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ABORTION IN DOMESTICATED ANIMALS.

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THERE are perhaps few veterinarians or stock-raisers who have not at some time encountered instances of this trouble in the domesticated animals. Authors on veterinary matters generally recognize two kinds of abortion.¹ The first, and probably the least in importance so far as this paper is concerned, is known professionally as sporadic abortion. We believe that a large number of the cases coming under this head are, as it is claimed for them, due to accidental causes or external influences. Some of them are very likely due to the ingestion of certain substances which have a specific influence upon the genital organs, acting directly upon them through the parturition centre. Other ingesta may, by causing violent purgation from irritation of the intestinal walls, have their influence upon the uterine muscular tissue by induced uterine hyperæmia.

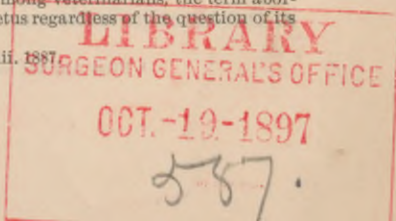
In support of the views held by many practitioners that cattle, horses, and sheep do at times eat along with their fodder certain plants which have abortifacient properties, I quote from a note by the late Professor Joseph Leidy,² in which he says: "Some years ago a physician living in the lower part of our city submitted to me for determination a root-fragment which he said was used in the circle of his practice in a rural district as a domestic emmenagogue. Not recognizing the root, he afterward brought to me a portion of the stem and leaves of a plant which proved to belong to the common ironweed (*Vernonia noveboracensis*), growing abundantly in the meadows. It has occurred to me that if this plant has the quality attributed to it, it may, when cut among hay and fed to cattle, be one of the causes of abortion among cows."

Because it is well known that ergot, by reason of its action upon the vasomotor nervous system, can cause the uterus to contract

¹ In this paper, and according to the general custom among veterinarians, the term abortion is used as indicating a premature expulsion of the fetus regardless of the question of its viability.

² Journal of Comparative Medicine and Surgery, vol. viii. 1887.

presented by the author



upon its contents with sufficient force to expel them, and because of the frequent occurrence of this fungus in the fodder of animals, it has been reported as being a factor in causing a large number of cases of sporadic abortion. There are, however, records of numerous experiments where ergot has been fed in large quantities to pregnant cattle without causing them to abort. If we accept that ergot has the same systemic effects in all animals we should conclude that either the doses given were not sufficiently large and frequent or that the ergot used did not contain the ebolic principle. We know that ergot does exert its physiological action upon cattle, because of a notable outbreak of ergotism which occurred several years ago in Kansas.¹ Great excitement prevailed among stockmen at the time, they fearing that they had to do with an outbreak of foot-and-mouth disease. An investigation by the department revealed the fact that the hay upon which the animals had been feeding contained large quantities of ergotized rye. The characteristic effects of the drug were present; the extremities became gangrenous and sloughed away.

The literature of the subject of abortion teems with contradictory statements both from members of the veterinary profession and from laymen. The agricultural societies of Great Britain have appointed numerous committees to investigate the disease, with the result that it seems to-day that very little more is known about it than formerly.

The alleged causes of sporadic abortion are very numerous, indeed, and it would seem that the number of conditions which might cause an animal to abort is limited entirely by environment and existing circumstances. We can very well understand that if a pregnant animal were jammed in a stall or doorway or were to receive a violent blow upon the abdomen, or were subject to external violence of any kind, that the placental attachments could thereby be ruptured. This happening the fœtus would die, become a foreign body, and be expelled.

Many arguments, pro and con, have been made regarding another cause of sporadic abortion—that of sympathy. We can conceive that an animal may, through the organs of special sense, receive a mental shock sufficiently severe to be reflected to parts of the sympathetic nervous system. While we have no data to prove that sympathy ever causes an animal to abort, and while we do not believe that the sympathetic nervous system is as highly developed in the lower animals as it is in man, we have the familiar old sight

¹ First Annual Report, Bureau of Animal Industry, 1884.

that a cow roughly treated will not "give down" her milk, and that the presence of the calf will cause the milk to flow.

It is an unquestioned fact that in human practice the uterus of the puerperal patient may be made to contract by the simple application of the newborn to the mother's breast. In fact, this knowledge is made use of in some instances where the uterus seems slow to contract. Can we have any better evidence of the close bond of sympathy existing between the various parts of the nervous system? If the slight stimulus exerted by the application of the young to the mammæ, or the mere presence of the young, so affects the nervous organization of the mother as to cause a "flow" of milk, or a contraction of the uterus, why might we not conclude that in severe nervous shocks, such as sudden fright, being chased by dogs, the sight and odor of blood, etc., we have stimuli sufficiently severe to cause the uterus to contract with sufficient force to expel its contents?

We must remember that in all the domesticated animals the sense of smell is much more highly developed than in ourselves, and that because an odor does not to us seem to be of sufficient intensity to warrant us in believing that it could exert any great influence upon the sympathetic nervous system, is no reason at all for believing that the same argument would be true in the case of the lower animals.

As before stated, we say that all cases of abortion which result from kicks, blows, disgusting sights, odors, etc., are due to external causes. Now we may have sporadic abortion occur from what we are pleased to term internal or systemic causes. Under this head we would put those cases which could occur from the ingestion of food containing plants which have ecobolic properties. We may also have as a cause of sporadic abortion certain conditions of the animal's system. Any severe disease may so affect the pregnant animal as to cause it to abort. A severe lung-disease in which the respiratory area is greatly lessened, causing an imperfect oxygenation of the blood, would make itself felt at the point of greatest tissue-change, the uterus in this case, and would be very apt to start up a revolution in that organ.

A badly ventilated stable containing many animals could, by virtue of the gradual accumulation of the carbon dioxide and other poisonous exhalations from the animal body, be the cause of abortion. This, however, we believe to be a very infrequent cause, as most stables have sufficient ventilation to prevent the accumulation of such gases in poisonous qualities.

Cases of abortion could occur from a displacement of the uterus, and by any cause which would operate to prevent the natural enlargement of that organ, such as fibrous adhesions to other structures.

On account of the immense volume of the stomachs in the cow, and of the cæcum and colon in the mare, it is easily understood how, in cases of acute indigestion, when those viscera are greatly distended with gas from the fermentation of their food-contents, they can by encroaching upon the gravid uterus exert an influence upon that organ and cause it to expel its contents.

Theoretically, any disease or condition which impoverishes the blood also impoverishes the uterine structures, and we probably have some cases of abortion due to this state of the blood, or anæmia. Therefore, Texas cattle-fever, which has been shown by Dr. Theobald Smith to be due to a parasite which lives at the expense of the blood, should cause a pregnant cow to abort, provided she had the disease in a severe form.

Since writing the above regarding the influence of anæmia brought about in the blood of cattle suffering with Texas cattle-fever, I have received the following evidence that the theory is a correct one. Col. R. J. Redding says in a letter addressed to Dr. D. E. Salmon: "Mr. Wing desires me to state a circumstance in regard to the outbreak of Southern cattle-fever in Greene County that he overlooked in writing to you the other day, viz., of the cows that were attacked that were pregnant, all, excepting one, aborted, and of several that were nearly due to calve or a few days overdue the calf in every case was dead."

On the contrary, abortion may be caused by an opposite condition—that of plethora, where we have an abnormal accumulation of food-principles in the blood, and where, from the decreased activity of the secreting and excreting organs, the abnormal accumulations are not removed.

Sudden changes of temperature can cause abortion by a central determination of the peripheral blood. In order to understand this condition, better known as a "congestive chill," we must recognize that as soon as an animal becomes pregnant the uterus becomes the seat of a most extraordinary tissue-metamorphosis; that in order for these great changes to take place the uterine blood-supply must be greatly increased. Those who have studied the uterine bloodvessels of a non-pregnant animal will remember that the uterine arteries are not relatively large. In the pregnant state, however, the reverse will be found to be true. The former small,

tortuous arteries are now much enlarged, carrying very much more blood than they did formerly. So when from a sudden blanching of the skin and superficial structures the blood is driven to the internal organs the uterus gets a large share, and becomes congested, the delicate lining of the walls of the arteries in the placental structures becomes injured, and the maternal connection of the fœtus is severed.

It will be seen from the foregoing remarks that abortion in our animals may be caused by an almost infinite number of conditions. In the case of the human family, with the possible exception of frequent bodily injuries, women are subject to and do abort from many of the same causes which are said to produce abortion in the lower animals. We find in all the standard works on midwifery, and it is a common experience of many persons, that abortion may be caused by numerous agencies, the most frequent being uterine hyperæmia and inflammations, over-frequent coitus, fevers, noxious gases in the atmosphere, states of the nervous system produced by fright, anxiety, sudden losses, shock, constant suckling in those who become pregnant during lactation, obstipation, excessive vomiting of pregnancy, alcoholism, trifacial neuralgia, albuminuria, abnormalities of the pelvis, inflammatory adhesions preventing the normal development of the gravid uterus, an atonic condition of the uterus, malnutrition, severe diarrhœa, tumors, etc. Knowing that any one of these may be operative in producing abortion, is it not reasonable to suppose that some of the same causes may also be operative in the lower animals?

In support of the theory held by many persons, both lay and professional, that strong mental impressions upon the mother are reflected upon the fœtus in utero, I will mention two cases where circumstances seem to narrow the question down to a point where we could hardly account for the conditions present on any other theory. Dr. Theobald Smith¹ had occasion to investigate tuberculosis in a herd of cattle, and used as a diagnostic agent hypodermatic injections of tuberculin. The injections were made in the shoulder and neck regions. In Case No. I. he found a twin-pregnancy, each fœtus being about sixty millimetres long. In each of these fœtuses he found a blood-red spot situated anterior to the shoulder-joint and surrounded by a tributary zone of injected blood-vessels which extended in fœtus No. 1 nearly to the occiput, down the sides of the neck to the median ventral line, and also down the lateral aspect of the forelimb to the carpus. In fœtus No. 2 the

¹ The Veterinary Magazine, 1895, vol. ii. No. 2.

left side was more affected than in fœtus No. 1. The hemorrhagic area extended from near the median dorsal line ventrad to the shoulder-joint, a distance of about six millimetres. This vascular injection extended not only over the area described in fœtus No. 1, but also nearly encircled the eye, and extended beyond the ear to the top of the head.

In Case No. II. the fœtus was seventy millimetres long. In front of the left shoulder there was a blood-red spot, suggesting a cutaneous hemorrhage. There was no anastomosing network of bloodvessels as in the fœtus in Case No. I.

In Case No. I. several injections of tuberculin were made, but no definite note was made of the exact points at which they were made. It is highly probable that both sides of the neck were injected, for in Case No. II. careful note was made of the side and exact location of the point of operation, and the post-mortem examination revealed the fact that the hemorrhagic area in the fœtus exactly corresponded with the seat of the tuberculin-injection in the mother.

Dr. Smith examined a number of fœtuses of more advanced age and several of the same age, but did not find similar lesions; and while he does not wish to put forth his discovery as a hypothesis to explain the relationship existing between the maternal organism and that of the fœtus in utero, it seems to me that these authenticated cases may be effectively used as an argument by those who believe that "birth-marks" are due to some disturbance of the nervous system of the mother being manifested in the fœtus.

In concluding his article, Dr. Smith says: "It is probable that we must realize a definite combination of certain conditions before this remarkable effect may be actually seen. These are a certain age-limit of the fœtus, a certain time-limit between the tuberculin-injection and the autopsy, and perhaps a certain impressionable condition of the mother."

Possibly the blow upon the head given at the time of slaughter of the mother may have had something to do with producing part or all of the extravascular condition of the skin of the fœtus. Granting this, the theory of the reflection of maternal impressions is not disproved, and we are met with the knowledge that this possible cause was of short duration, and of an entirely different character from the tuberculin-injections, which were repeated and operative for a much longer time, and in an entirely different way.

In human medicine we cannot, of course, advance any convincing proof of the theory, held by many persons, that strong mental impressions may affect the fœtus in utero, and evidence themselves

by causing certain abnormalities in the offspring. We find recorded in standard works on midwifery statements of authors who take up valuable space to relate the stories of the mothers of children so afflicted concerning the time and character of the circumstances which caused their children to be "marked". Many of these stories contain much strong circumstantial evidence, and would tend to show that there is a most intimate bond of union existing between the sympathetic nervous system or "mind" of the mother and the child she is developing.

If it is true that the vasomotor nervous system of the mother may be sufficiently shocked by a hypodermatic injection of tuberculin, which in a healthy non-tuberculous animal does not even cause a rise in temperature, could we not reason that the results of physical impressions upon the pregnant uterus and its contents are probably limited mainly by the intensity of the impressions received; that many of the cases of sporadic abortion are the outcome of these impressions, and that the differences between the mere transient vascular dilatations noted in the fœtus by Dr. Smith and a complete separation of the fœtal and maternal structures are those of degree only.

Having discussed the subject of sporadic abortion, and expressed my belief that the conditions mentioned are operative in causing it, I will now take up the other variety. Much has been written about infectious abortion, but we know very little regarding its etiology. It is hoped that this preliminary paper may be followed by others which will throw more light upon the subject.

In looking over the literature of the subject one is impressed with the similarity of the prescribed methods of treatment. Even those who try to explain all cases of abortion as being due to one or other of the causes already mentioned in this paper invariably prescribe a mode of treatment which would of itself indicate that, even though their views as to etiology be divergent, they can all meet upon a common ground as regards treatment.

Those who believe that odors, sympathy, fright, etc., are the factors in causing animals to abort could with perfect consistency adopt the cleansing methods of treatment, because by vaginal douches and removal of all material soiled by the discharges they get rid of the uterine *débris* which, were they not so treated, would decompose and give off disagreeable odors.

Those who believe that all cases of abortion are due to infection could, for obvious reasons, also adopt the same sanitary measures; and because each side to the controversy has had more or less suc-

cess in combating the disease by the adoption of the same sanitary measures each holds to its respective views regarding the etiology.

That there is a form of abortion in animals having as its cause a contagium cannot be doubted. Opinions have been handed down by investigators favorable to the contagium theory, and numerous experiments have been recorded which, while they give no direct evidence supporting the theory, show that there is sufficient evidence for their formulators to make known their views without much fear of successful contradiction.

The earliest accounts of infectious abortion in the domesticated animals were written as far back as the third century before the Christian era; from that early time down to the present the disease has existed in a more or less severe form, often amounting almost to a scourge in stock-raising countries, and has received the attention of the ablest veterinarians of all times.

Professor Nocard made an extended study of the subject, and his report to the French Department of Agriculture shows him to be a strong advocate of the theory of the infectious nature of the disease. Another French veterinarian, Professor Lebat, showed his belief in the infection-theory by treating a flock of aborting ewes by means of local applications of antiseptics to the vulvæ of all the pregnant ones.¹

In the report of the United States Department of Agriculture for 1883 Dr. D. E. Salmon wrote as follows: "This disease, which evidently depends upon some form of contagion for its causation, has been estimated to produce an annual loss in the State of New York alone of several millions of dollars. If, as seems likely from our general knowledge of the contagion, the germs of this disease are first scattered upon the stall-floors and upon the ground where the cattle run, to be taken into the system by soiled food, by the dust which rises and floats in the air, or in some similar way, then a thorough and continuous disinfection of the stables and runs should have a very marked effect in controlling it. In one rather large and plainly infected herd I have put this idea into practice with the happiest results, the disinfectant being a 1 per cent. solution of sulphuric acid."

Judging from the numerous articles upon the subject which have appeared in the *Agricultural Journal* of Cape Colony, Africa, the disease must be quite common in that country. In one of these articles² Mr. Hutcheon, the Colonial veterinary surgeon, says in

¹ Recueil de Méd. Vétérinaire, Sept. 15, 1896

² Agricultural Journal, vol. iii. No. 13, p. 326.

discussing the probability of the infectious nature of the disease: "Practically, however, all cases of abortion should be treated as if it were a contagious disease, for while many individual cases may occur which do not affect others, it is an undoubted fact that abortion very often becomes infectious, and, if precautions to prevent its spread are not taken, serious losses are certain to follow."

An important paper upon the subject of infectious abortion was written by Dr. W. L. Williams,¹ who was appointed by the department to investigate the disease. Dr. Williams tabulates ten cases in which he gives the details of certain experiments undertaken to prove the infectiousness of material removed from the vaginae of aborting mares. His experiments fail generally, however, to prove what he wished, he having caused only one animal to abort under conditions which could leave little doubt that the abortion was caused by the introduction of utero-vaginal discharges into the vulva of another pregnant mare. This mare aborted thirty-one days after. The period of incubation here seems to be a great drawback to the theory he advocates. It is difficult to understand why the material he introduced into the vulva did not manifest its pathogenic property in a shorter space of time. Dr. Williams states that the weather was unprecedentedly warm during the experimentation. This being the case, and as no mention is made of any extra precautions taken to prevent the multiplication of saprophytic bacteria in the material used, could we not reason that the hypothetical organism of abortion is one which quickly loses its virulence when associated with rapidly growing saprophytes in material rich in organic matter? In the one case where he produced abortion mention is made that the material was immediately transferred from the uterus and vagina to the vulva of the experimental mare. This one successful experiment in ten is, however, offset by a failure to produce abortion by the use of some of the same material under the same conditions in another mare. Could not this failure be explained on the theory of lack of susceptibility? Could not his failures, generally, be explained on the same theory? All the animals used, with one exception, and the author does not say whether this exception was the one in which abortion was induced, were from a herd of unbroken Texas mares free from abortion. The excepted mare had been in the State of Illinois, where the experiments were carried on, for some time previous to the introduction of the others, and had been in foal twice by a native horse.

¹ Sixth and Seventh Annual Reports of Bureau of Animal Industry, Department of Agriculture, pp. 449-456.

Might not the results have been different if the experimental animals had been selected at random from native Illinois stock?

Bernes¹ reports an outbreak of abortion in a herd of cows which he successfully combated by measures based on the assumption that the disease was caused by infection. By removing the affected and healthy animals to separate buildings and thoroughly cleansing and disinfecting the building in which the outbreak occurred no more abortions took place. All the cows were served by the same bull, and one of them had a vaginal discharge a few days after being served. Indications point to the probability in this outbreak of infection having been carried by the bull. The number of exposed animals was quite large—fifty-two in number—while the reported number of abortions was only nine.

We have recorded many instances where this disease, like many others, raged for a while and then disappeared spontaneously. Would not this outbreak have conformed to this rule regardless of the sanitary measures adopted? It seems plausible that others should have aborted, did we not know that an outbreak of abortion is somewhat self-limited in character. It is very probable that the specific agent is one which loses part of its virulence from contact with the blood and utero-vaginal secretions. That the glands in the mucous membrane secrete a fluid which has germicidal properties seems plausible, from the fact that others, as well as myself, have failed to get any growth in the ordinary bacterial culture-media after placing in it material taken from the uteri of animals in health, to which the male had not recently had access.

Dr. T. J. Turner,² in his article upon infectious abortion in mares, records the results of certain experiments made upon pregnant mares to produce abortion. On June 6th Dr. Turner introduced into the system (method not given) of a pregnant mare near term a culture made from diseased foetal membranes from a case of abortion. The mare foaled the following night. Dr. Turner says: "On June 29th the foal showed signs of joint-trouble in the right knee, and on July 1st the hock-joint was as large as a man's head. Thus, from this experiment, almost just begun, we might say, Do we produce the disease in a colt that when born was apparently in health, and that, too, after the inoculation had only been introduced a few hours? Another mare, a dun, inoculated with a culture from the blood of Bidley Mac's colt (culture used in the other experiment was from foetal membrane of same case, C. F. D.) on the 20th

¹ Journal of Com. Path. and Therapeutics, 1891, vol. iv. p. 167.

² The Veterinary Journal, vol. xxxvii. 1893.

day of June, gave birth to a dead foal. This was an abortion, as evidenced by the diseased placenta. Hence we see that from these two inoculations with cultures we have produced both the diseases—abortion and joint-trouble. The germs causing these two diseases are the same, as shown under the microscope. That these two maladies are one and the same disease, but differently manifested, there is no doubt.”

In the absence of more details concerning the experiments made by Dr. Turner we cannot accept his work as conclusive evidence that the case of abortion which took place, apparently the result of the introduction into the system of a pregnant mare of a culture of bacteria from the blood of a dead fetus, was due to a specific organism. It is possible that the severe arthritis from which the offspring of the first experimental mare suffered may, as he claims, be due to the presence in the affected joints of an organism identical with the one he claims was the cause of abortion in the other mare. His statement claiming such identity, however, must be sustained by more evidence than a similarity in the morphology of the organisms.

Dr. F. L. Kilborne¹ investigated an outbreak of abortion in the mares of a large stud near Franklin, Pa. He says in his report: “No history of any introduction of the infection from without could be obtained beyond the fact that mares were daily being received at the stock-farm from various parts of the State, to be bred to the stallions of the stud. But as far as could be ascertained no mare had been received from any stable in which abortions had previously occurred. The veterinarian in charge of the stables had taken the usual precaution to remove the aborting mares as soon as discovered and to disinfect the stall. Such mares were disinfected per vaginam by repeated injections of a diluted solution of corrosive sublimate, 1 part to 10,000 of water, and the external organs, tail, and hind limbs sponged over with a strong solution, 1 part to 1500 of water. The stable had also been repeatedly fumigated with burning sulphur. Fluid extract of black-haw (*Viburnum prunifolium*) in half-ounce doses once daily had been given the pregnant mares during the month preceding February 5th. In this outbreak the first case of abortion occurred on December 2d, the birth being premature by 109 days. Up to the time of Dr. Kilborne’s first visit—February 5th—ten cases had occurred, ranging in prematurity from 23 to 195 days. In addi-

¹ Bulletin No. 3, Bureau of Animal Industry, Department of Agriculture.

tion to the sanitary measures already practised by the resident veterinarian, Dr. Kilborne advised a more thorough disinfection of the stalls with a 2 per cent. solution of sulphuric acid. The abortions ceased from January 29th to February 15th, when another outbreak occurred, lasting till March 4th, six mares having aborted. It was then decided to take additional precautionary measures to check the outbreak. All pregnant mares were removed to another building. The floors of the stalls were thoroughly cleansed and disinfected with a 2 per cent. solution of sulphuric acid twice a week. The external genitals and tail were washed daily with bichloride of mercury solution. Intravaginal injections of the mercury solution caused the animals to strain, and were discontinued. Half the mares were given once daily one-half ounce of the fluid extract of black-haw in addition to the sanitary measures taken. The remaining half of the mares received in the feed one heaping teaspoonful of the following powder-mixture twice daily for two weeks, when it was omitted for four or five days: chlorate of potassium, phosphate of sodium, of each one pound; and sulphate of quinia, three ounces. This treatment and the rigid sanitary measures seem to have quelled the outbreak, no more abortions occurring till in the fall, when three of the mares brought in from the pasture and stalled in a small barn with several others aborted. This new outbreak was checked by a repetition of the treatment and disinfection measures employed in the former outbreaks.

A bacterial culture was made from the vaginal mucous membrane of one of the cases by Dr. Kilborne, and experiments were projected by Dr. Theobald Smith to determine the presence in it of a bacterium which had pathogenic properties. The culture obtained proved upon examination to contain only a single species, a short motile bacillus. Cultures in peptone-bouillon were made from the original culture, and were injected into the vagina of a mare nine months pregnant, with the result that in twenty-four hours the mare had an abundant purulent vaginal discharge. The discharge ceased in two days. This experiment was spoiled by the mare developing a severe case of influenza. She foaled in about a week after the injection, probably the result of the attack of influenza.

Intravaginal injections in several pregnant cows did not give any positive results, with the exception of a temporary vaginal discharge.

Intravenous injections of this bacillus into hogs caused only a temporary anorexia. Inoculations made into rabbits of this bacillus proved fatal in three out of four cases, the animals dying of a dis-

ease simulating hog-cholera in rabbits. Dr. Smith inclines to the belief that on account of its pathogenic properties and its cultural characters that the organism obtained from the case of abortion in a mare is closely related to the bacillus of hog-cholera. He says,¹ in discussing its peculiarities: "Another fact of interest in connection with this pathogenic bacillus is its close resemblance to the hog-cholera bacillus. . . . and if the bacillus in question had been sent me as having come from swine I should not have hesitated to regard it as a hog-cholera bacillus of rather feeble virulence, and possessing some slight differential characters from the virulent form."

In order to determine whether this bacillus is present in the genital passages of healthy pregnant and non-pregnant mares, Dr. V. A. Moore made a series of observations upon the vaginal secretions of five healthy mares, one of which was pregnant. These observations are recorded in Dr. Smith's report. Dr. Moore isolated eleven species of bacteria of the following genera: two species of non-motile bacilli; four species of micrococci; and five species of streptococci. Neither of the species of bacilli had characters which would show they were identical with the bacillus of which Dr. Smith wrote.

Recognizing the importance of having an intimate acquaintance with the normal bacterial flora of the genital passages as a prerequisite for the future investigation of infectious abortion in animals, I, at the suggestion of Dr. V. A. Moore, undertook a series of observations to determine those forms normally present in the vaginae of cows.²

My method for collecting the vaginal secretions was as follows: a cotton applicator, made by twisting absorbent cotton round the roughened end of a piece of stout copper wire, was thrust into a test-tube through its cotton-wool stopper. The whole was placed in a sterilizer kept at 140° C. for one hour. This proved an excellent means of transporting the secretions free from contamination. When the sample was to be taken the external genitals and under the surface of the tail were thoroughly washed with a 2½ per cent. solution of carbolic acid, followed by a bath of sterilized distilled water and dried by means of sterilized cotton-wool. An assistant held the tail to one side, the labia were separated, and a speculum, anointed with carbolized vaseline, was introduced and held in place

¹ Bulletin No. 3, Bureau of Animal Industry, Department of Agriculture, 1893, p. 58.

² The description of the biologic characters and the drawings of these organisms are reserved for a future communication.

by an assistant. By opening the speculum the interior of the vagina and the os uteri could be plainly seen, and the applicator could be applied to the parts and bring away secretions it had absorbed during contact. Upon reaching the laboratory the applicator was removed from the tube, and twirled around in a flask of about 50 c.c. of melted agar. By this means any bacteria which were removed from the vagina in the meshes of the cotton were washed out. The infected agar was then poured into a double dish ten inches in diameter and similar to the ordinary Petri pattern. By the use of this size dish ample room was given for the development of a large number of different organisms from a single inoculation. From the large number of species from bacteria which these observations show are present in the bovine vagina, and the infrequency of the occurrence of the same species in different observations, it would seem that the flora of the bovine vagina is either very extensive or that the presence of such large numbers of species is accidental.

If we admit that they gain entrance to the vagina from the ventral surfaces of the tail and from the soiled vulvar surfaces, it would seem that most of them came from the feces.

Upon reflection we find that the rumen is a most admirable bacterial incubator because of the fact that in this portion of the alimentary canal the very conditions exist which are necessary for the development of bacteria—*i. e.*, warmth, moisture, and an alkaline reaction. Flourens has shown that fluids pass with facility from the rumen into the other three stomach divisions, and might we not, therefore, expect to find a very large number of species of bacteria by this means washed from the stomach into the intestine and appearing in the feces of these animals?

It is only in the abomasum, fourth or true stomach, that we find conditions that are inhibitive to the multiplication of ~~some~~ bacteria. When a ruminant swallows water some of it passes without much delay into all four of the stomach-divisions. It is probable that many of the bacteria are thus washed into the fourth stomach, and that their sojourn there is of short duration, many of them passing through the pylorus with the chyme into the intestine, where conditions are more favorable for their multiplication.

It would, therefore, seem that the number of species to be found in the bovine vagina is limited in a measure by the number of species swallowed with the food.

The observations were made upon perfectly healthy cows which

were not known to have been in contact with a male for some time previous to my operations.

By the method given above forty-five species of bacteria of the following genera were studied: twenty-one species of bacilli, thirteen of which were motile, two of them being spore-producers, and eight of which were non-motile, two of these being spore-producers; seven species of micrococci, seven species of diplococci, eight species of staphylococci, and one streptococcus.

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