

FRICK'S
ANTISEPTIC TREATMENT
OF WOUNDS
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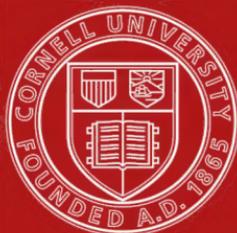
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OUTLINE OF THE
ANTISEPTIC TREATMENT OF
WOUNDS

FOR VETERINARIANS.

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TRANSLATOR'S PREFACE.

Being but a layman, and fearing that, by changing terms and reconstructing sentences, I might not exactly convey the ideas of the author, I simply made a literal translation, and left the arduous task of reconstructing all such sentences which would possibly impair the sense of any part, to Professors A. H. Baker and L. A. Merillat, who have also written many valuable annotations, thus bringing this little work to an up-to-date level. To these gentlemen belongs the credit of this addition to Veterinary Literature, and I hereby express to them my sincere thanks for their labor in arranging the matter.

If my readers, refraining from severe criticism, can obtain any useful information from these pages, I will feel fully repaid.

A. E.

Chicago, December 15th, 1899.

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PREFACE.

It is an undeniable fact that the medicinal treatment of internal diseases, as far as human medicine is concerned, is gradually becoming less, while the surgeon eventually draws more and more into his sphere such diseases, which, in regard to their therapeutics, belong in the territory of internal clinics. It is further proven that the surgeon has been able to encroach upon this territory of internal medicine chiefly through an acquisition of modern times, namely, the antiseptic treatment of wounds. The reason of this probably lies in the fact that a surgical operation in many internal diseases, for instance, of the peritoneal and thoracic cavities, without antiseptic precautions, was synonymous with death.

While the surgeon in human medicine thus continues to gain in both territory and importance, the corresponding circumstances in veterinary science are still wanting. Although for us veterinarians everything does not depend upon the saving of the life of the individual, without any consideration of the costs, means, and effects, we should nevertheless use all means offered by science to preserve for the national wealth, all the funds invested in our domestic animals.

Owing to the fact that we very frequently perform surgical operations to make animals more useful for our purposes, as well as to heal diseases, the consideration, whether the antiseptic treatment of wounds in veterinary surgery would not offer the same advantages as in human, was fully justified.

However, in the attempt to utilize antisepsis in veterinary surgery the progress and results of the past did not warrant its general adoption by the veterinary profession. I have never doubted the good intentions of the veterinary practitioner to give the public better services than was possible heretofore,

being aware that it was tardily adopted only because human clinical methods are not generally applicable in veterinary surgery.

As assistant in the Royal Veterinary High School, under the guidance of PROFESSOR MOELLER, I have for two years had ample opportunity to do practical antiseptics; then through the kindness of DR. HILDEBRANDT, director of the local hospital, I was offered abundant material on which to study all the details of antiseptics. I herewith express my sincere thanks to both these gentlemen.

Thus prepared, I adopted the antiseptic treatment of wounds in my private practice, and have laid down my experiences in this book.

In judging this work I beg to state that the few pointers, which are to be found in the current literature, are hardly sufficient to elucidate the antiseptic method of treating wounds, and that the works on human surgery on this subject could not very well be used, as veterinary science has to figure with entirely different conditions. I have therefore endeavored to make only clearly practical statements and to employ scientific explanations only, as far as they are necessary to render the subject comprehensible. I am well aware that this work is not complete, but should it be an incentive in causing the antiseptic treatment of wounds to be more universally adopted, and in inducing a more elaborate working out of the same for our purposes, I shall be satisfied.

FRICK, HETTSEDT, GERMANY.

INTRODUCTION.

For the modern surgeon there is but one fundamental maxim, which is leading and deciding in all its applications, namely:

“All accidental diseases caused by wounds (erysipelas, cellulitis, suppuration, pyaemia, septicaemia, etc.,) are caused by the immigration of vegetable life into the wounds as well as into their surroundings.”

LISTER was the first person to express himself in this sense, and he proved his opinion by the results of the “Antiseptic Treatment of Wounds,” inaugurated by him. For years the results of this method was the only proof that LISTER’S view, in regard to the accidental wound diseases, was correct, until by the bacteriological investigations of R. KOCH, ROSENBACH, PASSET and others, the experimental proofs were found. Thus LISTER was the founder of a new principle in the treatment of wounds, which was then, in view of the fact that it lead the chief points of consideration against septic processes in wounds, named “ANTISEPTIC.” Recently there was some argument in regard to whether the name “Antiseptic” was still justified, as it refers also to suppuration, which is not a sepsis. In my opinion these arguments are superfluous, as the word “Antisepsis,” which has been universally adopted, and freely discussed, means the “combating of accidental diseases of wounds.” No matter how much the technics of the methods may change, LISTER’S idea, which is expressed in the above sentence, must always determine the treatment of wounds. I must abstain from a discussion of the accidental wound diseases, as the limit of this work would be transgressed. Veterinary science cannot exclude itself from the advantages of this method, and most

clinicians, with the exception of a few country practitioners, have adopted antiseptis. No practical veterinarian will hesitate to adopt it, however, when it assumes a form capable of adopting itself to the very different conditions of our animals, as compared to the human.

The modern antiseptic treatment of wounds as well as the remarkable successful results in surgery, which have attracted even the attention of the layman, is due to the above mentioned maxim.

It must here be acknowledged that the antiseptic methods in vogue in human surgery (for example, bandaging) cannot readily be adopted by the veterinarian, but this work should be a guide, by which, with the aid of antiseptics, we can learn to improve our methods of treating the wounds of animals aseptically.

I. HISTORICAL.

LISTER must undoubtedly be looked upon as the originator of the antiseptic mode of treating wounds, as he was the first surgeon who methodically attended to their treatment with this object in view. The LISTER method was introduced to German physicians in 1872 by SHULTZE, who had studied and seen the procedures of LISTER himself in Edinburg. LISTER, when originating this method, relied upon the well-known putrefaction experiments of SCHULZE, SCHWANN, SCHLEIDEN, SCHROEDER, DUSCH, PASTEUR, and others, and assigned the results of the above mentioned investigators to the processes of decomposition in wounds. According to his conviction every decomposition in a wound could be arrested if all germs present in the wound could be killed, and the introduction of the same from outside, either through the air, or other things that come in contact with the wound, could be prevented. After several trials LISTER decided upon the following *modus operandi*: If a fresh wound is made, for instance, with the object of an operation, all articles in connection with it should be made germ free, that is, disinfected. LISTER used for this purpose carbolic acid. The instruments were lying in a 3 per cent. aqueous solution of carbolic acid, the hands of the operator, of his assistants, also the operating table, after a preliminary thorough cleansing with soap and water, were rinsed with a 2 per cent. solution of carbolic acid; finally the air in the vicinity of the operating field was disinfected by a 1 per cent. solution of carbolic acid spray. After these preparations the field of the operation itself was disinfected, all the hair shaved off the skin, thoroughly washed with a brush, soap and warm water, and rinsed with a 2 per cent. solution of carbolic acid.

And now we are ready to proceed with the operation. The same is carried through under a steady spray, even as far as the bandage is concerned. As the haemorrhage must be arrested or controlled, the ligatures must also be aseptic. LISTER introduced a material for that purpose which is also used at present and which has the advantage of becoming absorbed, namely, the catgut. This was made aseptic by being soaked for two months in an emulsion of one part of carbolic acid and five parts of olive oil, and was used both for ligating vessels as well as suturing. In the latter case LISTER substituted the catgut with carbolized silk, especially if the sutures had to stand a stronger strain. After inserting carbolized rubber tubes in the wound for drainage, LISTER put on the bandage, which, according to his idea, would save the wound from external infection. At this time he recommended wadding as bandaging material, on account of its property of keeping back the putrefactive germs of the air, but he did not follow this theory, as it was not reliable enough for him (we will see later that he did injustice to the wadding), and he therefore substituted gauze saturated with carbolic acid. The bandage was formed thus: On the wound itself came a piece of protective silk, then eight layers of gauze; between the seventh and eighth layers a piece of mackintosh was placed, and the whole thing fastened with several turns of gauze bandage. The idea of the protective silk in the bandage was to prevent the irritation caused by the wound coming in direct contact with the carbolic acid through the gauze. The secretions of the wound were to be absorbed by the carbolized gauze, but to prevent their passing through the eight layers and exposing them to infection by the air, the piece of mackintosh was inserted.

In this manner LISTER treated fresh wounds, but in wounds which were of longer standing, therefore already infected, he acknowledged that the above mentioned methods were not sufficient, being fully aware of the fact, that for the removal of sepsis, if present, stronger carbolic acid solutions were needed than for preventing infection of a fresh wound. On this ac-

count he washed all such wounds with a 2½ to 5 per cent. solution of carbolic acid, and he even used chloride of zinc in the form of an 8 to 10 per cent. watery solution, in which case he used carbolic acid only after the removal of the infection. Notwithstanding these facts he did not succeed in making every wound aseptic, which he explained by the fact, that the carbolic acid solution does not always enter into all the recesses and sinuses of a wound.

LISTER had so much success with this method, that it was justly wondered at, for while in his own practice, prior to the antiseptic time, 45.7 per cent. cases of amputation died; this number, by the application of antiseptics, was reduced to 15 per cent. Healing of wounds by first intention became by using LISTER'S method, a rule, while in the ante antiseptic times such occurrences were considered as exceptional and mere coincidents. Notwithstanding these successes there were numerous surgeons who claimed not to have had extra good results with this mode of treatment, but the fault was with the surgeon, not in the method. LISTER stated expressly that his successes were due mainly to the minutes' observation of all individual details, and this rule LISTER'S antagonists violated persistently.

On the recommendation of SCHULTZE, R. VOLKMANN and THIERSCH undertook to put LISTER'S method to a test. Both came to the same conclusion, namely, that upon minutely observing LISTER'S rules, the advantages gained by his methods were so great that the old mode of treating wounds could not at all compare with it. The statistics furnished by VOLKMAN and THIERSCH left no doubt whatever as to this fact. They both had but one objection; that is, that the carbolic acid did not prove harmless in some collapsed conditions, as intoxications occasionally appeared after an operation. LISTER himself does not mention anything of carbolic intoxications, possibly he did not recognize them; however, VOLKMANN, as well as THIERSCH reported them, and they looked about for a substitute that would be harmless to the organism. THIERSCH adopted salicylic acid

just discovered by KOLBE, and retained the carbolic acid only to disinfect the instruments and the catgut; for all the other manipulations, such as spraying, washing of the wound, disinfecting hands, saturating bandaging material, etc., he used salicylic acid. THIERSCH modified the bandage some, for the 3 to 10 per cent. salicylic wadding, which had been adopted, became impermeable on account of the drying of the wound exudations in it and obstructing their further flow. Instead of the protective silk he took fenestrated guttapercha paper, and left the mackintosh out, thus being able to saturate the bandage daily with salicylic water, and keep the deepest layers disinfected and filtered. Later on THIERSCH seldom used these moist bandages, because they were annoying to both the patient and medical staff, and superfluous in regular antiseptics. VOLKMANN, according to his own testimony, had carbolic intoxications only while he was unfamiliar with the procedure, later he has seldom seen them; notwithstanding this he experimentally tried benzoic acid, especially in the form of Benzoic wadding.

After the good results that THIERSCH and VOLKMANN attained with the LISTER method, all the surgeons, which were cautious heretofore in regard to its use, dropped their prejudices and adopted it. However, complaints regarding the danger of carbolic acid became so numerous that many others like VOLKMANN and THIERSCH, looked for a substitute for it, and a period commenced in which various remedies were recommended, but only a few ever cut even a passing figure in the antiseptic treatment of wounds. Of the antiseptics, which originated at this period and are partially in use still, the ones described below may be discussed. As much as the remedies may be changed today, LISTER'S principle has been the basis upon which the various authors have worked.

RANKE, who experimented under VOLKMANN, used thymol, which had been recommended by HAUSEMANN and LEWIN, instead of carbolic acid. In the form of a 1 per cent. aqueous solution it was adopted in many cases, on account of

being innocuous and sufficiently disinfectant. The only carbolized preparation that RANKE used was carbolized catgut.

KOCHER had had experience with carbolic antiseptics inasmuch as he lost several patients in rotation by intoxication; besides he also wanted to establish an aseptic condition in infected wounds. That carbolic acid, especially for the latter purpose, was not suitable, even LISTER emphasized and he substituted chloride of zinc, but as the latter has a caustic effect in concentration (8 per cent.), and thus hinders the primary intention, KOCHER tried to find out such a concentration, which would be sufficiently antiseptic without preventing healing by first intention. After many experiments, together with AMUAT, he decided on a 1 per cent. solution in infected and 0.2 per cent. solution of the remedy in fresh wounds. Besides he modified the process so far as to omit the spray, the same as was done by TRENDELENBURG, BRUNS, and BILLROTH ere this, though they otherwise strictly followed LISTER'S method. The carbolic acid was used only for disinfecting instruments while the ligatures were prepared in oil of juniper and preserved in a 95 per cent. solution of alcohol.

Notwithstanding these improvements in the technique of the methods, cases came up in which one or another remedy proved inadequate; besides the procedure was still too circumstantial, especially the preparation and use of the disinfecting fluids. MOSETIG-MOORHOF recommended a procedure, which in view of LISTER'S claims, was easily adoptable for the practical physician. He found iodoform to be a substance which proves effectual, owing to the fact that it is insoluble in wound secretions, and through the permanent chemical assimilation it undergoes by contacting living animal tissues, it forms a store of disinfecting material in the wound, and thereby permanently destroys all possible germs. Therewith he maintained that the bandage, which otherwise had to prevent the intrusion of micro organisms into the wound, had not to be put on with so much precision. He con-

sidered the advantages of iodoform for the treatment of wounds to be as follows:

First—Iodoform is a specific against local tubercular processes.

Second—It is a safe antiseptic for all wounds.

Third—If used in limited quantities it is absolutely harmless to the organism.

Fourth—It relieves pain, limits exudation, and promotes granulation.

Fifth—It does not prevent healing by first intention if brought between two sutured wound surfaces.

Sixth—It is so strongly antiseptic, that it is not necessary to use other antiseptics. For washing of the wound, therefore, only warm water is needed, and otherwise the cleanliness of all things which come in contact with the wound, such as instruments, hands, sewing material, etc., is necessary.

Seventh—It allows an essential simplification of the bandage.

Eighth—It is possible with the aid of iodoform to make wounds of the oral cavity, and of the rectum and bladder, aseptic.

MOSETIC used the iodoform in the shape of a fine powder, by strewing it on the wound washed with clean water, in a thickness of about one-half cm. and then covering it with iodoform gauze. Simple absorbent cotton and gauze bandages completed the dressing. In narrow wounds he applied the remedy in an emulsion (iodoform 50, glycerin 40, aq. dist. 10, gum tragacanth, 0.3), as iodoform gelatin. The form MIKULICZ and BIEDER recommended, iodoform ether, he did not consider suitable because it irritates the textures.

Although MOSETIG claimed his iodoform bandage to be an ideal one for wounds, he could not deny that it possessed many disadvantages, for instance, eczemas occasionally followed and even intoxications with deadly terminations. Though the cause of these accidents was due chiefly to the use of too large quantities, it has been ascertained that these evidences of intoxication could be observed even in the applications of smaller quantities. Therefore, the pure iodoform

bandage, as MOŠETIG recommended, did not become popular; only the iodoform itself has maintained its place in surgery, and it will continue to be used, notwithstanding the newly appeared counter current which disclaims any antiseptic value for it.

Probably on account of these disclosures by MOSETIG, KOCHER abandoned his chloride of zinc method and experimented with antiseptic powders, and selected the subnitrate of bismuth. A 1 per cent. watery emulsion (KOCHER always calls it mixture), is used for irrigating the wounds, while on a sutured wound the remedy is spread in the form of a thick pulp and the bandage is made out of crumpled gauze saturated with the bismuth mixture.

The bismuthum subnitricum also did not prove itself innocent, for KOCHER himself had a death to report as a consequence of bismuth poisoning, so that the bismuth treatment also did not spread further. With these the number of remedies recommended for the antiseptic treatment of wounds is by no means exhausted, but the remaining remedies belong entirely to the present antiseptic wound treatment, so that their discussion will follow in a later chapter. To those belong corrosive sublimate, as well as creolin and salol, introduced by BERGMANN and SCHEDE. For the same reason the usual bandaging materials, etc., will not be discussed, as far as the historical interest is concerned, mention of them having been made above. If we investigate how much benefit veterinary science has gained from these acquisitions in the field of wound treatment, it must be acknowledged that the antiseptic treatment has not as yet been in practice as much as should be expected, considering the eminent advantages which it offers. As has been mentioned above, it must be acknowledged that antiseptics, in the form practiced in the human, can only in a few cases be adopted in veterinary science, but LISTER'S direction can be followed in another mode. The oft repeated statement that the usual therapeutical methods of human practice cannot, in every instance, be adopted in veterinary science, is here also fully justified. The

occlusive bandage, for instance, is not always strictly occlusive in human surgery, for example, in operations around the natural body openings, and yet asepsis results on account of the procedure being modified. Therefore, if we want to practice asepsis in treatment of wounds, we must transform the known healing methods of human medicine in such a manner as to carry out LISTER'S idea, considering at the same time the usual circumstances of our branch. Where the present methods are insufficient we are obliged to find new ways to reach this aim.

Upon looking over the different literature we find that when antiseptics in surgery was introduced, veterinary authors were immediately ready to make use of it, but if the procedures and details of the cases thus treated are minutely looked into we find that there is frequently nothing left of the antiseptic treatment but the application of an antiseptic. That the simple application of an antiseptic remedy cannot be called antiseptics is plain to everybody that goes deeper into the subject. Considerable time elapsed before PUETZ, BAYER, KORNHOEUSER, SIEDAMGROTZKY and others demonstrated cases which left no doubt as to the applicability of antiseptics by an occlusive bandage.

PUETZ, MUELLER, HOFFMAN, as well as CADIOT and ROY, who wrote special essays in regard to antiseptic treatment of wounds and their applications in veterinary surgery, cannot depart from the occlusive bandage, so that according to this view many wounds of the trunk which do not permit bandaging, apparently cannot be treated antiseptically. The above authors do not mention anything in regard to the antiseptic treatment of these, so that this vast category of wounds is left to the old mode of treatment.

II. INFECTION OF WOUNDS.

As remarked in the introduction, we have to look for the cause of the so-called accidental diseases of wounds in the micro organisms which enter into the wound and live and multiply there. As our therapeutic precautions must be turned towards the removal of the causes of a disease, the indication for the surgeon is to keep away those pernicious living substances from the wound and make the ones that have invaded it harmless. To reach this latter purpose it is not sufficient to put a disinfectant on the wound, as has been heretofore frequently supposed, but we have to go further and close up all sources which are apt to bring micro organisms into it. Only the knowledge of all possible sources of infection enables us to take the necessary measures to check effectually such an infection; without this knowledge we will always more or less grope in the dark and unconsciously make a mistake in either one or another direction. KOCHER distinguished two different forms of infection:

First—Spontaneous infection.

Second—Infection by contact.

DR. KOCHER thought spontaneous infection possibly originated on account of the whole body being infiltrated with micro-organisms, the same taking effect only if by some cause, for example, traumatism, a favorably nutritive medium for these organisms was created; although recently it has been proven, with the aid of bacteriological culture methods, that, in normal circumstances, vegetable parasites do not exist in the textures. Infection has a certain justification in infectious diseases, as for instance, in glanders and tuberculosis. If a wound arises in an individual affected with one of these diseases, we can hardly expect typical healing to follow, but we must be prepared for a localization of the specific process in the wound. BECKER also proved that in cases of osteo-

myelitis an actual infection direct from the body may follow by way of the circulation. But when KOCHER made his assertion regarding spontaneous infection such generalized infectious diseases did not occur to him, besides the etiology of osteomyelitis was then as yet unknown, but he imagined that those wound infections, which we term accidental wound diseases, could originate in such manner. According to the bacteriological and surgical experience thus far collected such possibilities of wound infection must be looked upon as a rare exception, and we must consider the substances which come in contact with the wound from the outside and which are carriers of infectious germs, as the chief source of the infection of a wound.

The following are carriers of such infectious germs, which are important to the surgeon:

First—Air.

Second—Hands and clothing of the operator.

Third—Foreign bodies (stones, sand, nails, wood splinters, pieces of earthenware, etc.,) which enter into the wound simultaneously with the wounding.

Fourth—Resting place of the patient, either during the operation or afterwards.

Fifth—Instruments and bandaging materials.

Sixth—Vicinity of the wound (skin, hair, nails, hoof).

1. AIR.

The fact that the air contains a large number of not only innocent but pathogenic germs is so undisputed that it is hardly necessary to discuss it any further, but since we have to figure with the air as a carrier of pathogenic organisms into the wound, it must be discussed. If a sunbeam comes through a window we notice in the illuminated air space numerous small particles of dust, 24 to 34 per cent. of which is organic matter. As the pathogenic schizomycetes are of the same nature, there are certainly some contained in this sun dust. In fact, PODO, who injected such dust subcutaneously into rabbits, produced deadly septicaemia in a very short time.

HESSE, also, with his well-known apparatus, collected and cultivated the germs contained in the air, and at the same time discovered some of the already known pathogenic fungi. As far as the quantity of these organisms referred to in the air is concerned, it has been proven that in quiet air, according to the laws of nature, the fungi fall to the bottom. But since we have quiet air in neither our dwellings, stables, nor the outside, the quantity of fungi will vary according to the amount of movement in the air. This is not an absolute rule, as the amount of moisture in the air as well as its density cuts a figure, but at any rate a strong draft brings us more germs in the same length of time than quiet air would.

As far as the air, especially in the rooms where our patients are, is concerned, besides the factors named above, several other factors which are responsible for the condition of the air, must be considered, namely, rough provender (grass, hay, straw), bedding and the animal excrements. It may be remarked here that the above named substances, if they are in a dry condition, easily part with some of their germs as they whirl in the air when being thrown around, but in a moist condition they do not affect the air as far as its containing fungi is concerned. The experiments of CADEAC and MALET with the emanations of rotting organic substances make this latter supposition probable. As far as the special relation of the feed, resting place, and excrements, to wound infection is concerned, we will go deeper later. Another question which was referred to during occasional discussions of infection of wounds is, whether the expired air of the operator contains pathogenic germs? In this case, also, the experiments of CADEAC and MALET are decisive, as they could not detect any specific micro organisms in the expired air of horses which were affected with specific maladies of the respiratory organs.

2. HANDS AND CLOTHING OF THE OPERATOR.

As the surgeon continually operates with his hands in the immediate vicinity of the wound, special attention must be given to them as carriers of infection. The hands have the

greatest opportunity to come in contact with infectious germs, and the natural recesses are especially adapted to give the micro organisms a hiding place. In this regard the nail-bed and matrix of the nails can be looked upon as the most dangerous lurking holes—nor should the small furrows and lines in the skin as well as the orifices of the sweat glands and the hair, be overlooked as shelters for germs. The parts of the operator's clothing, which are brought nearest the wound (the coat sleeves) should be chiefly considered. The latter, on account of the porous material of which they are composed and also on account of the fact that in lying down, sitting, etc., they come in contact with various substances, are a regular collecting vehicle for fungi, and can on this account very easily bring about infection of a wound.

3. FOREIGN BODIES.

Formerly the influence of an injuring foreign body, as far as the healing of the wound is concerned, was explained thus: Smooth cutting or piercing bodies would produce a wound without contusion, and therefore would result aseptically, while dull, rough, splintering objects would cause contusion and would therefore produce healing that would not be aseptic. These conclusions were not based on facts, hence they are false. Not the contusion and the resulting necrosis are the causes of the deviation from the aseptic healing of the wound, but the fact that bodies with smooth surfaces are less often carriers of infectious germs, on account of the lack of loop-holes for the same, than the ones with fissured and rough surfaces; therefore the latter are more often the cause of an infection of the wound. By this is not meant that smooth surfaces are not carriers of pathogenic germs. We know that it makes no difference whatever whether the wound is contused or not, the former heal with aseptic progress exactly the same as the latter, provided the injuring body is not infected.

These foreign bodies differ from each other in regard to the germs; they may carry not only in quantity but also in quality. Through the investigations of KOCH, GAFFKY, PAS-

TEUR, HESSE and NICHOLAIER it is ascertained that in ordinary garden soil two bacilli can be found, which have caused great devastation in cases of operations and sometimes in very trivial injuries, namely the bacillus of malignant oedema and of tetanus. As our domesticated animals, not only while at work but also while at rest, come in continuous contact with the ground and all such subjects that are smeared with earth, it produces oedema or tetanus if they get injured.

Therefore the soil and all the items that come in direct contact with it, as far as foreign bodies that are capable of infecting a wound is concerned, should be considered as the main cause, and, therefore, all wounds coming in touch with them should be considered accordingly.

4. RESTING PLACE OF THE PATIENT.

If the resting places of our animals are specially discussed, although as far as treatment of wounds is concerned, they belong to the list of foreign bodies which bring about an infection, it is done for the reason that they belong to the carriers of infectious germs, which in one respect offer a very favorable nutritive medium for pathogenic micro organisms. On the other hand they come into a very intimate and long lasting contact with the wounds. In practice the operating bed, as an infection communicator, must be strictly separated from the stall litter, as it is the latter especially which comes into close contact with the wound, and doubtlessly as a result of the admixture of animal excretions, is more strongly polluted.

To prepare an operating bed we usually use straw of the different grain varieties in country practice. Only in rare exceptions we have other material, such as sand or tan bark at our disposal; therefore during an operation the patient lies on a material, which, as a consequence of its origin, that is, because it grows in the field and is more or less soiled with earth, possesses a certain amount of pathologic germs, and therefore contains dangerous elements for wounds. This danger rises on account of the patients while lying down, often struggle with pain, kick with their feet, and thus whirl the noxious

germs contained in the straw, into the air, and infect the wound.

【Shavings of southern pine—*pinus palustris*—is the safest bedding for an operating room either for temporary or permanent use. They seem to retain their original antiseptic properties and wound infection can seldom be traced to them. By sprinkling them with a 1 per cent solution of permanganate of potash before the operation, all dust is allayed and a veritable antiseptic litter is the result.—L. A. M.】

The stall litter as a carrier of infection germs has to be judged from a different standpoint, because of its importance in agriculture and its different nature and management as compared with the material used as an operating bed. The stall litter is to the animal not only a resting place, but it serves as an agent to collect the animal excrements for the purpose of making them more valuable for agricultural use. On this account it is seldom that the best material is used for litters; musty, frequently already rotten straw of various plants is thrown in, foliage, pine needles, spoiled hay, wood shavings, dry peat, etc., are often substituted on account of lack of cheaper or better bedding material. Though these materials themselves are already sufficiently infested with infectious germs, the sustenance of the latter increases still more on account of the urine and manure mixing with it; not because urine and manure are very rich in micro organism, but because these substances are excellent nutritive mediums for micro organisms. This fact has been sufficiently proven by KITT, as far as anthrax bacilli are concerned, and it is hardly to be doubted that other pathogenic fungi find their means of life in them. Besides if stall litter is thus looked upon as an important infection carrier, it is still more so the case if we consider that on account of decomposition it has a higher temperature which is favorable to the thriving of micro organisms.

【Through experiments conducted in the bacteriological laboratory of the McKillip Veterinary College, German peat, which is commonly used as stall bedding, was found to contain tetanus bacilli in large numbers and tetanus traced to this source was always very acute and fatal.—L. A. M.】

5. INSTRUMENTS AND BANDAGING MATERIAL.

While in the former chapters we became acquainted with substances which transmit infection to the wound, only by chance, because they do not necessarily come into contact with it, our instruments can lay claim to be of special importance as infection carriers, as they are the tools with which we make wounds, and work upon pre-existing wounds. It has already been mentioned in the discussion on foreign bodies that a substance which comes into direct contact with the wound is the more infectious if its surface is rough and torn: This is also the case with instruments, the smoother the surface the fewer loopholes will they have for micro organisms. Besides the construction, as well as care taken of the instruments, should by no means be looked upon with indifference, for with a more complicated construction there is necessarily an increased number of loopholes for micro organisms, and the way of taking care of them either assists in carrying infectious germs or in withdrawing them from these loopholes. Therefore, from this standpoint it is easily to be seen that a bistoury carried in a vest pocket or a cigar case hides more danger of infection than a scalpel which is kept in a clean etui. As far as bandaging materials are concerned we have to devote a great deal of attention to them, as they are employed to protect the wound against any infection from the outside, and as a consequence, are in immediate contact with the wound for a long time. In this case the quality which makes the material suitable for bandaging a wound, namely, its porosity, serves as the cause of frequently transmitted infections through the bandaging materials. It is the porosity which offers favorable conditions for the sojourning of pathogenic germs, and therefore care should be taken to destroy them.

6. VICINITY OF THE WOUND.

We could here conveniently refer to what is said in the chapter about the hands and clothing of the operator, but the location of wounds in domesticated animals should, on account of their hairiness, be judged somewhat differently from the

nearly hairless human skin. If KUMMEL, in his investigations in regard to the disinfection of the hands, has found that the latter sheltered numerous microbes, how much more must this be the case in the densely haired skin of the domestic animals, especially as their care is frequently neglected. This is the reason that we have to consider the localization of the wound in our domesticated animals as an important source of infection, for supposing that all the other infection possibilities are not taken into consideration, some hairs from the immediate vicinity of the wound, when the latter is first made, penetrate into it, together with the micro organisms sticking to them. To this must also be added that during the further process of the healing of the wound, the discharges flowing from it soil the vicinity, and being an excellent nutritive medium for pathogenic fungi they form direct brooding cavities for the vegetable parasites dangerous to the wound.

With very insignificant modifications the circumstances are just the same with the vicinity of wounds which have their seat on hoofs, claws, and talons; the latter parts, as modified hair formations shelters micro organisms in large numbers in their tubes, fissures and joints, simply because they are the parts which come in contact with the ground, and thus with all sorts of microbes.

III. ASEPSIS, ANTISEPSIS AND DISINFECTION.

After it has been discussed what infection is and in what way it is brought about, the questions arise:

First—By what mode and by what means can we prevent the infection of a wound?

Second—How are we to remove an infection already existing in the wound?

In compliance with these two questions we have to consider two different subjects according to whether the wound is already infected or not, and then if our aim is to protect a wound against infection we speak of an aseptic treatment of wounds, while disinfecting or antiseptic treatment of wounds is referred to when an already infected wound has to be liberated from the infection, that is, disinfected, or made aseptic. We therefore should not be surprised that the remedies used for the prevention of a wound infection are entirely different from those used for the removal of an already present infection, hence the remedies used in the treatment of wounds are divided into two groups, namely:

First—Bandaging materials.

Second—Disinfectants.

I. BANDAGING MATERIALS.

All substances which are to be used for bandaging purposes must possess certain qualities to obtain the desired effects.

First—They must be porous so as to be able to absorb the discharges of the wound.

Second—They must be free from infectious germs so as not to be a source of infection to the wound in itself.

Third—They must be soft, elastic and flexible so as not to cause any pressure on the wound and must adapt themselves

to the corresponding parts of the body without forming any gaps.

The effect of these bandaging materials explains itself as follows:

If there are no infectious germs present in the wound, their introduction can only take place from the outside, and although these porous bandaging materials permit the air to come on the surface of the wound, still all the germs suspended in the air are mechanically filtered through the bandage, so that, as other bodies are prevented from entering the wound, only the bandaging material is left to transmit infection. As the latter comes in use only in an aseptic condition, that is, free from infectious germs, so that the pure wound does not get infected from the outside, complications cannot take place. In the further course another possibility arises that the thus aseptically kept wound may get infected; the separated wound discharges would gradually push forward and would serve the micro organisms as an entering channel, but this forward gushing under the bandage is prevented because the porous bandaging material absorbs the discharges. Only in longer lasting, profuse discharges could such possibilities take effect, notwithstanding the porosity of the bandage.

That the procedure just described to prevent wound infection is not only a formation of clearly theoretical deliberations, but can be also carried out practically has been proven by NEUBER, but we have to take into consideration that we can get the same results quicker and cheaper if we substitute several points of this *modus operandi* by other rules. Thus, for instance, the preparation of germ free bandaging material is a very tedious procedure without the application of such chemical agents that kill vegetable germs, therefore, nowadays these bandages are impregnated with such substances, which we will know later as disinfectants. In this mode the germs contained in the bandage are killed and at the same time these bandages are furnished with a supply of disinfecting remedies that protect the wound against invading germs by making the discharges absorbed by the bandage unfit as a nutritive medium for microbes.

Among the most popular bandaging materials, as far as using them for the above purposes is concerned, the following may suffice; the corresponding advantages of one or another material will be further explained at the close of this chapter:

First—Wadding—The wadding (all fat removed) is most frequently used in the form of a simple fatless bandaging wadding for the padding of bandages, or impregnated as a 4 to 10 per cent. salicylic wadding, 3 to 10 per cent. benzoic wadding, 10 to 20 per cent. boracic acid wadding and thymol wadding, 10 to 20 per cent. iodoform wadding, 0.5 per cent. sublimate wadding, for the absorption and disinfection of the discharges.

Second—Jute—The best fiber of *corchorus capsularis* has been lately introduced and is used the same as the wadding as a 5 per cent benzoic jute, 5 to 10 per cent. carbolic jute, 5 to 10 per cent. salicylic jute, and 0.5 per cent. sublimate-jute.

Third—Wood wool wadding—The wood wool is manufactured by the grinding of soft woods; by working it together with fatless wadding, the so-called wood wool wadding is produced. Both products are used as sublimate wood wool wadding (0.5 per cent), and creolin wood wool wadding.

Fourth—Sawdust—is used frequently as a surrogate of wood wool and is mostly soaked in a 0.5 per cent. sublimate solution.

Fifth—Hemp, flax, oakum—These materials are chiefly used in country practice. Lately the oakum, after being previously cleaned, has found some propagation as sublimate oakum.

Sixth—Moss, mosspap—The moss, such as is used for bandaging purposes, is made by the drying of the different sphagnum varieties, chiefly sphagnum *cymbifolia* and sphagnum *cuspidata* and is used now mostly in the form of the HAGEDOMLEISERING mosspaps. To disinfect mosspaps 1 per cent. sublimate is used, in which the paps are dipped prior to using.

Seventh—Peat—Recommended by NEUBER, is useful if impregnated as iodoform peat, carbolic peat and sublimate peat.

Eighth—Gauze, mull (muslin)—Both materials are much liked in a fatless condition, as they hold well together. They are used in the shape of benzoic acid gauze (5 to 10 per cent.) boric acid gauze, carbolic gauze, creolin gauze, iodoform gauze (10 to 50 per cent.), salicyl gauze (10 per cent.), sublimate gauze, serosublimite gauze, tartaric acid gauze and thymol gauze.

Ninth—Glass wool—This represents a confusion of the finest glass threads, and is warmly recommended by KUEMMELL.

Tenth—Sand, cokes, ashes—These substances are used by SCHEDE with advantage, especially for the filling in of injuries of the bones in the shape of sublimate sand.

2. DISINFECTION MATERIALS.

The word "disinfection" explains itself, so that a definition is, perhaps, unnecessary, especially as the conception of an infection has been sufficiently explained, but to be explicit, disinfection means nothing else than the removal of the infection, and as the existence of an infection is to be looked for in the wound, as far as life and actions of micro organisms are concerned, the object of the disinfection is simply to make these micro organisms innocuous. Disinfection of a wound, or an instrument, or the operating field, etc., therefore means making innocuous the infectuous germs located in the respective media.

The ways which are at our disposal are various.

First—We remove from the article which is to be disinfected all pathogenic germs.

Second—We certainly leave the microbes in their substratum but

(a) we kill them direct, or

(b) we make the nutritive medium in which they grow unfit for their future growth, and thus cause their death.

Following the maxim "Cessante causa cessat effectus" the removal of the micro organisms from the focus of infection would be the most rational way to get rid of an infection, but in many cases it is impossible to follow this indication, as we

would be obliged simultaneously to remove the infected substratum with the infection germs in the immediate surroundings of the wound, so that probably in a wound of the size of a quarter of a dollar we would make a defect the size of a palm or larger. Notwithstanding this, however, we follow these indications as far as advisable, for we remove with a knife, scissors, sharp spoon or curette, necrotic shreads of tissue granulation surfaces of diseased bones, foreign bodies from the wound, etc. Thus we use the purely surgical adjuvants to attack infection mechanically, but we do not always succeed in reaching our object, for very frequently we would by using this method against infection, "spill the bath with the child," by simply destroying the infected organism.

Thus in the most frequent cases the other method only is left us, namely the killing of the microbes, and this mode is the most popular and is looked upon as the most essential, though not altogether justly, in the antiseptic treatment of wounds.

The above mentioned two methods of killing micro organisms:

First—Direct killing of the microbes.

Second—Withdrawing of the existence condition of the microbes by changing the nutritive medium, should not only theoretically, but also practically, be strictly separated, for the action of various remedies, which we use later in the treatment of wounds, can only be understood if we clearly comprehend the two above mentioned possibilities.

As far as the direct killing of the micro organism is concerned, the fact that they are vegetable living subjects with protoplasmic bodies is sufficient reason that the microbe will die if we change this protoplasmic body so that it cannot govern its nourishment and multiplication. We reach this end by certain chemical substances, which act as poison on the protoplasm of the micro organisms, and are called "Disinfectants."

The question of destroying the causes of infection by changing the nutritive medium is an entirely different one. We know that one of the most important requisites of existence for

all micro organisms is moisture; rapid drying as well as natural lack of moisture are not favorable conditions for the growth and life of those small vegetable organisms. Therefore, all means, which energetically withdraw moisture, cause a condition which hinders their growth and action. Hand in hand with this withdrawal of moisture, a change in the tissues on which these microbes have settled, usually takes place, for instance, in wounds where by the use of strongly drying remedies a coagulation of the albumen takes place so much that a fit nutritive medium no longer exists. The remedies we use for the purpose of disinfection are so heterogeneous that we need not wonder at this, especially if we consider the different ways by which we attain the desired effects through disinfection. In view of the above mentioned theories, however, their action cannot be said to be so exclusive that one remedy will kill the microbes only, while another will only deprive them of the possibilities of existence by changing their nutritive medium, or that a third will only remove them from the infected medium. Most disinfectants act simultaneously in two or more ways, so that classification according to their own action is impossible. As to nature, however, they may be classified into:

First—Physical disinfection agents.

Second—Chemical disinfection agents.

Among the physical agents we class all those surgical instruments with whose aid we can remove infected material in a purely mechanical way, for instance, the knife, scissors, sharp scoop, etc., also the high degrees of heat in the form of the firing iron or thermo-cautery of Paquelin, and finally the withdrawal of moisture, namely, exsiccation and permanent irrigation. The action of these remedies has been mostly discussed above; we will therefore not go into further details here, nor as to their uses; an opportunity in future chapters for that will be found.

We will now discuss those chemical agents which are hostile to the development of micro organisms.

The rotation in which they are taken up depends on their

utility. The value, action and use of these disinfectants will be briefly discussed, but as far as the more special action, as well as their chemical properties are concerned, pharmacological text books must be referred to.

(a) SUBLIMATE (Hg Cl_2).

(Mercuric Chlorid).

The credit of introducing sublimate into surgery is due to VON BERGMANN, for, although BINZ in 1867 and BUCKHOTZ in 1875, experimentally ascertained the antiseptic properties of sublimate, VON BERGMANN used it as a disinfectant in surgery in the year 1878 for the first time. To the labors of KUEMMELL and SCHEDE it was reserved, however, to draw the attention of surgeons to this agent, while KOCH, with the aid of the solid nutritive medium discovered by him, made exact and decisive experiments in regard to the antiseptic value of sublimate.

The sublimate, according to the investigations of KOCH, must be looked upon as the disinfectant possessing the strongest bactericide action, because a 1 per cent. solution kills anthrax spores in a few minutes, which thus far are known as the most resistant. Though in reference to the surgeon, there have not been sufficient investigations made to tell how strong sublimate solutions are necessary to destroy wound-infection germs, practice has proven to us that here also a 1 per cent. solution completely suffices. Therefore sublimate fills one demand of the surgeon, for weak solutions contain stronger antiseptic powers than any agent thus far known. It should not go unnoticed, however, that according to the investigations of SCHILL and FISHER tuberculosis bacilli possess an extraordinary ability to resist sublimate. However, as we seldom have an opportunity to treat tubercular processes surgically, this objection to sublimate does not greatly concern the veterinarian.

We need to discuss the second requisite which the veterinarian demands from disinfectants, namely, that it be harmless to animal organisms. That in human surgery precaution in

the use of sublimate has to be taken is due to the different individual predispositions toward mercurial preparations, producing in some cases eczemas, in another intoxications, while a third one will not be affected whatever. That much of this is exaggerated is proven by the successful results of VON BERGMANN, KUEMMELL, SCHEDE and MIKULICZ; the latter even in laparotomy washes out the peritoneal cavity with a 0.5 per cent. solution of sublimate. KROENLEIN uses sublimate (1:1000-3000) in wounds of the rectum, abdomen, and in empyema without apparent toxic effects. In veterinary surgery the condition is different. The fear of the toxic effect of sublimate on our domesticated animals, and especially ruminants, is groundless, of which facts TRINCHERA especially makes mention.

I used for the past three years in all surgical operations, as well as for the irrigation of all infectiously diseased mucous membranes (nose, mouth, vagina, uterus), only sublimate as an antiseptic, and must acknowledge that even in ruminants I did not notice any disadvantageous effects. The experiments of DOLERIS and BUTTE, who operated on the mucous membranes and fresh wounds of dogs, rabbits and guinea pigs with sublimate water 1:1000) have proven that its use on mucous membranes is entirely free from danger; but deep wounds have to be treated somewhat more carefully. Unless the injurious effects of a 1 per cent. solution of sublimate is doubtlessly proven in the treatment of wounds of our domesticated animals, I consider the fear of the virulence of sublimate, in external applications as prejudice. Later on I will have opportunity to illustrate with examples that sublimate is not dangerous.

Amongst the numerous preparations of sublimate used in surgery the following are recommended as practical:

(a) Sublimate triturates (ANGERER) are made by a compression of hydrargyrum bichloridum and natrium chloratum equal parts and on account of their convenient form 20 tablets can be carried in a test tube in the pocket without inconvenience, and owing to their solubility they are extraordinarily suitable for the practical veterinarian.

(b) Sublimate water is easily had by dissolving a sublimate tablet in water. It is used for the disinfection of wounds and their region, of the hands, and in case of necessity also of the instruments; sublimate does not affect the instruments as bad as is usually supposed, and the operating instruments especially do not get dull. In such sublimate water I usually also soak my bandaging materials shortly before putting it on by simply dipping the wadding, bandage, etc., into the water and then wringing it out moderately.

(c) Sublimate glycerine gelatine I recommend for covering superficial excoriations and sutured wounds. Simple gelatine, also glue, can be used by soaking it in as little as possible 1 per cent. sublimate water solution and then dissolving it by slight heating. To the glue thus formed 5 per cent. of glycerine is added to prevent the preparation from getting brittle. For using, the preparation is melted by a gentle fire, and with a camel's hair brush applied to the parts. I no longer use this preparation, as I have discovered more convenient remedies.

Recently LISTER mentions a few more sublimate preparations, which, chiefly on account of their price, have no special value in veterinary surgery, namely, the serosublimate and the double chloride of mercury. The former consists of a 1 per cent. solution of sublimate in horse blood serum, on account of the albumen, it sticks better on the bandaging material and does not irritate sensitive skin. The latter is a mixture of hydrarg. bichlor. corr. with ammon. chloridum 2-5; from this salt watery solutions (1:2000) slightly colored with blue anilin colors are used for the impregnation of the bandaging material. The bandaging materials thus dyed are a reagent for suppuration, for as soon as there is any trace of suppuration the blue anilin coloring matter gets white. Besides, this preparation is said to be less volatile and poisonous.

[The high value of mercuric chlorid in veterinary operations has been repeatedly and forcibly demonstrated especially to the surgeon, who has by experimentation compared the results obtained with that of other antiseptics. In points of uniformity of action, reliability, effectiveness and economy it is

equalled by no other known drug. It must, however, be applied only with a full and detailed knowledge of its peculiarities in order to obtain those delicate results which the surgeon seeks in his operations. The following points must be born in mind:

First—That it must be applied in such concentration as the work at hand demands, as follows:

(A) 1 to 200 solution. This strong concentration is useful to hurriedly disinfect an operating field and vicinity when for any justifiable reason there is no time for a systematic disinfection. I use it repeatedly and with excellent results to purify the scrotum and surrounding field in castration.

(B) 1 to 500 solution. This strength is the one generally used to purify the seat of operation after the usual scrubbing with soap and water, to wash the surgeon's hands before and repeatedly during the operation, and to soak the protective bandages.

(C) 1 to 1000 solution. For general use in wounds already infected for the purpose of rendering them aseptic, and for the after treatment of wounds that must granulate.

(D) 1 to 1500, to 1 to 2000 solution. This strength is applied in irrigating and bathing the wound during the operation and is specially weakened so as not to prevent immediate union, by destroying the vitality of the tissues. This strength is also suitable for irrigating the vagina, rectum, uterus, or internal cavities.

Second—That it is rendered more or less inert by combining with the constituents of tap, well or spring water. This fault is obviated in a measure by adding 1 per cent. of sodium chlorid to the solution and by making solutions only for immediate use, or by using distilled water.

Third—That it is immediately rendered inert when it comes in contact with blood, and therefore sponges or cotton used for baling must not be carried into the vessel containing the solution. I always use a small porcelain vessel for baling with which the solution is dipped from a larger container and in this way prevent the entire solution from becoming polluted with blood early in the operation.

Fourth—That it should be used in the form of soluble tablets to insure accuracy in the concentration of the solution.

Prof. Frick leaves the impression that mercuric chlorid is not specially injurious to edged instruments which is in direct conflict with my experience. The dark color it imparts to polished or plated instruments is readily removed when they are not left too long in the solution, but aside from this objection, if such it is, the keenness of a sharp knife is almost immediately destroyed when placed in a solution strong enough to disinfect it.—L. A. M.]

(b) IODINE.

Iodine has for a long time played a leading role in surgery, but it cannot attain a special place in the treatment of wounds, on account of its unpleasant properties of being very volatile and caustic, although its antiseptic qualities are pre-eminent. However, DAVAÏNE, DOTTER, and ANDRIEUX recommend tr. iodine diluted as a remedy in wound treatment. Much more importance is given in treatment of wounds to a compound of Iodine, namely,

(c) IODOFORM.

Iodoform (CHI_3) was introduced in the year 1822 by SERULLAS, but MOSETIG and MOORHOF first showed that it is a very useful preparation for the treatment of wounds. The hopes which MOSETIG placed in iodoform as well as the effects which he claimed it to have, were not entirely confirmed, in fact the contrary was proven. Judgments of HEYN, ROVSING, SATTLER, BAUMGARTEN, SCHNIRER are not correct. If these authors take the actions of iodoform on the cultures of the micro organisms as a standard for the antiseptic properties of the remedy, they evidently do not consider one factor, which for the understanding of its action is indispensable, namely that iodoform gets separated into free iodine only when it comes in contact with living animal cells and that this free iodine represents the antiseptic agent of the iodoform. KOENIG, BEHRING

and BRUNS met with good success in their experiments, so that especially its antituberculous action is not to be doubted. However, iodoform has but a certain limited value in surgery and on this account, extravagant use of it is discouraged. If we do not consider these clearly theoretical and experimental results, practice has shown that we possess a very valuable remedy in iodoform, as it possesses excellent qualities in certain conditions.

The action of iodoform depends upon the different modes of application as follows:

First—As powder it does not dissolve in wound exudates, but absorbs the latter, and thus excellently dries the wound surfaces, so that but little discharge appears; besides, it directly restricts the discharges of the wound.

Second—It certainly promotes granulation, because I have often observed that peripheral pieces of ligated vascular stumps, which otherwise regularly undergo necrosis, granulate profusely, by being treated with iodoform. Possibly an explanation for this is the known close relation of Iodine with the cell nuclei.

Third—It acts anaesthetically.

Fourth—By coming in contact with living animal cells the pure iodine gets permanently separated from the iodoform, and this pure iodine acts antiseptically.

Fifth—It certainly has antituberculous actions (BURNS).

In human surgery it has been observed that iodoform, besides the valuable qualities just mentioned has many injurious ones inasmuch as in a human being iodoform poisoning as well as iodoform eczemas sometimes appear after the use of the remedy.

In veterinary practice thus far, iodoform intoxications after external applications have been known in dogs only (GOOSENS, ALBRECHT, FROHNER). I had no opportunity thus far to notice this probably because I did not use excessive doses, which ALBRECHT and GOOSENS give as their cause. Experimentally, POLJAKOW ascertained the toxic doses for warm blooded animals to be as follows: 0.5

per kgm. body weight if brought into the serous sack, 1 gm. in the stomach and 1.5-2 gm. in subcutaneous applications. Owing to the popularity of iodoform treatment, we should more frequently hear of intoxications if our animals were sensitive to iodoform; in proper doses, therefore, iodoform can be considered free from danger as far as our domestic animals are concerned. Eczemas, such as are frequently seen in the human as a consequence of the use of iodoform have not as yet been recorded in our practice. Of the frequently mentioned iodoform preparations, the following are in use and very practical.

First—Iodoform powder I prefer to iodol substillissime pulv., because it can be strewn in a thin layer on the surface of wounds which have to be treated without a bandage.

Second—Iodoform sugar (5-10 per cent.), an excellent desiccant remedy. It forms a dry scab on such wounds that do not permit a bandage, thus causing the wound to heal under the scab.

Third—Iodoform tannin (50 per cent). In profusely discharging wounds, especially wounds of a joint, this is a good remedy to prevent excessive secretion, especially synovial flow.

Fourth—Iodoform ether (5-10 per cent.) is the most convenient remedy for sinuous wounds such as fistulas.

Fifth—Iodoform gelatine (25 per cent.) is manufactured mostly in tablet form and is very well adapted for fistulous canals, as little rods can be cut from these tablets, which are flexible and are therefore easily introduced into these canals.

Sixth—Iodoform sticks (iodoform 9, cocoa butter 1) are used for the same purpose as the rods of iodoform gelatine.

Seventh—Iodoform boric acid (10 per cent.), for the same purpose as iodoform sugar, is less desiccant.

Eighth—Iodoform collodion (5-10 per cent.) to cover shallow small wounds or excoriations, as well as to daub over fresh sutures, where a bandage cannot be put on. This remedy has the disadvantage that it does not stick to moist skin and easily gets brittle.

(d) IODOL AND IODINE TRICHLORID.

These two iodine preparations have been lately recommended in human surgery as a substitute for iodoform, as iodol is non-odorous and iodine trichlorid does not have such unpleasant odors as Iodoform. Besides, both are said to be non-poisonous. These two preparations are too costly for veterinary purposes and are, therefore, not recommended, especially as the odor of iodoform is only objectionable in canine practice. The application of iodol is exactly the same as of the iodoform, while the soluble iodine trichlorid is used as a 1 per cent. watery solution.

(e) CARBOLIC ACID.

Carbolic acid is a preparation which Lister, in 1864, introduced into the antiseptic treatment of wounds, and in which, until lately, too much confidence has been placed, inasmuch as we now have remedies which are more trustworthy and less dangerous.

According to the investigations of KOCH, BUCHOLTZ, V. ESMARCH, EISENBURG and others, carbolic acid is a germicide. If, however, we take into consideration the concentrations which said investigators state to be necessary to act antibacterially, we find carbolic acid to be an entirely unreliable antiseptic for surgical purposes, because it takes at least 3 per cent., occasionally even 5 per cent. watery solutions to assure effective action. LISTER himself knew this fault of carbolic acid, but he then did not possess a better remedy and therefore it has been the steady aim of all surgeons to discover better agents than carbolic acid. Notwithstanding this, carbolic acid has held its place, and will hold it, because it is indispensable for certain purposes.

In addition to the mentioned unreliability of carbolic acid it has other properties which must be considered in its application, namely, its virulence in the required concentrations and the irritation caused by such solutions on the wound and its surroundings. In literature we often find reports of carbolic poisoning, so that it is not necessary for me to add any new

ones. It is sufficient to emphasize the fact that all our domesticated animals, especially cats and dogs, will occasionally get carbolic intoxications. (SCHMIDT, GROSSWENDT, GOTTESWINTER, SCHUMANN, SCHAEFER, VAN LEUWENU, etc.)

Besides its foregoing qualities the irritation which carbolic acid causes on the surface of wounds and to which LISTER calls attention, is unfavorable as far as the application of this remedy in the treatment of wounds is concerned. All wounds treated with a 3-5 per cent. watery solution secrete profusely, therefore they come into a condition which we do not consider beneficial but rather detrimental to the healing of the wound.

Carbolic acid is applied now as carbolic water (1-5 per cent.). It is only used in exceptional cases for irrigation of fresh wounds in from 2-3 per cent. and in old infected wounds in 5 per cent. solutions. The 3 per cent. solution is most generally used and chiefly for the disinfection of instruments.

All other preparations of carbolic acid (carbolic oil, carbolic spirits, etc.,) are, according to KOCH'S investigations, totally ineffectual.

It is undeniable that the unreliability of carbolic acid is becoming more and more apparent. It has, however, one indication through which it will retain a place in veterinary surgery and that is to keep instruments aseptic during operations. This precaution is seldom necessary in human surgery and the use of antiseptics on instruments can only be regarded as a reflection on the work of the assistant who is entrusted with their care. But the veterinarian usually operates in a contaminated atmosphere and the chances of instruments becoming infected in other ways are greater than in the human operating room; therefore it is not only advisable but essential to place the instruments in an antiseptic medium when not in use during an operation. For this purpose carbolic acid is highly commendable. It is used in a 5 per cent. aqueous solution contained in a flat tray. This precaution also serves the purpose of disinfecting the tips of the surgeon's fingers, because in

reaching for an instrument they come in contact with the antiseptic fluid.—L. A. M.】

(f) CREOLIN.

First investigated by ATTFIELD, it was recommended by FROEHNER as antiseptic in Germany in 1887 and later V. ESMARCH and EISENBERG experimentally ascertained that anthrax spores are killed in two days in a 3 per cent. watery solution, the suppuration producing microbes in one minute in 3 per cent. solutions, and in ten seconds in 5 per cent. solutions. The antiseptic properties of creolin are therefore certainly not to be doubted, but nevertheless I have not thus far adopted creolin for general use, as for country practice it is not easily transported, for while we can comfortably and in large quantities carry the sublimate pastilles, it is difficult to carry as much creolin as is necessary in operations. I think, as is the case with every new antiseptic, the enthusiasm will gradually slacken and the application of the remedy will be limited to certain cases, especially as BAUMGARTEN has recently proved the poisonous character of creolin. The supposed non-poisonous character of creolin was a chief reason for its popularity.

Creolin is applied as

(a) Creolin water (0.5-2 per cent. watery solutions better than emulsions) to irrigate and rinse out all kinds of wounds.

(b) Mixture of creolin (2 per cent.) with boric acid for use as powder on wounds.

【Creolin is a disappointment so far as performing antiseptic operations is concerned. Its place in veterinary surgery is for the purpose of irrigating large wounds, internal cavities, sinuses of the head or in any condition where there is danger of intoxication from more potent remedies.

There are a number of cheaper substitutes sold on the American drug market, but their popularity depends more upon the amount of water they will color white than on the amount they will actually disinfect. In the absence of more reliable preparations, however, the veterinarian is justified in

recommending them for large foot baths or for any purpose where a large amount of antiseptic fluid is needed.

The action of these products on water together with their innocuousness recommends them in obstetrical operations.—
L. A. M.]

(g) SALICYLIC ACID.

THIERSCH, in his efforts to discover a substitute for carbolic acid, found in salicylic acid just discovered by KOLBE, a remedy with which he constructed a regular antiseptic. Now we know, specially owing to the recent investigations of SAMTER that Salicylic acid is a totally unreliable antiseptic, so that this long since abandoned remedy will soon have but historical value. Now it exists only in the form of salicyl wadding for surgeons.

(h) BORIC ACID.

LISTER first recommended boric acid and experimented much with it, but it has never reached an important place as an antiseptic, as it acts much weaker than carbolic acid. It is applied in the form of:

(a) Powder or mixed with creolin (2 per cent.) as lycopodium on wounds, especially near the end of the healing process when it hastens the forming of the scar.

(b) Boric water (4 per cent.) as wound water on such places where the virulence of carbolic acid and of the sublimate is feared, for instance, in the nose, in the mouth, on the eyes, etc., etc.

(i) ACETIC ALUMINA.

Acetic alumina was first applied by BUROW and has been adopted on account of being non-poisonous and having good antiseptic properties. In every instance where the usual antiseptics cannot be made use of, either on account of virulence or because the patient cannot endure them, the liquor aluminae aceticae (8 per cent.) is indicated. In veterinary science this preparation has been in use for a long time (acetate of lead alum solution). It is applied in the form of:

Watery solution of acetic alumina (2-4 per cent.) as disinfectant for all wounds.

(j) CHLORIDE OF ZINC.

Chloride of zinc was used in surgery prior to LISTER'S time, but LISTER was the first one to use it (8 per cent.) to disinfect wounds. LISTER and KOCHER used 0.2 per cent. solutions for the rinsing out of wounds and applied it as a regular antiseptic, but KOCH'S investigations soon proved that too much confidence was placed in chloride of zinc, as in 5 per cent. solutions anthrax spores lived after one month. I use only a:

Chloride of zinc solution (10 per cent.) to wipe out infected wounds after the walls have been first thoroughly scraped with the sharp spoon.

【BURNETT'S disinfecting fluid (20 gr. zinc chlorid to 1 drachm water) in the strength of 1 part to 40 of water is indeed a useful and effectual antiseptic for veterinary purposes. It deserves a more general use especially in disinfecting old, suppurating or fetid wounds. In a fresh open wound it will prevent septic processes longer than any other drug.—L. A. M.】

(k) NAPHTHALIN.

According to Fisher's investigations, Naphthalin is a powerful antiseptic which has but one fault, viz: that it is insoluble in water. SCHADRIN, POPOW and others, however, have doubtlessly proven the usefulness of this remedy; especially does it help granulation.

BOUCHARD and PANNAS noticed that upon long internal application cloudiness of the crystal line lense with formation of cataract (Naphthalin cataract) occurs, but thus far external applications on our domesticated animals have had no bad effects.

Amongst the forms used the following are recommended:

Naphthalin powder, pure or mixed with 5-10 per cent. alum, sugar or boric acid (SCHADRIN), naphthalin salves (5-10 per cent.).

(l) THYMOL.

RANKE introduced thymol for treatment of wounds, and its power for checking the development of bacteria was ascertained experimentally by SAMTER; but for veterinary practice thymol is too expensive. In canine practice it can be occasionally used as a 1 per cent. aqueous solution if the expense does not prohibit it.

(m) CAMPHOR.

In surgery camphor was used before the antiseptic era, especially in bruises and gangrenous and ichorous wounds. Although camphor possesses good antiseptic properties it is not very suitable for treating wounds. However, in case of necessity, camphor, in the universal form of spirits of camphor is a good disinfectant. It is usually applied in the form of:

(a) Camphor gruel (with but little alcohol) as a good disinfectant in gangrenous wounds and bruises.

(b) Spirits of camphor (1 :7 alcohol 1 :2 water) to rinse out wounds and to soak the bandage, in cases of necessity only.

(n) TAR.

Tar, that is, charcoal tar, has been in use for some time, but it has not been given the deserved importance as an antiseptic. On account of its containing carbolic acid, creosot, naphthalin and many other antiseptic aromatics, tar, especially in cattle practice, is to me nearly indispensable, the action being in every regard satisfactory so that I can recommend the application of tar as an antiseptic especially in foot and hoof diseases, as the preparation is very cheap and can be obtained in every rope maker's shop. I use:

(a) Tar (clear) in claw diseases, if they are much spread amongst cattle and hogs, where it is not possible to put on daily a number of bandages; also, in order to make bandages moisture proof, to paint the bandage; and lastly, in all hoof and claw diseases which are forming scars.

(b) Plaster of paris and tar (5-10 per cent.) and boric acid

and tar (2-5 per cent.) are well recommended, but are not indispensable.

(c) Tar with ferrum sulphas aa if we intend to dry up strongly secreting hoof and claw wounds.

(o) TURPENTINE.

AMBROSIUS PARE (1550) knew the antiseptic properties of turpentine which make it, as well as tar, suitable for the treatment of hoof and claw wounds, especially in easily bleeding wounds. The only unpleasant effect was the irritation it produced on granulations, causing pain. It has the disadvantage of producing pain by irritating the surface to which it is applied.

(p) OIL OF TURPENTINE.

The antiseptic properties of the oil of turpentine have been experimentally ascertained by GRAWITZ and DE BARY and confirmed also by KOCH. Later investigators claim to have had negative results, but it has yet to be proven that the statement backed up by KOCH, GRAWITZ, and DE BARY that the preparation in a proportion of 1-75,000 does not act antiseptically is a mistake. Notwithstanding its antiseptic properties, oil of turpentine is only used in cases of necessity on account of the irritation it causes.

(q) SUGAR.

As an old public remedy against strongly granulating wounds, sugar in the shape of powder has long been in use, but in surgery it was first introduced by LUCKE as an antiseptic. Sugar acts antiseptically on the wound by excellently drying it up and by its forming concentrated sugar solutions (just as in canning fruits), which prevent the settling of microbes. Frequently a dry scab forms on wounds treated with sugar, under which an antiseptic healing takes place. As sugar can be found in nearly every household and its cost is not great, I can, according to the experience which I have had with it, recommend it. It is best applied in the form of:

Powdered sugar (clear or mixed with 5 per cent. powdered

iodoform). In this form I use sugar in all wounds on the surface of the body when a bandage is unnecessary and which on account of their condition (not bruised) allow healing by a scab.

(r) COFFEE.

Roasted coffee contains, in addition to 5 per cent. of tannic acid, several aromatic substances, so that it possesses antiseptic properties. On this account OPPOLZER used it in the form of powder for the treatment of wounds. VOIGT also recommends it for veterinary use. I frequently use powdered coffee, as it is easily obtained, but I would use it only in case of necessity, as its action is not entirely reliable.

(s) SALOL.

Salol has been recommended by SAHLI instead of iodoform, as it is said to be non-poisonous when applied externally.

(t) BISMUTHUM SUBNITRICUM.

KOCHER recommended this preparation for the treatment of wounds and he reported good results, but this remedy has not become popular.

(u) BENZOIC ACID.

According to BUCHHOLTZ it acts stronger antiseptically than salicylic acid (1:1,000), but on account of the cost this remedy will not gain importance in veterinary surgery. The only preparation of benzoic acid which is used to any extent in human surgery is the benzoic acid wadding.

(v) PICRIC ACID.

SOZEWITSCH tested picric acid for its antiseptic properties and proved that it acts stronger than carbolic and salicylic acid. Picric acid as an antiseptic has not become popular, nor is it altogether non-poisonous, especially when used on small domesticated animals.

(w) OLEUM EUCALYPTI.

Oleum eucalypti possesses good antiseptic properties and is recommended especially by English physicians (ALL-MANN, NUNN) as salve, and for the soaking of wadding, etc.

Besides the above mentioned remedies which possess directly antiseptic properties, there are many other remedies for the antiseptic treatment of wounds recommended, but they cannot gain any foothold, partly because their antiseptic properties are insufficient, and partly because their application is not very convenient, for instance :

- (x) ZINCUM OXYDATUM.
- (y) ZINCUM SULFOCARBOLICUM.
- (z) KALIUM HYPERMANGANICUM.
- (za) ACIDUM SULPHURICUM.
- (zb) ACIDUM SULPHUROSUM.
- (zc) SULPHATE SALTS.
- (aa) PEROXIDE OF HYDROGEN.
- (bb) RESORCIN.
- (cc) NAPHTHALOL.
- (dd) ASEPTOL.
- (ee) A AND B OXYNAPHTHOICACID.
- (ff) HYDROCHINON, ETC.

In addition to the remedies which we use in antiseptic wound treatment, we would now have to discuss the draining and suturing materials, but as they do not belong directly to the bandaging materials and disinfectants, I will treat them separately in a future chapter, and only mention something in regard to the way of using these remedies in order to fulfill the stipulations of antiseptic wound treatment.

IV. DISINFECTION OF INFECTED CARRIERS AND THE WOUND.

We have seen in one of the above chapters that the infection of wounds is transmitted by certain substances coming in contact with the wound, namely, infection carriers. At the same time we did not consider those infectious diseases of domesticated animals which cause wound infection through the blood, as for instance, tuberculosis, glanders, anthrax, etc. As they do not give us cause for any surgical interference the main object in the antiseptic treatment of wounds is to make all the germs that stick to the infection carriers innocuous. The most important task for the surgeon must therefore be the disinfection of all the infection carriers, which during treatment, necessarily come in contact with the wound. We will therefore discuss the disinfection of these infection carriers in the same rotation as we have adhered to above.

I. AIR.

Infection through the air, according to our experience today, happens more infrequently than was formerly supposed, but in human surgery it is still recognized, and we also must not undervalue its importance, especially since in treatment of wounds, we are assigned to rooms where there is a strongly agitated air, and therefore is rich in germs. Only at times, for instance, in the case of smaller animals or in hospitals, can we have conditions similar to those the human physicians find in their treatment in closed rooms. Owing to this difference of conditions, we can only in a few cases disinfect the air, namely, when we operate in closed rooms free from currents.

LISTER attempted to disinfect the air in closed rooms by the spray, and for this purpose he sprayed carbolic solutions

through forge bellows. Now in clinics, if sprays are used at all, the steam spray is adopted. The disinfectant is sprayed near the point of operation by means of a stream of steam. For private practice certainly a steam spray cannot be made use of, and if a spray is to be employed at all, it can be produced with a Richardson sprayer with which a $2\frac{1}{2}$ per cent. carbolic solution can be easily converted into a spray.

It is different in country practice, however. Here, as a rule, an operation must be performed suddenly and we are compelled often to operate in the field without a spray. It is difficult, however, to disinfect the air in closed rooms by means of a carbolic spray; consequently it is an impossibility if we are compelled to perform an operation in the open air. The spray, therefore, is of no use in country practice, especially if we take into consideration the annoyance to the operator which it connected with its use and to the wound itself. In human surgery in most cases the use of the spray is dispensed with, and only on rare occasions, for instance, on opening the peritoneal cavity, it is still used.

For these reasons we try, in country practice, to protect the wound from germs contained in the air by trying to avoid all such causes as would aid in bringing these germs into the air, the most important of which is the air current. We therefore lay or stand the patient in a place where the air is as quiet as possible, and avoid, if possible, operations in windy weather. We further prevent the patient from making strong movements, especially with the feet, so as not to disturb the air. To possibly prevent the latter morphia narcosis and also moistening the floor of the operating place with sublimate water is recommended. Nothing more can be done to disinfect the air, and according to my experience, these precautions are ample, for should some micro organisms actually enter the wound via the air it would certainly be made innocuous by irrigating the wound.

[The air is no longer regarded as an important medium for carrying infection to the wound during an operation, and therefore the famous "Phenicated Cloud" (carbolic spray) is now en-

tirely discarded in human surgery. For veterinary operations occasional irrigation with weak solutions of mercuric chlorid is sufficient to render innocuous any organism that find their way to the wound through this medium.—L. A. M.】

2. HANDS AND CLOTHING OF THE SURGEON.

As the surgeon continually uses his hands on the wound, special care must be given to them. KUEMELL and FORSTER tried to ascertain experimentally what mode of cleaning and disinfecting is necessary to make the hands free from bacteria. Both authors agree that a five minutes' washing and brushing with warm water and potash soap is necessary, they disagree however, in regard to additional necessary disinfection, inasmuch as after having first washed the hands KUEMELL recommends bathing them in a five per cent. solution of carbolic acid or liquor chlori, and not with mercuric chlorid, while FORSTER adopted the latter and condemned the former. According to my experience, it is entirely sufficient if the hands and forearms, after carefully cleaning them with soap and a sharp brush, the nail bed and matrix being chiefly considered, are well washed with a 0.1 per cent solution of mercuric chloral. It is best if the finger nails are kept shortly trimmed so that they do not hold dirt.

As for the clothing of the surgeon, the coatsleeves especially deserve particular attention. As they are not easily disinfected, I either take off my coat entirely or bare the arm by rolling up the sleeves above the elbow. The use of special clothing for operations or treatment of wounds in country practice cannot be practically carried out.

【Veterinary surgeons are not all equipped with an artificially heated operating room and therefore, in cold weather, it would be very uncomfortable to perform operations with bared arms, especially if the procedure is a long one or a number of operations must be performed, as is often the case in both city and country practice. Under these adverse circumstances, the surgeon may wear a newly laundried jacket, sterilized if possible. Another method is to wear rubber sleeves.

These can be purchased at instrument dealers generally at very small cost. They are durable and easily disinfected without injuring the material.—L. A. M.]

3. RESTING PLACE OF PATIENT.

The resting place of our domesticated animals coming into very close contact, partly temporarily and partly constantly, with most parts of the body, plays an important role, as far as the treatment of wounds is concerned, owing to the presence of great numbers of infectious germs. If we take into consideration the analogous circumstances in human, we notice that here absolute cleanliness of the sick bed cannot be accomplished either; however, owing to the fact that in the human we can bandage up every part strictly occlusively, except wounds in the natural body openings, the importance of the bed is not so great as the resting place of our domestic animals. As we are only able to put a strictly occlusive bandage on the limbs, all the wounds on other parts are exposed to infection through the litter. A disinfection of the litter is impossible; therefore, in order to prevent an infection through it, the following proceedings are indicated:

Keep the litter as clean as possible, that is, have all manure and urine carefully removed; moisten moderately the litter material itself (grain or straw is the best), and avoid shaking it up. If the patients, on account of pain, cannot lie quietly, it is best to compel them to stand, especially during the first five to six days, after which time a healing *per primam intentionem* follows; or until sufficient granulation takes place to give the wound protection against infection.

While performing many operations, we are obliged to cast our patients, and thus an opportunity is offered for freshly made wounds to become infected.

In some clinics (Berlin, Stuttgart, etc.) this source of infection has been removed by using on an operating table, leather covered mattresses, but for country practice such complicated apparatus is not convenient, and we have to depend chiefly on

straw, hence have to consider the dangers connected with its use.

I prepare my place for operation on the so-called dung hill, only in case of necessity; as a rule, I have it made on the ground out of grain straw and have it lightly sprinkled with water. Where the soil permits it (light, sandy soil), we can make an operating ground by digging up the soil, which has the advantage that the irrigating fluids are easily absorbed, so that the patients are lying drier than on straw.

[Infection from this source is easily obviated. Dust should be allayed by light sprinkling with an antiseptic solution (Potassium Permanganate) and a sterilized rug, or, still better, a clean rubber sheet is spread over the bed beneath the operating region. Such a sheet should be in the equipment of every surgeon. It matters not whether the bedding is straw, shavings, soil, or the dung hill, such a sheet, in the absence of any dust, will perfectly exclude infection from the litter.—L. A. M.]

4. INSTRUMENTS AND BANDAGING MATERIAL.

As mentioned in a preceding chapter the usual care of instruments, as well as their construction, favors infection, and therefore they must be dealt with accordingly.

All surgical instruments should be as simple as possible so that they can be easily and thoroughly cleansed, their surfaces must be as smooth as possible without furrows and grooves, therefore, especially knives, they should consist of one piece. Joined instruments (torsion forceps, scissors, etc.) must be easily taken apart, so as to allow their being cleaned thoroughly.

In regard to the care of instruments, since, in country practice, the smaller instruments have to be carried mostly in the pocket, it is advisable to have them in cases. All cases that do not close well are not recommended, as they give the instruments but little protection against dirt. This is especially the case with cigar cases and the pockets of the

clothing, which are often used to carry instruments, already none too clean.

To properly disinfect instruments they should be placed in a three per cent. solution of carbolic acid, if no carbolic acid is at hand in a 0.1 per cent. solution of mercuric chlorid, as the instruments get but little affected, and stay sharp. TRENDELENBURG in BONN has his instruments lying permanently in a sublimate solution; although they turn black on this account, and separate occasionally, the cutting edge of the instruments does not get affected. (See Annotation, Page 32.)

The one instrument which is especially noteworthy on account of its infectiousness, is the sponge. It is still used very often, but possesses so many dangers, that I often wonder how, even in human surgery, there can still be defenders of the sponge. According to KUEMMELL the disinfection of sponges can be accomplished with sufficient safety by boiling them out and putting them for four or five minutes in a 5 per cent. solution of carbolic acid or 0.1 per cent. sublimate water. But it is well to get used to other utensils, because disinfected sponges are not always to be had in country practice. To clean the part or place to be operated on, I prefer to use bandage wadding, and I have had no cause thus far to resort to the sponge.

As to the disinfection of bandaging material, there is but little to be said, for as mentioned before it is prepared by soaking the bandage material with the desired disinfectant. I prepare my disinfected bandage material myself by simply soaking it prior to putting on the bandage, in the disinfection fluid and pressing it out moderately. This procedure is cheap and besides necessary, as dry bandages fit badly to the form of the body and absorb fluids to a greater extent.

☐The methods described above are not entirely adequate and may prove a source of repeated disappointment. Of course cleanliness alone is half the battle in dealing with instruments as well as in all the steps of aseptic treatment, but to simply bath even very clean instruments in a 5 per cent.

carbolic solution is not regarded as sufficient by the experienced surgeon of today. Modern methods may be described under two headings:—first, by the use of heat, and second, with formaldehyde gas.

HEAT. Metallic instruments should be boiled for at least fifteen minutes in a 1 per cent. sodium carbonate solution, and when spread out for the operation they should be placed in a tray containing a 3 per cent. carbolic solution. As has been stated before this latter precaution is not considered necessary in human surgery, but the chances of instruments becoming contaminated during an operation is much greater in veterinary practice. After the operation they should be carefully dried and replaced into the sterilizer, or in the absence of such an equipment, in a dust-proof case.

Sponges are, indeed, treacherous, and yet no other article can readily supplant them for baling blood from a wound during operations. Cotton, gauze, oakum, etc., are very poor substitutes for this purpose in spite of the fact that they are less liable to carry infection into a wound. Sponges are here to stay, however, so far as veterinary operations are concerned, and therefore we should make the best of the situation and adopt the best method of sterilizing them, which consists of boiling and then wringing them from a 1 to 500 mercuric chlorid solution, or with formaldehyde gas, as described in the following paragraph. Bandages, wadding and ligatures are made entirely safe by soaking for fifteen minutes in mercuric solution of the same strength. Ligatures may be boiled, but this is not absolutely necessary in the case of bandages and wadding, as soaking them in such a concentrated solution is certain to destroy any organisms they may carry. Even when these materials are boiled or subjected to dry heat the soaking should not be omitted, because it is an antiseptic bandage and not simply an aseptic one that is desired to cover veterinary operations.

FORMALDEHYDE GAS. The use of this gas for surgical sterilization requires special apparatus, namely a formaldehyde sterilizer, with which metallic instruments, wooden

tools, bandages, wadding and all manner of materials can be promptly disinfected with but little trouble.

The apparatus consists of a strong copper chamber, the inside of which is supplied with drawers and compartments. A suitable size for the veterinary hospital is 33 inches high, 16 inches wide, and 12 inches deep. The front is furnished with a glass door which permits a good view of the interior. The gas is generated at the bottom by a formaldehyde lamp and the outlet at the top is closed with a damper to prevent escape of gas into the room. In from ten to twenty minutes all the contents, even the very center of tightly rolled bandages, folded towels, etc., are perfectly disinfected. When the operator desires to withdraw instruments or dressings the damper is turned and the gas allowed to escape.

PROF. I. D. RAWLINGS, Chicago, who has conducted an extensive series of experiments to determine the efficacy of formaldehyde gas for surgical sterilization reports the following as a fair sample of his many experiments: Squares of gauze soaked in bullion cultures of *staphylococcus pyogenes aureus* were placed on surgical towels, which were carefully folded over them and subjected to the action of the gas in the upper division of the sterilizer. One square removed in five minutes and placed in bullion gave growth after 24 hours in the incubator as did those removed after $7\frac{1}{2}$ and 10 minutes, but those removed after $12\frac{1}{2}$ minutes remained sterile after 72 hours in the incubator at 37 C. **The same results** were obtained from sponges soaked in bullion cultures of *pus micrococci*. L. A. M.]

5. VICINITY OF THE WOUND.

In our domestic animals, which have a more or less hairy skin, it is not to be wondered at that the vicinity of the wound is very frequently the cause of a wound infection. If in the human being, with his scantily haired skin, it is important that all germs in the region of the wound be removed, it can be readily understood that it is all important to disinfect the vicinity of the wound thoroughly. For in our

domestic animals, on account of their mode of living, and on account of the very frequent lack of proper care of the skin, the vicinity of the wound is full of dirt and dried exudations. This fact is often overlooked while the surface of the wound is being treated with all sorts of disinfecting material. This neglect of the vicinity of the wound permits a luxurious growth of pathogenic germs in the unshorn hair. Very frequently I have heard such treatment of wounds called anti-septic.

6. THE WOUND.

From a theoretical standpoint we distinguish two kinds of wounds—aseptic and infected wounds. In practice this difference is also justified, for experience has taught us that it is a good deal easier to keep a non-infected wound aseptic, than to make an infected wound aseptic. We therefore have to take measures accordingly, that is, we have to proceed differently with infected than non-infected wounds. Practice has proven that it is safer to consider every wound that we did not make ourselves and know to be aseptic, as infected and to treat it accordingly. The reasons for this is plain.

First—We usually get patients to be treated which have had an open wound for some time.

Second—The mode of living and use of our domestic animals causes infection to take place simultaneously with the wounding.

Third—We are not able to diagnose positively the preliminary stages of a wound infection. All symptoms which are, as a rule, considered a criterion for a wound infection, namely, rise of temperature, changes in the wound, its color, exudation, swelling, etc., appear only in the advanced stages of infection and occasionally without the latter.

The treatment of aseptic wounds is a purely prophylactic one, that is, it is only necessary to prevent pathogenic germs from entering the wound in the usual ways. This is one reason why I am not going to discuss the necessary modes of procedure at present, as we will take it up later, when methods of wound treatment will be described. However, disin-

fection of infected wounds will be given the deserved attention here.

The disinfection of a wound consists in making innocuous all pathogenic germs that have entered into it and are living there. We have the following ways to do that :

First—Removal of the microbes.

Second—Killing of the microbes.

(a) Through chemical means, which directly kill the microbes.

(b) By changing the substratum so that the microbes cannot find a suitable condition for vitality, and hence, die.

If we have to treat a simple three or four-day-old wound of the soft parts with smooth walls, a thorough rinsing out with a 1 per cent. sublimate or 5 per cent. carbolic solution is sufficient to disinfect it. This simple rinsing, however, does not suffice if we have a granulating wound or one with sinuses, or a contused wound. In such cases the conditions favoring the settlement of micro organisms must be first removed, and for this purpose the cutting instruments only are useful. It is best to scrape off the granulating surfaces with the sharp scoop, cut off with the scissors or knife all shreds of tissue, which cleave to the fissures, even up the edges of the wound, remove all foreign bodies, or, in a word, change the fissured wound, with the aid of the surgical instruments, into as smooth a one as possible. With this dressing of the wound, especially with the sharp scoop, a large portion of the microbes present in the wound are removed, and we disinfect in this manner. Only after the coarsest portion of the disinfection has thus been mechanically performed, do we use, as in a simple wound, the disinfecting fluids to irrigate it.

Occasionally it happens, owing to larger surface hemorrhages, especially in cavity or socket wounds, that we are prevented from proceeding in the above manner. In such cases the use of heat is recommended to attain a sufficient disinfection. For this purpose PAQUELIN'S Thermo-Cautery is to be recommended, because with it we can conveniently disinfect larger surfaces by simply searing them

over with the firing iron. At the same time, the heat acts on the surroundings of the wound so that some microbes, on which neither the knife nor sublimate had any effect, are thus destroyed. In case of necessity the firing irons can be used for this purpose, but some have the disadvantage of getting cold too quick. To cool off the highly heated textures afterwards, the wound surface after the application of the hot iron may be irrigated with a disinfecting fluid.

Though it is not necessary in most of the wounds of the soft parts to use such strict measures as far as the sharp scoop and scissors are concerned, these precautions are a necessity in all wounds of the bones, cartilages, and tendons. These parts, owing to their anatomical relation, seem to get diseased to a greater extent, therefore, these tissues must be worked upon energetically with both the sharp scoop and chisel and eventually the Paquelin burner before the application of chemical disinfecting materials are to be thought of.

In these ways we can always succeed in disinfecting an infected wound and I would especially call attention to the mechanical disinfection, that is, to the use of the cutting instruments and of fire, as they play the chief role with me in wound disinfection, while the chemical agents come secondary. The most effectual amongst them is the sublimate; carbolic acid does not develop a sufficient action until a 5 per cent. solution is used, and then it irritates the wound.

V. SUTURING AND LIGATURE MATERIAL, DRAINAGE BANDAGES

In the preliminary chapters we have learned the method of disinfecting a wound; now, therefore, we should discuss how to keep this disinfected wound aseptic and make it heal, were it not necessary before we proceed in this routine, to take into closer observation a few substances, which, although they are not essential to the aseptic treatment of wounds, are often used.

To ligate vessels and to sew up wounds, which should heal by direct union, we are in need of a substance which should possess certain qualities for the purpose of treating wounds antiseptically, viz.:

First—It must be disinfected so as not to infect the wound.

Second It must not, if it stays in the tissue, act as a foreign body in such a way that, after a healing of the wound has been effected, a reaction for the purpose of eliminating the suturing and ligating material shall take place. It is again LISTER that furnished us such a material in catgut. He laid twisted sheep-guts for two to three months in a 20 per cent carbolic oil and preserved them in it for further use. The advantages of this catgut were so numerous that it immediately displaced all other materials, for it healed in the wound and finally became absorbed without causing the slightest irritation. Now the catgut manufacture, according to LISTER, is much in use, but it has the fault of being too expensive for veterinary purposes, besides the knots, considering the large numbers we use, do not hold well, so that the ligatures and sutures easily open up. With the discovery and introduction of other antiseptics and in the same proportion as carbolic acid, on account of its being poisonous, commenced to be interdicted, other methods of pre-

paring catgut were introduced; thus the chromic acid catgut (LISTER), juniperus catgut (KOCHER), and sublimate catgut (SCHEDE), originated. Amongst all these new preparations, none became popular, and the old LISTER carbolic catgut is chiefly used.

For such sutures and ligatures that do not have to stand a long strain, catgut is sufficient, but in our domestic animals with their strongly developed muscles the catgut cannot stand the strain of the muscles on account of the changes which take place after a little time in it. Therefore I abandoned the catgut and used only silk. The fear that the silk may not act as a foreign body, because it is not absorbed, is not justified. I prepare disinfected silk for myself by soaking plain twisted raw silk in a 2 per cent. solution of sublimate water and also keep it there to be used when needed. Formerly I boiled the raw silk thoroughly, and only after that preserved it in the sublimate solution, but I found that preserving it is amply sufficient for disinfection. In case of necessity, if I did not have any disinfected silk with me, I obtained a substitute by simply soaking the silk in a 1 per cent. sublimate solution, which had the same effect on the tissues as disinfected silk; however, I venture this only if absolutely necessary.

The disinfected silks generally sold, such as carbolic, sublimate, and iodoform silks are too expensive for veterinary use.

Beside catgut and silk no other suturing materials can be substituted in the antiseptic treatment of wounds, although there have not been any lack of other preparations and substitutions, thus for instance, VIGEZZO recommended horse hair which he prepared, for suturing and ligating.

[Kangaroo tendon is prepared in Australia, and is being extensively used especially where great strength in the suture is required. It softens and becomes absorbed as readily as catgut. A. H. B.]

The healing per primam intentionem has at all times been the ideal treatment of wounds, but it is impossible to succeed in healing all wounds thus, especially wounds that have lost much substance. Even if the surgeon succeeds, in the latter

case, in directly connecting the skin and the superficial layers of the tissue by suturing, cavities are left at the bottom, which easily lead to an accumulation of exudations, and which are thus direct breeding cavities for infectious germs. To prevent such conditions and yet at the same time to bring the greater part of a wound to a close *prima intentione*, such cavities have to be kept accessible for disinfection. Drainage serves this purpose, that is, the exudations are drained from the tissue cavities by means of tubes, which are manufactured from different materials.

LISTER used rubber hose as drain tubes, which were of different diameters and had side openings for the escape of the exudations. These drainage tubes are first disinfected by putting them in a 5 per cent. carbolic or sublimate solution, and are then used.

SCHEDE used instead of rubber tubing pigtaails made of twisted glass threads; also skeins of horsehair or catgut threads were recommended, but, although capillary attraction acts favorably in this mode of drawing off the exudations, a generalization of this method has not been accomplished. Likewise the use of absorbable drainage tubes such as NEUBER made out of decalcinated bird bones did not become popular, although these drains, on account of their being absorbed, do not possess the disadvantages of the rubber drains. Though the drainage doubtlessly offers many advantages to the healing of the wound, certain disadvantages are attached to it so that partly by changing the material and partly by taking special technical measures, we try to avoid these disadvantages. Since we are never entirely successful, it is necessary to limit them by following certain rules when adjusting a wound drainage so as to avoid as much as possible any hindrances to the healing of the wound. First of all, the drainage tube being always a foreign body, prevents a direct union of the respective parts on account of its lying between the surfaces of the wound. Therefore, it is compulsory, if the wound heals regularly otherwise, to change the bandage after a time in order to remove this drainage tube.

Even NEUBER'S absorbent drainage tubes did not do away with the necessity of changing the bandage, because they do not cling to the parts of the wound as well as the more elastic rubber tubes. From these facts the rule follows:

That every drainage tube should remain in the wound no longer than is absolutely necessary.

As narrow tubes are apt to get easily clogged by coagulum and hence cease to perform their function, tubes with comparatively wide lumen should be always used.

Drainage tubes with light walls are very easily crushed, especially in the muscles, therefore the walls should be as strong as possible so as to withstand the pressure of the tissues.

An essential disadvantage for the wound lies in the fenestral openings of the drainage tubes because the granulation proliferates into the latter, thus nearly always causing lacerations and haemorrhages on these granulation knobs when the drainage tube is taken out. Unfortunately we are not able to prevent this, for without these fenestral openings drainage would hardly be effected.

Too narrow, as well as too long tubes are apt to clog up, and therefore it is necessary to lead them out by the shortest possible way, and instead of a single long drainage tube, to use several short ones.

☐ Proper drainage of wounds, as a principle in surgery, being a *sine qua non*, and rubber tubes proving quite unsatisfactory, glass tubes were used, which had the advantage of strong walls to resist the pressure of encroaching granulations and adjacent muscles, but during the last few years antiseptic gauze and oakum have taken the place of tubes almost entirely. It is impossible in veterinary practice to keep the tubes in position on account of the restlessness of our patients, but gauze and oakum are easily kept in place by the bandage. Gauze, being a thick, open-meshed, woven cloth is peculiarly adapted for the packing of wounds, and is obtainable in all drug stores, ready for use. In its preparation, after being thoroughly washed, it is impregnated with some

antiseptic, such as bichloride of mercury, iodoform, boric or carbolic acid. It maintains asepsis in aseptic wounds, and helps to disinfect septic ones. It takes up the exudations so perfectly that it is not necessary to change the bandage oftener than once every two or three days in wounds with medium-sized cavities that have not become septic, but in septic wounds and those attended with profuse exudation, absolutely requiring drainage, the bandage needs to be changed usually twice a day. For all wounds requiring drainage in the smaller animals and the smaller wounds in the larger animals antiseptic gauze is the ideal packing. Oakum is more suitable for the larger wounds, especially those with cavities in them that require the maintenance of a free external opening till they fill up from the bottom with solid, healthy granulations. It takes up the exudations and maintains a good drainage better than other substances. Before being used it should be soaked for ten or fifteen minutes in a one per cent. solution of bichloride of mercury, or a five per cent. solution of carbolic acid or other antiseptics. A. H. B.]

Another drawback to the use of drainage tubes is their liability to either fall out, or be drawn into the wound. In our domesticated animals the former usually occurs. This can, however, be avoided by suturing the outer end of the tube to the edge of the wound.

As wound exudates do not always absorb, one of the important demands, without which the best applied drainage does not perform its function, is to allow them to flow downward according to the laws of gravity. This may require counter openings for the sole purpose of establishing proper drainage.

On account of these drawbacks attempts were made to entirely discard the use of drainage in human surgery. As a matter of fact, it is possible to attain good results without drainage, and as, especially in veterinary surgery, these mishaps appear rather frequently, we must discover and eventually adopt only such measures which will make drainage unnecessary.

The methods, which have thus far been frequently applied in place of drainage, are

(1st) The depressed suture.

(2nd) The row of sutures.

(3rd) The secondary suture.

These three styles of suturing will not be discussed any further here, as they really belong to the domain of surgery.

The last material to consider in the adjustment of an anti-septic bandage is the cord or band which holds it in place.

As the only object of this cord is to retain the bandage in place, its form and construction is really of no great importance; but opinions, as far as veterinary science is concerned, differ somewhat on this subject. Hence I will make a few remarks about it.

It has always been supposed that the bands should be firmly woven so as to stand the strong strain caused by the violent movement of our domestic animals. Therefore linen bands with woven edges were used, and for the hoof a special style of fastening, the so-called chain bandaging, has been invented. My experience, however, has taught me that these linen bands, on account of their lacking elasticity, squeeze the wound and do not cling to the body; also, that the successive turns slip from each other, thus permitting the bandage to get easily loose, and finally come off. In a word, I found that linen bands, aside from their high price, are the most unfit material for bandages in existence. On this account I now use only cambric and mull bands 5 m. in length and 7 cm. in width. They have all the advantages and are much cheaper than linen. Before putting them on, I usually soak them in a 1 per cent. sublimate solution, to make them fit better as well as to disinfect them.

VI. ANTISEPTIC MODE OF TREATING WOUNDS.

I have stated in a former chapter that the method of treating wounds in human surgery cannot entirely be utilized in veterinary surgery, because veterinarians, in contrast to human surgeons, cannot always apply a strictly occlusive bandage. In human surgery, where the wound is left to itself, bandaging is the one method of treating it, while in veterinary surgery we must distinguish between wounds which can be bandaged and those which cannot. Most veterinary authors seem to be of the opinion that antiseptics is impossible without an occlusive bandage, but as this is not the case, we will have to consider those methods by which wounds can be treated antiseptically without them.

These methods and the possibilities in this direction will be explained in this chapter.

In view of the above fact we distinguish:

1st. Wound treatment with the occlusive bandage.

(a) Dry bandage.

(b) Moist bandage.

2nd. Open wound treatment.

(a) Treatment under the dry scab.

(b) Irrigation with antiseptics and afterwards dusting with iodoform.

The object of a dry occlusive bandage is to keep an aseptic wound aseptic. This is reached by the following means:

The disinfected wound is covered with a pad of jute, which is moistened with a 1 per cent. solution of sublimate water. On top of this pad we put wadding, gauze, or any bandaging material which should be disinfected by dipping them in a 1 per cent. solution of sublimate, and which should extend considerably beyond the wound on all sides. With the aid of a

cambric or mull band, which is also moistened with sublimate water, this material should be bound on tightly.

After these general statements in regard to dry occlusive bandages, I find it necessary to give more particulars in regard to the necessary disinfectants and various other points that may be worth mentioning, as failures may easily be recorded if trifles are disregarded.

When discussing the various disinfectants, I have mentioned that we possess in sublimate both a reliable, and, if properly used, harmless disinfectant, which, besides, is easily transportable, especially for country practice, and can be conveniently dosed if made in the form of Angerer pastilles. Moreover, on account of its cheapness, it can be easily understood why I use only sublimate as a disinfectant.

For a long time in a greater or less degree the ability to absorb wound exudations was of importance in determining what bandaging material to use. However, as SCHEDE'S remarks, considering the small amount of exudation which flows from an aseptic wound, any bandaging material is sufficient to absorb them. Therefore, it is not surprising that I take the price into consideration only when selecting bandaging material, and either use jute or fatless wadding. I stated that usually a pack of sublimate jute is put on the wound, which is especially advisable in sutured wounds. In open wounds with pockets, the objection could be easily raised that the jute pack by coming in direct contact with the granulations, might cause a damaging irritation or that it might stick to the wound and injure the granulating surface. Finally it would not be impossible for single threads of the jute pack to prove injurious later by healing in the wound. All these disadvantages actually take place, if wadding is used, but I have not as yet noticed them with jute; on the contrary, I found that in pocket wounds, the jute pack very effectually carries the exudation outwards. Frequently I use, on account of these draining qualities of the jute, splices of the same for drainage.

As I soak the bandaging material and band in a sublimate

solution before putting them on, it is not exactly proper to call such a bandage "dry," but it should be remembered that such bandages dry very fast, so that, although moistened, they very soon dry by evaporation. The causes which compel us to proceed thus, when a dry occlusive bandage is put on, are as follows:

(a) If we put the bandaging material on dry, it does not fit tightly to the shape of the body, thus forming dead space (cavities) in the bandage, which frequently are the cause of accumulation and decomposition of the exudation, and the loosening of the bandage.

(b) Furthermore, this preliminary soaking is necessary because, on account of its cheapness, I procure bandaging material which is not disinfected, and I disinfect it myself in this way.

(c) Besides, dry bandaging material absorbs the exudation poorly, and, if the exudation formed soon after putting on the bandage is not carried into the deeper layers of the bandage, it dries up in the immediate vicinity of the wound and makes the bandage unfit for absorbing more.

(d) In our domesticated animals it is essential that the bandage should be put on rather tight, as, on account of the restlessness of the patient, the bandage usually gets somewhat loosened. By all means we should not forget that excessive pressure on a part of the bandage may easily cause bandage necrosis. I found that this moistening of the bandaging material before putting it on is of the greatest help in maintaining it. If the band that holds the bandage on is drawn close, the band after the bandage has dried up gets longer so that the bandage will be somewhat loose. While the bandaging material dries up and at the same time expands, it provides for the filling of the space between the body and the band, and a sufficiently tight hold.

Finally, the question as to how long such a bandage should be allowed to remain unmolested must be considered:

The advantage lies in the fact that a daily cleansing and treatment of the wound, which in the preantiseptic era was

considered necessary, is superfluous. The endeavor of every surgeon is, if possible, to bring about the healing of the wound under one bandage; however, a change of bandage is indispensable in certain cases, and therefore a minute knowledge of all the circumstances which make such change necessary is required.

Though we could easily ascertain how the wound is progressing by taking off the bandage, we would at the same time expose the wound to new dangers. Therefore, we have to be on the lookout, as in internal diseases, for symptoms, which tell us what takes place under the bandage. Though these symptoms are not as numerous as they are in internal diseases, it takes practice to decide from them whether the bandage should be changed or not.

LISTER, by his bi-chloride of mercury bandage, as previously mentioned, attempted to use the bandage itself as a reagent for the procedures of the wound; but this does not seem to me to completely solve the question, as wound exudations, especially pus, produce the necessary discoloration only, if they soak through the bandage. We do not therefore obtain any disclosure as to the condition of the wound unless the exudation is abundant.

One of the most important symptoms for determining the processes going on in the wound is undoubtedly the temperature of the body. Every rise in body temperature during the healing of a wound, is, if no other illness is present, due to some abnormal action in the wound. To avoid mistakes, we certainly must, in accordance with VOLKMANN and GENZMER'S theory, strictly draw the line between septic and antiseptic fever. These authors frequently call our attention to the fact that frequently high fever up to 41° C. occurs in patients with a completely aseptic healing of the wound, and that the patients alluded to did not show signs of any constitutional disorder. This aseptic fever is of no importance in healing wounds, and the question arises, how are these two styles of traumatic fever distinguished from each other? As already mentioned, aseptic fever consists chiefly of a rise in

temperature without any disturbance of the general constitution and is caused, according to the theory of VOLKMANN and GENZMER, simply through resorption of bland wound exudations. The case is entirely different with aseptic fever. In it we find, besides a rise in temperature, a great nervous prostration, so that some horses stagger with the hind parts, and if slightly pushed with the hand stumble sideways, and even fall down. Furthermore, such patients suffer from complete loss of appetite and dizziness with stupor.

To return to our subject as to the importance of traumatic fever in judging the healing of the wound, only septic fever necessitates a change of the bandage, while the aseptic fever is of no importance. Naturally there are septic fevers which show the above mentioned symptoms in only a small degree, for instance, the appetite is irregular with a temperature of from 39° to 40° C. In such cases we should not immediately change the bandage but wait and see as to whether this condition lasts longer than twenty-four hours or gets worse. In the latter case the bandage must be changed immediately; however, if the temperature returns to its normal condition in the specified time, we omit taking off the bandage.

Another, though not absolutely reliable, symptom of the wound-healing processes is the painfulness of the wound and surroundings. This symptom is unreliable inasmuch as the varied sensibilities of single individuals are shown in the painfulness of the wound. While dogs with wounded limbs as a rule put no weight whatever on them, oxen with even large hoof defects still work, although with pain. Just as different sometimes is the degree of sensibility even between individuals of the same animal species, thus, for instance, well bred horses do not, in slight hoof affections, put any weight on the affected limb, while working horses of a lower grade frequently show, even in severe affections, but insignificant pain. We can thus see that the painfulness has but a relative value according to circumstances, and I consider, as a rule, that only a pain which remained the same for over five days, and an increasing pain-

fulness after surgical encroachment, necessitates a change of bandage.

【One of the main indications of sepsis is more or less extensive swelling. Aseptic wounds, as a rule, swell very little.—A. H. B.】

Amongst the many causes to which an increased painfulness of a wound, especially the nondisappearance of present pain, is due, we will only mention the one that has any relation with the bandage, namely, pressure on any part by the bandage. If the bandage is put on too tight it necessarily presses the soft parts, especially in the hoof, and creates pain.

Profuse exudation may be the cause for change of bandage, especially in a case where an articular cavity sheath of a tendon etc., which has been opened, furnishes its normal exudation, and then easily saturates through the bandage. Although this saturation of the bandage with the secretion of serous or synovial membranes is not an absolute indication for changing the bandage, it is a good idea to do so, as these serous secretions form an excellent nutritive channel for micro organisms. Though we could, by placing over such bandage that has imbibed pure serous secretions a thick layer of disinfected bandaging and fastening it with a band, avoid bad results, it is not advisable to allow such cases to go into extremes, especially in country practice, where the patient is not seen every day.

If the saturation of the bandage with bland exudations was not such as to be decisive for the change of the bandage, every imbibition by the bandage of exudations other than bland, which are immediately recognizable on the body temperature, must lead us to put on another bandage, for otherwise the whole antiseptics of the wound is illusory. That a bad fitting, loose bandage does not perform its function and is therefore worse than no bandage whatever, is a fact which is well known, therefore, it goes without saying that the loosening of a bandage always necessitates a change.

In conclusion, we may mention one more symptom on which, in human surgery, a certain value is placed; I mean

the scent of the bandage. In our domesticated animals the scent of the bandage is nearly valueless, for even in an entirely aseptic condition of the wound and its vicinity, especially with a moist bandage, a scent which is like that of old cheese or a sweating foot, is observed. This scent, which is chiefly found in hoof bandages, originates from decayed epithelium, especially hoofhorn, and has nothing whatever to do with the wound, and is of no importance whatever.

(2) The moist occlusive bandage differs only in its purpose and treatment from the dry one, so that nearly everything that is said of the latter is of value for the moist bandages.

If we want to put a moist occlusive bandage into use we use the same *modus operandi* as with a dry bandage, only we have to see that the bandage should be permanently moistened with antiseptic fluids. In human surgery this moisture is kept up by placing between the layers of bandaging material gum paper or any non-porous material. By this method an evaporation, drying of the moisture contained in the bandage as well as perspiration is prevented and the intended object reached. Although the bandage under these conditions stays moist, an increase of disinfecting matter will by no means be obtained, therefore, as the disinfection means will gradually be used up, a scarcity of the latter will result; besides, by the mentioned mode a maceration of the skin which often results in eczema and its consequences will be started. For these latter reasons I abandoned this mode of moist bandaging, the more so as the bandages of our domestic animals so easily get infected, especially on the extremities, which necessitates a repeated disinfection. This disinfection is reached by simply having a 5 per cent. sublimate solution poured upon the bandage several times a day. Experience has taught me that no intoxication arises by this treatment and I have decided to use a moist sublimate bandage as a rule in all fresh wounds, and until the first change is necessary, and I have thus gained complete asepsis even in hoof bandages, which are exposed to infection.

As to the incidents in the wound also as to whether a change of bandage has to follow, the symptoms mentioned in the dry occlusive bandage (with exception of the saturation of the bandage), give us the desired information.

(3) In human wounds, which are not treated at all, we frequently see a healing take place without any pus or abnormality in the healing process. By inquiring into the reasons and what takes place in the healings of these wounds we find that nature, by certain processes, is able to frustrate such wound diseases which are due to infection. We notice that such wounds, on account of the drying up of the exudations, form a dry scab under which healing takes place, just the same as we notice by adopting the bandaging methods previously described. Healing under a dry scab is also possible in our domestic animals, but less so than in the human, because of the work they do as well as on account of the greater danger of infection and its consequences. Notwithstanding these unfavorable conditions, healing under the dry scab is possible in our domestic animals under certain circumstances.

As it is impossible for us to put on a bandage on many wounds of the body, the question arises whether this natural process of the healing under the dry scab may not be artificially imitated. After many experiments in this direction, I obtained a result not to be undervalued, as I succeeded, with but few exceptions, in all wounds where no violent or forcible motion takes place or any specially profuse exudation is present, that is, in wounds not located around or on the joints, by spraying iodoform sugar or iodoform tannin on the wound surface to produce a dry scab which is sufficient to protect the wound against infection. Considering what was said above in regard to the life conditions of micro organisms, the effect of this method explains itself. On account of the exudations having been reduced to nearly nothing, one of the most necessary stipulations for the growth of microbes, namely, the moisture, is lacking. Furthermore, the little exudation which exists turns, on account of the sugar present, into a concentrated sugar solution, which latter also does not form

a suitable nutritive medium for vegetable life substances. Besides, the iodoform, when coming into contact with granulation, produces vigorous antiseptic effects.

Where it is necessary to dry up a wound surface effectually, that is, to restrict exuberant granulation, I do not know of a better remedy than iodoform sugar, considering the demands of antiseptics. In case of necessity, I have used also pure sugar with the same result.

The iodoform tannin I used for healing purposes under the dry scab only, for if the discharge has a synovial character, the sugar is not capable of coagulating and drying up the great quantity discharged. Here iodoform tannin is more effectual.

(4) In all cases in which we can neither apply a bandage nor succeed in bringing on a scab healing, we have to resort to "the open wound treatment" in a closer sense of the word. However, as I mentioned above, I very frequently succeed in healing wounds under the dry scab, and only in such wounds of the trunk, which are either located in the vicinity of the natural body openings or are bruised wounds, and as such have to cast off first all necrotic parts, or are such which, on account of strong unavoidable movements, do not permit scab formation, do I resort to open treatment of wounds.

The antiseptic treatment of such wounds is as follows: The wound as well as vicinity is freely rinsed and carefully cleansed with a 1 per cent. sublimate water solution, and then the surface is thinly covered with powdered iodoform. For the latter manipulation I prefer to use rubber ball syringes such as are used for spraying insect powder. They are practical, and on account of their cheapness are preferable to the expensive iodoform sprays.

Now there is only left for us to discuss the conditions which would indicate the adoption and use of any of the above methods, but we have to restrict ourselves to the general indications which are mentioned before, when the different methods were separately discussed, as we are often compelled to transgress from the original to another mode of treatment during the process of healing of some wounds.

It would be carried too far were we to describe all the details of the course of a wound and all indications for further treatment which may follow. In judging single cases practice must aid us in using the necessary practical judgment and precaution. Therefore, I can only recommend to everyone who is desirous of thoroughly posting himself as to the technics of the antiseptic treatment of wounds, to go through the separate details of the *modus operandi* either in a clinic or in practice. It is thus learned much faster and with more thoroughness (which is pre-eminent) than is possible from books.

VII. ANTISEPTIC OUTFIT FOR PRACTICE.

In former chapters we learned of the necessary precautions, materials, etc., necessary in the antiseptic treatment of wounds. Should we draw a conclusion from these statements as far as carrying out the antiseptic treatment of wounds in country practice is concerned, it would be evidence in itself to justify the remark (untrue though it be) which is often made in regard to antiseptics in country practice, namely, that it is too complicated to be of practical value to the country veterinarian. I acknowledge myself that such an apparatus as referred to in former chapters, could be conveniently kept in a clinic but could not be very well lugged around by the country practitioner.

As thus far in our literature there are no suggestions as to what the antiseptic outfit of the practical veterinarian should consist of, I will put my own experiences down as a basis for the following: The facts mentioned in the last chapter should by no means be considered the limit; they should only prove as the intention of this book indicates, that antiseptics in country practice can be carried through, and country practitioners should furthermore be urged to follow up this plan. I, at least, shall accept and be very grateful for any improvements and teachings that may be offered at any time.

The instruments play an important role as infection transmitters, and on this account I have given up the use of leather pocket or bandage cases, as they contain much that is superfluous, and besides, the material which they are made of is entirely inaccessible to disinfection, I carry only an antiseptic case with me such as made by HAUPTNER, Berlin, and which, as they are manufactured entirely out of metal, can be easily dis-

infected by putting them into a carbolic solution. These cases fill all requirements which I expect from an instrument case and which I have to carry with me for treating wounds.

As a disinfectant I use sublimate which I carry with me in a glass tube in the shape of 20 ANGERER'S pastilles.

As bandaging material, two bands (cambric or mull bands, 5 m. long, 7 cm. wide), with a corresponding quantity of jute wadding or other bandaging material that can be conveniently carried along.

With these few remedies a regular antiseptics can be carried out, and I mostly limit myself in my practice to them, for the more simple an apparatus is, the more simple is its application.

My placing this simple antiseptic outfit first is to show that without any special inconvenience everything can be carried along to comply with the requirements of antiseptics, and that many of the items mentioned in the preliminary chapters represent a luxury to a certain extent, that can be carried along if we are not too particular as to the cost and room. For instance, he who rides in his own vehicle, while practicing, can conveniently carry iodoform, carbolic acid, disinfected silk, several bandages, etc., etc., besides the above mentioned outfit. In hospital practice we can have even more conveniences, for instance, irrigators, iodoform sprays, etc. However, as mentioned above, I confine myself to the most necessary, and as a rule carry only the first mentioned items with me; if, however, I know that an operation will be necessary, I also take along the following articles:—iodoform, pure carbolic acid, brush, 200-300 g jute or fatless wadding, 4 or 5 cambric and mull bands each 5 m. in length, 7 cm. wide. All this can be easily transported in a small tin box.

On farms with much live stock it is well to keep at hand all such materials for disinfection. Some farms in my locality have, on my advice, furnished themselves with bandaging cases, which contain the following:

1,000 grams jute (in plaits).

1,000 g fatless wadding.

500 g pure carbolic acid.
500 g pure sublimate spirit (1:5).
500 g iodoform (powdered).
20 cotton bandages.
20 muslin bandages.
Iodoform spray.
Esmarch tube.
Disinfected silk.
Drainage tube.
Brush for antiseptis.

VIII. EXAMINATION OF WOUNDS AND THEIR PREPARATION FOR OPERATION.

As the proper treatment of a wound cannot be carried on without a thorough knowledge of its nature and the conditions present, the first stipulation is a thorough examination. Very frequently we are compelled to go at this examination manually, that is to use instruments (probes) for the purpose; in every instance danger of infection during examination is present, our hands, vicinity of the wound, and instruments being carriers of infection, as already referred to above. It should, therefore, be made a rule, that in examining wounds a direct contact with them should be avoided as much as possible and only with certain precaution should a manual examination or one with the aid of instruments be undertaken. I proceed, therefore, in examining wounds, considering the rules of antiseptics, as follows:

If the condition of a wound (depth, length, affected tissues, possible foreign bodies, character of the wound surface, the discharge, vicinity) can be sufficiently recognized and judged by mere inspection, I do not touch the wound, and therefore obviate the use of special antiseptic precautions in the examination.

When a manual or instrumental examination is necessary, I prepare by dissolving one sublimate pastille in one-half pint of water a sublimate solution (the best way is in a clean wash bowl), disinfect the hands in same, after their having been washed clean with water and also dip the instruments in the same solution, and then thoroughly clean the vicinity of the wound.

The hair, with the dirt and discharges, is trimmed short, to about 5 cm. from the edge of the wound, and eventually with

soap and brush in a rather large circumference the vicinity of the wound is washed and finally disinfected with sublimate water, which is either directly poured on, by means of a pot, irrigator, etc., or is put on with the aid of a wadding or jute compress. After this disinfection of the vicinity of the wound it is irrigated thoroughly with sublimate water and only now follows the examination, with disinfected hands and instruments.

These manipulations may seem tedious, but they are performed much faster than they are described here, and habit has much to do with it, so that I proceed in the described method nearly entirely mechanically. By these means the danger of wound infection during the examination is nearly entirely prevented, and then I am of the opinion that many of the wounds would heal much better if they were not permanently infected through their uselessly coming in contact with the instruments, as well as hands, of both professional and non-professional persons, that are not disinfected.

Similar preparations, as described at the examination of wounds, are necessary to perform operations with antiseptic precautions. The field of operation stands first in need of being prepared. Though in human surgery we almost always succeed in disinfecting an operating field in a short time, even here it has been decided, especially in opening any cavities of the body, to prepare the operating field days before, and the so-called preparatory bandages or poultices are applied. These bandages are for no other purpose than to bring about a thorough disinfection. As the disinfection of the operating fields in our domesticated animals for reasons formerly given, is much more difficult than in the human, I make such preparation of the operating territory in advance whenever possible, for success depends upon a careful disinfection.

To obtain my object, I proceed as follows: If a bandage can be put on, for instance, on the extremities, after the operating field is priorily cleansed, we apply the bandage (hoofs are cleanly trimmed), which is daily moistened with a sublimate

solution. It is practical to use heavy sack linen for such bandages, to prevent their being tread through.

Where such bandaging is not practical, the operating field is to be thoroughly washed, eventually the hair trimmed off, and afterwards irrigated with sublimate water.

Unfortunately, it is not always possible to carry out this effectual preparation of the operating field, hence there is nothing left for us but the disinfection, which was formerly described in all details.

If I perform an operation with antiseptic precautions, and I do this in every instance, I supply myself before commencing it with the following materials, provided I did not bring them along with me:

(1) Five or ten litres of sublimate water. For this purpose I dissolve in one-half to one bucket of water (a well-washed horse pail will suffice) five or ten Angerer's sublimate pastilles. Instead of the irrigator I use a clay pot with a nozzle, with the aid of which the wound can be conveniently washed.

(2) A washbowl with carbolic water (3 per cent.) to put in and disinfect the instruments.

(3) a piece of soap.

(4) a brush.

(5) disinfected silk.

(6) bandaging material.

(7) iodoform powder.

As stated before, all these above mentioned items cannot be carried along permanently, therefore we meet with cases where we have to be contented with the outfit described above, it being the one I always carry along. For disinfecting instruments, sublimate water must then be substituted, the disinfected silk is replaced by raw silk, which is saturated in sublimate water. As bandaging material we can, in case of necessity, use linen compresses, namely, small linen sacks filled with fine sand and saturated in sublimate water, while linen bands come in place of cambric and mull bandages.

During a military drill of six weeks, in which I recently

took part (army veterinarians very seldom have a pharmacy handy, and the medicine case which is carried along on the freight trucks, though it contains a good deal, does not suffice for the demands of antiseptics), I treated almost typically all saddle galls, contused, lacerated and bruised wounds as follows: After the wound has been dressed, and well washed with mild vinegar water, a thick layer of powdered sugar is applied. With this simple, easily administrable method, I always succeeded in healing the wound, under the dry scab, so that I can especially recommend this method in case of necessity.

EXAMPLES OF ANTISEPTICALLY TREATED CASES.

In the following examples, which I discretionally select from among a number in my country practice, I shall endeavor to show the practical application of this treatment, as not everybody has an opportunity to visit various clinics to particularly study the procedure.

OTHAEMATOMA IN THE HORSE.

A heavy Belgian working horse possessed for some time on the inner surface of the left ear a haematoma of the size of a hen's egg, connected with strongly inflamed swelling of the whole concha, as well as the vicinity of the ear. As the swelling already showed numerous erosions and the horse was shaking his head considerably, and permitted the touching of the latter by force only, a removal of the trouble became necessary.

The following treatment was indicated: Removal of the swelling through the fissures of same, and as on account of suppuration the auricular cartilage, if not the whole ear could be easily destroyed, strict antiseptic treatment of the wound was imperative.

After the hair on the swelling had been clipped off, the external auditory canal was cleaned with soap and water, and rinsed out with sublimate water, and then stopped up with a cotton wool tampon saturated in glycerin. The rest of the ear was also washed with soap and disinfected, so that after a

disinfection of the hands and instruments, the opening of the swelling with an *endeuxtemps* oval amputation could follow. A large tablespoonful of a turbid grayish-red fluid, containing numerous pieces of cartilage, was evacuated. The cavity of the wound was then irrigated with sublimate water, and after dusting with iodoform, was tamponed with gauze moistened with sublimate water. Over the wound and the whole ear, wadding was put, then a pair of linen protective hoods, such as are used to ward off flies, was pulled over the ears, and on the lateral portions the halter was fastened. The whole bandage was saturated once a day with sublimate water and was changed every four days, while at the same time the wound was rinsed out with sublimate water and a little iodoform was strewn into it. Within the three weeks which passed until the wound completely healed, a few pieces of cartilage came off, but there was hardly any exudation from the wound, proving the wound's course to be typically aseptic.

CONTUSED WOUNDS ON THE THORACIC WALL.

A well-bred carriage horse from some unknown reason received a contused wound on the left thoracic wall. The wound was 20 cm. in length, gaped 3 cm. and showed at the bottom the ribs still covered with periosteum. It extended horizontally to the olecranon. Otherwise the wound had the aspect of any fresh wound.

As the horse was used for pleasure, it was desired that he should have no disfiguring scar, not even a harness scar, so I had to endeavor to heal the wound *per primam intentionem*.

Treatment—Cutting off of the hair in the vicinity of the wound, disinfection of the wound and vicinity with soap and a 1 per cent. sublimate solution, after scraping with sharp scoop, disinfection of the hands, and suturing the wound. The single stitches of the interrupted suture were put very close, and in the center of the wound a space 3 cm. long was left without suture, so as to allow the cavity of the wound to be treated antiseptically. The latter was rinsed out daily with a 1 per cent. sublimate solution, also the wound itself externally, then

a little iodoform ether (5 per cent.) was injected into the cavity. The wound healed within fourteen days without forming a conspicuous scar: the sutured part healed per primam intentionem, the other by granulations with a purely aseptic course. To prevent any infection during the healing, the horse was turned backwards in the stall, and the head was tied up high on both sides, so that the animal could not lie down nor lick the wound.

SUPERFICIAL AND MUSCULAR WOUND OF THE PELVIS.

A heavy Hanover draught horse, while stepping back, ran against an iron pillar, and thus received a flap wound of the gluteal muscles on the left side. Three lobes (flaps) were formed, and in the center of the wound a large piece about the size of a man's fist was torn out of the senutendinon muscle, which was connected with the muscle with but a few connective tissue bands.

Treatment—After removing the piece of muscle and disinfecting the vicinity of the wound and the wound itself by a 1 per cent. sublimate solution, the two side laps were sutured with an interrupted suture, while in the cavity which was formed by the removal of a portion of the muscle and also on the sutures, powdered iodoform sugar (5 per cent.) was thickly applied. A dry scab formed, under which the wound healed up without any reaction (formation of pus, swelling, etc.,) whatever. Whenever a moist spot appeared on the wound a thick layer of iodoform was put on to keep the scab continuous.

LOBULATED CQNTUSED WOUND ON THE INNER SIDE OF THE KNEE JOINT OF THE HORSE, LAY- ING THE TIBIA BARE.

A Hanover work horse was kicked by another horse under the belly, so that on the inside of the left knee joint a lobulated wound of the size of a large plate was formed, through the center of which the tibia was laid bare, exposing the periosteum in a spot the size of a twenty-five-cent piece.

Treatment—After liberally rinsing out the wound with a

one-tenth per cent. solution of sublimate, all necrotic as well as probably dying shreds were removed and the wound to commence with, was treated as "open." The wound and vicinity were twice daily rinsed with sublimate water, and powdered with iodoform. On the sixth day the wound was clean, and treatment with iodoform sugar, in order to obtain the forming of a scab, was resorted to. On the tenth day a dry scab was formed, under which the wound healed, so that after four weeks the animal was capable of resuming work. The definite cicatrization came into effect after six weeks. Formation of pus, or swelling of the vicinity, during the process, was not present.

TENDON AND SHEATH OF TENDON WOUND ON THE HIND LEGS OF A HORSE.

The following case is especially interesting on account of the complications in its course, and refers to a cob, that received a wound on his hind legs by a plowshare, on the fifteenth of May, and the following were the conditions:

In the center of the left metatarsus, there was a superficial wound 10 cm. long, which extended from below outwards, and in front obliquely upwards, behind and inwards, exposing the inner edge of the perforatus flexor tendon. The wound gaped in the center about 2 cm., the edges were rather smooth and covered with coagulated synovia. The vicinity of the wound was not swollen, but was covered with coagulated synovia.

After removal of the exudations and coagulated synovia present in the wound, by means of a 1 per cent. sublimate solution, the intact tendon of the flexor pedis perforatus came into view. In the center the wound had a depth of 2 cm. These holes were caused by the flexor pedis perforans tendon being half severed. The walls of the cavity of the wound were moderately smooth, and were but partly covered with blood coagulum, but not as yet with granulations. By running the finger down on the upper sheath of the tendon of the flexor pedis perforans, a clear wine yellow, threadlike synovia was

evacuated. However, an opening, or a further filling up of the lower tendon sheath of the perforans could not be ascertained. Besides, the mentioned solutions of continuity, the recurrent metatarsal artery, as well as the outer branch of the plantar nerve was cut through.

The state of the wound clearly indicated the following treatment: If we did not succeed in preventing the infection of the wound, a suppuration in the wound and in the opening of upper tendon sheath of the flexor pedis perforans, would necessarily result, and then certainly a recovery of the patient would be out of the question.

After the hair in the vicinity of the wound was trimmed and the leg cleansed with soap from the ankle joint upwards and washed with a 1 per cent. sublimate solution, it was then thoroughly rinsed out with a 1 per cent. sublimate solution and then in its rear angle three, and in the front two sutures of sublimate silk were inserted. In the remaining cavity, a carbolized jute tampon, powdered with iodoform, was inserted, and the whole metatarsus was surrounded with several layers of sublimate wood wool wadding, and wrapped around by means of cambric bands.

On the 19th of May I visited the patient again and found a regular agglutination of the wound as far as the sutured parts were concerned, the cavity of the wound was covered with nice pale red granulation; however, the synovial flow still continued. The temperature was 38.2 degrees (REAUMUR), and there was no trace of suppuration. The bandage was again put on exactly as on the 15th of May, and the owner was ordered to saturate same once daily with a 1 per cent. sublimate solution.

The tendon of the flexor pedis perforans on the injured spot and the tendon of the flexor perforatus at the top of the sesamoid was totally torn asunder; the wound was gaping owing to the sutures being torn out about 10 cm. and the tendon stump of the perforatus protruded out of the wound about the length of 10 cm. The lower tendon sheath of the perforans was also open and synovia flowed from it.

Notwithstanding these complications, I continued the treatment by first of all cutting off the stump referred to above 10 cm., then diligently rinsing out the wound with 1 per cent. sublimate water and bandaging up as above described.

By renewing bandage on the 1st and 4th of June the course of the wound was a purely aseptic one, only the surface of the wound did not granulate satisfactorily as the upper tendon stump proliferated to a full hen's egg size granuloma, which did not come in contact with the lower stump. I decided on the 9th of June to cut off this granuloma at its base with the scissors, so that about 5 cm. of the *os pedis flexor tendon* was lost.

When I again visited the patient on the 16th of June, I found an altogether aseptic granulating wound of about the size of a hand, which on the edge already showed a new formation of epithelial covering. Synovia did not flow out of either of the flexor sheaths that were open. It was cleaned with a 1 per cent. solution of sublimate and tied up again so that on the 23d of June I found a considerable smaller wound surface, which I endeavored to cure by means of a scar under a dry scab, as there was sufficient granulation formed. To gain this object I had the wound powdered daily with iodoform sugar (5 per cent.) until a dry scab formed.

On the 8th of July the patient walked around in the stall, though the pastern joint was somewhat weak as yet, the horse did not show any pain, and four weeks later could resume its service as coach horse again. On the wound there was an entirely dry scab, and it was hardly the size of the palm of the hand.

NAILPRICK.

In course of time I have had under my treatment the most various forms of Nailpricks (with or without injury to the flexor tendon, navicular bone, frog cushion, and *os pedis*); and I adopted the following rule as to treatment:

Cutting down, occasionally removing all of the horn in the vicinity of the punctured wound, plugging of the puncture-

canal which is widened with the sharp spoon up to its base, with a jute compress, which is saturated in a 1 per cent. solution of sublimate. On the top of this tampon a pledget of jute, fastened by means of a covering iron, is placed, and kept moist by occasionally pouring sublimate water on it. A change of this bandage is necessary every three or four days.

Under such treatment all fresh nailpricks heal nearly without an exception within from eight to fourteen days, on account of the antiseptics, which prevents suppuration and its consequences.

The therapy of all nailpricks, in which the pain does not become materially alleviated within five or six days after the course of treatment as above mentioned, or when fever sets in, (especially in nailpricks, which perforate the flexor tendon, that is, old nailpricks, where necrosis in the depth of the puncture canal takes place) is a surgical one, and will be discussed later.

THRUSH WITH LAYING OPEN OF THE SOFT PARTS ON BOTH HIND HOOFS.

As a consequence of permanent standing in urine soaked peat litter, on both hind hoofs of a horse the frog was so badly macerated, and the side lacunae so putrefied, that in the latter the hoof cutis vera was laid open. The disease was diagnosed as frog canker, and was accordingly treated chiefly with plumbum nitricum. This treatment did not heal the wound, and the owner was recommended to have the animal destroyed.

On my recommendation the horse was treated in such a way as to have the wound rinsed with a 1 per cent. sublimate water and bandaged up afterwards with iodoform tannin (5 per cent.) and jute. In the course of four weeks, healing resulted, during which time the horse worked along in the field.

SUPPURATING STONE BRUISES.

As a rule in suppurating stone galls we simultaneously find necrosis of the soft parts in larger or smaller dimension and

the indications, therefore, are as follows: Removal of necrosed parts, laying open the wound surface by cutting out the neighboring horn, and disinfected treatment of the wound. I therefore proceed thus:

After the shoe is removed, by means of a brush and soap the whole hoof is thoroughly cleansed. Then, after disinfecting with a 1 per cent. sublimate solution, the wound is laid open by removing all undermined horn. Necrotic corium of the hoof is removed, and then another plentiful rinsing with sublimate water follows. After this, either iodoform, or if such cannot be obtained, powdered sugar in a thick layer or granulated coffee, is strewn on the wound, and a moist sublimate bandage put on. After eight days at the latest, such a new formation of horn is present that after shoeing the horse and putting on a few turns of a tarred bandage, the patient can be put to work.

IX. OPERATIONS WITH ANTISEPTIC PRECAUTIONS.

RESECTION OF BODY OF INFERIOR MAXILLA OF DOG ON ACCOUNT OF FRACTURE.

A spaniel was bitten by a large Leonberg dog and the latter fractured both rami of the former's lower jaw closely behind their union (body), so that the lower lip and body of the lower jaw was pendulous.

After narcotising the dog by means of a morphia injection, I resected the fractured portion of the inferior maxilla, also the corresponding part of the lower lip. As I was afraid at that time of the poisonous action from applying sublimate on mucous membrane, the operating region was washed with salicylic water (0.3 per cent.) and the instruments as well as hands disinfected in the same solution. I then made two incisions commencing sidewise on the edge of the lower lip at the height of the fracture, and coming together, going downwards at the mental angle, so that a wedge-shaped portion of the lower lip with the part of the lower jaw situated on it was removed. The two rami of the lower jaw were fastened to each other with a sling made out of silver wire, and the wound on the lip was sutured with silk saturated in salicylic water. In the space between the lip and the fractured ends of the lower jaw rami some iodoform and a gauze tampon were placed, and within the first three days the patient received only drinking water. After six days the sutures could be removed from the lip wound, as a healing per primam intentionem took place. After the course of fourteen days, a few bone splinters came off. The silver wire was removed after three weeks, as the two rami now adhered closely to each other.

After six weeks complete healing took place so that the dog could chew small bones.

ATHEROMA ON THE FALSE NOSTRIL OF A FILLY.

On the outer wall of the left false nostril of a filly a tumor the size of a fist was present, which proved to be an Atheroma, it having been previously opened up several times without success. A radical operation was decided upon in order to remove the continually recurring tumor.

After casting the horse, the skin right above the swelling was washed with soap, the hair was trimmed, and the field of operation disinfected with 1 per cent. sublimate water. After splitting open the skin, the sac of the tumor proved to be so thin that its contents evacuated immediately through a fissure. The encysted tumor was excised and after the wound was thoroughly rinsed in a 1 per cent. solution of sublimate water, it was saturated with sublimate silk. The suture and linear wound were powdered over with iodoform sugar (5 per cent.), so that after a formation of dry scab a healing of the wound, *priman intentionem*, took place after six days.

As an interesting fact I might as well mention here that during my presence six months later on the same farm, I was requested by the owner to again examine the filly's nose as the sutures apparently had not yet come out. As a matter of fact, all sutures were still present, without, however, any suppuration or irritation of the vicinity being present. The sutures were simply healed in, so that I had to remove them with the scissors.

ACTINOMYCOMA IN THE REGION OF THE PAROTID GLAND OF A BULL—REMOVAL—HEALING IN THREE WEEKS.

A Simmenthal bull had a hard painless tumor in the region of the left parotid gland, which was supposed to be an actinomycoma, and later proved to be such. As all my former modes of treatment (cauterization, cutting open, pungent

salves, etc.) proved ineffectual, I resorted to the knife to remove the swelling.

In a dorsal position with head stretched backwards the hair was trimmed off the tumor, the field of operation washed with soap and disinfected with sublimate water. Hands and instruments were also treated the same.

The skin as well as the platysma myodes were cleaved in a direction from the front backwards to a length of about 15 cm. and the tumor up to its pedicle was decorticated, and it was noticed at the time that the jugular vein was partly grown around by the tumor. The pedicle, in order to prevent bleeding as much as possible, was torn off by twisting the tumor. The cavity in the wound, which was at least double the size of a fist, was rinsed out lavishly with sublimate water, and then the skin, as well as the nearby sections of muscle, were closely sutured with sublimate silk. When the bull got up, a secondary hemorrhage into the wound cavity took place, forming a tumor the size of a man's hand. Notwithstanding this the sutures were left intact, as the blood did not percolate, and the tumor was rinsed once daily with sublimate water.

The haemorrhage absorbed and the wound healed up *prima intentione*, so that after three weeks the swelling was no longer visible. In this case also the "healed-in" sutures had to be removed later.

NEURECTOMY OF THE INNER AND OUTER BRANCH OF THE PLANTAR NERVES OVER THE PASTER JOINT. (HIGH PLANTAR NEURECTOMY.)

Neurectomy is an operation which, considering the many important advantages that it offers in the treatment of many hoof and toe ailments, and considering the fact that the great fear of bad results is not justified, should be much more frequently performed than it really is. To express myself briefly, I will state that in my opinion (especially in draught horses) neurectomy is always indicated in all such cases (where there is a chronic ailment of any part, from the pastern joint down-

wards, including the lower sheath of tendon of the flexor pedis perforans), which are painful, but do not show any acute inflammatory systems, and which do not yield to any derivative treatment such as firing, blisters, etc., within six weeks.

Although there is but one incision (surgical wound) made if the median nerve is cut through on the inner surface of the arm at the height of the elbow joint, I concluded for the following reasons instead of neurectomy of the median nerve, to perform the operation on its inner and outer branch over the pastern joint. With this mode certainly we have to operate upon the inner as well as the outer side of the pastern joint, and, therefore, we have to turn the horse after operating on one side, but whoever had frequent opportunities to perform neurectomy of the median nerve, has certainly convinced himself that it is not such an easy operation as it appears to be. On the cadaver certainly with one single incision the median nerve can be exposed, as I have had ample opportunity to observe at the surgical exercises of the Royal Veterinary High School; entirely different, however, are the conditions on the living animal.

The median nerve at the elbow, where it has to be exposed in order to cut it through, is covered by the flexor metacarpi internus. The latter muscle stretches itself, on account of the exertions which the horse makes to liberate himself from the hobbles, so tensely, that it hides the nerves located under it both to the eye and the finger. Besides, in this vicinity, in fact, close to the nerve, lies the vena radialis, vena mediana and vena collateralis radialis inferior. All these three have a rather tolerable lumen, and are easily injured when the nerve is searched for, so that the severe hæmorrhages cause quite a difficulty in finding it.

For the practitioner, who does not have all helping material and assistance at his disposal same as the clinical teacher, the difficulty to find the median nerve on the mentioned spot, would be sufficient to cause him to abandon the operation. Another cause, however, besides this one, induced me to prefer neurectomy of both branches of median nerve on the past-

ern joint rather than cutting through the body of that nerve, I have noticed cases where, undoubtedly, the median nerve was totally cut through, and notwithstanding this, the sensibility did not immediately disappear after the operation. The plea that the muscular sensation in stepping on the corona produces a deceptive sensibility is frail, owing to the fact that needle pricks were also felt on the coronet, I think an explanation for these appearances lies in anatomical conditions, for it is well known that a connecting branch from the ulnar nerve leads at the top of the root of the metacarpus to the outer branch of the median. Possibly through this branch of the ulnar nerve, sensitive fibres enter into the outer branch of the median and thus transmit sensibility into the parts provided for by the latter, although its body is cut through.

To prevent this eventuality, I do not cut through the body of the median, but both of its branches close to the pastern joint.

I attend to the operation as follows: After securing the horse, I trim the hair off, wash the skin with soap, disinfect it with a 1 per cent. sublimate solution, and with an incision from 4 to 5 cm. long, close above the pastern, I expose the nerve. It is practical to make the first incision the proper depth, so that the nerve can at once be seen at the bottom. If only the skin is cut open, as is usually recommended, the connective tissue must then be removed by means of scissors and small forceps. This leads to unnecessary hemorrhages and a shredded condition of the wound, and thus considerably interferes with the finding of the nerve as well as delays the healing. As soon as I know the nerve to be lying at the bottom of the wound, which can be easily determined on account of the violent movements of the patient, when the supposed nerve is pricked with the knife or pinched with the forceps, I carry, by means of the Dechamp needle, a sublimate silk thread under the nerve, also through the neighboring connective tissue, and then tightly fasten the thread around the nerve, during which performance the patient struggles violently. Next thing the nerve, centrally from

the ligature, is cut through with one short cut, and a piece about the length of 1.5 cm. is taken off the peripheral stump. Should any hemorrhage show itself now, owing to a small vein or artery being injured, or even if a lateral artery of the toe having been cut through, it is simply undertied with sublimate silk, otherwise these incidents are of no importance. After a liberal rinsing out of the wound with sublimate water, I suture the wound with sublimate silk, making close stitches. Cut through the other branch of the nerve in the same manner as above described, and after the horse stands up, I put on a moist sublimate bandage. To this we add a few layers of absorbent cotton saturated with sublimate water around the leg, extending from the hoof half way up the metacarpus, which are tightened with closely placed bands.

The after treatment consists of a moistening of the bandage with sublimate water twice daily during the first three or four days, while after that, up to the 12th day after the operation, the saturation is made but once a day. After that time the patient can be put to work with the bandage still on, healing takes place as a rule *prima intentione* and only, if the patient is worked before the twelfth day, the scab is apt to burst open again, which, however, has no other effect than to prolong the healing.

NEURECTOMY OF THE TIBIAL NERVE.

The same indications which justify neurectomy on the front leg are often present on the hind one. Here, however, the trunk of the nerve to be looked for can be easily detected (tibial nerve), so that it is unnecessary to cut through its inner and outer branch separately. The anatomical conditions also do not contra-indicate the operation on the nerve trunk.

As accurate information in literature as far as the anatomical conditions, which are of importance in this operation, are concerned are thus far only given by EICHBAUM. (*Fasciae of the horse. Berlin Arch. Vol. 15.*) I will briefly describe them here. The tibial nerve, as a branch of the sciatic nerve, appears on the medial side of the leg under the *gastrocnemii*

muscles, and lies most superficially about 20 cm. above the astragalus. In a better bred horse it is higher, according to the length of the tibia. The point of operation is located, so that in larger, well-bred horses the operation must be performed up to 25 cm. above the protuberance of the astragalus, while in commoner, smaller horses, 15 cm. is the limit. At this point the nerve is located in the space between the muscle bellies of the flexor pedis, which is surrounded by a muscle sheath, on one side, and the lamellar ligament, which originates by the uniting of the superficial and deep laminae of the fascia of the leg and in front of the tendo-Achillis, goes downward, inserting itself on the astragalus, on the other side. In the median direction the nerve lies close to the deep lamina of the fascia of the leg, and outwards, then follows the superficial lamina of the fascia of the leg, (fascia superficialis of the hind leg,) and finally the skin. Besides this, the nerve is accompanied by the small artery, recurrent tibial artery, also by the plantar vein, the latter, however, does not seem to be constantly present, as I missed it frequently.

The performance of the operation is as follows:

After laying the horse down, I have the top hind leg elevated some by an assistant. I did not find it necessary to untie the leg, and then cut at the specified place with a disinfected knife through the skin to the length of from 4 to 5 cm., after the hair has been trimmed off, the skin washed with soap and disinfected with a 1 per cent. sublimate solution.

Now I assure myself, by touching it with the finger again, that the superficial incision is located exactly above the above mentioned interstice in which the nerve lies; should this latter not be the case, the incision can be enlarged accordingly, or if such enlargement should not suffice, a fresh incision had better be made. If the superficial wound and the space between the flexor pedis muscle and the lamellar ligament, which is formed by the union of the superficial and deep laminae of the fascia of the leg, are not exactly over each other, we reach, by cutting the fascia located under the skin of the hind leg, into the space between the lamellar ligament and the

tendo Achillis, and naturally, notwithstanding we zealously look for it, we do not find the nerve. If both the superficial wound and nerve correspond, we cut through the above mentioned fasciae which covered the nerve, with a long cut, which can be even longer than the superficial one, and find the tibial nerve in the space referred to. In fat horses the nerve is always surrounded by abundance of fat. I, therefore, with the aid of the Dechamp needle in every instance, pull out the nerve with the fat, recurrent tibial artery, and plantar vein and dissect the nerve out of them, then a thread of sublimate silk is by means of the above mentioned needle, carried under the nerve and tied down. After a piece of the tibial nerve from 2 to 3 cm. long is cut out, we convince ourselves by examining the portion cut out, as well as by our pricking the crown of the hoof, that both branches of the nerve have been taken hold of, for it sometimes occurs, that in the preliminary division of the tibial nerve, but one branch is cut through, thus making the object of the operation a failure. The wound is rinsed well with sublimate water and closely sutured with sublimate silk without any regard to possible bleeding, which is of no importance, and besides, does not prevent healing per prima intentione.

The after treatment consists of daily powdering the suture with iodoform sugar (5 per cent.) to produce a dry scab, as a bandage cannot be very well placed there. In fourteen days, at the utmost, the patient can again be put to work.

AMPUTATION OF A COW'S HOOF.

A heavy Dutch cow acquired a whitlow on the outer hoof of the hind foot with a subsequent decomposition of the hoof joint. As the cow, as a consequence of this, became rather thin, I decided to amputate the hoof, which proved to be the more necessary, as there was evidence of caries of the amputated hoof.

The hoofs, as well as the whole leg up to the ankle joint, were cleansed with soap and water, and thoroughly washed with a 1 per cent. sublimate solution.

By a circular amputation, closely above the edge of the hoof, the latter was without much difficulty excised. Haemorrhage did not take place, as all vessels were thrombosed. The whole operating field, including the wound, was rinsed out with a sublimate solution, and by means of jute, which was saturated with sublimate water, and a few cambric bands, a bandage was put on which reached half way up the metatarsus. To prevent any moisture and dirt from penetrating through the bandage it was painted over with tar.

The after treatment consisted of pouring in sublimate water behind the bandage daily, and changing the bandage every fourteen days. With this treatment the wound healed within eight weeks, without any trace of pus or even exudation worth mentioning.

CROWN PRICK. (TREADS.)

As in nail prick the importance of crown prick depends entirely upon how deep the injuring body has entered. As to the mode of treatment, however, there is no difference at all between the various forms of the trouble, as a superficial injury is apt to cause disease to the deeper lying tissues, on account of a slowly encroaching suppuration downwards. By all means surgery has to be resorted to, and according to the size and circumference of the injury, occasionally more and at other times less horn, etc., has to be removed, so that sometimes the operation can be performed on the horse standing, while at other times he has to be laid down, especially in more severe injuries. I proceed as follows:

After the hair and coarse shreds of tissue in the vicinity of the injury have been removed, a cleansing with soap and water follows, and finally disinfection by free after rinsing with one per cent. sublimate water. After that the horn in the neighborhood of the wound is thinned, occasionally entirely removed as far as the connection between the horn and flesh wall is loosened. All foreign bodies and hair which may have entered into the wound, as well as all necrotic or dying shreds of tissue, are removed. It is also well to trim off all irregu-

larities of the wound's edge or soft parts as the formation of the horn later would be irregular. After a thorough disinfection of the wound with a one per cent. sublimate water it is covered with iodoform and a pressure bandage is put on which is, during the first 4 or 5 days, saturated at least three times daily with a sublimate solution. If no peculiarities (fever, increased pain, etc.,) appear in course of time, such a bandage can safely stay on for 8 days, and according to the depth of the injury from 8 to 20 days. A new growth of horn will appear so fast that after putting on a few tarred bands the animal can be put to work again.

NAILPRICK.

In many cases the injury caused to the hoof by a foreign body is such, that deeper lying portions, such as the flexor pedis perforans, navicular bone and hoof joints become affected. In such cases it is not sufficient to tamponize the canal and keep it aseptic, as more or less necrosis of the injured parts often takes place. These necrosed parts cannot be simply shoved out of the punctured canal, but it is necessary to enlarge the canal and to lay it open up to its base. Before discussing the operation itself any further, I would like to annul the objection, that it is impracticable to perform an operation whenever the navicular bone or the coffin joint is injured. This is actually not so, for under antiseptic precautions such injuries heal without any trouble provided that the operation is performed in time, before any important changes or destruction of the parts alluded to has taken place. Should a suppuration of the coffin joint, or extensive necrosis of the os pedis, frog cushion or the flexor tendon already be present, then certainly an operation would not be advisable, for the certainly bad results would be claimed to have been caused by the operation.

After this explanation, and also what I have previously said regarding the treatment of nail prick, I would formulate the indications for the operation as follows:

Should the injuring body perforate the flexor pedis perforans

an immediate operation is always indicated, for should we in these cases use such treatment as mentioned formerly and wait for the result, we would as a rule notice an increased pain, setting in of fever, etc., etc., which is a sign of spreading of the affection, which makes a success of the operation more or less doubtful.

In all other cases in which the flexor pedis perforans remained intact, say that either the frog cushion, or only the os pedis is injured, an operation is only then necessary if necrosis sets in deeply, or if the pain without any further visible cause continues in the same spot longer than from 8 to 14 days, or if finally some complications arise (remaining of a portion of the injuring body, suppuration, etc.).

In performing the operation I use the following *modus operandi*:

After casting the horse, the injured foot is tied on top of the diagonal foot and an Esmarch compress bandage is applied. As I lay the horse on the affected side, the sole of the foot, which is as a rule the field of the operation, on account of the above-mentioned mode of tying (on the diagonal foot), is turned upwards, and thus permits a full view of the field of operation. Within the opening of the puncture (to a circumference of from a quarter to a half dollar piece) the already previously thinned sole or frog is entirely cut down, the whole hoof having been previously cleaned with soap and water and disinfected by pouring a solution of sublimate water on it. Then the soft parts, by means of a disinfected laurel leaf knife, are cut down in cone form, so that the point of the cone is located at the base of the puncture canal, while the axis is formed by the punctured canal itself. The base of this cone corresponds in regard to circumference and location to the surface of the sole as well as frog of which the horn has been removed. We don't need to be too anxious in regard to that, especially regarding the frog, as no tissue grows and regenerates as well as the hoof matrix, so that I have frequently cut out the whole fleshy frog, without any damage to its shape and formation.

If we in this way create a funnel shaped wound we can, with one glance, see in what direction the wound, or any changes in its condition are located.

If the flexor pedis perforans should be found to be punctured through, or necrotic, it should be reduced in such a way that the rear frog surface in its center part is laid bare. If we then see that the navicular bone also has been injured, or that the canal penetrates still deeper, I bore the canal out with a sharp scoop so that all diseased bony tissue is removed, even an opening of the navicular-coffin joint can, under antiseptic precautions, be ventured in this way, with no danger whatever.

Very often we find, especially if the flexor pedis perforans is intact, the inflammatory and suppurative process creeping along in the frog cushion, so that it is pierced by numerous canals in the region of the plantar cushion and the cushion fossa. These canals I scrape out with a sharp scoop, and eventually I place a drainage tube of rather large caliber through the fleshy frog, which is led into the operation wound and carried out by an opening through the fossa.

The after treatment consists chiefly in a regular disinfection of the wound. To obtain this object I put on a moist sublimate bandage, which can, if the course is normal, stay there from 14 days to three weeks if necessary, changed every three or four days.

If an opening is made in the fossa for drainage purposes, the bandage must cover the pastern joint, and has to, in this case, be changed oftener. The reason for the necessity of frequent bandaging in such a case is not the drainage itself, but the fact that the drainage is conditional, as a rule, on the strongly secreting processes of the frog cushion, which causes a quick saturation of the bandage.

If there is but one wound made on the plantar surface of the hoof, one moistened sublimated bandage, reaching up to the pastern, is sufficient. Lately in such cases I have simplified the bandage so that I merely put a covering iron on it, and the space between the cover and sole I pad with absorbent cotton, while a few layers of cotton and bandage tours are put around

the plantar cushion and wall to prevent an infection of the wound from behind.

No matter whether the bandage covers the pastern joint or only reaches the pastern, or whether the covering iron is used, in every case I have the bandage moistened with sublimate water two to three times daily, during the first six days, one-half per cent., and after this, provided the course is normal, only once daily.

If these instructions are carried out precisely, the wound, as a rule, heals after six weeks, and the patient can resume his work. The only evil that cannot be prevented by antisepsis, is that, in some instances, (it is by no means the rule), a painfulness is left in the new cicatricial tissue. In this case neurectomy is indicated, as I formerly stated when discussing neurectomy. I perform neurectomy in all cases of nail prick when, after the wound is healed, a painfulness, without any appearances of inflammation (such as can be recognized, or the missing of an increased artery pulsation) is present.

SEPTIC INFLAMMATION OF THE SOFT PARTS OF THE
HOOF IN THE REGION OF THE SENSITIVE LAM-
INA, PLANTAR CUSHION, FROG AND SOLE
OF THE LEFT FRONT FOOT.

At the request of the owner a bar shoe was put on a horse's foot. Shortly afterwards the horse commenced to go lame. An examination showed a severe inflammation of the parts mentioned in the heading. Cooling bandages did not improve it any. In the course of two days the corresponding horn parts commenced to get loose, so that to check this process an operation had to be resorted to. The indications for the treatment, therefore, were simply as follows:

- 1.—Removal of all horny portions as far as they covered any infected soft parts.
- 2.—Reducing as much as possible all infected, that is, necrotic hoof matrix.
- 3.—Careful disinfection of all wounds.

The horse was laid down, the lame foot downwards. The left fore foot was tied on to the right hind foot and an Esmarch bandage applied. After thoroughly washing the whole foot up to the pastern joint, with soap and water and disinfecting with plenty of sublimate water, the following horn parts on the inner side of the hoof were cut out: wall of the sensitive lamina, plantar cushion, corner prop bar and plantar frog. These parts were severed from the hoof matrix and exposed grayish red, turbid serum. As a consequence of these changes, which represented the commencement of the necrosis, the corresponding soft parts of the horny portions removed, also had to be cut down and the pad of the crown as far as the hornwall, was removed, as well as the inner plantar cushion, which showed the same condition.

The wound, fully the size of a palm, in which the lateral cartilage ribs were laid bare, was plentifully rinsed out with sublimate water and powdered with iodoform. On the wound a few tours of gauze were put, and then absorbent cotton and bandage, reaching up to the pastern joint, was laid on.

As in all hoof operations, I ordered the bandage to be saturated with sublimate water one-half per cent. three times daily, during the first six days after the operation, then until the fourteenth day but once daily.

When changing the bandage after fourteen days, it was evident that the wound had exudated but little, but was already all covered with granulation, while on the edges quite a new formation of horn was noticeable.

The bandage was changed twice more, in intervals of fourteen days, and seven weeks after the operation the patient was able to do easy work, having been shod with a bar shoe. The horse, after a regular hoof formation had come into effect, resumed his work as carriage horse without going lame.

CASTRATION OF STALLION.

According to BAYER'S procedure, also considering that with antiseptics, the dangers, which undoubtedly lie in the pres-

ent methods of castration, are very much reduced, in fact can be entirely avoided, I very often perform castration, with antiseptic precautions, with brilliant results. For reasons, specified in my special pamphlet regarding castration under antiseptic precautions (German periodical for Veterinary medicine and comp. Path. Vol. 14) I did not exactly adopt BAYER'S modus operandi, but adhered to the following useful method for private practice:

The horse receives, half an hour before he is laid down, five decigrams of Morph. hydrochl. subcutaneously to reduce the sensibility, which is to the interest of the patient, (preventing fractures), as well as the surgeon and the method. After the horse is placed in a dorsal position, the scrotum and vicinity (penis, inner surface of thigh, etc.,) are thoroughly cleansed with soap and water with a sharp brush, and then rinsed off with lot of sublimate water one to one thousand or two thousand. The testicle is then taken hold of with the left hand in the usual manner, and the scrotum opened with one incision, just big enough to allow the testicle to pass through, (from 6 to 7 cm.). An assistant then immediately pours sublimate water on the protruding testicle; so as to make any possible appearing micro organisms harmless. Then the so-called mesentery of the testicles close by the epididymis is pushed through the center with the finger, and the two portions of the spermatic cord thus treated, are each ligated, by tightly fastened threads of sublimated silk. To prevent the slipping off of these cords the testicle is cut off so that a small piece of the epididymis is left on the spermatic cord. These ligated stumps do not affect the antiseptic healing of the wound any, as they are (BAYER'S statement) aseptic, and as a consequence become simply resorbed. After the ligature threads are cut off short, the scrotal cavity is again thoroughly rinsed out with sublimate water, and then the scrotal wound is sutured with from five to six sutures in such a way that the stitches commence about one and a half cm. from the wound's edge, and simultaneously get hold of the common tunica testis. The same procedure is gone through with the other testicle, and then

the horse can get up. Then, with the horse standing, the field of operation is again rinsed out with sublimate water and the tail tied up. The latter is important to prevent the tail from dirtying the wound.

The disinfection of the instruments (knives, scissors, and needles) necessary for the operation is effected by simply dipping them in sublimate water every time before they are used.

The after treatment consists in merely letting the patient stand for six days, tied high, so as to prevent his dirtying or dragging the wound on the litter, and rinsing out the field of operation daily once or twice with sublimate water. A bandage or suspensory is not put on, as an occlusive bandage on the horse in this region is impossible. Besides, a dry scurf forms on the wound shortly, which keeps the wound closed.

In the course of the next two days oedema sets in in the vicinity of the penis, which disturbs the circulation some, but is of no importance. This disappears quickly when the patient can take exercise again, which is about six days after the operation.

Occasionally fever sets in on the second day after the operation, which rises even to 39.80 c; however, this is a simple resorption fever, which mainly differs from the consecutive septic wound fever, for the patients are lively and eat their food heartily, while the latter form of fever is always associated with the general symptoms of loss of appetite, depression, disinclination to walk, etc., etc.

We may also mention as a complication, which, however, seldom delays healing, those hemorrhages which set in after the horse arises from the operation. BAYER mentions this accumulation of blood into the scrotal cavity, and thinks it to be the blood which flowed into this cavity during the operation, but according to my observation this haemorrhage originates from the veins that are cut through when the scrotum is opened, and which are located between the common tunica and the dartos. During the operation, on account of the dorsal position of the patient, there is no recurrent motion in these veins, which, however, comes into effect imme-

diately when the horse gets up. As stated, this haemorrhage, which does not always take place, interferes with healing per primam intentionem only when it is profuse, so that the wound edges are forced apart by the pressure. Blood effusions, up to the size of an infant's head, are resorbed without any harm. If a profuse effusion of blood follows, so that a healing per primam intentionem is not expected, the sutures are removed on the fourth or fifth day, the scrotal wound is made a little larger, and the healing with granulation follows, upon a daily rinsing out of the wound with sublimate water, in four weeks at the latest. A noteworthy fact which I noticed was that even in this healing per secundam intentionem suppuration never took place.

I have castrated in this manner twelve horses of various types, from the pony up to the Hanover race, English full blood, and heavy Belgian, and gained the following results: Seven times healing per primam intentionem on both sides, twice on one side, and three times per secundam intentionem, so that out of twenty-four wounds 16, or 2-3 per cent. healed up per primam intentionem. I cannot record thus far any losses or after affects (spermatic cord fistula, peritonitis, etc.).

To pacify anxious minds, who may think that tying up the spermatic cord with two ligatures of sublimate silk, which are left there, they possibly act as foreign bodies and produce an inflammatory process on the spermatic stump, I may state, that disinfected silk heals in as well as catgut, the only difference being that silk does not get resorbed. I noticed in a post mortem I held on a horse that died from colic, and which I castrated the year previous, that the ligatures on the spermatic stumps were smoothly healed in, without any trace of reaction in that vicinity.

CONDYLOMA ON THE PRAEPUTIUM OF THE HORSE— REMOVAL—HEALING PER PRIMAM INTENTI- ONEM IN SIX DAYS.

A heavy Belgian work horse had a wart the size of a dove's egg on the point of its prepuce, which on account of its

frequent reappearing, was removed several times, partly by elastic ligature, and partly by simply cutting it off and cauterizing with nitric acid. Notwithstanding this, the wart always reappeared, and as it finally grew to be the size of a man's fist, I proposed to the owner a radical operation, to which he consented.

The horse was laid down on his left side and the right hind leg tied to the right front one. Prepuce and vicinity, also the condyloma, were thoroughly cleansed with soap and water and disinfected with sublimate water (1 per cent.). By means of a semilunar incision the swelling was removed as far as possible from healthy parts, bleeding vessels were torsioned, and the wound united with close buttoned sutures. Although the urine always had to come in contact with the wound when evacuating, and although the prepuce secretion cannot by any means be considered aseptic, the wound healed by first intention in six days. The after treatment consisted of once daily rinsing the field of operation with sublimate water. The sutures put in are still there to this day.

DOCKING OF TAIL.

It often happened to me that horses full of temper resisted the regular method of docking, in as much that after having cut off the tail with the docking shears, they struggle considerably before the cauterization to stop the hemorrhage. On account of this, bleeding takes place, which, although not very dangerous, disquiets the owner. In such cases I proceed as follows:

After the hair of the tail is trimmed off the place where it is to be docked and the skin is cleansed with soap and water and disinfected with sublimate water (1 per cent.), I put on a tight ligature or rubber tube about 3 or 4 cns. above the point of operation to prevent hemorrhage. Then on each side of the tail I make an incision, so that the two incision surfaces form a V, the point of which is directed towards the root of the tail and rests on the spot where the vertebral column of the tail is to be severed. Thus two flaps are created, which are

used later as a cover for the amputation stump. If possible we must try to make the cuts so that the vertebral column of the tail is severed through a symphysis.

The only cut vessel I tie is the middle tail artery, by means of sublimate silk; the side tail arteries are secured by uniting the above mentioned flaps with sutures.

After the surface of the wound has been well rinsed with sublimate water, I sew up both flaps with sublimate silk, making the sutures as closely together as possible.

An after treatment is hardly necessary, as healing takes place promptly. The sutures, also, I hardly ever have to remove.

Exactly as described above I proceed in dogs, as in the latter, on account of their licking the tail and hitting it against the cage, more haemorrhage, even necrosis of the end of the tail, takes place. In rare cases I noticed in dogs, that after simply chopping off and cauterizing the tail, a connective tissue proliferation formed on the amputation stump, which reached the size of a child's fist. Whether this was a mycofibroma I leave undecided, as I did not make a very thorough examination, as at the time when I noticed these things the term mycofibroma was unknown.

CASTRATION OF HORSES IN CITY PRACTICE.

[In this country a great majority of the horses are castrated as colts before they are offered for sale on the city marts, and therefore the city practitioner does not, proportionately, perform as many of these operations as the country veterinarian. But when we seek information from this source or from the non-professional oophorectomist, we do not hear of methods that would inspire confidence or that we would be justified in adopting in city practice in view of the present knowledge of septic processes in wounds. In fact we learn that the operation is usually performed without regard for the dangers of wound infection and its consequences, ordinary cleanliness of the instruments and the meager use of some antiseptic liquid being the only precaution used to prevent septic sequelae. When called to task for this condition of affairs,

we are told that the mortality is not great and that the time, trouble and expense of the task of operating under strict asepsis cannot be expected in the face of the small remuneration allowed for the operation. But the fact that death is a possibility is sufficient reason for the general adoption of better methods, which, if carried out, would soon result, in the passing of the non-professional castrator and subsequently in better remuneration for the educated and skillful surgeon. In any event, if the veterinarian of the large cities operated in the same careless manner, the mortality would be alarming.

During the last few years the high price of carriage horses has resulted in bringing many trotting bred stallions to this market (Chicago) to be castrated and sold for the above purpose, and it has fallen to my lot, from time to time, to operate on a large number of such animals. The stables in which they are kept are never free from the usual infectious respiratory diseases so common in the Chicago Horse Market, and it has by no means been an uncommon occurrence for recently castrated animals to contract such diseases as early as the first, second or third day after the operation; and besides this unpleasant feature the stables are in close proximity to the slaughter houses, fertilizing factories, hair fields, glue factories, the dead animal platform and the open sewer (the Chicago River). Confronted with such circumstances, the castration of valuable adult horses was always a hazardous undertaking, and after fighting with septic processes in a number of cases, I adopted the following method which thus far has given flattering results, and in spite of the fact that a number of animals operated unfortunately contracted various asthenic diseases of the air passages before the healing process was complete, no deaths have ever followed.

I provide myself with the following equipment:

(a) Scalpel, ecraseur, a slender grappling forcep about 2 decimeters in length, and a sponge, all of which have been sterilized by boiling and conveyed to the place of operation in a sterilizer or wrapped in a sterilized towel.

(b) Mercuric chlorid triturates.

- (c) Carbolic Acid, 95 per cent.
- (d) Iodoform powder.
- (e) An emulsion consisting of Thioform 30 grams, Sodium bicarbonate 30 grams, and Glycerine 240 grams.
- (f) An ointment consisting of Thioform or Iodoform 15 grams, and Lanolin 240 grams.
- (g) A large clean tray for the instruments.
- (h) Clean metal pails for the antiseptic solutions.
- (i) Casting harness and twitch.

The Operation:—

1st Step:—The animal is placed in the dorsal position, the legs well parted and the scrotum, sheath, penis and posterior abdominal region energetically scrubbed with soap and hot water and then sponged for a time with a solution of mercuric chlorid, 1-200.

2nd Step:—The scrotum is dried moderately with the sterilized sponge and then sprinkled with iodoform powder, which is rubbed in well until a dry crust results.

3rd Step:—The testicle is then exposed by an incision as small as possible, and now instead of grasping it with the hand it is pulled from the scrotum with the forceps. The ecraseur chain, without permitting it to touch the hands, is passed over the forceps and testicle and adjusted to the proper place upon the spermatic cord. When the cord is sufficiently crushed, twist the testicle off with the forcep before loosening the ecraseur. Hold the cord in the center of the wound with the ecraseur and pour 120 grams of the emulsion into the scrotum and disseminate it by circular motions of the ecraseur, which is still holding the cord.

4th Step:—The ecraseur is now loosened and placed in a tray containing a 10 per cent. solution of carbolic acid, where the scalpel, sponge and forcep have been previously laid. As the instruments were aseptic, it was not necessary to place them in such solution for the first testicle, but as they have now been in contact with the hands of both the assistant and surgeon, their disinfection is very essential to insure success.

5th Step:—Remove the opposite testicle in the same manner

and then anoint the whole field with the thioform or iodoform unguent.

6th Step:—Untie the animal carefully and prevent, if possible, any particles of the litter from falling upon the region, then tie him in a clean compartment.

The after treatment consists of keeping him in the standing posture without exercise for four days, or even much longer, if conditions warrant. If there is no haemorrhage from the spermatic cord, the thioform emulsion will adhere to the exposed tissues and perfectly prevent infection, while if considerable haemorrhage takes place, it will be washed out and the wound will only be aseptic instead of antiseptic. The slight haemorrhage from the scrotum is of no particular consequence, as it does not molest the emulsion in the deeper parts, but as the antiseptics are thus washed off from the scrotal incision the wound will become slightly infected and an oedema of the sheath will result. A clear sanguinous serum will discharge from the wound and when such secretion lodges upon the legs it must be removed with an antiseptic solution. Moderate exercise may be given about the fifth or sixth day, and unless there appears evidence of failure of the purpose no manual examination of the wound should be made.

Note:—For information regarding thioform, I am indebted to Prof. Dr. Hoffmann, Professor of Surgery, at the Royal Veterinary High School in Stuttgart, Germany. L. A. M.】

NEURECTOMY.

【Inasmuch as the removal of a portion of the posterior digital nerve is the only treatment for navicular arthritis that proves at all satisfactory; and as this operation, as usually performed, leaves quite a large cicatrix, which is, a conspicuous advertisement of the existence of this incurable disease, it is desirable to get union of the skin after the operation by first intention. It can be done by the observance of the principles of antiseptic surgery and the intelligent use of proper dressings. It is preferable to put the horse on an operating table, to avoid the dirt and dust of the litter, incidental to casting him; tie the

legs together above the knees, remove the leg to be operated upon from the hobble, tie a strap around the foot and draw it forward to tense the tissues of the leg in their natural positions relative to each other; clip, or, better, shave, the hair from the field of operation, wash it well with soap and water, rinse it with a three per cent. solution of carbolic acid, then, with sterilized instruments and hands, make an incision one inch long just below the fetlock over the nerve, take it up with a hook, dissect it out carefully, give it gentle traction downwards, to stretch it a little and cut it off as close as possible to the upper end of the incision, then catch the lower portion with the artery forceps and roll it downwards with considerable force so as to remove as much of the nerve as possible, taking out at least an inch and a half. Now pour into the wound a little of a one per cent solution of bichloride of mercury; after letting it soak for a minute lay a piece of absorbent cotton over it and bandage temporarily. Turn horse over and repeat the same details on the other side after removing the bandage. After rinsing both wounds again with the bichloride lotion, apply a dry dressing of powdered boracic acid and iodoform in equal parts with a piece of absorbent cotton large enough to reach around the pastern and bandage rather tightly so as to press the edges of the skin together. Do not touch it till the 4th day, then if the operation was well done, union will have taken place without visible granulation.

If there is any suppuration, rinse it out with a one-fifth per cent solution of bichloride and do it up again with the dry dressing. After removal of the section of the nerve a stitch may be taken in the skin if the surgeon prefers.

During the operation if there is haemorrhage enough to be inconvenient mop the wound with wads of absorbent cotton, never with a sponge. In about two weeks the horse is ready for work with no lasting evidences of the operation but a white line that becomes hidden by the hair.

ABSCESS IN THE LEVATOR HUMERI.

A tumor containing a small deep seated abscess often occurs in the levator humeri just above the shoulder joint, that, in

its acute stage, is large, hot and painful, and is often cut out bodily by stupid surgeons, which nearly ruins the muscle. After poulticing it for five days clip off the hair and make a puncture into the center of the tumor large enough to insert the index finger. An abscess will be found there containing from one to four drams of pus. Rinse it out with a one per cent solution of bichloride of mercury for three or four minutes and pack it with a pledget of clean oakum to maintain drainage. Poultice it for about five days with linseed meal soaked well in boiling water, dressing it once a day. The horse will usually be ready for work in 2 or 3 weeks.

Other abscesses may be treated similarly, omitting the poultices, and reducing the strength of the bichloride to one-fifth per cent after the third day, without any suppuration during the filling of the cavity and resolutions of the inflammation.

A. H. B.]

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