

cases where there was found in association with an atypical furunculosis a mixture of streptococci and staphylococci, the extinction of one of the microbes under the influence of the corresponding vaccine has indirectly led to the extinction of the other. This event is, however, extremely exceptional. In most cases the employment of vaccine-therapy directed to the destruction of a single species of microbe leaves the other species quite unaffected. It may even, and this applies in particular to surface infections of mucous membranes or ulcers, conduce to the multiplication of the other, *i.e.*, the originally competing microbe.

(b.) *Case where Vaccine-therapy is Directed to the Destruction of all the Infecting Microbes.*—Where in cases of mixed infection measures are taken to immunise the patient against each of the different infectious very successful results have been achieved. Successful results have been achieved notably in the case of lupus, cystitis, and endometritis. While naturally the task of the immunisator is more laborious and more intricate in the case where two or three different vaccines are employed, it would seem that the organism of the patient does not find the task of responding to a series of different vaccines (always supposing that each of these is administered in appropriate and properly interspaced doses) more difficult than the task of responding to one variety of vaccine only.

(g.) *Generalised Infections.*

In association with my fellow-workers, I have up to the present treated by vaccine-therapy some half-dozen cases of Malta fever and an equal number of cases of streptococcal septicæmia. In each of the cases of Malta fever the course of the disease would seem to have been favourably influenced, the clinical improvement occurring in each case in association with an increased development of antibacterial substances in the blood. In the cases of streptococcal septicæmia the results have been as follows: In two cases, one of these being a case of malignant endocarditis, a complete cure was achieved, in each case in association with a very satisfactory immunising response. In a third case, also a case of malignant endocarditis, the high temperature which had lasted for three months before vaccine-therapy was resorted to came down to the normal under the influence of the inoculations, the patient making an excellent immunising response. In this case death by cardiac complication occurred on the fourth day after defervescence. In three other cases of streptococcal endocarditis the patient succumbed, having in each case failed to make any immunising response to the inoculations.

GRANULAR INFECTIOUS VAGINITIS OF CATTLE.¹

By Dr H. RAEBIGER, Director of the Bacteriological Institute of the Chamber of Agriculture for the Kingdom of Saxony.

AS the disease known as granular infectious vaginitis of bovine animals has assumed considerable development in Germany, and is becoming in other countries a matter of increasing importance, I

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believe the present moment to be opportune to give an account of the attempts which have been made in Germany in the way of treating and stamping out this epizootic.

It is to Dr Ostertag, the Director of the Experimental Institute of the Veterinary School in Berlin, that we owe the earlier researches which have cleared up the etiology and method of development of infectious vaginitis, and showed its importance from the point of view of agricultural economy.

According to Dr Ostertag's observations, which extend back to the year 1898, and which have been verified by numerous experimenters, the cause of this disease is a streptococcus which is found in the purulent vaginal discharge and in the exudates taken from the diseased parts. This streptococcus multiplies external to the cells, but it may also be included in the pus corpuscles.

The streptococcus of granular vaginitis is found only in the secretions of the vagina and in those of the uterus when that organ is invaded; it is never found in the blood.

According to its form the causal agent may be classed with the short streptococci. It forms chains of from six to nine elements, held together by a thin envelope which does not stain readily.

The bacillus is non-motile, but it possesses great power of development, which permits it to penetrate into the epithelium and into the papillary layer of the vaginal mucous membrane.

In preparations on slides, it is found both in the epithelium and in the papillary layer. This capacity of the streptococcus to penetrate into the tissues of the mucous membrane explains the difficulties which were encountered in the first attempts made to treat the disease about six years ago.

The streptococcus of granular vaginitis stains readily with the basic aniline dyes. Particularly fine preparations are obtained by staining with Loeffler's methylene blue. The streptococci do not stain by the method of Gram.

Cultures of the streptococcus are obtainable either at the temperature of the incubator or at room temperature on urine, agar, coagulated blood serum, or in gelatine or broth.

The streptococcus develops perfectly on glycerine agar or on urine agar, provided that the culture medium has not been allowed to ferment; in the latter case the growth is meagre. In liquid media, such as broth and condensation water, the micro-organism forms chains of from six to nine elements. Blood serum and gelatine are not liquefied. Milk is not coagulated, and neither sulphuretted hydrogen, indol, nor gas is formed in glucose broth.

These observations of Ostertag's have been confirmed by numerous researches, extending over several years, regarding this disease. I have been able to verify the exactitude of his accounts on all points, and as incontestable proof that the streptococcus found by Ostertag is the actual cause of this specific disease I may cite the following facts:—

- (1.) It is always present in the morbid secretions of the disease.
- (2.) Pure cultures of it always produce the typical catarrh.
- (3.) It can always be recovered from the cases artificially infected.

The disease is transmissible not only to bovine animals but also to horses, pigs, sheep, cats, and dogs, as well as to the majority of small

laboratory animals, such as rats, mice, rabbits, and guinea-pigs. Attempts to transmit the disease to pigeons have failed.

The other bacteria found in the vaginal discharges from animals affected with granular vaginitis (*staphylococcus pyogenes aureus* and the *bacillus coli communis*) when introduced in pure culture have never produced the typical catarrh in cattle.

In the cow the natural contagion may be either immediate or mediate. It may be caused directly by the vaginal discharge of other diseased animals kept in contact with healthy subjects, or indirectly by the litter or utensils of infected premises, by the hands of the attendants, or by the bull in the act of coition. The disease may also be spread by calves, for these may not only be infected at the moment of their birth but also later through contact with the mother or with some other diseased animal in the same premises.

The disease, which exhibits greater virulence in heifers and young calves than in older animals (very old cows have escaped the disease although standing in an extensively diseased herd), reveals in general at the outset the same symptoms as regards the appearance of the mucous membrane. However, as we shall see later, granular vaginitis presents itself in very variable forms.

The period of incubation is from two to six days.

In a state of health the vaginal mucous membrane is constituted by a fibrillated, non-glandular, resistant, supple, and elastic membrane, provided with a papillary layer, and covered with squamous epithelium. The colour varies from white to rose tint, and in old cows it has a whitish-yellow colour. The surface is moist, shiny, and smooth. Save in some transient physiological conditions, it does not show any lymphatic follicles.

At the outset of the inflammation one already observes a slight swelling of the exterior of the vulva, and on manual examination one detects a great sensibility and a swelling of the vaginal mucous membrane. According to the virulence of the causal agent, this mucous membrane, especially in its anterior region, is seen to be more or less inflamed and red, and it is coated with a thready, sticky, dirty-white pus.

A day or two later there appear on the inflamed mucous membrane small absolutely typical lymphatic follicles, which persist throughout the whole of the stages of the catarrh, are very numerous and close together, and vary in size from that of a millet seed to that of a hemp seed.

These follicles, which give a level character to the surface of the mucous membrane, are very easy to distinguish even at a certain distance when they are viewed from the side. The follicles, which represent the lymphatics normally present in the mucous membrane, are of a deep red, and show up clearly against the inflamed tissue of the membrane. They are most numerous in the anterior part and on the small projections which are ordinarily formed around the clitoris.

In the succeeding stages of vaginal catarrh the mucous membrane often begins to be covered by superimposed folds, on and between which the lymphatic follicles may be observed as far as the neck of the uterus. Pretty frequently one finds these follicles so numerous and so close together that one might compare the surface of the mucous membrane to that of a raspberry.

These lymphatic follicles are neither warty nor lumpy on their surface, but smooth and of a solid consistence. They diminish in size and take on a bright red or a yellow tint if the disease assumes a chronic character. They then acquire a transparency which makes them look like vesicles, but puncture immediately shows their fleshy homogeneous structure.

These follicles are never absent ; they are characteristic of granular vaginitis, whether that be the result of natural contagion or produced by artificial infection.

They are always very manifest in cases of this disease in cattle, and they have never been observed in any other vaginal disease in bovine animals. Besides, they are never accompanied by vesicles or ulcers.

The engorgement of the lymphatics produces an excess of secretion from the vaginal mucous membrane, and if the typical streptococci have invaded the mucous membrane of the uterus they provoke a clear, albuminous discharge, or one which is sometimes creamy, and more or less mixed with flocculi of yellowish pus resembling clots of milk. This discharge, which, unlike others (*fluor albus*), always remains odourless throughout all stages of the disease, dries on the hairs of the thighs, where it forms a dirty grey crust with an alkaline or neutral reaction. The discharge is rarely abundant ; usually it is very moderate in amount, and it becomes more apparent when the animal is lying down or when it is exercised. It is always most marked at the outset of treatment. In the majority of cases it is so slight that it is not noticed.

In consequence of the irritation caused by the inflammation, the animals show suspicious symptoms from the first four days of the disease. They are markedly restless, pass urine with abnormal frequency, and sometimes stand with their legs apart as if they had a pressing need to urinate.

After about four weeks the engorgement of the vulva and the vaginal mucous membrane diminishes, the latter losing its inflammatory redness and taking on a dirty yellow tint. The follicles gradually become decolourised, and, as has already been said, assume the appearance of small vesicles, at which stage they somewhat resemble the eggs of a herring. The layer of mucus covering the vaginal mucous membrane becomes less and less in amount, but the discharge still persists for a long time when the affection is complicated with catarrh of the uterus.

With regard to the duration of the disease, one may affirm that it will extend not only to three or four months, as has often been asserted, but that a herd may suffer from it for six months or more. I have known instances in which it has continued for several years.

It follows, from the description which has just been given of its symptoms, that infectious granular vaginitis of bovine animals can be easily diagnosed at any of its stages by the simple examination of the genital organs of the cow, and especially by the reddish-yellow colour of the more or less swollen and inflamed mucous membrane, by the appearance on this membrane of firm follicles, by the engorgement of the lymphatics, and the albuminous odourless discharge containing flakes of whitish pus.

The inspection of the female animals can be made very rapidly.

It suffices that one man holds the animal by the nose while another pulls the tail to one side; or, in the case of cows or heifers which are specially skittish, three assistants may be employed, one at the head and one on each side. One of the latter at the same time pulls the tail towards the animal's flank. The person making the inspection then seizes between the forefinger and thumb in each hand the lower half of the lips of the vulva, separates the one from the other, and examines the mucous membrane. According to the position and size of the farm, one can examine from fifty to seventy animals in an hour.

If the byre is an unusually dark one it will be necessary to take the animals out into the courtyard, or to employ an electric vaginal speculum, such as the one made by Plate.

As a rule, bulls which have served infected cows or heifers do not show any visible signs of infection, although they transmit the disease to healthy animals. In from 20 to 30 per cent. only of bulls examined one observes a slight inflammation of the free extremity of the sheath, up to its orifice.

In these cases the greyish-white secretion escapes drop by drop when moderate pressure with the hand is exerted from behind forwards on the sheath. In the half of these animals one also observes when the penis is protruded some slight inflammatory redness of that organ. It is only in some bulls, showing a more pronounced inflammation of the penis and swelling of the scrotum, that one observes a visible discharge in the form of drops.

Repeated examinations of this secretion have always proved the presence of the streptococci of the disease, which may, in certain circumstances, produce in bulls a catarrh of the prepuce. Where the animals that have to be examined are nervous or vicious the examination of the sheath of the bulls may be easily made at the same time in the byre. But the examination may be facilitated by taking the animal out of the byre and placing a cow before him, so that the penis may become erected.

Putting aside transient uneasiness in the case of female animals, the general condition is not affected. Even in very grave cases one does not remark either in the females or in the bulls any elevation of temperature or any interference with nutrition. None the less, the disease has a great economic importance, for it may be the cause of serious loss to agriculturists and breeders.

In consequence of its extremely contagious character it spreads immediately, and affects all the lots of animals in the neighbourhood of the primary focus. It has been observed that in the majority of affected localities where all the cattle have been examined from 50 to 80 per cent. of the animals were diseased. In only a few localities did the average fall to from 50 to 60 per cent.

It is especially with regard to female animals that the complications and the losses take place. In cows one observes a diminution or an absence of the periods of œstrum (10 to 75 per cent., and sometimes even 100 per cent.), and uncertainty in breeding or actual sterility. Other accidents following in the train of the disease are abortion at all stages of gestation (10 to 70 per cent.), adhesion of the placenta, death of the fœtus, catarrh of the womb, affections of the ovaries, and,

finally, a marked diminution in the production of milk. Alterations in the quality of the milk have also been observed.

To these accidents consequent on the disease it is necessary to add that the calves born of cows that are or have been infected are more sickly and more apt to contract the disease than the progeny of healthy cows.

The contamination of the bulls in a herd has for consequence a rapid extension of the epizootic. Besides, the contaminated bulls get fewer calves than healthy bulls. In certain bulls the disease leads to a passing disinclination for copulation, but lasting impotence has not been observed.

A posteriori one may say that in many cases the losses caused by granular infectious vaginitis of bovine animals exceed considerably those caused by foot-and-mouth disease.

With regard to the question of differential diagnosis, one has to consider the "vesicular exanthematous inflammation of the vagina of cattle." This is a benign disease running an acute course, in which one does not observe any follicles on the vaginal mucous membrane, but vesicles varying in size from that of a millet seed to that of a pea. These vesicles, which are filled with pus, evolve rapidly and rapidly disappear, leaving the skin intact, and only rarely causing cicatrices. When the rupture of the vesicles takes place there is produced an abundant suppuration, preceded by a pretty copious mucous discharge. This affection in the case of bulls shows itself in a striking manner in connection with the sheath and penis. The mucous membrane is covered with vesicles and abscesses, and at the same time purulent mucus escapes in drops from the sheath.

Whereas granular infectious vaginitis persists for a long time, the vesicular exanthematous disease runs a rapid course. The diseased subjects recover after eight to fourteen days, or at the utmost after three or four weeks, and that without their having been subjected to any treatment. On the other hand, horses, sheep, goats, and pigs, which are always refractory to granular infectious vaginitis of cattle, may be attacked by the vesicular exanthematous disease. The cause and agent of this latter infection is not yet known.

Treatment.

I commenced my observations with regard to the treatment of granular infectious vaginitis of cattle during the winter of 1900, and I continued them almost without interruption until 1906. The object which I had in view all along was to find a rational method of treatment, capable not only of bringing about a cure, but also at the same time one that might be applied by the owners themselves or by trustworthy servants. In such a case the veterinary surgeon himself will only have to commence the treatment and to supervise its execution. But in general his personal attendance will only be required at the outset. My researches with the object of finding out a proper system of therapeutics consisted at the outset in laboratory experiments with the known antiseptics, in order to obtain precise knowledge regarding their bactericidal power for the streptococci of vaginitis. In these researches, which were frequently repeated, only fresh virulent cultures

were employed. The results of the experiments, which have been strictly controlled, are collected together in the following Table:—

<i>Name of Preparation.</i>	<i>Degree of Dilution in Water.</i>	<i>Time necessary to Kill Strepto. occi.</i>	<i>Wholesale Price per Kilogramme.</i>
Creolin	$2\frac{1}{3}$ per cent.	1 minute.	Marks 1'80
Lysol	$2\frac{1}{2}$ "	1 "	" 2'25
Bacillol	$1\frac{1}{2}$ "	1 "	" 0'70
Lysoform	$2\frac{1}{2}$ "	1 "	" 2'75
Septoform	$2\frac{1}{2}$ "	1 "	" 2'50
Lactic Acid	2 "	1 "	" 6
Phenic Acid (chemically pure)	$2\frac{1}{2}$ "	10 minutes.	" 1'80
Nitrate of Silver	$\frac{1}{2}$ "	1 minute.	" 82
Ichthargan	1 per 1000	2 minutes.	" 200
Tannin (chemically pure)	1 "	Proved inactive after 20 hours exposure.	" 4'80

The agents employed ought to be: (1) readily soluble in water, (2) capable of killing the streptococcus, (3) capable of penetrating into the tissues, (4) only slightly toxic, (5) without corrosive action on the mucous membrane, and (6) moderate in price.

Tannin may be discarded at the outset as non-*efficacious*. According to Ostertag's experiments, solutions of the mineral astringents (sulphate of zinc, copper, or iron) of the ordinary strength ($2\frac{1}{2}$ per cent.) do not succeed in killing the microbe of granular vaginitis after one hour's contact.

Astringents are therefore not to be recommended for treatment, since it is only in the most favourable cases that they yield an apparent and illusory success. Although ichthargan fulfils all the therapeutic conditions in a satisfactory way, it must on account of its price be put aside as not serviceable in veterinary practice, especially where large quantities of it would have to be used.

For the same reason one must give up the employment of nitrate of silver and even of lactic acid, these substances being much too dear. With regard to the solutions of phenic acid, their action on the streptococcus is very slow. There therefore remain only the cresol products, and among those bacillol, which seems the most *efficacious* and the cheapest. Bacillol, according to my experience, extending over several years, without any doubt satisfies most completely the conditions which one ought to require of an *efficacious* preparation in the treatment of vaginal disease. It may be diluted with water in any proportion. A $1\frac{1}{2}$ per cent. solution is certainly fatal to the streptococcus in one minute. Of the power of penetration of bacillol into the living tissues in the vaginal disease, I have been able to satisfy myself in practice from numerous cases of cure. As to its toxicological power, it results from experiments carried out at the Bacteriological Institute in Budapest that this preparation is relatively less toxic than any of the products of cresol at present

known, since it is fatal to rabbits only in doses over 22 to 24 decigrammes per kilogramme of their weight, whereas phenic acid or lysol is fatal with a smaller dose.

In the strength of 2 per cent., solutions of bacillol have no irritative influence on the mucous membrane. Even when concentrated and applied to the skin it produces only a slight blistering effect, similar to that produced by lysol.

Bacillol has the further great economic advantage that it is the cheapest of all the analogous pharmaceutical products.

After these preliminary observations I commenced my first practical experiments with regard to the treatment of granular vaginitis by injecting antiseptics into the diseased parts. The injections, even when warm, were inefficacious; and, as the causal agent penetrates into the vagina from the outside, and produces many grave manifestations in its anterior part, I supported my treatment by the introduction of swabs into the vagina. I used swabs of cotton-wool or gauze, saturated with the disinfectant solutions and introduced into the vagina immediately after the injection. The method was good, but it had the inconvenience of necessitating daily operations, and, besides, it was not favourable for the pregnant cows in consequence of the considerable irritation which it caused.

Besides, one could not in this way assure the simultaneous cure of all the animals in the herd. It was on that account that, in concert with my colleague and ex-collaborator, M. P. Reimers, I undertook to replace the swabs by a method of treatment involving the use of powders. This method was subsequently described by the Brothers Streit, and it was based on the employment of a powder of sulphate of zinc and boracic acid combined in the proportion of four to one. This powder, well dried, was projected on to the diseased vaginal mucous membrane by means of a rubber insufflator furnished with a vaginal canula of about 15 centimetres in length. The dose per animal was a teaspoonful, this dose being reduced for the young animals or for those slightly affected. It was not necessary to repeat the insufflation oftener than every six or ten days, but, like the use of the swabs, it had the inconvenience of exposing the pregnant cows to the risk of abortion.

In order to treat pregnant cows at the same time and by the same method as the other members of the herd, it occurred to us for the first time to lubricate the vaginal mucous membrane with some warm ointment, after having by means of antiseptic injections got rid of the adherent vaginal discharge.

The utility and efficacy of treatment by the ointment have, during recent years, been frequently affirmed by Ritzer and other authors. The special advantages of this method of treatment result from the fact that the ointment softens the tissues, exerts its action at some depth as well as at the surface, and does not cause any irritation. It may, therefore, be applied simultaneously to all the animals in a herd, whether they are pregnant or not.

At the outset the ointment was introduced on the finger, but later with various instruments specially constructed for the purpose, such as wooden spatulas, trocars, etc., and under various forms, such as capsules of gelatine, bougies, etc.

According to my own experience, which up to the present time

extends to 35,000 cattle, placed in the most diverse conditions, the methods of treatment which have proved to be the most practical and most efficacious are those which involve the use of capsules of gelatine, bougies, and the application of ointment to the mucous membrane by means of special syringes.

For this latter method of treatment I have constructed a special ointment-syringe. As the cylinder of the syringe contains 100 grammes of ointment and the canula 10 grammes, one charge is sufficient for the treatment of ten cows or twenty heifers, the efficient dose for large animals being 10 grammes, and for the smaller 5 grammes.

The construction of this syringe was entrusted to the firm of Hauptner, of Berlin. It may be filled with ointment of any consistence. It enables the dose to be accurately regulated, and permits of rapid treatment of cattle of any age. The transmission of the contagion by means of the syringe is easily avoided if one before treatment separates the healthy from the suspected and diseased animals. Moreover, the syringe may easily be boiled and disinfected.

In my experiments bearing on treatment, which were carried out at the request of the Chamber of Agriculture of Saxony, I have, for the reasons already mentioned, employed bacillol ointment prepared at the Bacillol Works in Hamburg. This ointment is made in different strengths. In the treatment of female animals one employs a 10 per cent. ointment, and for bulls, which are more sensitive, one of 6 per cent. The animals receive, according to the stage of the disease, two or three injections per week. It may be observed that it is also necessary to treat with a view to prevention, but with smaller doses, the animals which for the moment appear to be clinically healthy.

A very simple method of introducing the ointment without any instrument consists in employing gelatine capsules. This method of treatment we owe to M. Ritzer, of Lichtenfels, veterinary surgeon for the county. It was on his invitation that the Bacillol Works at Hamburg manufactured capsules of gelatine containing the bacillol ointment of the strength of 6 to 10 per cent. These capsules, the size of which varies according to the age of the animals, facilitate the introduction of the material into the vagina, shorten the time necessary for the operation, and avoid any waste of the ointment.

The capsules are introduced as far as possible into the vagina with the finger, and they become liquefied by the natural heat of the body in about half a minute, thus allowing the ointment which they contain to spread all over the mucous membrane.

According to Ritzer, the capsules containing the bacillol ointment ought to be administered at three periods. Every animal treated receives for the first five days one capsule daily. From the sixth to the fifteenth day a capsule is introduced every two days, and from the sixteenth to the thirtieth day one is given every three days. In the case of animals that are severely attacked one continues the introduction of capsules every three days from the outset until the disappearance of the symptoms.

With a view to lessening the cost of the treatment by the gelatine capsules the bacillol ointment has been made up in the form of

bougies of 15 centimetres in length, which have the wrapper divided into centimetres, so as to permit of their being cut into longer or shorter pieces according to the requirements of the case. The introduction is effected by means of a rod of wood, and it is made as deep as possible in order to obtain a direct action on the neighbourhood of the neck of the womb, and to avoid the expulsion of the bougie.

This method of treatment by Ritzer's bougies is more economical than that by capsules, but naturally the latter is much simpler.

When the animals have been cured, impregnation may be favoured by the injection of a 2 per cent. solution of bicarbonate of soda into the vagina before the act of copulation.

Every bull which has served a cow attacked with granular infectious vaginitis, whether it shows symptoms of disease or not, and every bull which comes from a district where the disease is supposed to exist, ought to be submitted to treatment before it is allowed to serve a healthy animal. After having carefully cut away with scissors the hairs which surround the opening of the sheath, one may introduce into the sheath with the forefinger either capsules or a bougie of the bacillol ointment, or one may introduce the ointment into the sheath by means of a syringe.

Finally, one may once or twice a day inject a warm solution of bacillol into the sheath.

Before undertaking the treatment of a herd it is advisable to make careful inspection of all the animals and to divide them into two groups, namely, (1) the healthy animals, and (2) the diseased and suspected animals. Seeing that animals in which the womb is involved in the disease, which as a rule form only a small proportion of the whole (according to my own observation 1 to 2½ per cent.), are incurable and constitute a permanent source of infection for the remainder of the herd, they ought to be immediately got rid of.

As it is rarely possible to assign separate buildings to the two groups of animals, the separation ought to be so effected as to prevent all direct contact between the animals of the different groups. It is necessary to see that the healthy animals shall not be soiled by the litter, urine, etc. coming from the other group. With that object the healthy animals should be so placed that discharges from them will pass towards the diseased animals and not in the contrary direction.

Before commencing the treatment it is essential that the whole of the byre, and especially the channel for the urine, should be subjected to thorough cleansing and rational disinfection. The urine channels, the floor, and the walls ought to be thoroughly washed. The walls with which the animals are in contact ought to be washed with milk of lime, to which it is well to add a little bacillol, or a solution of bacillol in the strength of 2 per cent. The cleansing and disinfection of the byres (urine channels, etc.), ought to be repeated every week until the end of the treatment.

The milk of lime, in virtue of its chemical property of absorbing carbonic acid from the air and thus becoming transformed into carbonate of lime, cannot be employed except when freshly prepared. To make the milk of lime one treats the lime with water in the proportion of one part of lime to two of water in the case of a wash intended for the walls, etc., or in the strength of one part of lime for twenty parts of water to make a disinfectant liquid suitable for

washing the floor of the byres, the utensils which are suspected of contamination, the channel for the manure, etc. By adding to the lime 5 per cent. of common salt one improves the preparation. This addition makes the wash much more adherent, and prevents it from being so easily removed. For the disinfection of the premises I highly approve of white-washing machines, which may be employed not only for the walls but also for washing the animals with disinfectant liquids.

In those cases where the two groups of animals have to be kept in the same building they ought to be kept under observation for a long time. Each animal ought to be examined daily as regards its sexual organs and the neighbouring parts, including the tail throughout the whole of its extent; and those parts of the body with which the tail may be brought into contact ought also to be maintained throughout the whole of the treatment in a condition of the most thorough cleanliness. As a disinfectant liquid for the purpose one ought to employ bacillol in the strength of $\frac{1}{2}$ to $2\frac{1}{2}$ per cent.

Throughout the whole course of the treatment neither males nor females ought to be allowed to copulate, and after the treatment the bulls ought not to be employed for serving diseased or suspected cows. The proprietor of a bull ought to be instructed regarding the symptoms of the disease, and he ought to examine each female as to the existence of infectious vaginitis before allowing it to be served. He must on no account allow diseased cows to be presented to the bull before they are cured. Besides, after service of healthy cows coming from an infected locality he ought immediately to disinfect the sheath of the bull by introducing some bacillol ointment and washing the neighbouring parts with some antiseptic.

The signs by which one recognises that the animal has been cured are the following: The females may be considered cured if the discharge, the mucous coating on the vaginal membrane, and the inflammation of this membrane have disappeared, and if the lymphatic follicles have diminished in size and lost their colour, or have disappeared, as is generally the case in animals that have recently recovered. But, as Thoms has shown, recovery does not depend upon the complete disappearance of the lymphatic follicles.

Apart from the proof of the destruction of the causal agent obtainable by bacteriological examination, the practitioner may recognise with certainty that recovery has taken place from the fact that the cow is no longer continuously in œstrum, that it becomes pregnant at the proper time, and that it does not show any discharge during the period of gestation and finally calves at full term.

Doubts as to the occurrence of recovery may arise in those cases where there is a marked inflammation of the whole of the vaginal mucous membrane as a result of the employment of medicinal substances in too strong concentration. Such doubts may be removed by interrupting the treatment. If after several repeated inspections one observes a diminution of the inflammation the latter may with certainty be ascribed to the action of the medicinal substance. In the contrary case the typical symptoms will continue and the condition of the mucous membrane will become worse.

If before treatment is begun one has observed in the bulls certain symptoms of infection one may consider them as cured when the

inflammation of the penis and prepuce has disappeared. But if no manifestations of the disease have been visible one may in practice ascertain whether recovery has taken place or not by allowing the bull to serve a cow known to be healthy. If the bull is still diseased, some days afterwards the cow will certainly show the commencing inflammation which is characteristic of the disease, accompanied by the characteristic discharge. There is, however, as a rule, no occasion to make such a test, for experience shows that bulls may be considered cured after a rational treatment extending over four weeks.

As soon as one has satisfied one's self that all the animals in the stock have been completely cured it is indispensable to still carry out cleansing and disinfection of the byre and of the materials and articles contained in it. One ought also to carefully disinfect the boots of all the attendants. As regards the objects of little value, such as brooms, etc., the best way is to burn them.

The prospect of recovery will always depend naturally in the first place on the duration and degree of virulence, on the character of the epizootic, on the stage at which treatment was begun, and on the arrangement of the premises and the size of the herd (the chances of prompt cure will be in inverse proportion to the number of animals in the herd). The complete cure of a herd will also depend greatly on the possibility of carrying out a thorough radical disinfection of the byre and its contents. An important factor will be the more or less active assistance rendered by the owners of the animals; but, as has already been said, the primary condition for success, whatever may be the assistance of this kind, is to enlighten the owners of animals with regard to the economic importance of the epizootic and the means of recognising it, and to instruct them as to the rational methods of combating it.

Most frequently failure of treatment will depend on non-observance of the rules with regard to the strength of the medicaments to be employed, on the interruption or premature abandonment of the care given to the animals, on inefficiency or incapacity of the servants employed, and, above all, on the omission to carry out the indispensable disinfection, or on the defective manner in which that is accomplished.

Granular infectious vaginitis, contrary to other epizootics, does not generally leave any immunity, and it is therefore necessary to take with regard to it the most serious precautions, not only to completely destroy the contagion in those cases where the disease has just broken out in a herd in order to avoid a second outbreak after a temporary suppression of the disease, but also to protect the whole stock by preventive measures calculated to prevent a reintroduction of the contagion or a recrudescence of the disease.

In order to satisfy these conditions the following may be recommended:—

(1.) That every newly purchased cow or heifer ought, before it is introduced into a herd, to be minutely examined with regard to the existence of granular vaginitis, and refused if it is recognised to be infected.

(2.) That every bull coming from a district known or suspected to be infected ought to be submitted to sanitary treatment before it is used for service.

(3.) To protect healthy bulls from contagion after each service, even if the cow appears to be a healthy one, by means of an injection into the sheath of a litre of a warm solution of bacillol of the strength of 1 to 1½ per cent., or the introduction of some bacillol ointment of the strength of 6 per cent.

(4.) To submit to permanent sanitary supervision every herd, or even every animal, where there is danger of infection.

(5.) To instruct every owner of a bull regarding the manner of inspecting cows as to the existence of granular vaginitis, so that he may know the symptoms by which this infection may be recognised, and to compel him strictly to refuse to allow the bull to be used for any cow or heifer which is diseased or suspected.

A number of years ago there was some discussion regarding the question whether granular infectious vaginitis possessed characteristics entitling it to be classed among the diseases subject to compulsory notification and requiring treatment according to the regulations of veterinary police. In the month of March 1901 the Technical Commission for Veterinary Questions of the Kingdom of Prussia issued to the Chamber of Agriculture of the province of Saxony a report to the effect that official measures would eventually have to be taken against the epizootic in question. The Technical Commission was of opinion that the diseases known under the names of "infectious vaginal catarrh of bovine animals" and of "vesicular exanthematous disease of the vaginal mucous membrane of bovine animals" ought to be combated by official regulations. The first of these measures would consist in compulsory notification, according to articles 9 and 10 of the "Law of the German Empire on Epizootics." The owners of animals can conform to this obligation, for in its acute stage the disease is manifested by typical symptoms which suffice to attract their attention and to make them immediately suspect the outbreak of an epizootic, especially if within a short time several animals are affected in the same way on their genital organs. The Technical Veterinary Commission added that it was necessary, by means of information, cast in a popular style, to inform the owners of animals regarding the diagnostic signs, the course, and the economical importance of the disease. In view of the nature of the disease the Commission in conclusion proposed that the repressive measures should be simple and not very rigorous, but analogous to those already enforced against "vaginal vesicular catarrh" of cattle (exclusion of animals from breeding until their complete recovery has been certified by a veterinary official).

On the other hand, it was proposed to introduce a regulation regarding periodical official inspections by veterinary police, the exclusion from breeding of all infected animals (six weeks for bulls and ten weeks for the females), isolation of infected byres, separation of the different lots of animals, restrictions on the movements of animals except those destined for the abattoir, slaughter in the case of infected animals of small value, obligation to treat infected animals, and subsequent disinfection of litter, urine, manure, byre utensils, and the animals themselves. Finally, the owner of the bull was to be compelled to examine the cows which had to be served, and a general control was to be introduced.

As yet it is only in the Grand Duchy of Baden and the Duchy of

Saxe-Altenbourg that measures of veterinary police have been prescribed against granular infectious vaginitis in cattle. The State of Baden withdrew the regulations a short time after they were introduced, in the first place because they occasioned too much loss to the owners of animals, and afterwards because the neighbouring states did not take action. In Saxe-Altenbourg the regulations have also raised many objections. It is obvious that measures of this kind cannot be successfully applied unless they are adopted and executed simultaneously by all the neighbouring states, and according to a uniform plan.

In my opinion there is no doubt that in countries such as France, where the epizootic has not yet attained to a great development, sanitary regulations would be of great service in the way of immediately stamping out the primary foci of the disease, and in preventing the extension of an epizootic capable of causing serious loss to agriculture. The owners of cattle ought to be everywhere taught by means of official notices with regard to the nature, symptoms, and course of the disease, as well as regarding its economic consequences. Finally, they ought to be compelled to notify the existence of the disease.

The most efficacious measure would be a regulation, placing the treatment of every herd in which the disease has broken out in the hands of a veterinary surgeon. The diseased animals ought to be rigorously excluded from breeding. If, in consequence of the disease having already obtained too great an extension, this measure were inapplicable, one ought at least to protect the bulls which are still healthy, or which have recovered, by not allowing them to approach any female which is diseased or suspected. Besides, one ought to regulate the movements to pasture, and to forbid the movement of diseased animals. Finally, after recovery of the animals one ought to ensure the extinction of the epizootic by thorough cleansing and disinfection of the premises.

One ought to refrain from enforcing more severe measures against the disease, for, in my opinion, to do so would be too onerous for the owners.

What has already been said may be summed up in the following sentences:—

(1.) The etiology and the symptomatology of granular infectious vaginitis of bovine animals are established beyond any doubt.

(2.) This contagious disease is a curable one.

(3.) The treatment of contaminated herds ought to be undertaken at the same time and in the same manner.

(4.) The important complement to treatment consists in instructing the owners of animals regarding the appropriate means of dealing with the disease.

(5.) As the disease does not leave any immunity, rational preventive measures ought to be permanently enforced in order to prevent a recurrence of it.