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# FOOT AND MOUTH DISEASE

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# FOOT AND MOUTH DISEASE

This bulletin is issued to outline the far-reaching effects of Foot and Mouth disease should it ever gain an entrance into Canada and also to give information on the care taken to exclude the infection. The disease is discussed and the symptoms are given together with the probable course which would be followed in dealing with it. As Foot and Mouth disease has never occurred in Canada advantage has been taken of all available sources of information.

## THE DISEASE IN OTHER COUNTRIES

The disastrous results of an outbreak may be realized by the experiences of other countries. The following figures illustrate how quickly the disease spreads. In England during 1924 when it was believed the disease was gradually being overcome 1,515 outbreaks occurred. In Denmark during 1925 over 50,000 farms were involved. In the Netherlands during the first eight months of 1925 over 16,000 outbreaks occurred. In Poland in two months over 14,000; Czecho-Slovakia in five months over 2,000; Hungary had over 2,000, and Belgium had over 1,500 outbreaks in five months, while Germany had 1,439 outbreaks in two weeks. France also had very many herds affected during the year.

## LOSSES

The rapidity with which Foot and Mouth disease spreads is accountable for the enormous loss it brings about. The death rate is comparatively low, from about 3 per cent in mild forms up to as high as 50 per cent in malignant outbreaks. This tends to cause the seriousness of the disease to be underestimated. The most important loss is not due to death of the animals so much as to the extreme loss of flesh caused by the fever, the inability to eat and the reduction in milk secretion. The udders are frequently ruined by mammitis and abcesses. The inflammation set up in the feet often results in sloughing of the hoofs which besides causing painful lameness may result in permanent injury. Abortion is common in cows. Calves are very susceptible to the disease and a large percentage die. Those losses, apart from deaths, may total as high as 30 per cent of the value of the animals.

Indirect losses may also be enormous owing to restrictions necessary on animal products and the losses sustained by transportation companies, packing houses, dairy factories, markets and export firms.

## PRECAUTIONS TAKEN TO PREVENT THE ENTRY OF FOOT AND MOUTH DISEASE INTO CANADA

No ruminants or swine are allowed to be imported from countries in which Foot and Mouth disease exists. In the case of the United States the state in which the disease exists together with the surrounding states as a buffer area are subject to embargo.

Animal products such as hides, wool, horns, hoofs, bones, and the flesh of food animals as well as manure, etc., are excluded or are only allowed entry under stringent restrictions. Hay, straw, and fodders of any kind which are

used in connection with animals are also excluded or are allowed entry, when used for packing merchandise, only when accompanied by a certificate signed by an authorized official that the fodder has been thoroughly disinfected.

When animals such as horses, not susceptible under ordinary conditions, are allowed entry under a special permit their feet are carefully cleaned out and disinfected before being allowed to enter Canada and any fodder or bedding accompanying them is burned under supervision or returned to the country of origin.

Even with such restrictions there still remain channels through which infection might gain an entrance which are difficult to control. For example, the clothes or footwear of immigrants who have come from farms where infection exists; biological products manufactured in countries where the disease is indigenous; migratory birds carrying contaminated dirt or particles of manure; small packages with articles packed in hay or straw entering the country by mail or carried by hand or anything indeed which has been in contact with the infection.

With our present knowledge no agent can be absolutely excluded as being a possible means for carriage of the infection of Foot and Mouth disease. It is believed possible that the disease is wind borne. Outbreaks have occurred which offer no other likely explanation.

It is evident therefore that in spite of experienced officials, veterinarians and others whose work is concerned with excluding serious diseases from Canada constant danger exists of infection gaining entrance by obscure means. If the disease spread in Canada no worse disaster could befall our live stock industry and all the numerous allied trades and industries would suffer.

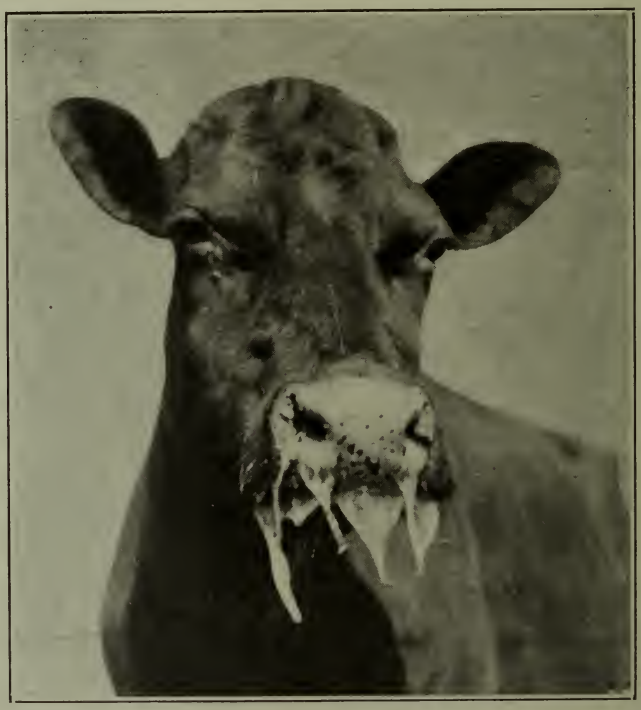

FIG. 1.—Foot and Mouth Disease. Ropy saliva from mouth and discharge from nostrils.

## DEFINITION

Foot and Mouth disease is a contagious and infectious eruptive fever characterized by the formation of vesicles or blisters most commonly on the mucous membrane of the mouth, round the coronet and between the hoofs and, in females, on the udder and teats. It is caused by a filtrable virus. The germs are too small to be seen through the highest power of the misroscope and they pass through filters which arrest ordinary bacteria.

## ANIMALS AFFECTED

Although Foot and Mouth disease is usually considered essentially a disease of cattle; swine, sheep and ruminants in general are commonly infected. The infection is probably different in degree but the virus soon becomes accommodated to the particular species and spreads quickly. Thus it may take some time to spread from cattle to sheep but once started will progress rapidly and may increase in virulence from the change.

There is no conclusive evidence that horses and poultry contract the disease naturally although infection has been reported. Dogs and cats may become infected. Rodents such as rats have been suspected to be agents which have transmitted the disease from one farm to another but there is no evidence that these animals become infected in a natural way. All of these animals and birds however are dangerous as mechanical carriers of contagion.

Man is not immune and cases have frequently been reported of his infection from diseased animals. Children have contracted the disease from infected milk.

Infection occurs (1) directly when healthy animals come in contact with diseased ones or (2) indirectly from stables, pastures, yards or fodder by getting the virus on the mucous membranes. The earlier stages of the disease appear to be the most infectious and consequently infection may be spreading before an animal is noticed to be sick. It is not certain how the virus is excreted in the early stages but probably it is sprayed around by the moisture of the breath.

Saliva which flows from the mouths of infected animals, the contents of the udder, or vesicles on the feet contaminate the mangers, drinking water, straw, stable floors, pastures, highways, railway cars and the hands and clothes of attendants. The disease is spread by animals when driven on roads, during railway transportation and from the use of common yards, stables and drinking places. The blood in the early stages and natural excretions convey infection.

As the internal layers of the hoofs may be infected animals which have had the disease and which have recovered may harbour the infection inside the hoofs. The virus will persist, owing to its favourable location, until the hoof is worn down and the virus exposed some months later.

Farm utensils and old sacks have been found guilty of carrying infection and even vegetables have been suspected. If hay were loaded in a railway box car which had carried infected hides but had not been disinfected the hay might convey the infection to the animals to which it was subsequently fed.

Markets, stockyards, stock cars, slaughter houses or any place where animals are congregated may be fruitful sources of infection. During the existence of the disease in a district any product which comes in contact with animals must be held in suspicion so that the stock owner himself has great power to prevent spread of the disease if he can be persuaded to exercise constant care.

The disease spreads rapidly in warm weather and is retarded in winter. This is partly dependent on the greater traffic in cattle during the warmer periods of the year.

## SYMPTOMS

After natural exposure to infection the disease makes its appearance in from two to six days. The first symptoms noticed are loss of appetite, dullness, and shivering. Following this the temperature rises (in cattle to .105° F. or 106° F.). These general symptoms are closely followed in one or two days by the formation of vesicles or blisters (aphthae) on the mucous membrane of the mouth, on the upper surface of the tongue near the tip, on the gums, cheeks, the margin of the dental pad or on the muzzle. Any one or all of these locations may show vesicles.

Following the appearance of the vesicles in the mouth there may be tenderness and swelling about the feet, around the coronet and between the hoofs of each digit. Vesicles similar to those seen in the mouth form around the feet a day or two later and at this time they may also be found on the udder and teats of females Any of the delicate portions of the skin such as the nasal cavities or the perineum may show these lesions and, very rarely, they may appear at the base of the horns.

FIG. 2.—Vesicles and scabs on teats.

The vesicles show at first about the size of a flaxseed but later extend until they may be two inches in diameter. They contain a yellowish fluid, clear at first but later becoming opaque.

The blisters usually rupture soon after their appearance, rarely remaining intact more than two days. After breaking, the cover may remain for a time but soon disappears leaving reddened erosions which in a day or two become covered with fresh epithelium and leave the area as yellowish brown spots. The vesicles are formed by fluid penetrating between the cells of the malpighian layer of the outer skin. On exposed parts secondary infection may gain entrance into the wound and deep and persistent ulcers may remain. If vesicles on the teats are broken by milking deep sores may result which heal slowly.

In hogs the vesicles may appear on the snout but in sheep and swine foot lesions may be the only ones seen.

When the disease is established eating may become so painful that the animal will refuse all feed and the mouth is opened and shut with a characteristic sucking and smacking sound while the saliva at first thin and frothy soon grows thicker and forms long cohesive ropes which may reach to the ground. Lameness may be very pronounced and the feet so painful that the animal will remain lying down. It is frequently observed that animals shake their feet as if a stone had lodged between the toes.

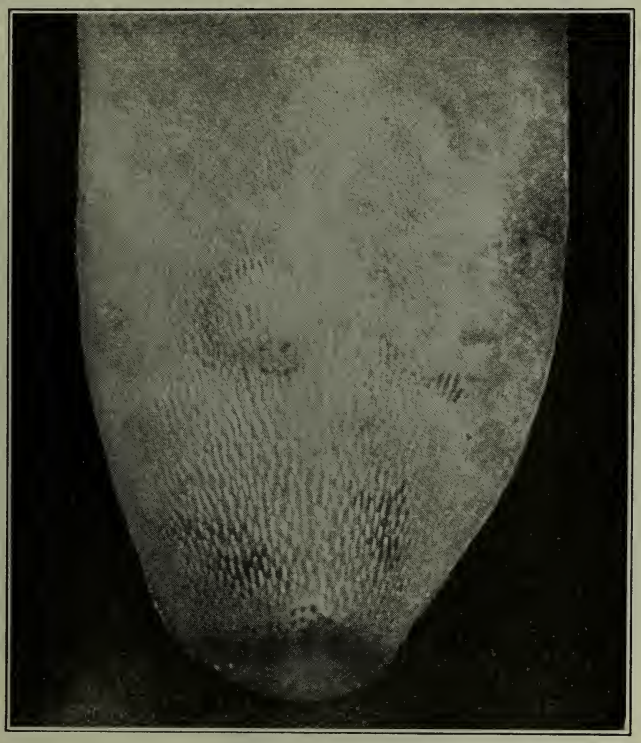

FIG. 3.—Portion of the tongue of an ox, showing early lesions of foot-and-mouth disease. The tip of the tongue shows a recently ruptured vesicle, while further back an unruptured vesicle is seen.

## DIAGNOSIS

When Foot and Mouth disease is established and is spreading, diagnosis is comparatively simple with the history of the outbreak and the presence of vesicles; but we cannot afford to wait until the disease spreads. We may not be confronted with a typical outbreak but with a single animal showing only one of the classical lesions or the disease may be in a mild form and spread slowly, making the diagnosis of an initial outbreak uncertain. This is precisely the time when exceptional care must be exercised in making a diagnosis.

The veterinary inspector should be provided with suitable overalls and rubber boots which can be disinfected readily. His sleeves should be turned back so that his attention is not distracted from the immediate object of the examination by the fear of having his clothes soiled by infective material. It is better to use the bare hands unless one has gloves exclusively reserved for this work.

The examination should be done methodically. It is good practice to observe the animals before disturbing them and while this is being done the history and symptoms since sickness was noticed may be obtained from the owner. The pulse and temperature should also be taken before the animals are unsettled by handling them.

The mammary glands and teats should be examined and the hand passed down each leg to see if any tenderness is noticed. An animal will resent slight pressure before vesicles form.

The head and mouth should be examined in good light, the examiner's hands being kept free for handling the parts and not for restraining the animal. It is usually advisable to withdraw the tongue, and this is best done with the use of a piece of cloth or towelling which prevents the organ from slipping from the grasp.

FIG. 4.—Tongue of an ox affected with foot-and-mouth disease, showing two recently ruptured vesicles and a considerable amount of scaling of the epithelial covering at other parts.

When more than one species of animal is affected this fact should arouse suspicion. A number of cattle or swine lame at the same time should lead to a thorough examination of the feet. When suspicion exists careful inspection of the mouth, teats, udder and perineum should also be made in the different species of animals examined.

In pigs the vesicles when found around the mouth are most commonly located on the snout and inside the nostrils.

In sheep the mouth lesions are usually confined to the dental pad and there is not usually any great amount of fluid in the vesicles but the whole covering may be pushed off or removed with the finger.

Fig. 5.—Foot and Mouth Disease in hogs. Note lameness.

With animals showing mouth lesions in a herd the temperature of the others should be taken as fever occurs before the vesicles form.

The slavering often accompanied with a smacking and sucking sound is very characteristic in cattle but slavering is rarely seen in pigs and sheep. In the latter animals sudden lameness is usually the most prominent symptom.

The mouth lesions may vary in the earlier stages from minute capillary extravasions of the blood to the formed vesicle which may vary in size from a pinhead to a dollar piece and be flat or bulging upwards. When the lesions are older there may be a wide variety of conditions due to infection with secondary organisms producing a definite catarrhal, croupous, diphtheritic, fungoid, fibrous or necrotic appearance. The question then arises as to whether these lesions, which are not typical of Foot and Mouth disease are the result of a former typical vesicle.

*The only specific and characteristic lesions are the vesicles.* The erosions following these with their pronounced borders which have a punched out appearance are next in importance.

The history of the infection must be carefully gone into and the evidence of contagion duly weighed.

Differentiation must be made from a number of different forms of stomatitis and dermatitis which may be caused from moulds in food, irritating plants, infection with calf diphtheria, the bacillus necrophorus and even actinomycosis. In sheep, lip and leg ulceration must be borne in mind.

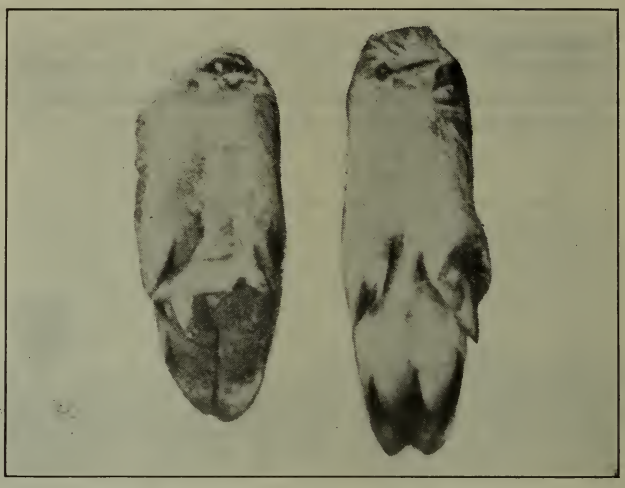

FIG. 6.—Feet of a pig affected with foot-and-mouth disease. The vesicles have ruptured and the horn is separating.

## SPECIMENS FOR LABORATORY TESTS

The measures of control necessary are so severe that before the diagnosis, in a primary outbreak, was accepted by the Health of Animals Branch inoculation experiments would probably be carried out on hogs, calves and horses. If these experiments proved the presence of the disease the slaughter of the herd would follow, rigid quarantine would, of course, be established from the beginning.

For laboratory examination material should only be collected by a veterinary inspector who understands and minutely observes all the precautions necessary in handling it. The bottle or sealer to contain the specimen should first be carefully cleansed and then sterilized in boiling water. Glycerine and boiling water, in equal parts, are poured into the container and into this fluid, when cooled, the specimen is dropped and immersed. When possible, the specimen should include an intact vesicle. For purposes of inoculation it is best to collect the contents of one or two vesicles by means of a hypodermic syringe and then expel the fluid into a small sterile test tube or vial. The bottles containing the specimen should always be hermetically sealed and then washed on the outside with a disinfectant. At the same time the operator's hands should be disinfected. A label giving the necessary particulars must be attached which in addition must be clearly marked in large letters " DANGEROUS—To be opened by the pathologist." This container is then to be carefully packed in an outer container so as to avoid any possibility of breakage or leakage in transit to the laboratory.

ACKNOWLEDGMENT

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## APPENDIX

### PERSISTENCE OF THE INFECTION

Generally it has been believed the virus was short lived. Pastures, not disinfected, have been found safe after a period of six weeks. Following the restocking of premises, however, infection has occurred on several occasions as long as three or four months after an apparently thorough disinfection. In one case the disease broke out afresh on premises believed to be free from contagion after disinfection when healthy cattle were placed thereon a year later. In this case the infection was believed to have been contracted from hay which was stored in the barn. The constant journeying to and fro by attendants feeding the infected cattle would readily explain how the hay had become contaminated.

Although buildings are most likely to harbour infection, it is equally important that small wisps of hay or straw are not allowed to blow about so that they might escape disinfection. Although the virus is infective in very high dilution it would probably soon be dissipated in a stream, but a stream is dangerous as it may carry the infection on fragments of manure, hay or straw, for long distances.

The virus is destroyed by slow dessication and by the chemical rays of the sun, but it is not destroyed by rapid drying, as on a slide, and may retain its virulence for three months if kept from sunlight. When dried on hay or straw the virus will remain alive for months in a dark stable.

Putrefactive fermentation and the heat evolved have a powerful action on the virus so that if manure is stacked and allowed to ripen with the outside soaked in strong disinfectant and the pile covered with four to six inches of earth it would soon be safe but great danger exists if the pile is left so that the surface material might be blown long distances by the wind.

Comparatively low temperatures kill the virus; 45 C in half an hour; 50 C in twenty minutes; 85 C in ten minutes, and at boiling point it is killed instantly. When heat is used to destroy the virus care must be taken that the virus becomes directly subjected to the heat (this also applies to all disinfectants, liquid or gaseous). For example a piece of meat containing infection might be placed in boiling water but it would take some time for the heat to penetrate to the centre of the meat in order to destroy the germ. It is easily destroyed by the ordinary disinfectants, including strong alkalies with a defatting action.

In a refrigerator there is no difficulty in keeping the virus alive for several months, especially if it is kept in 50 per cent glycerine.

### ARTIFICIAL INFECTION

Lymph from vesicles on hogs is the most effective in producing the disease, then that from the cattle and then that from sheep.

1/5000 cc. of lymph from a vesicle will produce the disease if inocculated into a susceptible animal, either by scarifying the mucous membrane and rubbing it in or by intravenous injection of the pure lymph.

The actual fluid from vesicles is frequently infective in a dilution of 1 in 1,000,000 and one strain of Foot and Mouth disease carried through guinea pigs for over a year produced the typical disease in cattle.

Infection follows if the virus is dropped into the conjunctiva, the rectum or on the vaginal mucous membrane. Further, the disease is produced by intramuscular or intraperitoneal injection or if introduced into the milk ducts. There may be difficulty in producing infection by the intracutaneous or subcutaneous injection of virus.

Young pigs die after several days from paralysis of the heart following the injection of from 1/50 to 1/10 cc. of fresh lymph. The artificial infection of goats and sheep is difficult.

Dogs and cats are susceptible to artificial inoculation, vesicles developing between the digits.

In 1920 Waldeman and Pape showed that Foot and Mouth disease could be transmitted to guinea pigs and this has been confirmed by different workers. In about 24 to 28 hours after inoculation a local vesicle makes its appearance. The mortality in experimental Foot and Mouth disease in guinea pigs is about 5 per cent and when recovery takes place there is a high degree of immunity in these animals.

Recent experiments have shown that the disease can be produced in rats and mice by inoculating large doses intramuscularly. The virus can be recovered from the blood and occasionally vesicles have been seen on the tongue.

Long-tailed field mice have been infected with great regularity while house mice and white mice are resistant except for a transient infectivity of the blood.

Fowls and ducks are probably not susceptible although the virus remained alive in fowls for from 2 to 5 days.

All attempts to spread the disease naturally either in the laboratory or in the field in these small animals have been unsuccessful.

## IMMUNITY AND IMMUNIZATION

Animals may be immunized against Foot and Mouth disease and this is sometimes done in countries where the disease is constantly recurring. The immunity is short lived however, the average is probably six months, but as it is within the bounds of possibility for an animal to contract the disease naturally three times within a year the prospects from immunization are not promising.

As the virus is used in the process it is not one to be considered in a country which desires entirely to exclude the disease, for no matter what care is used there is danger of the virus reaching healthy herds if it exists in the country. It is for this reason that no experimental work is carried on in either Canada or the United States. When it is desired to carry out such work with Foot and Mouth disease it is arranged to do so in a country in which the disease is indigenous.

There are three methods by which immunization is brought about in countries in which the disease is constantly recurring and in which quarantine and isolation are the usual measures of control.

The simplest method is that followed by farmers when the disease first makes its appearance, of infecting all the cattle on the farm by rubbing the saliva from an infected animal in the mouths of all the others with the object of getting it through the herd as quickly as possible and hoping for immunity for possibly the ensuing year.

Immunity may be gained by the use of virus combined with an immune serum. This has been used as a measure of control with varying success. There are different strains of the virus and an animal immune to one may not be immune to another. It has been demonstrated that animals immune to the disease prevailing in France were not immune to the disease as it occurred in Germany at the same time.

There are good grounds for believing that the virulence of the disease is variable and immunization is uncertain. Undoubtedly also differences exist in the natural susceptibility of different individuals amongst cattle so that a single animal may be the cause of preventing artificial immunity from being effective.

No fixed attenuated virus has been obtained although usually virulence becomes reduced after long passage through cattle, but the same virus if it gained entrance to another type of animal, for example a sheep, might increase in virulence enormously for a time.

Passive immunity may be conferred on an animal by the use of a hyper-immune serum. This serum is made by repeated injections of virus into horses or cattle. The first injection being combined with an immune serum. The doses of virus are then repeated until an antiserum of high potency is obtained. Such a serum when injected into a healthy animal may enable it to resist the injection of large doses of the virus of Foot and Mouth disease. This method has been of use in restricting the rapid spread of the disease in badly infected countries. The immunity conferred is of short duration, probably two or three weeks, and there are from 6 to 8 per cent of animals which may not resist infection. This fact combined with the necessity of having the virus in the country for the manufacture of the immune serum with the constant danger of the infection being carried by obscure means precludes the use of the serum in Canada as a method of control. The quantity of serum necessary, up to 200 cc. or more for each cow, makes the cost very great and even if it could be made without risk it would not be a practical measure on a large scale.

## THE CASE FOR IMMEDIATE SLAUGHTER

All authorities are agreed that immediate slaughter of all infected and exposed animals is the most effective policy in a country in which Foot and Mouth disease has not got beyond control or has not become enzootic.

Speed in getting diseased animals underground is the essence of effective control, followed by immediate disinfection of premises. The living diseased animal is the greatest danger and as in the earlier stages no external symptoms may be apparent, this coupled with the extreme infectivity makes immediate destruction of all susceptible animals which are diseased or have been exposed to infection necessary.

The question of saving valuable breeding animals has been carefully studied and although it is possible to isolate and save a herd, the time necessary before safety can be assured and the precautions which must be taken, together with the constant danger of spreading infection, make the attempt impracticable and not economic even with the most valuable herd.

The policy of slaughter is recognized to be an expensive one but the expenditure spread over years of freedom from infection is very much less than the loss which occurs annually in countries in which Foot and Mouth disease has gained such a hold that it cannot be eradicated by measures which are within the bounds of practical procedure.

For example, the outbreak of Foot and Mouth disease which occurred in the United States in 1914, dealt with by slaughter of diseased and in-contact animals, cost about 5,000,000 dollars, which is only about half of Holland's estimated yearly loss from the disease.

The secondary effects of an outbreak of Foot and Mouth disease in Canada would be disastrous in addition. Our export trade in live stock would be immediately closed. Restrictions would be imposed against fodders and animal products. The movement of animals within Canada would be restricted. Railways and factories dealing with agricultural and dairy products would all feel the effect.

As agriculture is our greatest industry and live stock an important part of it, it follows that the policy which would give the best results to the nation as a whole would be adopted. If therefore Foot and Mouth disease, in spite of the precautions taken, should gain entrance into Canada the quickest method

of eradicating it would be adopted. In this country that would undoubtedly be immediate destruction of diseased and exposed animals and the rigid enforcement of quarantine covering the surrounding district.

## ADVICE TO FARMERS AND STOCKOWNERS WHEN FOOT AND MOUTH DISEASE EXISTS IN THEIR DISTRICT

Report suspected cases at once—this is required by law.

If the disease is present consider the infection has been carried to all parts of the farm.

Remember, your boots and clothes may carry infection. Keep overalls and rubbers for stable use and change them when leaving the barn.

Keep on your own premises as much as possible. Don't make unnecessary visits, especially to places where there are susceptible animals.

The disease is undoubtedly conveyed by human agency and this is one of the most difficult to control as it is almost impossible to segregate human beings in connection with a disease of animals. In order to emphasize this point it should be remembered that a handshake with a person who has been attending infected animals may be sufficient to transmit the disease if the other party is working with susceptible animals.

Avoid sick animals on your neighbour's premises and don't encourage the owner to come to you for advice, it may be very costly.

Keep away from stockyards and markets.

Keep your animals off the roads.

If you must use your horses disinfect their feet before leaving and when re-entering your premises.

Use your own fodder and vegetables and burn all hay or straw which has been used for packing merchandise.

No refuse should be fed without first having been boiled. Slaughter-house offal should be avoided.

Suspect all old sacks whose origin is unknown.

All farm utensils should be disinfected. Milk cans may be sterilized inside with steam or boiling water and outside with 3 per cent solution of permanganate of potash.

In closely settled districts a large mat of hay soaked in disinfectant should be kept at the gate so that horses' feet and waggon wheels would be brought in contact with disinfectant before leaving and on returning to the farm. A bed of lime through which they would have to pass is also of use. A pail with disinfectant and a brush should be provided for the use of persons entering or leaving the farm premises.

Meetings of farmers should not be encouraged as they have frequently been followed by fresh outbreaks.

If you hear of an outbreak keep away from it.

Use disinfectants freely in at least the strength recommended, the stronger the better. Remember disinfectants are only effective when they touch or are in contact. The smell of a disinfectant won't kill germs (except certain gases in an enclosed space).

The disinfection of *infected* premises will be carried out under the supervision of Government officials after the infected or exposed animals have been destroyed.

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