by evisceration, (60), and followed still further by the introduction of the chisel guided by the hand and the ribs, on one or both sides, severed one after another until the chest can completely collapse. Or the ribs may be yet more conveniently severed by introducing the sector in the body cavity, pushing it forward until the first rib is reached, catching the spherical end over the rib and drawing backward, severing each rib in turn. If need be, some of these may be removed and one of the anterior limbs caught by a cord around the scapula and the fore leg extracted intra-fetally. The remnant of the fetus is to be extracted by means of a cord fastened about the lumbar region of the spine.

59. EVISCERATION

Evisceration of the fetus is frequently desirable in obstetric practice and has a variety of uses. It decreases the size of the fetal trunk greatly and permits its more ready passage through the genital canal, as in the anterior presentation; it renders the fetal trunk flaccid through the removal of the viscera supporting the body walls, and permits the body remnant to be bent or moved more readily for the correction of any mal-presentation like that of the lateral deviation of the head; it permits freedom of intra-fetal operations directed against other parts, as for detruncation, or for the destruction of the pelvic girdle in the anterior presentation; and when a fetus is emphysematous, evisceration permits the gases of decomposition to pass into the fetal body cavity and thence externally. The escape of gases is very greatly favored further by the cutting of the ribs.

Technic. Evisceration may be variously performed, but is generally demanded in either the anterior or posterior presentation and a description of these will suffice.

In the anterior presentation, unless the fetus is far advanced through the vulva, evisceration is best performed by the removal of one or more of the anterior ribs. The ribs are generally best reached by the removal of the shoulder, as already described under subcutaneous amputation of the anterior limbs (54). When the ribs have been laid bare in the manner described, the operator can thrust the finger tips through the intercostal muscles in the first space and enlarge the opening thus made by tearing through the muscles upward to the spinal column and downward to the sternum; then grasping the posterior border of the rib near its middle, fracture it by means of a sudden and vigorous pull. The fractured ends may then be grasped and pulled, broken, or twisted off. The chisel may be brought into use, if required, in order to divide the rib, the hand of the operator constantly guiding and guarding the chisel blade. The operation is then to be repeated, if required, upon the second and third ribs in the same manner until an opening into the chest is secured ample in size for the introduction of the operator's hand.

Pass one hand through the opening and tear the mediastium above and below from the thoracic walls, and then grasp either the trachea at its bifurcation or the heart and tear them away. The heart, which constitutes the greater bulk of the thoracic viscera, is best grasped in the palm of the hand with the fingers engaging the aorta and pulmonary arteries. When the thoracic viscera have been withdrawn, thrust the fingers through the diaphragm and locating the liver, isolate the diaphragmatic area to which it is attached, and engaging both with the fingers remove the two together. The liver constitutes, in a normal fetus, the chief intra-abdominal mass, occupying more space than all

other organs combined. After the liver has been removed, the intestinal tube, with its contents, is withdrawn without difficulty, as its attachments are feeble. The kidneys may also be removed.

Evisceration in the posterior presentation is preferably performed through the pelvis, generally in connection with intra-pelvic amputation of the posterior limbs (59). It may be performed without destruction of the pelvic girdle by making an incision through the perineal region and by then severing the sacro-sciatic ligament as directed under 59. When admission has been gained to the abdominal cavity, introduce the hand and withdraw the alimentary tube, then rupture the diaphragm about the liver and tear away the latter organ in the same manner as in the anterior presentation. The liver is so friable that it cannot well be removed by grasping the organ itself, but comes away entire with the central part of the diaphragm.

Remove the heart and lungs as above directed.