

was found that rabbits which had been resistant to abscess formation from subcutaneous inoculation succumbed to large doses administered intra-peritoneally. A test, however, by this means has no parallel in infection by natural means, and is therefore of little practical value.

*Conclusions.*—As a result of these experiments it would appear that subcutaneous vaccination with either a broth culture killed under toluol, or an agar culture in salt solution killed at a temperature of 58° C., will have a very considerable effect in raising an animal's resistance to a streptococcic infection, and is therefore useful as a preventive to the disease. Control animals will show a more or less severe abscess when tested with a non-lethal dose of strangles streptococcus culture, whereas the vaccinated animal will suffer practically no ill effects. These results should have a practical bearing on the vaccination of young horses when entering a stud. Vaccination produces an active immunity which is of a lasting nature, so that this method recommends itself in preference to a preventive serum, the benefits from which are of so evanescent a nature as to render it inefficient.

The fixation of a minimum lethal dose of organisms is almost impossible, so that to standardise the vaccine by experimental methods is difficult. Counting of the organisms is, however, comparatively simple in young cultures, and it can be ascertained how much of a vaccine so standardised an animal can stand without showing any great local or general reaction. The necessity for such a standardisation is evident from the fact that an excessive dose of a pure killed culture will induce grave toxic results, which in the rabbit may end in death.

An efficient vaccine must necessarily be made from organisms derived from as many sources as possible to insure its polyvalency, these different strains to be each grown separately, and the subsequent vaccines pooled.

I wish to thank Dr Besredka for his kindness, and also Drs Binot and Legroux for the facilities they afforded me. I am indebted to Professor Vallée for sending me fresh strangles pus.

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### STRANGLES.

By E. CLIVE WEBB, Lieutenant A.V.C., Mona, Punjab, India.

AS in England probably few veterinary surgeons have the opportunity of observing outbreaks of strangles amongst large numbers of very young stock (*i.e.*, from the age of nine months to one and a half or two years) running at liberty in paddocks, and since the younger the animal the less are its powers of resistance, and consequently the more severe is the type of any disease with which it may become infected, the following notes may not be without interest.

This dépôt, which up to within a few months ago was the only one of its kind in India, is essentially one for the rearing of young country-bred horse and mule stock, and also, but on a much smaller scale, of donkey stock. The animals are purchased from their breeders very soon after weaning, and sent straight away into this dépôt, where, in the case of the horse stock, they are reared to the

age of four and a half to five years old, at which age they are issued as remounts. On their arrival here their ages vary from nine months to two years, but a few are purchased older.

During the cold weather (October to May), *i.e.*, the purchasing season, there is a more or less continuous influx of these youngsters, amounting in the case of both horse and mule stock to several hundreds of each class. On arrival they are put into segregation paddocks, and from the day on which each separate paddock becomes full a period of six months' segregation commences. It is not surprising, therefore, that with so many young stock collected together strangles should be rife amongst them, and should at times be a cause of serious mortality.

The months during which the disease is at its height are the spring months of March, April, and May, during which months also in the Punjab one expects the January rains. It is interesting to compare the figures of a bad with those of a good year as far as the disease is concerned, and to discuss what are the factors determining a heavy mortality or the reverse.

In 1907, during the worst months mentioned above, there were over 100 cases of the disease under treatment at the same time, and a correspondingly heavy mortality, whereas the mortality this year has been comparatively light, as the following table will show:—

*Comparative Return of Strangles amongst Horses.*

	<i>No. of Young Stock which Arrived in Depôt.</i>	<i>No. of Cases of Strangles.</i>	<i>No. of Casualties.</i>	<i>Percentage of Casualties amongst Animals Attacked.</i>
From 1/10/06 } To 30/ 4/07 }	491	355	36	10'14
From 1/10/07 } To 30/ 4/08 }	383	272	13	4'77

In the above I have shown the numbers this year up to the 30th April 1908, although there still remain a few days of April; but the table is accurate enough for a comparison to be made, as at the present moment I have no serious cases under treatment and the outbreak is practically over. In seeking the causes of so marked a difference the following points stand out prominently.

(a.) If animals arrive in small batches, say of six, twelve, or fifteen, they receive more individual attention than they possibly could if they were of a batch of, say, fifty or more; and, although they do not escape infection, if the latter can be warded off for a week or two, during which time they are getting a very liberal ration, and until their system has recovered from the shock of change of locality, the journey, change of surroundings, etc., their chances of recovery are much enhanced and the attack likely to be of a benign and regular form.

I should mention here that henceforward, unless I state to the contrary, I am referring to horse stock only.

On the other hand, when a large batch of young stock (fifty or more) arrive, and they are at once confined together in paddocks, if the disease breaks out amongst them almost at once, which is usually the case since many appear to arrive in the incubative stage of the disease, there is likely to be a greater percentage of "dangerous" cases and casualties, than were the same number of animals attacked among animals coming from smaller distinct batches and more widely separated paddocks. If this has not been mere coincidence in the outbreaks which have come under my observation, then possibly some of the reasons may be as follows.

The strangles streptococcus may increase in virulence from a rapid passage through many animals, and hence, when infection takes place from animal to animal rapidly, the type of the disease may increase in severity. In outbreaks of other diseases occurring as large epizootics, where the type of the particular disease assumes a much greater virulence than is ordinarily met with in smaller outbreaks, this same explanation has been given.

It follows, therefore, that an animal infected not directly from an animal suffering from the disease, but from infected materials, such as paddock-fittings, etc., would be likely to suffer from the disease in a milder form. These cases might, however, be accounted for in another way, by supposing that in the former (the more virulent), when infection takes place from animal to animal, the patient receives a much larger dose of infective material, added to which is the fact that the infective material has not been weakened by exposure to adverse circumstances, such as desiccation, sunlight, etc.

(b.) *The Influence of Rain.*—This seems more marked in producing bad cases of strangles than in any other disease; in fact, its aggravating influence seems almost out of proportion to the amount of extra exposure and chill induced.

Last year, when the outbreak was at its worst, almost without exception each downfall would surely bring into hospital two or three very bad cases, suffering from such dyspnoea, with its resulting roaring symptom, as to make tracheotomy seem inevitable; yet these were animals which up to the time of the rain were in their paddocks and had shown no marked symptoms of the disease. It only shows how very rapidly exposure to wet and chilling influences can bring on inflammatory swelling and infiltration of the mucous membrane of the pharynx and larynx and of the surrounding tissues. There is no doubt, of course, that all such cases were already in the incubative stage of the disease just prior to the rain. The fact that this year the January rains were very late, and did not appear until after the disease had been through practically all the paddocks, accounts in great measure for the lighter mortality.

*Symptoms.*—As far as these are concerned I have nothing new to add. Although, as I well know, the common seat of the strangles abscess is the submaxillary or parotid region, yet abscesses may break out at any single point of the body's surface—face, eyelids, neck, sides, legs, sheath, perineum, etc., or at any or all of these parts at the same time. Frequently one gets a chain of abscesses resembling somewhat the appearance seen in cases of epizootic lymphangitis, but the nature of the case is easily determined by microscopical examination. I have counted as many as thirty abscesses on one

patient, and until I had seen outbreaks in these young animals, little more than foals, I had no idea that the disease could assume such a malignant type. It has been my experience, however, that these cases in which many abscesses make their appearance usually do well, although they take some time to pick up their condition again. The cases which do badly are those in which external abscesses are late in making their appearance, and which at the commencement of the disease suffer from dyspnœa.

A word or two with regard to this latter symptom. Dyspnœa and "roaring" are practically always due to inflammatory infiltration and swelling of the mucous membrane of the larynx and base of the tongue, plus swelling of the surrounding tissues (subparotideal), which latter is seldom markedly observable externally. In the majority of cases of this sort which have come under my observation, that is to say, cases in which the chief symptom is dyspnœa accompanied by very noisy "roaring" respiration, the usual strangles swelling—submaxillary or parotideal—has been conspicuous by its absence. In such cases the appearance after a day or two of such a swelling is usually the forerunner of relief of the dyspnœa and marked improvement. In cases of the kind under discussion which succumb one usually finds that although there is a general suppurative inflammation going on in the parotideal region, with small collections of pus throughout the depth of the tissues, yet the excessive dyspnœa was not due to any large discrete abscess causing pressure on the glottis, but to a general inflammatory infiltration and swelling of all the tissues in the parotideal region, and primarily to swelling of the mucous membrane of the laryngeal cartilages themselves and base of the tongue. This has been my experience, and hence I have never had any good result from making deep incisions in the parotideal region in the hopes of being able to evacuate a deep-seated abscess. Although in a large percentage of cases of this sort which succumb pus is present in the guttural pouches, it is usually present in comparatively small quantity, and I have never seen the pouches containing sufficient pus to cause distension and pressure. Hence I am of opinion that they play a comparatively unimportant rôle in the causation of dyspnœa in the majority of cases, and that no good result would be obtained by attempting to evacuate the pus in them, were such a difficult operation contemplated.

The foregoing remarks on the active cause of dyspnœa lead up to a discussion as to what is the best method of treatment in these cases.

I very much condemn the operation of tracheotomy in such young animals, except as a very last resource to actually prevent sudden death from suffocation, and it is, I find, chiefly in the very young that this acute dyspnœa occurs. Those animals which escape infection during their first six months or year in the dépôt rarely suffer from more than a mild and benign form if they contract the disease as a two- or three-year-old.

My reasons for condemning the operation are as follows: In the first place, I have not seen a tube on the market which I consider of sufficiently small calibre for a foal. The regulation size tube is too clumsy for so small a trachea, besides being of unnecessarily large calibre for the purpose required, viz., a temporary relief. Added to this is the fact that the larger the opening unprotected by any form

of filter, the larger is the port of entrance for organisms or any extraneous material, and the greater the risk of infection of the lungs. However, were the size of the tube the only objection it could easily be remedied. Secondly, and more important, is the fact that the operation immediately throws all the tissues surrounding the larynx, and the latter organ itself, into a more or less quiescent state.

Although for most lesions of an inflammatory nature one cannot deny that rest is essential, yet in cases of the kind under discussion, where inflammatory swelling is present, the rapid reduction of which is a vital necessity, the ordinary active movements which take place during respiration are essential to a quick resolution of such swellings. In these acute cases of dyspnoea the movements are all the more active owing to the difficulty of inspiring sufficient air. It may seem cruel when one meets with a case in which there is excessive dyspnoea not to give the immediate relief which can be effected by such a surgically simple operation as tracheotomy, but I can only affirm that I have performed the operation on many youngsters under one year old, and of those which I treated by this method during last year's outbreak not one single case recovered, all of them being followed by pneumonia and death, although in some cases the patient lived on for some little time. It might, then, fairly be asked: What is the best treatment in these cases? I used to rely upon a good smart blister around the throat, plus steam inhalations, but there was rarely any relief of the distressing symptoms for many hours after their application; nevertheless, a good percentage of these cases ultimately obtained relief and recovered.

At the beginning of this year, more or less as an experiment, I tried a new drug in their treatment, viz., citric acid, and have had great success with it. I have now used it regularly for the past four months in all cases in which dyspnoea accompanied by "roaring" was present. The more or less routine treatment in these cases has been to apply immediately a smart blister, and to give 1 drachm doses of citric acid dissolved in water three times daily, for not longer than three days (*i.e.*, nine doses in all), or for a less period if relief was obtained quickly. What I have found is that the patient usually obtains considerable relief after the second or third dose, or, at any rate, the dyspnoea becomes sufficiently relieved to obviate any risk of mechanical asphyxia, although a slight noise may continue to be made for several days. The change of symptoms which one notices is that the hard, roaring, rasping noise made during inspiration gives way to a softer, easier, and more liquid sound, more like a bronchial r le. From the use of this drug I have seen the worst cases speedily obtain relief, and, although it is not possible to state that the cases in question would not have obtained relief without its administration in the ordinary course of events, one can only draw conclusions by giving any drug a thorough trial, which I have given citric acid, and I am very satisfied with the results obtained and with its efficacy.

The therapeutic action of citric acid would be to render the blood and also the lymph less readily coagulable. In the edition of *Veterinary Medicines* by Finlay Dun of which I have a copy, the only reference to the drug I can find is in connection with tartaric acid, which latter drug, it states, closely resembles citric acid, and, like it, is used as a cooling antipyretic.

In human medicine, I am told that, given in the form of limes, it forms a part of the regular diet of enteric patients with the object of preventing thrombosis and phlebitis, the commonest complications of that disease.

My reasons for giving the drug a trial were:—

(a.) That if the blood and lymph of the patient could be rendered less readily coagulable, and the transudation of lymph thereby rendered freer, the result would be to determine a greater flow of lymph to the affected part, thereby assisting to bring the means of bacterial defence more quickly into operation against the streptococci.

(b.) By rendering the blood less viscid, to cause a freer circulation at the seat of inflammation, thereby hastening the carrying away of products the result of bacterial activity, including toxins, and that by these latter entering the general circulation (auto-inoculations) a corresponding anti-bacterial response would be generated.

With regard to mule young stock from the age of nine months up to two years, in actual numbers they appear to become infected to the same extent as horse stock, but show their hardiness and great powers of resistance in this as in most other diseases by the very small percentage of casualties. In the outbreak in 1907, out of several hundred mules which came under treatment, the casualties were under 2 per cent.

Young donkeys appear to be much more resistant to the disease than either horses or mules, and it is, I presume, from this side of their breeding (*i.e.*, the donkey) that mules inherit their hardiness. However, as the numbers of donkeys coming into the dépôt are so very few, I am hardly justified in drawing any firm conclusion as to their susceptibility to strangles.

*Protective and Curative Inoculation.*—If a practical method of protective inoculation could be perfected, it would undoubtedly be a great boon in preventing losses where large numbers of young animals are of necessity collected together, in which cases outbreaks of strangles are almost inevitable.

If only a passive immunity of short duration can be conferred, the practical utility of such immunisation from the point of view of the owner of three or four young horses is questionable, since animals can contract the disease at any age, and a passive immunity would only be useful to tide over a period where an outbreak appeared imminent, or where the animals in question were likely to be brought into contact with infective material.

Under the conditions prevailing in this dépôt, if a passive immunity could be conferred immediately on arrival of stock by serum inoculation or vaccination, even if the immunity lasted only a short time, good results might be expected, by giving the animals time to recover from their journey, and also by tiding over a rainy period when the disease is usually at its worst. The only danger would be that an animal might be already infected at the time of inoculation and the effect of the latter might be the opposite of that which was intended.

As far as curative treatment by inoculation is concerned, there is no reason why vaccination in conjunction with Wright's method of checking the opsonic index should not be successful, as suggested to me by the Imperial Bacteriologist (Captain Holmes) when corresponding with him on the subject.

In the outbreaks, however, which occur in this dépôt, where the trained staff at my disposal is hardly sufficient to carry out the ordinary simple dressing and treatment, and my own time is fully occupied in supervising the veterinary work of the whole dépôt, strangles being only a very small part of it, the difficulties in the way of the application of such treatment are insuperable, and unless such vaccination were carried out scientifically, in conjunction with checking the opsonic index, good results could not be expected.

If it were possible to prepare a vaccine which could be inoculated at regular intervals without the necessity of checking the opsonic index, and at the same time to run no risk of giving a second inoculation during the negative phase of a previous one, when the patient is not in a fit state to receive such inoculation, then the method could be brought within the bounds of practical utility for use on a large scale. There is little hope, however, of this being effected, seeing that no two animals' systems respond in the same way.

While on the subject of this method of vaccination, it occurs to me to ask if the opsonic index of the blood of a patient in relation to the decrease or increase of anti-bacterial substances (opsonins) after inoculations of vaccines can be determined, why should not such opsonic indices be taken after the administration of drugs by the mouth in the treatment of various bacterial diseases, in order to gauge the effect of the treatment?

At the present time our knowledge of the actions and uses of many drugs is inclined to be empirical. We know the actions of certain drugs in relation to temperature, action of heart, skin, glands, etc., but we do not know whether whilst exerting this particular action they are also exerting a beneficial influence or otherwise on the anti-bacterial defences of the body.

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## THE ULTRAVISIBLE VIRUSES.

By Sir JOHN M'FADYEAN, Royal Veterinary College, London.

(Continued from page 68.)

### FOWL-PLAGUE.

IN 1901 Centanni and Savonuzzi<sup>1</sup> investigated a disease which occurred among fowls in the province of Ferrara, in Italy, and to which they gave the name fowl-plague (*peste aviaria*). The disease had apparently existed for a long time in Italy, and although it closely resembles fowl-cholera, it had by Perroncito and others been differentiated from the latter affection by minor clinical and pathological characters, and by the absence of the easily recognised fowl-cholera bacteria in the blood. In practice, however, the two diseases appear to have been frequently confounded until Centanni and Savonuzzi showed that the cause of fowl-plague is an ultravisible

<sup>1</sup> La peste aviaria. "Comunicazione fatta all'Accademia delle Scienze mediche e naturali di Ferrara," 9th March and 4th April 1901. Reference by Maggiore and Valenti