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FOOT-AND-MOUTH DISEASE.^a

By D. E. SALMON, D. V. M., and THEOBALD SMITH, M. D.

[Revised by D. E. Salmon, D. V. M., and John R. Mohler, V. M. D.]

NATURE AND LOSSES.

This disease is also known as epizootic aphtha, apthous fever, infectious aphtha, eczema epizootica, and may be defined as an acute, highly contagious fever of a specific nature, characterized by the eruption of vesicles, or blisters, in the mouth, around the coronets of the feet, and between the toes.

The tremendous ravages of the disease are seen in the number and variety of species attacked. While it may be regarded as essentially a disease of cattle, hogs would seem to be as easy a prey. Almost in the same grade of receptivity come sheep and goats. Next in order of liability come the buffalo, American bison, camel, deer, chamois, llama, giraffe, and antelope. Horses, dogs, cats, and even poultry have been victims of the infection, the last three classes being particularly dangerous as carriers of the contagion. Man himself is not immune, and the frequency of his infection by coming in contact with the diseased animals themselves is established by numerous observations. Children suffer as a result of drinking the unboiled milk from infected cattle. In such cases the symptoms resemble those observed in animals. There is fever and difficulty in swallowing, followed by an eruption of blisters in the mouth and very rarely by similar ones on the fingers. The disease is very seldom fatal, and chiefly restricted to children and to those adults who handle sick animals or drink large quantities of unboiled milk. Some veterinarians regard the human affection as by no means uncommon in countries where foot-and-mouth disease prevails, but that the disturbance of health is usually too slight to come to the notice of the family doctor.

The disease prevails in European countries and occasions great losses. Although the actual mortality is quite low, serious losses result from the diminution of the milk secretion and consequent interference with the business of the dairy. There is likewise more or less loss of flesh in animals.

^a Reprinted (with slight revision) from Special Report on Diseases of Cattle, 1904.

Every appearance of foot-and-mouth disease upon American soil has been quickly followed by the total suppression of the disease, and it will therefore be necessary to go abroad for evidences of the devastation which always follows in the wake of an outbreak of this scourge and for estimates of the loss which it entails upon the farmers and stock owners in affected districts.

According to the very accurate statistics collected by the German Empire, 431,235 head of cattle, 230,868 sheep and goats, and 153,808 swine were affected with the disease in that country in 1890. The infection, quite insignificant in 1886, had been gradually spreading until it reached the enormous figures given above in 1890. During this same year it prevailed in France, Italy, Belgium, Austria-Hungary, Switzerland, Roumania, and Bulgaria.

The losses from this disease in England in the year 1883 were estimated at \$5,000,000. An English practitioner of wide experience states that it is none too high to place the loss upon each animal that becomes infected but that ultimately recovers at \$20, when milch cows or feeding cattle that are nearly finished are under consideration. On store cattle and calves the loss is proportionally less.

Estimating the losses upon the surviving animals from this basis and adding the value of those that die, it will be seen that an outbreak of this disease may quickly result in direct losses of many millions of dollars. In addition to this, a considerable spread of the contagion in this country would entail the entire loss of our export trade in live animals, interruptions of domestic commerce, and quarantines, which would surpass the loss caused by the ravages of the disease.

Unlike most other infectious diseases, foot-and-mouth disease may attack the same animals repeatedly. The immunity or protection conferred is thus only of limited duration. Hence protective inoculation with the virus, in whatever manner it may be practiced, is not only of no use, but decidedly dangerous, as it will introduce the disease. It is, however, not uncommon in European countries to practice inoculation after the disease has appeared in a herd in order to hasten its progress. This is highly recommended by some, since it not only hastens the infection, but the disease is apt to be milder and limited to the mouth. It consists in rubbing with the finger or a piece of cloth a little of the mucus from the mouth of a diseased animal upon the inner surface of the upper lip of those to be inoculated. From 50 to 75 per cent of the inoculated animals take the disease.

CAUSE.

As with other communicable diseases, the source and origin of foot-and-mouth disease has given rise to much speculation. The disease had been known in Europe for centuries, but it was not until a com-

paratively recent date that the erroneous conceptions of its spontaneous origin as a result of climatic and meteorological conditions, exhausting journeys, etc., were abandoned. It is now conceded that foot-and-mouth disease is propagated by a specific virus and that every outbreak starts from some preexisting outbreak.

The causative agent of this disease has not been isolated, although numerous attempts have been made to cultivate and stain it. Experiments have shown that the virus will pass through standard germ-proof filters, thus indicating its minute size and the reason it has not been detected by the staining methods. The contagion may be found in the serum of the vesicles on the mouth, feet, and udder; in the saliva, milk, and various secretions and excretions; also in the blood during the rise of temperature.

A wide distribution of the virus and a rapid infection of a herd is the result. Animals may be infected directly, as by licking, and in calves by sucking, or indirectly by fomites, such as infected manure, hay, utensils, drinking troughs, railway cars, animal markets, barnyards, and pastures. Human beings may carry the virus on their clothing and transmit it on their hands when milking, since the udder is occasionally the seat of the eruption. Milk in a raw state may also transmit the disease to animals fed with it.

The observations made by some veterinarians would lead us to suppose that the virus is quite readily destroyed. It is claimed that stables thoroughly cleaned become safe after drying for a short time. Hence litter of all kinds, such as manure or soiled hay and straw, may remain infective for a longer time because they do not dry out. Other authorities maintain that the virus is quite tenacious and may live in stables even so long as a year. They also state that animals which have passed through the disease may be a source of infection for several months after recovery.

SYMPTOMS.

In three to six days after the exposure of the animal to the infection the disease makes its appearance. It is first indicated by the animal suffering from a chill, quickly followed by an invasion of fever, which may cause the temperature to rise as high as 106° F. Following this in one or two days it will be noticed that small vesicles about the size of hemp seeds or a pea are making their appearance upon the mucous membranes of the mouth at the border and upper surface of the tongue near the tip, the inside of the cheeks, on the gums and the inner surface of the lips, or on the margin of the dental pad. These little blebs contain a yellowish watery fluid and gradually become more extensive as the disease advances. Soon after the erup-

tions have appeared in the mouth of the animal it will be noticed that there is considerable swelling, redness, and tenderness manifest about the feet, at the coronet and between the digits of each foot. Eruptions similar to those within the mouth make their appearance upon these swollen regions of the foot a day or two later, and at this stage it is usual to find that like lesions have made their appearance upon the perineum of the victim. In the case of milch cows, the udder, and more particularly the teats, show the same vesicular eruption, but the latter as the result of milking soon become covered with reddened spots deprived of the superficial layer of skin and may develop deep, obstinate fissures.

As soon as the disease has become well established the patient evinces pain when attempting to eat, in fact the appetite is often so seriously affected that all food is refused and the animal uneasily opens and shuts its mouth with a characteristic smacking sound, while strings of cohesive, ropy saliva hang suspended from the lips. With the advance of the disease the vesicles have widened and extended until they may reach a diameter ranging from that of a dime to that of a silver dollar. These rupture soon after their appearance, sometimes on the first day, more rarely on the second or third day. After they have ruptured the grayish white membrane forming the blister may remain attached for a day or more, or disappear speedily and leave deeply reddened sensitive spots or erosions, both within the mouth and upon the coronet and between the claws of the feet. The same ulceration may be noticed in cases in which the teats of milch cows have become affected, and instances are reported in which sloughing of the tegument immediately around the ulcer upon the udder has occurred. Owing to the tough, fibrous nature of the bovine skin it is exceedingly rare for sloughing to occur upon any part of the body other than those mentioned.

The attack upon the feet of an animal is frequently manifested in all four feet at once, but one or more of the feet may entirely escape and remain unaffected throughout the course of the disease. As the feet become sensitive and sore the animal lies down persistently, and it has been found that bed sores develop with amazing rapidity in all such cases and wholly baffle all attempts at treatment until after the patient has regained its feet.

The disease may attack some of the internal organs before it appears upon any of the external tissues. These cases are very liable to prove quickly fatal. The animal dies from paralysis of the heart due to the formation of poisonous principles within the system, or it may suffocate by reason of the action of these same poisons upon the tissues of the lungs, or it may choke to death as a result of paralysis of the throat.

In cases of serious affection of the udder the erosions will often be found located within the passages of the teats, resulting in a "caked" udder, and the same toxic poisoning which is the cause of death in the apoplectiform types just mentioned may arise from this source. In any event the milk from such cases will be found dangerous for use, causing fatal diarrhea in sucking calves or young pigs and serious illness in human consumers. The milk obtained from cows suffering with foot-and-mouth disease is not readily converted into either butter or cheese, but remains thick, slimy, and inert in spite of churning and attempts at curdling. The ulceration of the interdigital tissue may extend to the ligaments of the fetlock or produce disease of the joint or bone. Pregnant animals may abort. In pigs, sheep, and goats the lesions in the foot are most common, but both forms may be observed or only the mouth lesions.

When the disease has become fully established it will be found that the duration of the attack will vary greatly with different animals. From ten to twenty days are usually required for the recovery of the normal appetite and spirits in mild outbreaks, while the return to a full flow of milk, in the case of milch cows, is seldom witnessed before the arrival of the following season.

In the malignant type of the disease it requires from three months to a year for an animal to recover. The mortality is not great, generally about 1 to 3 per cent, but in severe outbreaks it may reach 5 per cent. It is more fatal in young animals that have been fed on infected milk, and produces death in from 60 to 80 per cent of these cases as a result of gastro-enteritis.

DIAGNOSIS.

The recognition of this affection should not, as a rule, be difficult, especially when the disease is known to be in the vicinity; in fact, the group of symptoms form a clinical picture too decided to be doubted. The combination of high fever, vesicular inflammation of the mouth, and hot, painful, swollen condition of the feet, followed in twenty-four to forty-eight hours by the appearance of numerous small vesicles varying in size from that of a pea to that of a hazelnut on the udder and feet and in the mouth should prevent any serious or long-continued error in the diagnosis. However, in the inoculation of calves we have a certain and final test. In twenty-four to seventy-two hours after inoculation the calves present the characteristic vesicles. Such inoculation should be practiced, however, only by officials who are properly authorized to deal with contagious diseases.

DIFFERENTIAL DIAGNOSIS.

It can be asserted positively that no disease of cattle closely simulates the symptoms of the eruption of aphthous fever on the lining membrane of the mouth. Cowpox or horsepox may be accidentally

transmitted by inoculation. But the eruption in the "pox" goes on to the development of a pustule, while in foot-and-mouth disease the eruption is never more than a vesicle, even though the contained fluid may become turbid.

The inoculation test in the case of cowpox does not respond with fever and eruption for at least ten days, and often longer.

In mycotic stomatitis or inflammation of the lining membrane of the mouth the entire buccal cavity is inflamed and in a few days the croupous membrane forms, peels off, and exposes a raw, bleeding surface, while the thin skin between the toes may also be inflamed. The previous history of the case; the failure of the vesicles, if any appear, to spread extensively; the absence of vesicular eruptions on other portions of the body, notably the udder and teats, and, characteristically, the hoof, together with the absence of infection in the herd and the complete negative character of inoculation of calves, distinguishes between the local disease named and foot-and-mouth disease.

The lesion resulting from ergotism may be differentiated from those of foot-and-mouth disease by the lack of eruptions in the mouth and by the location of the disease at the tips of the ears, end of the tail, or upon the lower part of the legs, usually below the knees or hocks. The lesion of ergotism does not take the form of pustules or blisters, but manifests itself first as a swelling about the ankle, which later may slough and circumscribe the limb, forming a deep crack, extending entirely around the limb and forming a distinct line of demarcation between the healthy skin above and the diseased below. The absence of ulcerous sores on the coronet and between the claws, together with a healthy condition of the membranes of the mouth and the knowledge that the lesion upon the limb in question extends uninterruptedly around it, should point conclusively to a diagnosis of ergotism and to the exclusion of all fears of foot-and-mouth disease.

In foul foot or ground itch of cattle the inflammation of the skin and toes is general and not in certain spots, as in foot-and-mouth disease; the mouth remains unaffected, and the presence of the disease may be traced to filth and poor drainage.

The severer forms of the disease might be confounded with certain general diseases. Where gastro-intestinal symptoms predominate acute gastric catarrh or inflammation of the intestines might be thought of. Involvement of the lungs might lead to a diagnosis of acute congestion of the lungs or pneumonia. The distinction is apparent in these diseases by the lack of vesicular eruption on the mucous membrane or skin, and also by lack of evidences of infection in the herd or neighboring animals.

PREVENTION.

The measures to be adopted to prevent the spread of the affection must take into consideration the highly infectious nature of the

disease, its ease of dissemination, and the liability of the virus to live a saprophytic life for long periods. Great care should therefore be observed in keeping healthy animals unexposed to the contagion. When an outbreak occurs in a community, the owner should make every effort to keep other animals from coming in contact with his diseased cattle. This especially applies to dogs, cats, goats, and poultry, which usually have access to the stables and barnyards and in this way furnish excellent means for disseminating the infectious principle. He should be equally particular in prohibiting any person from coming onto his premises, especially an attendant or owner or other person in any way connected with cattle. Such a herd may be placed under quarantine, with an inspector appointed to keep the premises under constant surveillance.

This method of quarantine alone, while very satisfactory in many instances, is rather tardy in obtaining the desired result. For this reason when the disease breaks out in a country like the United States, where the contagion is likely to spread rapidly by means of infected cars, manure, hay, and other feed, and where the results of its obtaining a firm foothold would be so disastrous, it seems that this method of temporizing is rather tedious, and more radical steps are required in order to suppress and eradicate completely the infection in the quickest and most thorough manner possible.

It would therefore appear better to concentrate the expense incident to the extermination of foot-and-mouth disease by purchasing and slaughtering all affected and exposed cattle after judicious appraisalment. The carcasses of these animals should be totally destroyed, preferably by cremation, or otherwise by burying them in a hole 6 feet deep and covering them with air-slaked lime. The infected stable should be disinfected by thoroughly cleaning it, scrubbing the floor with hot water, brushing down all loose dust from the walls, and tearing off all woodwork which is partly decayed. Then the whole interior of the stable should be covered with a good coat of limewash containing 1 part of a 40 per cent solution of formaldehyde (which is sold by the drug trade under the commercial name of formalin) to 30 parts of the limewash, or 4 ounces of formalin to each gallon of limewash. Another efficient wash for this purpose may be prepared by adding 6 ounces of chlorid of lime to each gallon of limewash. All stable utensils should be thoroughly cleaned and disinfected by the application of a solution containing 4 ounces of formalin to a gallon of water, or 6 ounces of crude carbolic acid to each gallon of water. The manure should be burned or spread over ground (other than meadow land) that is to be turned under. No other cattle should be purchased for at least thirty days after the complete disinfection of the premises.

The method of eradicating the outbreak of foot-and-mouth disease in New England in 1902-3 consisted in the rigid quarantine of all infected premises and of the animals upon them, in slaughtering the diseased and exposed animals at the earliest practicable moment, and in thoroughly disinfecting the stables and the contents of the buildings in which they had been sheltered. The progress of this work, the confinement of the disease to four of the New England States, and its complete eradication in a comparatively short time demonstrates in a striking manner the efficacy of slaughtering and the futility of relying upon quarantine alone in stamping out the disease.

Inoculation has been adopted in some countries in order to have the disease spread quickly through the herds, and while this practice has undoubted value where the disease is indigenous, it is not desirable in this country and should not be adopted.

MEDICINAL TREATMENT.

In some mild attacks of foot-and-mouth disease great benefit may be derived from a judicious attempt to relieve the symptoms and thus assist nature in overcoming the disease, but the great danger attached to the presence of an infectious disease in any noninfected locality for twelve to twenty days, while the disease is running its course, must appeal to the sanitarian and prevent indiscriminate medicinal treatment.

However, beneficial results have been obtained by the local application of disinfecting and astringent lotions. A teaspoonful of alum, chlorate of potash, boracic acid, or one-half teaspoonful of the tincture of aloes and myrrh placed in the mouth has proved efficacious. The infected animals may be made to stand from five to ten minutes in a shallow trough containing medicinal agents such as a 1-to-1,000 solution of bichlorid of mercury or a 3 per cent carbolic acid or creolin solution. Where the teats and udder are affected the application of carbolized vaseline, camphor ointment, or borated glycerin has given excellent results. If the symptoms of heart weakness are manifest, give digitalis, camphor, or alcohol, while excessive fever may be reduced with phenacetin.

The complications that may follow the disease are usually the result of contaminating bacteria, and it is therefore desirable to have the animals and their surroundings kept in as cleanly a condition as possible. The cattle should be fed on soft meal or grain and given a plentiful supply of clean water.

Approved:

JAMES WILSON,
Secretary of Agriculture.

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