which appeared a few years ago. Such cases as have been seen are always similar. The lymphangitous abscesses begin in the groin or in the breast and even in the mandible; later, they may be seen in the fetlock joint.

The treatment has consisted especially in cautery tapping and in injections of tincture of iodine; many experiments have been attempted by various veterinarians (therapeutic antisyphilitic, pyotherapy) with varying results, but it cannot be said that there has been revealed a medicine that will really cure.

In two cases, the abscess in the chest fixed with guaïacolated essence of turpentine, has given, at the beginning a temporary return to health, if not a complete cure. The autohemotherapy tried by Mr. Geoffroy appears to be efficacious in some cases.

The iodurated therapeutics has cured some horses which had affections resembling ulcerous lymphangitis; but in such cases as shown by the Veterinary Inspector-General, Mr. Carougeau, it was sporotrichosis (*Sporotrichum beurmanni*).

Prophylaxy.—It is more especially through tick-picking, and, better still, tick destruction through dipping, that it will be possible to successfully fight ticks. Tick-baths are now being built in some establishments of the agricultural and veterinary services, but it is only a beginning. The native will also need to be taught to bring his cattle to such tick-bath in the same way as he now brings them along for vaccination.

Parasitic Diseases.

It is but in the last few years that, through the construction of laboratories at Befanamy and Tananarive, these diseases have been studied; yet they play a preponderant rôle in malagache pathology. In this domain, everything has to be actually studied, created, done.

Paper No. 23.

BLACK-QUARTER AND ALLIED ANAEROBIC DISEASES IN SOUTH AFRICA.

By J. R. Scheuber, Dr.Med.Vet., Veterinary Research Officer, Department of Agriculture, Union of South Africa.

Black-quarter is the most common of the diseases caused by the pathogenic sporulating anaerobic bacteria which may be grouped together as gas gangrene producers. It is the only disease of this group which is of undisputed practical importance in this country.

In addition *Vibrion septique* and *B. Welchii* have been isolated. *B. oedematiens*, or any other organism of this group, has not so far been diagnosed in South Africa.

This paper is not intended to give a full account of the diseases just mentioned. Only a few remarks will be made on them according to their importance in the Union ,especially where conditions may be different from those in other countries. Our local experience will be given on questions where a difference of opinion exists.

Black-quarter.

Black-quarter, blackleg, or quarter-evil has by the old Boers been named " sponssiekte " which means " spongy disease."

Economic Significance.—Quarter-evil is not a scheduled disease in South Africa. No reliable figures are, therefore, available with regard to the losses caused by it, but there is sufficient evidence to show that the disease is widespread in this country.

The first indication is the sale of vaccine, of which during the last few years roughly 350,000 doses have been issued annually from our laboratory. The exact figures for 1928 is 342,310 doses, the highest issue being reached in 1927, namely 375,635 doses. It may be taken for granted that nearly all animals inoculated were actually exposed to the infection.

Further, there are many farms, especially in native territories, where the disease occurs, but vaccination is not carried out. This is shown by the fact that in the course of our routine smear examination we frequently receive reports that black-quarter is suspected as the cause of death. Often symptoms such as " swollen shoulder and sudden death " are mentioned. The accompanying smears, however, are generally so hopelessly decomposed that it is quite impossible to confirm the diagnosis of quarter-evil as a result of microscopical examination. On the other hand, spleen smears are often sent to the laboratory without any indication or suspicion of black-quarter being expressed in the accompanying report; but in the smears themselves bacilli microscopically indistinguishable from *B. chauvoei* are found in apparently pure culture. Although this does not necessarily mean that all these cases are black-quarter, it can safely be assumed that at least in a fairly large proportion we have actually to deal with quarter-evil.

All this evidence tends to show fairly conclusively that black-quarter is widespread in this country.

Animals Affected.—In South Africa natural cases of black-quarter have been observed in cattle and sheep. Experimentally goats have also been killed with this disease. Other domestic animals were not experimented with.

So far, most of the losses reported have been in cattle, but during the last few years the disease has become more frequent in sheep as well, and usually follows shearing operations. Last year it assumed alarming proportions in one of our sheep breeding districts, and the direct losses amounted to some thousands of pounds sterling. On inquiries made by Marais (1928), the death of 749 sheep from black-quarter in that particular district, were actually brought to his notice, and it is fairly evident that some smaller outbreaks, especially such which had at that time already been overcome, may not have been reported. The highest proportion of losses reported in one particular flock was 250 out of 500 sheep shorn, the lowest 8 out of 700. Incidentally these 8 sheep were valued at about £3,000. The average losses are estimated at 5-10 per cent.

In this connection it may be pointed out that the outbreaks of black-quarter in South Africa are probably more severe than those in some countries. It is a practice of farmers that, if an animal dies from a disease apparently harmless to man, the carcass is given to the natives. It is thus by no means of rare occurrence that an animal dead of black-quarter is left to the natives, who cut it up in a shed or other convenient place, eat some of the meat and hang the remainder out to dry. In this way the locality, as well as the natives,

become infected. As cleanliness is not an outstanding characteristic of our natives the conditions for the spread of an infection are almost ideal. A case which occurred during the last shearing season may serve as an illustration:—

On a farm, known to be infected with black-quarter, a young beast died suddenly. According to information obtained from the owner the symptoms, as far as they were noticed, corresponded with those of quarter-evil, but no post-mortem examination was made nor was at that time any particular importance attached to the case. The carcass was skinned next to the shearing shed the same day as shearing was commenced and the natives had the meat for lunch. The same natives who had been skinning the carcass were later handling the sheep just after being shorn. Out of the 200 sheep shorn that day the first 60 were kept apart and no losses were experienced amongst them. Out of the remaining lot 3 died 2 days later. Their death was attributed by the owner to "blood poisoning" and the meat consumed by the natives. None of the sheep shorn the second day were lost, but out of every lot shorn subsequently a few animals died. At the time our assistance was called in, some nine days after the first sheep had died, the total losses already amounted to 30 sheep, some of them stud ewes worth £10 to £15. Black-quarter was then diagnosed as the cause of this mortality, rigorous disinfection was carried out and shearing continued without further loss.

This is by no means a solitary case. In many instances all the evidence leads to a similar conclusion, although often the circumstances cannot be studied with the same accuracy. The farmer usually has either not been aware that the first case in question was black-quarter, or he did not realize the danger of it.

It is hardly necessary to mention that native shearers going from farm to farm are almost sure to carry the infection on their body, clothes, shears, and other belongings from an infected flock over to a clean one, unless special and rigorous measures for disinfection are taken.

The position of black-quarter in sheep is made more serious by the fact that, as already shown, many farmers do not recognize it as such. They attribute the losses to "blood poisoning" and put up with them as long as they are not too alarming. This difficulty is increased by the fact that sheep dead of black-quarter after shearing do not show the typical lesions as prominently as cattle usually do. The well known muscle changes are very often small or cannot be traced at all. In 10 post-mortem examinations made on sheep dead of black-quarter on a particular farm, dark red spongy muscles were found only in one case, and even here the lesions were so small that they might easily have escaped observation by a farmer. The outstanding symptom in such cases is a fairly extensive haemorrhagic oedema in the subcutaneous tissues and associated with one or several shearing wounds. A smell suggesting black-quarter is noticed in fresh cases, but very soon it is masked by the smell of a mixed infection which, under the circumstances, is usually present.

Etiology of Black-quarter in Cattle and Sheep.

That black-quarter in South Africa is caused by the typical *B. chauvoei* has been shown by Viljoen and Scheuber (1926), also that sheep can be infected with cattle strains under natural conditions even without any evidence or history of trauma. The history of many outbreaks of black-quarter in sheep proves beyond doubt that the infection was actually carried over from cattle to sheep. All our vaccine has so far been prepared from cattle strains, and it never failed to stop an outbreak amongst sheep, where it was used. Further, all our sheep experiments were carried out with cattle strains. The reason for minor differences between black-quarter in cattle and sheep should not be looked for in the organism; it can usually be explained sufficiently with the difference of the animals infected, the mode of infection and other incidental circumstances.

The same conclusions as in South Africa were arrived at in America. Jungherr (1928) found that in comparative laboratory studies ovine strains of black-quarter from an outbreak in Montana and recognized bovine strains of *B. chauvoei* were undistinguishable in cultural, biological, guinea-pig protection, and cross agglutination tests. In a joint article by Marsh, Welch, and Jungherr (1928), many instances are published where outbreaks of Blackleg in sheep were traced back to the same disease in cattle. Although they did not observe any cases in sheep grazed over the same range where cattle would succumb to black-quarter, they found that, if sheep are camped on premises where cattle have died of quarter-evil, and if they have open wounds in the skin, they may develop typical black-quarter. Following such an outbreak, there may be enzootic " spontaneous " blackleg in sheep on the infected premises with no evidence of trauma in the infected animal. They are of opinion that under natural conditions sheep have a greater resistance to black-quarter than cattle, and that for this reason, blackleg does not ordinarily occur as an enzootic spontaneous disease in sheep, but occurs only when there is a favourable combination of circumstances such as exposure to heavy infection when sheep have fresh skin wounds, or exposure without trauma to a heavy infection of a strain which has recently passed through sheep.

The opposite view has also been held, namely that black-quarter in cattle and sheep are not identical, but should be regarded as two separate diseases. The reasons advanced for this opinion have been summed up by Miessner and Meyer (1927) as follows:—

(*a*) On blood agar plates prepared with blood of an animal immunized against sheep's black-quarter, sheep strains show only a feeble growth, whilst cattle strains grow well, and vice versa.

(*b*) Guinea-pigs immunized with culture filtrate of a sheep strain show an " essentially " better resistance against the infection with sheep's black-quarter than against black-quarter strains obtained from cattle and vice versa.

(*c*) Black-quarter in sheep is never observed in areas where cattle suffer from field infection of black-quarter and vice versa.

(*d*) Cattle black-quarter is a field gas oedema set up by enteral infection, sheep's black-quarter is a wound oedema due to parental infection.

The deciding factor now is whether this evidence contains sufficient proof of a distinct and constant difference on an essential point. This does not seem to be the case, since the differences put forward either concern minor points or are not sufficiently proved.

The differences under (*a*) and (*b*) are both based on the presence of substances antagonistic to the development of the black-quarter organism. Under (*a*) an inhibitory influence on the growth of the more closely related set of strains is demonstrated, whilst no apparent influence is shown to be exercised on the less closely related strains. But from the presence of the cross immunity demonstrated under (*b*), it can be logically deducted that, if correspondingly more or stronger antiserum is used, a stage must be arrived at where the less closely related strains will show the same weak growth as obtained with the more closely related ones in the actual test, whilst the inhibitory action on the more closely related strains will be increased accordingly, so that this difference can only be claimed as one of degree. The same argument applies to (*b*). Here the presence of a cross immunity, which is admitted, is the point that matters, but little importance should be attached to the actual difference in the degree of immunity, especially since it is common experience that cattle strains show a considerable variation in cross immunity tests amongst themselves.

The statement under (*c*) is of a negative character and falls to the ground in view of the positive evidence published in South Africa (1926) and America (1928).

Under (*d*) stress is laid on a difference in the mode of infection, but this is of no importance whatsoever, since both modes of infection are actually known to occur in one and the same disease, for instance, anthrax. Further, one is not justified in assuming that black-quarter in cattle *must* be caused by enteral infection since the usual way of producing the disease in cattle experimentally is by intramuscular injection, therefore, parenteral, whilst it seems rather difficult to demonstrate that cattle *can* experimentally be infected through the mouth. As far as such experiments were made in South Africa, they gave negative results, although Green (1929) actually used cattle to experiment on. On the other hand, sufficient evidence has been published in America (see Jungheer, Marsh, and Welch) and South Africa [see Viljoen and Scheuber (1926)] to show that cases of black-quarter in sheep have occurred without any history or trace of trauma.

It would, therefore, appear that no essential difference between black-quarter in cattle and sheep has been proved. There seems to be no reason why in consideration of the conclusive evidence available, the identity of black-quarter in cattle and sheep should not generally be accepted.

Control of Black-quarter.—The control of black-quarter in South Africa largely depends on the judgment of the farmer and his good will in carrying out the measures recommended by the Veterinary Division. The importance of the proper disposal of carcasses is strongly emphasized. Disinfection is recommended, and in many cases carried out with good results.

The chief measure employed to prevent losses from black-quarter is vaccination. In the olden days powder vaccine was chiefly used. The first experiments on record in connection with the preparation of such vaccines in South Africa date back to 1887. That powder vaccine, in spite of its shortcomings, was extensively used, is shown by the fact that during the fiscal year 1919-20, over half a million doses were issued. In 1923 the sale of powder vaccine was gradually abolished since in February of the same year the first locally prepared liquid vaccine in the form of culture filtrate was put on the market. The total issue of these culture filtrates up to January, 1929, when it was discontinued in favour of formalized cultures, amounted to just over 1,800,000 doses. It may be repeated here, that the culture filtrates have been an undisputed success in this country, even at the beginning when the immunity shown experimentally was so weak that vaccinated sheep often died from one M.L.D. of culture. Constant experiments then led to considerable improvements, and a method was arrived at which gave excellent results in the experimental tests as well. This method is described in detail by Viljoen and Scheuber (1926), and consists essentially of the superimposing of several periods of vigorous growth in the same culture, by adding glucose and sodium hydroxide whenever the growth becomes unsatisfactory. A large number of batches of vaccine prepared in this way gave an immunity of 5-10 M.L.D., and in two cases the immunized sheep, as shown by experimental tests, resisted up to 30 M.L.D. of virulent black-quarter cultures. The issue of this type of vaccine was, therefore, stopped, not because it did not give general satisfaction, but the newer method of formalized culture was simpler, and to judge from reports in the literature and the experimental evidence furnished locally by Green (1929) promised even better results.

The general use of our black-quarter vaccines is greatly encouraged by their cheapness. They are issued to the farmer at 3d. for 5 c.c. which is the dose recommended for cattle, whilst the dose for sheep has been cut down to 2 c.c.

Probably a moderate amount of efficient vaccine is imported chiefly from America, the import of unsatisfactory vaccines being prevented by the Government. These imported vaccines are almost exclusively natural aggressins, and are bought by farmers who are specially impressed by the promise that they confer a lifelong immunity.

Finally, the question may be asked, why black-quarter is not a scheduled disease in South Africa. This is the case because it would serve no good purpose to split the forces engaged in a successful campaign against East Coast fever and other diseases scheduled already. The farmer has further ample means at his disposal to save himself from losses in a simple and inexpensive way.

Malignant Oedema.

Under malignant oedema, we understand the disease caused by *Vibrion septique*, or *Cl. septicum*. This organism has been isolated from a few outbreaks in South Africa where it has been regarded as the actual cause of the losses.

The clinical and pathological picture in malignant oedema can as a rule not be distinguished from that of black-quarter. Haemorrhagic oedema in the subcutaneous tissues, dark red, spongy muscles, " crackling " and what is conventionally called " typical black-quarter smell," are equally typical for both diseases.

Microscopial and cultural differentiation would appear to be easy enough, but since *Vibrion septique* is regarded as ubiquitous and as a secondary or post-mortem invader, its demonstration in a carcass is not sufficient to prove that it was actually the cause of death. Being the faster growing and more virulent, *Cl. septicum* will outgrow the black-quarter organism and be isolated in pure culture without any indication as to the presence of *B. chauvoei* in the specimen under examination, except if guinea-pigs highly immunized with antiserum on the lines suggested by Scott (1928) or similar methods are used, and even so success cannot always be relied on.

In spite of these difficulties, we have regarded *Vibrion septique* as the causal organism in outbreaks where it was isolated, after vaccination against black-quarter had not given the expected results, and which were subsequently stopped by the inoculation of malignant oedema vaccine, prepared in the same way as black-quarter filtrate. In one outbreak diagnosed as malignant oedema, 400 cattle were vaccinated and for four months kept under observation by a Government Veterinary Officer. During this period none of the 400 animals had died from the disease.

It may be added that these strains of *Vibrion septique* correspond with the descriptions usually given for typical strains, in morphological and cultural characteristics and in the fermentation of carbohydrates. Two strains were so far tested on cattle, and both killed them experimentally.

This is strong evidence in favour of our opinion that true outbreaks of malignant oedema in cattle do occasionally occur in South Africa, but they are so rare that during the last year not a single genuine case was reported.

Bacillus Welchii.

This organism has been isolated on many occasions, but it has generally been regarded as a secondary invader, all the more as it was found in specimens from which other pathogenic organisms, usually *B. chauvoei* were also isolated, and where by subsequent inoculation the outbreak was proved to have been black-quarter.

B. welchii may cause death of individual animals by secondary invasion, and even play a part in outbreaks of certain diseases, but it has so far not been proved that it was the causal organism or the chief factor in regard to such losses.

It is not suggested that these are the only oedema producing anaerobes occurring in South Africa, but so far no others have been diagnosed. This would tend to indicate that whatever such organisms which may exist here, they must at least not have caused any appreciable damage.

In conclusion it may be stated that black-quarter is the only disease of this group—(gas oedemas would be a more correct name than gas gangrenes)—which is of economic interest. Even here the position can be regarded as satisfactory in so far that the farmer can protect himself against losses at very little expense and that to a large extent he actually avails himself of this opportunity.

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Paper No. 24.

BOTULISM IN THE DOMESTICATED ANIMALS IN SOUTH AFRICA.

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THE study of botulism in the domesticated animals is a comparatively recent one and has only received much attention during the past thirteen years. In considering the occurrence of the disease in South Africa, it will be necessary to do so under different headings, dealing with the condition as it occurs in the different species of domesticated animals. In each case the incidence in other countries will be considered first and then the occurrence in South Africa from the comparative standpoint.

Botulism may be defined as a disease caused under natural conditions by the ingestion of the powerful exotoxins produced by the bacilli of the botulinus group. The symptoms are, in general, those of a bulbar paralysis and are fairly characteristic. The disease has long been known in man as the cause of a very fatal type of food poisoning, usually associated with the eating of canned foods or preserved meats such as ham. The usual symptoms in man are paralysis of the tongue and throat, disturbance of vision, severe headache, ptosis of the eyelids accompanied by a general paralysis of the skeletal muscles. Marked constipation is usually present. In animals the symptoms are essentially the same, except that ptosis of the eyelids is unusual. The intensity of the symptoms and the course of the disease depend on the amount of toxin ingested, large amounts causing death in some cases in less than twenty-four hours. Recovery sometimes takes place, but the convalescence is very protracted.