ANTHRAX.—THE EFFECT OF TANNERIES IN SPREADING THE DISEASE.

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My attention was called to this subject by the outbreak of anthrax in men and cattle at three different points in the State of Pennsylvania during the summer and fall of 1897. From reports which I have not been able to entirely verify, it is likely that as many as twelve men and sixty head of cattle died of anthrax near the tanneries in this State during the year.

The men were without exception operatives at the tanneries, while the cattle were on pastures watered by the streams carrying off the refuse of these tanneries.

The importance of the subject led us to make as thorough an investigation of these outbreaks as was possible under the circumstances. At the instance of Dr. Leonard Pearson, State Veterinarian of Pennsylvania, on December 9, 1897, I visited the tannery at Proctor, Penna., where the last outbreak occurred. I found the operatives considerably excited, and standing in groups about the street, as a result of three cases of anthrax, two of which resulted fatally within a short period of time, and one of which was then under treatment, and fortunately terminated in the recovery of the patient.

From one of the physicians in attendance on this case I learned that four men had died in the vicinity besides the two just mentioned, from an acute affection which was diagnosed at the time as pneumonia, but which he considered, in the light of subsequent events, to have been cases of pulmonary anthrax. I made bacteriological examinations from the blood and eschar which marked the initial lesion in the men then sick and isolated the anthrax bacillus, which proved to be of quite a virulent type when inoculated into guinea pigs. From the liver and spleen of a cow which had died at one of the other two tanneries at which outbreaks occurred, I also succeeded in isolating virulent anthrax bacilli. The superintendent of the third tannery, which I did not visit, told me that twenty-four cases of "malignant pustule" had developed among the operatives recently, three of the cases proving fatal. No bacteriological examination was made in any of these cases and the diagnosis was made entirely from the symptoms. Below this tannery at least twelve head of cattle had died in a short time before my visit to the neighborhood, deaths occurring as
much as ten miles down the stream. From one of these animals I obtained specimens some time after death, and though I failed to isolate the anthrax bacillus, the symptoms were such as to leave little doubt that anthrax was the cause of death in most if not in all of the cattle which had died. In tracing the history of these cases at these three tanneries and in looking for the cause of the outbreak, I gained the information that they were all operated under the United States Leather Company, and that each of them had received a part of a cargo of hides shipped from China. Among the operatives, these Chinese hides go under the technical name of "murrain" hides and are believed by them to come from cattle which have died of disease; but the superintendent of the Proctor tannery did not agree in this opinion, believing some of them to have been from animals slaughtered for beef, and that some had been taken from animals dead of disease. There seems to be no positive way of telling the difference between the two.

This brief outline shows the danger to which every State engaged in the tanning business is at all times liable. It cannot be doubted that from all the countries which ship raw hides to the United States there may come at times the hides of cattle which have died of anthrax. There is a law in the United States providing against the importation of hides from districts where anthrax is known to exist, but the difficulty of enforcing it lies in the fact that the hides often do not come directly from such districts, and also that the reports from some such countries are exceedingly meagre, and it is impossible from them to be sure of the good health of the cattle there. We also occasionally hear of cases of anthrax among workers in leather, and one case has occurred in the city of Philadelphia in a brush maker, employed in making coarse scrubbing brushes, in the manufacture of which a mixture of hogs' bristles and horse-tail hairs were used, the hair being all imported from Siberia and the southern part of Russia, both sections of Europe in which anthrax occurs quite frequently. One instance has come under my observation in which a horse died of anthrax, the infection seeming to come either from the leather of which the collar was made or else from the hair with which it was stuffed, although I was not able to prove this mode of infection positively. The horse was one of a number in a stable all doing similar work, and all had been together for quite a period of time, none of the others having had the disease, either previously or after.

In studying the cases which occurred in men at the tanneries in this State I was struck with the fact, that as far as I could obtain positive histories, all of these cases occurred in those handling the hides in a dry state and in no case could I trace the history of an infection
taking place after the immersion of the hides into the tanning fluids. While there are some reasons for this, such as the inability of a soft and flexible hide to produce a wound in the skin, which is easily done by the ragged edge of a stiff, dry hide, it occurred to me that the tanning fluid might have such an action on the anthrax germs as to prevent danger from them after exposure to these fluids. This has led me to make a study with the object of determining what, if any, disinfecting action the process of tanning has on anthrax germs.

Briefly outlined, the process of tanning as carried out in the tanneries of the State of Pennsylvania, which I presume is that in common use elsewhere also, is as follows:

The hides are soaked in clean water for about ten days, then milled, and sweated for four days in order to loosen the hair, after which they are milled again and put on the beams for scraping. They next go into the tanning liquors, which are seven in number. The hide is put into a solution made of three parts of water to one part of liquor No. 1. This liquor is changed quite frequently, so that at the end of five or six days it is of the strength of liquor No. 2, in which it is left from six to ten days; it is then transferred to No. 3 for about twelve days; No. 4 for sixteen days; No. 5 from eighteen to twenty days, and No. 6 and No. 7 for about twenty days, the whole process occupying usually about one hundred and twenty days. No chemicals whatever are used in the process, except the solution of bark.

Through the kindness of Mr. J. H. Ball, superintendent of the tannery at Proctor, Penna., I obtained a supply of each of these seven tanning fluids. I have with them carried out two separate experiments, both having as an object the determination of the effect of these fluids on the spores of anthrax. I have used silk threads impregnated with the spore culture of the germ and dried. These threads are easily penetrated and contained nothing which would protect the spores from the action of the fluids as is the case with hides, which contain a large amount of albuminous material, which, as is well known, combines with tannin to form a protective covering for bacteria, so that we may consider that the spores on silk threads should be more easily killed than spores contained in hides, or in dried blood which may be adherent to hides. The culture of anthrax used was obtained from the organs of a cow which had died of anthrax in the neighborhood of one of the infected tanneries.

In experiment No. 1 the spore threads were treated as outlined in the process for tanning, beginning with the solution of fluid No. 1 and gradually increasing in strength until No. 7 was used. In experiment No. 2 the threads were at once immersed into the strongest tanning fluid, No. 7. This was changed every week for the first
month and subsequently changed once a month. The fluids were always used in abundance, 100 cc. being the amount in which the threads were immersed. One thread from each of these was at first taken out each week, inoculated into bouillon, and the culture thus obtained inoculated into guinea pigs. After the first month this was only done once a month. The threads have now been immersed for a period of one hundred and eighty days. The growths obtained at this date are perhaps a trifle less abundant than those obtained at the early stages of the experiment and the virulence of the germ has been possibly lessened in a very slight degree, the last guinea pigs inoculated living for about thirty-six hours, whereas in former inoculations death occurred in from twenty-four to twenty-six hours. However, I unfortunately neglected to weigh the animals used accurately, and the attenuation of virulence is so slight as to have very little practical value. From these experiments we may conclude that the process of tanning, as ordinarily carried out, does not in any way protect the operatives from infection by the anthrax germ, so far, at least, as regards its effect on the viability and virulence of the anthrax germ, though it is possible that the combination of the tannin with the albumen in the hide may, as it were, “fix” the germs so that they are less liable to become detached from the hide.

These experiments, together with the cases mentioned, illustrate the necessity of some method of properly disinfecting hides brought from foreign countries before allowing them to be sent to our tanneries, and this disinfection should preferably be done at the port of shipment. Unfortunately no method has yet been devised for the disinfection of hides which does not injure them for subsequent use, though attempts have been made by the Federal Government to plan and enforce some such method. In this connection much is to be hoped for from some one of the several methods recently devised for tanning by the use of formalin, which is unquestionably one of our most powerful germicides.

In some experiments by the writer a few years since it was found that anthrax spores on silk threads were killed by a momentary immersion into formalin, and it is hard to see how they could escape destruction during a prolonged immersion of a hide in a solution of this substance. Any method of disinfection should be capable of destroying the most resistant spores. It is stated by some authorities that anthrax spores from different sources have varying degrees of resistance to destructive agents, which may be regarded as a race peculiarity. Thus von Esmarch found that anthrax spores, according to their origin, required a five per cent. solution of carbolic acid for at least two days, and in some cases even as long as forty days, for their
destruction. Some anthrax spores will resist a one per cent. aqueous solution of corrosive sublimate as much as three days, though their virulence is destroyed in twenty hours. They will occasionally live in water or steam at 100 degrees C. for as much as twelve minutes, and not infrequently as long as five minutes. A dry heat of 140 degrees C. for at least one hour is required for their certain destruction. It is probable also that the resistance of different spore cultures depends somewhat on the culture media on which these cultures are grown, on the temperature at which the formation of the spores takes place and on their age. Frankland has shown that spores formed at 20 degrees C. are more resistant to the action of light than those formed at the incubator temperature. Dry spores seem to be particularly indestructible under ordinary circumstances, and may keep for years without any deterioration of their virulence or power of growth. It is certain also that the hide of an animal dying of anthrax will contain the spores of the germ and not simply the vegetative form, which is comparatively easily killed, for it must be remembered that the flaying of the animal gives free access of the oxygen of the air to the germs contained in the capillaries of the skin and subcutaneous cellular tissues, the one condition so necessary to the formation of the spores. Animals usually die of anthrax during warm seasons, so that the temperature necessary for the formation of spores is also usually to be had under these circumstances.

The important points for the protection of our cattle industry and of the operatives in tanneries are, then, as follows:

First: The discovery of an economical and simple method of thoroughly disinfecting hides without injury.

Second: A more reliable method of obtaining reports from countries which export hides.

Third: A process of tanning which will in itself destroy the germs of anthrax.