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ANTHRAX

By

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HONOURABLE MARTIN BURRELL,
Minister of Agriculture.

Sir,—I have the honour to submit to you a report with regard to Anthrax, by Chas. H. Higgins, D.V.S., Pathologist, Biological Laboratory, Central Experimental Farm, Ottawa, Ont., and would request that it be printed as Bulletin No. 23.

I have the honour to be, sir,

Your obedient servant,

F. TORRANCE,
Veterinary Director-General.

Ottawa, 27th June, 1917.

ANTHRAX

INTRODUCTION.

Anthrax is a disease that has been known from time immemorial. It is recorded by Moses in Exodus IX:9. Ovid, Plutarch, Virgil, Pliny and many others have mentioned it in their writings. It exists in all latitudes and countries. Human beings were formerly affected in large numbers. Sixty thousand people near Naples are reported to have died from Anthrax in 1617. Fifteen thousand persons died from Anthrax in San Domingo within six weeks in 1770. The excessive death rate is attributed to the eating of carcasses that had died of this disease.

Anthrax occurs epizootically among sheep, horses, cattle and other herbivora or grain eating animals. No animal is capable of resisting anthrax infection providing suitable conditions obtain. In natural outbreaks the course followed by the disease is that of a septicemia ending fatally within a very short period. In such cases enormous numbers of the characteristic causative organisms are to be found in the blood.

In this age anthrax does not appear epidemically in man although he may be infected through the handling of infected animals or their hides, hair, and wool. Many cases have recently been reported where deaths have resulted from various causes such as the skinning of an infected animal; the infection from wool or "wool sorters' disease," which is usually seen in the form of a rapidly fatal infection of the lungs (pneumonia) from the inhalation of infected material; cases in man have also been reported where the infection was contracted from the use of shaving brushes the bristles of which came from the carcass of a hog dead of the disease. In man the disease is usually termed "malignant pustule," is localized at the outset, and unless the resistance of the individual is very high an extension of these pustules takes place with the result that death comes rapidly in the form of a septicemia.

More work of an investigational character has undoubtedly been conducted with anthrax than with any other disease. This resulted from the fact that its organisms are, compared with the infective agents of other diseases, comparatively large, thus enabling them to be observed much more readily and with low-powered microscopes than is the case with other infections. Through the study of the organism of this disease and the improvement of microscopes, it has been possible to develop the whole field related to the investigation of bacterial or germ diseases.

The anthrax organisms were first observed by Polender, who, in 1849, described their existence in the blood, but it was not until fourteen years later that Davaine announced these bodies to be bacteria and demonstrated that the disease could be transmitted from animal to animal only when these bodies were present. Although these views were not immediately accepted others took up the work and it was not until 1876 that Dr. Robert Koch in his first paper on bacteriology announced that Davaine was correct in his determination after which the matter was fully accepted.

Cause of Anthrax.—At the present time the causative organism of anthrax

is known to be the organism briefly described above. This organism or the *Bacillus Anthracis* is a short rod that can be demonstrated in the blood of animals dead of the disease by means of a proper microscope. The germ while visible in an unstained condition is much more easily seen when stained by a proper dye. Any of what are termed the aniline dyes will bring out the characteristics of the organism very plainly when certain characteristics can be made out.

The bacillus or germ of anthrax grows very readily under artificial conditions upon suitable food materials. When, however, conditions become unfavourable for its growth either through the exhaustion of food material or temperature, the organism is able to change its form into a special resisting body or spore. An observation of the development of a spore would show a clear space forming in the centre of the organism. The end portions gradually lose their opaque appearance and the oval spore is seen to be surrounded by a thin envelope, the whole having much the same appearance as a miniature egg. In this spore stage the organism is able to withstand a high temperature for an extended period which under other circumstances would destroy its vitality almost instantly. In this stage it may rest for an indefinite period. Records are available of the existence in this form for twenty years. We may assume, however, from the data at hand, that it can retain its vitality for a much longer period.

In the blood the germs of anthrax are seen to be in chains joined end to end. The ends of the germs or bacteria are either sharply cut across or slightly concave. They are also surrounded by a capsule that can be vividly demonstrated by the use of proper dyes. This feature is especially valuable in arriving at a laboratory diagnosis.

Occurrence of Anthrax.—Anthrax may occur at any season of the year and in any species of animals or even man. Usually, however, it is seen when animals are on a pasture which at some time has been infected with the disease. The infection may be brought to a farm in a variety of ways, for instance, infected hides, hair, wool, etc., from animals dead of the disease; by dogs that have had access to an anthrax carcass on another premises; by means of earth adhering to the wheels of vehicles, hoofs of cattle, sheep or horses; or by particles of infected material adhering to the clothing of human beings who have visited infected premises. One of the most commonly reported sources of infection is that through water and other wastes coming from tanneries. So suspicious is this latter source considered that when deaths of animals supposedly due to anthrax occur, one of the first questions is: "*Does a tannery exist in the neighborhood*"? When tanneries do exist the greatest precautions possible should be taken to prevent animals coming in contact with their possibly infected wastes. As tanneries usually locate on a small stream or creek for the purpose of ensuring an ample supply of water for their manufacturing requirements they should exercise every precaution to remove the suspicion which attends the pursuit of their industry.

Anthrax may appear periodically in a certain locality. Why this is so cannot be explained unless it is assumed that conditions in nature are more favourable for the growth of the organism under certain climatic influences than they are at other times.

In certain outbreaks a single species of animal may show a more marked

susceptibility than others which are apparently similarly exposed. The only explanation that can be made in this connection is, that the organism has undergone a special sensitizing process which renders its growth more easy in the species presenting the greatest losses.

Methods of Infection.—Animals become infected with anthrax through the entry of the causative organisms directly into the system by inoculation. This inoculation may occur in a variety of ways. It may result from the germ passing in through an abrasion of the skin on the surface of the body or through a similar injury occurring in the lungs or intestines. The feeding of anthrax organisms does not always result in the contracting of the disease. If, however, the organisms are fed along with thistles, briars, or similar materials having sharp points, anthrax will invariably result.

The pasturing of animals on infected land may result in infection either through the digestive tract or through inoculation under the skin. Inoculation through the skin is possible in muddy soils, swamps, swales, and in fact any low lying soil, as sharp sticks and stones are invariably present. Where present they cannot be avoided by an animal whose weight causes it to sink to a greater or less depth.

Soil Infection.—Bearing in mind the statement already made that the organism or germ may be transformed into a very resistant state it is easily seen how a piece of ground once infected must thereafter be considered dangerous to the pasturing of animals. This being the case the necessary precautions should be taken to keep animals away from such infected soil, or, if they are to be permitted to graze thereon, they must be protected by vaccination, which will be described later.

We have been able to demonstrate the anthrax organism in the soil at the border of an infected creek. An amount of soil approximately two grains in weight had sufficient anthrax germs to prove fatal to a guinea-pig. Our experiments would also indicate the probability that the germ is not only capable of remaining alive in soil but that it can also reproduce itself where conditions are favourable. All soils, however, would not lend themselves with equal facility to the vegetation of the anthrax organism. A suitable soil must be slightly alkaline if marked growth is to take place. We have found that a decoction of leaves is too acid to permit the growth of the bacilli. When, however, such a decoction is tempered with an alkaline soil growth may take place under favourable temperature conditions.

Diagnosis of Anthrax.—So rapidly does anthrax run its course that it is frequently thought that death has resulted from the eating of poisonous weeds or from poison administered by some enemy. While death appears to take place very suddenly a careful observer would note something amiss with the animal some hours previously. Infection usually takes place about three days before death supervenes. A very high temperature may be expected twenty-four hours before the fatal issue and in some instances has been recorded as being from 108°F. to 110°F. in cattle.

After death or just immediately before, bloody discharges may be seen coming from the normal openings of the body. Such discharges should always make one very careful as these bloody discharges teem with the causative germs and their spore formation may assist in disseminating the disease not only to the ground but to other animals.

Anthrax may occur in all species of animals. Epidemics among human beings have occurred as well as epizootics among animals. Sheep, horses, cattle, swine, dogs, cats, and birds may be affected in the order mentioned. Anthrax, however, may be contracted by birds providing they are so treated that their normal body temperature is lowered.

A microscopic examination is the sole means of positively diagnosing this disease.

The bacilli of anthrax are microscopic in size, and occur in enormous numbers in the blood of affected animals. Their presence in the blood renders it tarry in consistency, very dark in colour and prevents it clotting after the death of the animal. These germs form themselves into long chains during their multiplication and growth, and, when deprived of favourable surroundings, resting bodies (spores) are formed, these having special resistant powers so that ordinary disinfectants do not destroy their vitality unless applied for a considerable time. These resting forms or spores do not form in the carcass of an animal dead of the disease, provided the skin is left whole on the animal, as a large amount of air (oxygen) is required for their development, although they are found in the bloody discharges which exude from the natural openings of the body, such as the mouth, nose, anus, etc.

The reappearance of anthrax on ground once infected is due to these spores or resistant forms which retain their vitality for years, even though their surroundings are unfavourable. The destruction of anthrax germs within the carcass, as above described, is in part due to the presence of other microbes, which, while otherwise harmless, are their natural enemies.

One may be led to suspect anthrax by the short duration of the illness. The animal may have been perfectly healthy the night previous, but is found dead in the morning and is also observed to have a bloody discharge from the natural openings of the body (mouth, nostrils, anus, etc.). These features should arouse suspicion, and make one exceedingly careful in handling the carcass, so as to avoid infecting himself and others or distributing the infection over the ground when removing the carcass to a suitable place for burial.

If there is still doubt, place a few drops of blood on a clean piece of note-paper, permit it to dry in the air, fold and place in an envelope. Mark the outside of the envelope with data which will identify it, such as the name of the owner of the animal, the kind of animal: sheep, horse, cow, etc. Enclose this envelope containing the blood specimen in another envelope which should contain a letter giving further details and forward to the "Biological Laboratory, Ottawa." A careful study should be made of the Animal Contagious Diseases Act and the regulations made thereunder relating to anthrax for the purpose of safeguarding the interests of all parties concerned.

A post mortem examination may be performed, but this is not advised as it is a very dangerous procedure. At a post mortem on a case of anthrax, bloody stains are noted throughout the tissues and organs of the body. The spleen (milt) is greatly enlarged, very dark or black in colour; the blood is dark in colour, tarry and does not clot after death.

Disposition of Carcasses.—The carcass of such an animal should be destroyed by fire as soon as the diagnosis is made or suspected, care being taken that all discharges and litter about the animal be burned with it, even to the halter. The animal should, under no consideration, be skinned, as this is a

most dangerous procedure; nor should it be dragged over the farm with a chain around the neck or leg that a spot may be found where the digging is easy, for by this means the infection is spread, contaminating any enclosure through which the animal may be drawn.

Deep burial is sometimes resorted to, but is not nearly so satisfactory as the method just described.

Treatment.—The treatment of animals affected with anthrax is usually rendered impossible by the very short course which the disease runs. Should the resistance of the animal be great and death delayed no system of treatment can be expected to result satisfactorily.

Prevention or Prophylactic Treatment.—Anthrax can be prevented by the use of anthrax vaccines, a short description of which is as follows:

ANTHRAX VACCINES.

Anthrax vaccines properly used, afford protection or immunity to a subsequent artificial or natural infection. Anthrax vaccines are attenuated or weakened cultures of the germ causing anthrax (*Bacillus anthracis*). The process of attenuating or reducing the strength of the germ is confined to the Laboratory and cannot with safety be conducted elsewhere.

To protect or immunize an animal against anthrax, two vaccines are required and protection or immunity is the result of the animal passing through two mild, properly graded attacks of the disease, which, as a rule, cause no inconvenience to the patient save a slight elevation in temperature. During these two mild attacks of the disease it is advisable to take particular care of the animals, protecting them from inclement weather, extremes of heat or cold, etc.

The **First Anthrax Vaccine** (yellow label), is a very weak virus and is only intended to protect against a subsequent administration after the proper interval (twelve days) of the **Second Anthrax Vaccine** (green label), which is a very much stronger virus and this in turn protects against virulent anthrax. Protection or immunity against anthrax is established in from twelve to twenty days after the administration of the second vaccine. During this interval, from the administration of the first vaccine until immunity is established in the vaccinated animals, they should be kept from grazing on infected pastures and no hay from infected lands should be used for feeding.

Vaccine used on an animal already affected with anthrax will not protect such an animal, nor will it prevent its death. *The use of anthrax vaccine, during or immediately after the occurrence of an outbreak of anthrax, may be followed by death*, in some instances due to the stimulation of the anthrax germs already in the system of the animal and such accidents cannot be prevented. In the use of anthrax vaccine it is well to take the temperature of the animal to be vaccinated immediately before inoculating and in the event of the temperature being elevated, vaccination should be deferred until the temperature of the animal is again normal.

In the manufacture of anthrax vaccines at the Biological Laboratory, every possible precaution in their preparation and subsequent testing is taken, but

the Department can assume no responsibility for untoward effects following their use.

Anthrax vaccines are prepared at the Biological Laboratory and are supplied only through the office of the Veterinary Director-General to qualified veterinarians. They are sold at their approximate cost or five cents per dose. Full instructions for their use accompany each shipment.

Anthrax in Man.—In man anthrax is usually seen as a local infection in the skin and nearby tissues. The persons most liable to infection are those who come in contact with diseased or dead animals. Veterinarians, herders, butchers, and labourers who work on hides, hair, bristles, or wool are most commonly victims of accidental infection. Intestinal infection is rarely seen in man although an infection of the lungs may take place from the inhalation of infected dust.

Anyone suspicious of being infected with anthrax should consult a physician without delay in order that a proper diagnosis may be made and suitable treatment applied. The treatment usually consists of the surgical removal of the local point of infection or the treatment with a serum prepared for this disease.

Veterinarians, farmers and others who have reason to suspect the existence of Anthrax are compelled, under the Animal Contagious Diseases Act, to promptly notify the Minister of Agriculture, the Veterinary Director-General, or the nearest Veterinary Inspector.