

## ANTHRAX IN MINK (*MUSTELA VISON*)

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It is only within comparatively recent years that the industry of fur-farming in this country has been practised at all intensively. One consequence of this is that our knowledge of the diseases which afflict fur-bearing animals is still somewhat limited. During 1938 considerable losses, mainly amongst mink, were caused by anthrax, and the object of this paper is to discuss certain features of this matter. First, there is interest in giving an account of the disease in a species of animal not regularly attacked, and secondly, it is necessary to consider the possible danger to human health that may arise from this source.

I am indebted to the Ministry of Agriculture for the following information relating to anthrax in fur-bearing animals in the years 1936–8, the data for 1936 and 1937 being taken from the *Annual Reports* of the Chief Veterinary Officer of the Ministry of Agriculture.

1936. In January, sixteen mink and one ferret died of anthrax on a farm in Kent.

1937. Deaths from anthrax were as follows: In July, seven mink in east Sussex and, in February, two racoons and two badgers in Kent.

One of the mink from the 1936 outbreak was dealt with in this laboratory. The blood was swarming with the typical encapsulated bacilli, and a guinea-pig, inoculated by scarification on the skin with material from the spleen, died of anthrax 3 days later. A trace of culture, raised from the blood of the mink, killed a guinea-pig from anthrax 2 days after subcutaneous inoculation.

The more complete information for the year 1938 is set out in Table I.

In connexion with outbreaks nos. 6, 4 and 1 of 1938, it has been possible to obtain the following supplementary information from the owners of the farms.

### OUTBREAK NO. 6

The meat fed to the mink had been purchased from a knackery and was afterwards shown to contain anthrax bacilli. Most of the mink died unexpectedly, though two or three of them had shown slight signs of illness the night before. The meat was fed on the Monday and Tuesday and the deaths occurred as follows: two on Wednesday, seven on Thursday, two on Friday and one on Saturday. A dog and a cat on the farm remained unaffected, but it was not quite certain that the meat they had consumed had been part of the infected consignment.

Table I. *Outbreaks of anthrax in mink in 1938*

Out-break	County	Date of outbreak	Total mink on premises	No. dying of anthrax		Total no. of deaths proved or presumed	Remarks
				Proved	Pre-sumed		
1	West Sussex	16. iii. 38	8	2	—	2	Detailed account of this outbreak in present paper. Survivors had been treated with anti-anthrax serum.
2	Oxford	20. v. 38	320	1	3	4	
3	Lancs.	21. vi. 38	407	11	—	11	—
4	East Sussex	9. viii. 38	154	22	81	103	—
5	East Sussex	12. viii. 38	(approx.) 257	6	182	188	After a large number of mink had died, some of the carcasses were sent to two different laboratories but without result. The owner, on hearing of outbreak no. 4, then reported to the Ministry's Divisional Veterinary Inspector. Seven ferrets out of eight also died of anthrax.
6	East Sussex	11. xi. 38	144	12	—	12	—
		Total	1290	54	—	320	

*Notes.* (1) All above outbreaks were officially confirmed as due to anthrax by the Ministry of Agriculture. The diagnosis was based on a microscopical examination of fresh blood smears, in nearly all cases at the Ministry's Veterinary Laboratory and occasionally at some other laboratory.

(2) Excluding the outbreak where anti-anthrax serum was used, the mortality in the five outbreaks was therefore 316 of 970 animals, or 32.5%. Although it cannot be assumed that all the surviving mink consumed infected meat, the information is sufficient to demonstrate the high susceptibility of mink to anthrax.

(3) With regard to column "Presumed dying of anthrax", it should be said that, as all the deaths occurred within 3-5 days and under exactly similar conditions in animals until then quite healthy, there can be no reasonable doubt that anthrax was the cause of death in all cases.

(4) On 9. ii. 38 an outbreak of anthrax, involving the death of two silver foxes, occurred in Dumfriesshire.

#### OUTBREAK NO. 4

All the mink died within about 3 days. Most of them were found dead in their pens; only a few were seen to die and then after signs of coughing or choking. Anthrax bacilli were found microscopically in meat from the consignment which had been fed.

#### OUTBREAK NO. 1

In view of the peculiar circumstances, this outbreak is of exceptional interest.

Of the eight mink on the farm at the time of the outbreak, four were males and four females, and of these two, both females, died of anthrax at an interval of 24 hr. Both these animals were found dead in their nesting boxes

in the morning, although they appeared perfectly fit overnight, and had been strong and active and in good coat. A peculiar point is that these two mink had been mated 5 days before their death, two different males being used. It seems that, during mating, the male seizes the female by the back of the neck, so causing a severe abrasion of the skin, the animals remaining fixed in this position during the period of mating, which occupies some 30 min. So far as could be ascertained, no symptoms were shown by any of the males or the two remaining females, although all the mink on the premises had been receiving food from the same source.

The diet of the animals on this farm consisted of raw beef and liver minced up and mixed with oatmeal, bran, tomato and milk, each animal getting about 4 oz. of this mixture each day. The meat was obtained from a private slaughterhouse in the neighbourhood and in the ordinary way fresh supplies are obtained three times weekly in the summer and twice weekly in the winter. The owner's cat and dog had eaten a small quantity of the same meat, but had shown no symptoms.

On 15 March, the carcase of a mink without its pelt was sent to the Institute. The flesh was very dark in colour, the subcutaneous and visceral veins were engorged, but the most obvious abnormality was seen on opening the abdominal cavity, viz. the great enlargement of the spleen. The substance of this organ was turgid with dark blood. Unfortunately, no special attention was paid to the tissues in the region of the neck since the information regarding injury in this situation was not available at the time the autopsy was made. On examination of films from the blood and from the spleen, enormous numbers of bacilli having the typical appearance of *B. anthracis* were seen, showing the characteristic sky blue tint with 1.0% watery methylene blue and surrounded by well-developed mauve-coloured capsules. As the appearance was so exactly like that commonly seen in the blood of cattle dead of anthrax, it was not judged necessary to make any virulence tests.

The carcase of the second mink was sent to another laboratory and in this case also anthrax was diagnosed.

#### DISCUSSION

It is the belief of breeders of mink that the feeding of raw meat is necessary for full development of a good coat. Doubtless the sequence of events in a susceptible animal that has consumed anthrax flesh will largely depend on the number of living bacilli ingested. In those outbreaks mentioned above where the mortality rate was high and the deaths occurred rapidly one can suppose the dose was large. On the other hand, in Outbreak no. 1, the dose presumably was small and this outbreak calls for special notice, since in some way it was obviously concerned with the act of mating. Apparently the only infected meat was that supplied on one particular day since other matings took place at varying dates between 3 and 20 March, with different males and females and with the same two males that were involved in the present outbreak, but

no other cases of infection developed. The first suggestion that might be made as to the method of infection is simply that the teeth of the male mink were soiled with anthrax organisms and that these were implanted in the skin at the time of mating. Since, however, the female mink also had consumed infected flesh, an alternative and more probable explanation can be put forward based on the work of Sanarelli, who has studied the pathogenesis of anthrax, more particularly in respect of so-called "intestinal anthrax". As is well known, anthrax bacilli or spores in large numbers can be fed to laboratory animals without producing anthrax, whereas they are highly susceptible to cutaneous inoculation. Indeed, Sanarelli (1924) has shown that the digestive juices of guinea-pigs, rabbits and dogs are strongly bactericidal for anthrax bacilli and that the spores fail to germinate in intestinal juice. He has also shown (1924*a*, 1925) that when anthrax spores are carefully instilled into the nasal cavities of rabbits anthrax is not produced. The spores are ingested by phagocytes and remain latent in the body for several days, in one case the period of survival was as long as 13 days; if during this period the animal is subjected to some form of interference, e.g. a subcutaneous injection of lactic acid, an intravenous injection of distilled water, an intranasal injection of small doses of arsenic or quinine, the spores are enabled to germinate and produce anthrax. The fact that a similar result may follow traumatic injury to the skin of animals with a latent infection was proved by Hruska (1928). A number of young goats were given anthrax spores by the mouth or by the rectum and half of them were then scarified on the skin of the neck. Some of the animals so treated developed anthrax, while the controls suffered no ill-effects.

An important point to be considered concerns the possible danger to human beings through anthrax organisms surviving the process of dressing the pelts. The process of preparation and dressing is as follows. The pelt is first removed from the carcase in sleeve fashion, so that the under surface of the skin is outwards, after which a piece of board is slipped inside so as to cause slight stretching. The object of this procedure is to prevent blood and dirt coming in contact with the hair. In this position, the pelt is left for about 2 days to dry, when it is sent away for dressing. It is obvious that exposure of the pelt to air in this way would facilitate sporulation. The process commonly used for dressing is a relatively simple one. The skins are moistened and the flesh side is freed from fat and then brushed over with a pickle made of salt and acid. The exact composition of this pickle varies with the kind of skin being treated. The pickled pelts are laid aside for some hours in a warm room to allow a thorough penetration of the pickle. They remain in the warmth until dry and are then again slightly moistened and smeared with a mixture of oil and fat which is worked in by gentle mechanical means. The oil penetrates the pickled pelt and becomes slowly oxidized, the pelt being at the same time converted into leather. The excess of grease is then removed by drumming the skin in sawdust, firstly on the pelt side and again, after turning, on the

fur side. The fine sawdust penetrates to the base of the fur and absorbs all traces of grease, dirt, etc.

In factories, where fur skins are dressed, the dressers have to conform to certain Anthrax Regulations under the Factory Act. These apply only to workmen engaged in the early stages of the work and include soaking and fleshing. It has always been assumed that when the skins have reached the pickled state, they are in a safe condition. This assumption is to a considerable extent justified by the evidence presented by Leymann (1923) in a report to the International Labour Office. This report summarizes the work of Schattentfroth (1911) and of Gegenbauer & Reichel (1913) and concludes that a pickle containing 10% of sodium chloride and 1–2% of hydrochloric acid, particularly if used warm (at least 20° C.), is a rapid disinfectant for anthrax-infected hides and skins provided that the treatment is carried out according to certain prescribed conditions.

#### SUMMARY

An account is given of outbreaks of anthrax among mink, which occurred in Great Britain during 1936–8, and the possible danger to human beings from this source is discussed. Attention is called to the peculiar features of one of the outbreaks and to the probable mode of infection.

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