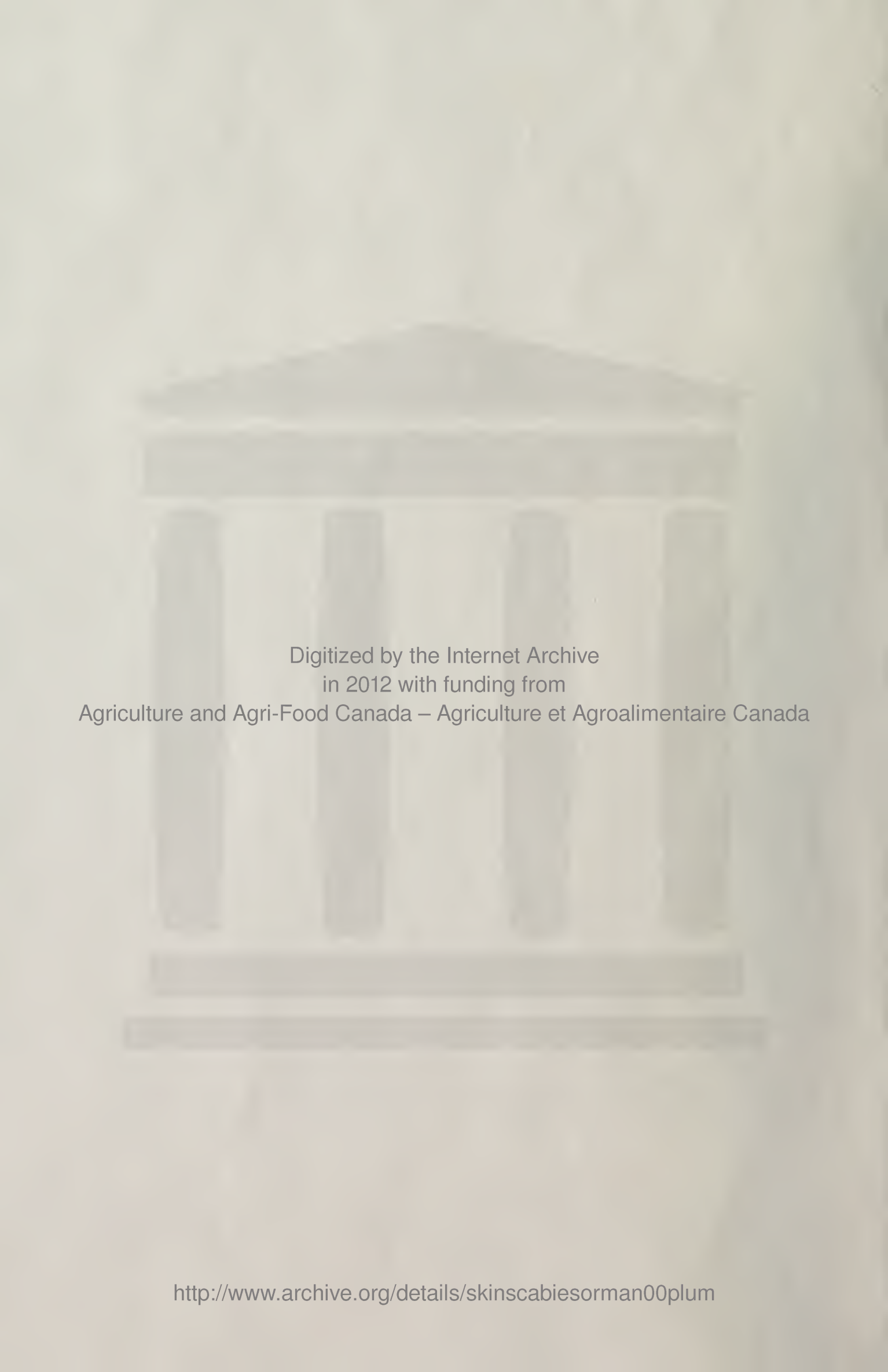

PUBLICATION 502 ISSUED MAY, 1936
FARMERS' BULLETIN 6 FIRST PRINTING
DOMINION OF CANADA, DEPARTMENT OF AGRICULTURE

SKIN SCABIES OR MANGE OF THE FOX

By
P. J. G. PLUMMER

ANIMAL DISEASES RESEARCH INSTITUTE
Hull, Quebec

PATHOLOGICAL DIVISION
Health of Animals Branch

Published by authority of the Hon. JAMES G. GARDINER, Minister of Agriculture
Ottawa, Canada

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FIG. I
Sarcoptes scabiei. Female.
Magnified 90.

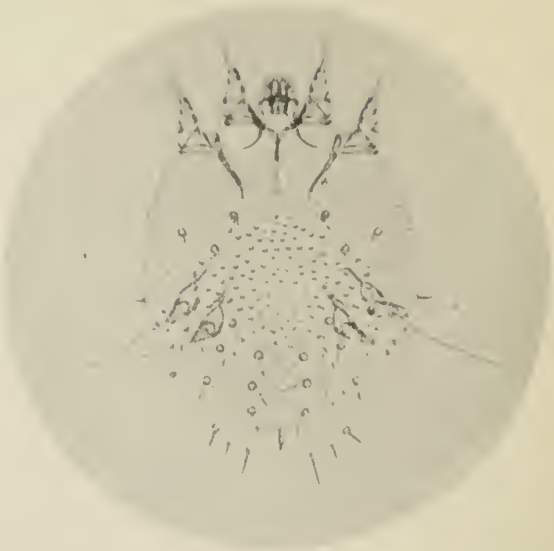

FIG. II
Sarcoptes scabiei. Ovigerous female.
Magnified 90.

FIG. III
Sarcoptes scabiei. Male.
Magnified 90.

The *Sarcoptes scabeii* is the parasite which causes Skin Mange.

FIG. IV
Otodectes cynotis. Female.
Magnified 90.

FIG. V
Otodectes cynotis. Male.
Magnified 90.

The *Otodectes cynotis* is the parasite which causes Ear Mange.

Skin Scabies or Mange of the Fox

Scabies, or mange as it is frequently called, is a disease to which practically all species of animals are susceptible. This disease is familiar to many breeders as cattle mange, horse mange, dog mange, etc., and each species of animal is susceptible to more than one form. The majority of fox breeders are already more or less familiar with ear mange of the fox. It is not with this affection but with the more serious disease—skin mange[1]—that this paper deals.

A fox suffering from skin mange may also be affected with ear mange, but the mites which cause the former disease will not cause the latter, and vice versa.

Foxes are raised for their pelts, and any affection which attacks the skin is therefore very serious. Skin mange not only renders the pelt worthless but, if not checked, will cause death. Once established this disease is very difficult to eradicate and every fox rancher should be on the alert for its appearance.

During 1933, three outbreaks of scabies among foxes were reported. More recently an opportunity occurred of studying an outbreak of scabies on a ranch maintained for experimental purposes. Although the disease was early detected its spread was not controlled until many animals had become affected and considerable damage done. From this outbreak was obtained much valuable information.

The Nature and Cause of Scabies

Skin scabies is a contagious parasitic disease. The causative parasites are known as mites. To date we have found only one species affecting foxes—the *Sarcoptes scabiei.* The mites burrow through the layers of the skin and feed upon the cell and tissue juices. Thus a severe inflammation is set up. The area becomes covered with scales or scabs and the skin is thickened. The hair follicles are damaged and the hair falls out. The mites produce an intense itchiness and in order to relieve this the fox rubs or scratches itself. In so doing scabs containing mites are transferred to other parts of the body and new areas of infestation occur. If the disease is not checked, the entire body, including the legs and tail, become affected and death not infrequently results.

The Mites

To the unaided eye, the mites appear as very minute greyish white specks. They can best be seen by placing scrapings from an affected fox on a black background. After the scrapings have been left standing for half an hour or more small greyish specks may be seen moving slowly around the edge of the scabs. If a magnifying glass or, better still a microscope is available, it will be noticed that there are different sizes of mites. Generally speaking, the females are the larger mites. (See Figs. 1, II, and III.) There are, however, different stages of development, to which reference will be made later.

The mites are oval or nearly round in shape. The head, thorax, and body are fused together. The young mite is possessed of six legs while the adult or mature forms have eight. If a compound microscope is used, it will be noticed that the mouth parts and front legs are approximately same length. A careful observation shows the relatively long hairs and the sucker discs that are on some

[1] The term, "skin mange", is used in this paper to denote a disease which involves the skin of the body and extremities. "Ear mange", which is caused by a different parasite, also attacks the skin but the affection is always localized to that of the ear passages.

pairs of legs. Grooves and spines may also be found on different portions of the body. Parasitologists are able to distinguish and differentiate the different species and varieties of mange mites by the presence or absence of the hair and sucker discs on the legs, by the length and size of the mouth parts and legs, and also by the number and locations of the spines and other markings of the bodies.

As mentioned before, practically all animals are susceptible to skin scabies. There are, however, slight differences in the mites which cause mange on the different species of animals. But since this paper is intended primarily for the information of fur ranchers, a scientific description of these mites will not be given.

Life History of the Scabies Mite

Although it is important to know how the parasite develops and multiplies, the life history of the mite causing scabies of the fox has not been completely worked out. It is presumed, and there is every reason for believing, that the life history is similar to that of other varieties of *Sarcoptes scabiei,* and which is as follows:—

The parasite first burrows into the skin and makes passages or galleries. Many mites enter the skin by way of the hair follicles. It is believed that the females go farther along the passages than the males, the latter remaining close to the opening of the skin. The female lays oval or nearly round eggs, of microscopic size. These are deposited in the prepared passages or alongside of the hair follicles. Occasionally eggs are found attached to the crusts or scabs. It is estimated that a female lays from twenty to forty eggs during her life. In two or three days the eggs hatch into six-legged larvae. These larvae though smaller in size than the adult have a similar shape. The larvae pass through different stages of development, and in two or three days become a form called nymphs. At this stage of development the mites have eight pairs of legs but no sexual organs. There is now a three- or four-day period during which time certain nymphs develop into male mites and others into pubescent females. The male mites fertilize the females and the latter become known as ovigerous females (see Fig. III). The period between the different stages of development is of course dependent upon many factors. *A female is ready to lay eggs nine to fifteen days after it is hatched.* It has been estimated that a pair of mites will produce under favourable conditions a million and a half descendants in three months. This prolific reproduction is, however, considerably reduced by many of the mites dying in various stages of their development.

How Scabies is Transmitted

Scabies is transmitted by those means which convey the causative mites or their eggs from an infested to an uninfested animal. Direct contact between an infested and a non-infested fox is doubtless the most common method, although indirect contact is also important, especially where the resistant egg is involved. Thus the clothing and boots of the attendant, brooms and utensils, are capable of transferring the parasite or egg. There is also transmission from pen to pen of hair and scab by winds or other mechanical means.

The possibility of mange spreading from one species of animal to another should not be ignored. In one outbreak investigated, fitch known to have scabies of the feet appeared to have been the source of the infestation. Mink, ferrets, and fitch are closely related animals and must ever be looked upon as sources of danger when infested with mange.

How Scabies is Produced

It is believed that the ovigerous female mites are the first to penetrate the skin. The males and other forms remain longer on the surface. The mites burrowing into the epidermis cause a local irritation which brings about swelling

and redness of the skin. Small quantities of serum ooze from the minute wounds. This dries and forms the initial scab. As the mites increase in number, the epidermis in the affected region becomes riddled with small egg galleries and the hair follicles and the small nerve endings damaged. In time the area becomes covered with a thick rough scab, and most of the hair dies and falls out.

When a large area of the fox's body is affected, the general health of the animal is impaired and its resistance lowered to other diseases.

Symptoms

Probably three or four weeks elapse after the initial infestation before an area sufficiently large to attract attention becomes apparent. While any part of the body, legs, and tail may be affected, observations indicate that the first lesions occur on the legs, frequently around the hocks and elbows. Next the sides of the face, the tail, and the belly become affected.

The lesions on the legs and face can easily be seen. The fur in these regions is not dense and the yellowish white scabs show up very plainly. The scabs over the face, if not treated, become very thick. The fox scratches them and bleeding frequently occurs. Instances have been observed where the eyes have been practically closed due to the heavy scab formation. When the disease spreads to areas ordinarily covered with dense fur, the scab is not easily seen as the fur does not fall out for some time. It is not uncommon to find the tail twice its natural thickness owing to the enormous formation of scabs. In the far advanced stages of the disease the entire belly and sides of the body may be covered with a mass of gummy scab, and when the dense crust is picked off a raw, weeping surface of inflamed skin is exposed.

When a patch of skin becomes affected the disease rapidly spreads over a large surface of the fox's body. For instance, a fox was noticed to have two small areas of mange on the hocks. It was caught and examined. The remainder of the body, legs, and tail appeared free from infestation. The areas affected were treated once with the lime and sulphur dip, and in three weeks' time it was surprising to find the tail extensively affected, double its natural size, and lesions of considerable extent on the belly. In this short period the disease had progressed from two patches, each having an area the size of a twenty-five cent piece, to a point where the entire tail and a quarter of the lower part of the belly were involved.

Foxes in an advanced stage of scabies rapidly lose condition, become thin and emaciated and eat very little.

The disease appears more noticeable and possibly more active in summer than in winter. When the animals are in good fur a false impression may be created that the mange is cured. With the return of warm weather and shedding of the winter coat it reappears and rapidly assumes an active contagious nature. If unchecked, mange is likely to cause serious losses especially among the pups.

Diagnosis

Scabies is an extremely difficult disease to control and eradicate and therefore the importance of early diagnosis when few animals are affected. Simply seeing a fox scratching and biting its body does not necessarily indicate the animal has mange. An infestation of fleas can cause the animal to act thus. When mange is first suspected, each fox should be carefully examined for visible evidence of the disease.

The first indication of mange is the presence of bare patches usually on the hocks and elbows. Within a few days there is a rapid formation of scab material. If the disease is not treated and arrested new areas soon occur on other parts of the body, particularly on the face, tail, and belly.

The detection of the causative agent, the mite, is of course a positive means of definitely diagnosing scabies. When scales and scabs are found these should be examined for the presence of mites, as follows: Scrape off the scab down to the raw skin with a knife or spoon. Place the scabs on a dark background, such as piece of black paper, and keep them in a warm place. In thirty to sixty minutes the mites will commence to leave the scab and may be seen, especially if a hand magnifier is used, as small grey specks slowly moving around the edge of the specimen.

If there is any doubt as to the diagnosis of mange a veterinarian should be consulted. When this is not possible, scrapings may be taken and placed in a small box, such as a tin or porcelain ointment jar, and sent to a provincial or Dominion veterinary laboratory for examination.

To facilitate diagnosis by microscopic and laboratory methods, the scabs should be softened in a 10 per cent solution of sodium or potassium hydroxide for twenty or thirty minutes. The scab should then be broken down with pointed instruments and spread over a glass slide. When present, the mites are easily observed under the microscope.

Management and Sanitary Control of Outbreak

Two factors must be kept clearly in mind in the management of an outbreak of scabies. First, an infected animal harbours mites and eggs, the mites being relatively easily killed if a suitable parasiticide comes in direct contact with them. The eggs, however, are not killed by these chemical substances and consequently must hatch before being destroyed. The second and equally important factor is that mites and eggs may be harboured by surroundings, such as pens, floors, etc., and the transference of these to other quarters where foxes are being kept will set up new centres of disease. The mites do not live long away from the animal's body, but unfortunately the eggs may survive for six to eight weeks, during which time under favourable conditions they are capable of hatching and producing infestation.

It is therefore self-apparent that the control and elimination of scabies is dependent upon:

(*a*) The prevention of transference of mites and eggs from infested to non-infested animals;
(*b*) The periodic destruction of the vulnerable mites on the bodies of infested animals at times which do not permit newly hatched eggs to become ovigerous females and, in turn, to lay more eggs;
(*c*) The destruction of mites and eggs in pens where infested animals have been or are being housed.

Once skin mange has been diagnosed, all foxes on the premises should be examined for visible evidence of the disease. Those affected should be segregated if possible in quarters at a distance from the non-infested animals and contact, either direct or indirect, between diseased and healthy foxes avoided. The infested animals should be kept in pens containing the least possible equipment and their shelters should permit of easy and frequent sanitary cleansing. Too much emphasis cannot be placed on the care and attention paid to pens where infested animals are being kept. Infested foxes shed a considerable amount of hair and scab, this shedding being assisted by their scratching and rubbing. The shed tissue containing many mites and eggs is easily transferred by the hands and feet of the attendants, winds, etc., to other pens, where it serves to set up new areas of infestation. It also serves to reinfest the animals under treatment. Therefore, the systematic destruction of this tissue and its contents is a most important step in the control of scabies. This can best be accomplished in the manner described in the next paragraph.

The pens which contained the infested animals should be cleansed and means taken to destroy the mites and eggs. The material from which the pens are constructed will govern the method. Thus pens having cement floors or earth floors should be thoroughly swept and the debris burned. Houses and troughs should be painted with hot lime wash containing a coal tar disinfectant. Following this the entire floor, meshing, etc., should be flamed with a fire gun and this operation repeated three or four times at weekly intervals. Pens constructed of material which prevent such radical treatment must be dealt with as circumstances permit, but always the object is the same, the destruction of the vulnerable mite and the resistant egg. If possible, pens should be left vacant for at least two months. All brushes and other utensils, also the clothing and boots worn by the person cleansing the pens, should be immersed in hot water containing a disinfectant. Much of the success of controlling scabies is dependent upon the thoroughness with which these sanitary operations are carried out.

Treatment

Considerable difficulty is encountered in successfully treating skin scabies. The dense fur, the thickness of the scab, and the impossibility of killing eggs in the live skin are contributory factors. Treatment to be effective must be carried out systematically and combined with those suggestions outlined under "Sanitary Control." The underlying principle of treatment is that the parasiticide must not only come in contact with the mite, but the treatment must be repeated at sufficiently frequent intervals to kill all recently hatched mites before the necessary time has elapsed to permit of their laying eggs. *It is imperative that this circle be broken by killing the vulnerable mites every four to six days.*

Reference has already been made to an outbreak of scabies met with on an experimental ranch and proved to be due to the *Sarcoptes scabiei.* Advantage was taken of this outbreak to study the efficiency of various treatments. Since the lime sulphur dip[2] is so effective in mange of large animals, it was thought that this dip would be a practical and efficient treatment for mange of foxes. A very considerable amount of work was carried out and as a result it was demonstrated that the lime sulphur dip is not satisfactory for foxes. It does, however, hold the affection in check and prevents to some extent its spread to other parts of the body. Consequently it is valuable as a supplemental measure to control the spread of the infestation from affected to non-affected parts of the body.

It was soon found that the fox should be clipped in order that the lime sulphur dip or other parasiticides employed may penetrate to the affected tissues. This is not a simple matter since it is difficult to get the fine hair of the fox into the teeth of the machine, and also in the affected areas the gummy scab clogs up the apparatus. However, in spite of these handicaps the time and effort is well repaid and in fact treatment is largely ineffective unless clipping is carried out. A hand or electric clipper with fairly close blades is the most satisfactory machine for this purpose.

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[2] The concentrated lime and sulphur dip is made by a number of commercial houses and the rancher may find it more convenient to buy the commercial product.

The following is the recognized formula,—

Unslaked lime	10 lbs.
Flowers of sulphur	24 lbs.

Rain or soft water to be added 100 gals. These ingredients will make 100 gallons of dip.

Slake the lime in enough water to make a thin paste. Sift the sulphur into the paste and mix thoroughly. Water may be added to bring the mixture up to the consistency of mortar. The mixture is then added to 30 gallons of boiling water. Add slowly so as not to interrupt the boiling. Continue boiling for one and a half hours, stirring constantly to prevent settling. When the sulphur has disappeared from the surface and the mixture is a dark amber colour, the boiling should be discontinued.

After standing for approximately twelve hours, draw off the fluid taking particular care not to disturb the sediment. The fluid is three and a third times the required strength. It should be kept in suitable containers and diluted as required.

Fig. VI

Fig. VII
Skin Mange of the Fox

Several other parasiticides were tried. Two were found to give effective results, and the formulae of these are given below:—

I. Oil of tar	1 part	II. Oil of tar	1 part
Soft soap	1 part	Crude petrolatum oil	1 part
Alcohol	8 parts	Liquid petrolatum	1 part

No. I has more penetrating power and is the more efficient.

Method of Use

Since No. I is the more efficient treatment, it is presumed that this will be used and No. II used only as an alternative. As formerly pointed out, the remedy is more effective if the fox is clipped. *Only one-quarter of the body should be treated at a time,* a different quarter being treated each successive day. Thus four days will elapse before the entire body is treated.

The application is thoroughly rubbed into the quarter with a brush and should be repeated four or five times at four-day intervals. It is advisable to dip the fox in lime sulphur and allow it to dry before hand treatment starts, and to again dip on the fifth or sixth day. This tends to hold the parasites localized and prevents their migration through the hair to other parts of the body.

The brush used for applying the parasiticide must be immersed for a minute in boiling water between the treatment of each fox, so that any live eggs adherent to the bristles are killed.

Directions for Use of Lime Sulphur Dip

A vat or vessel large enough to accommodate a fox is secured and into this is placed rain or soft water which has been brought to the boiling point. Sufficient lime sulphur solution is added to bring the amount up to 30 per cent. For instance, if seven gallons of water are used three gallons of lime sulphur solution is required. The fox is placed in the solution when the temperature of the dip has dropped to 115°F. It is immersed for three or four minutes, the affected parts being constantly scrubbed with a stiff brush. If many foxes are to be dipped, provision should be made to continuously heat the solution, in order that the above-mentioned temperature is maintained.

Eight Questions and Answers Regarding Skin Mange of Foxes

1. Q. What is skin mange of foxes?
   A. A contagious disease caused by a parasite, the *Sarcoptes scabiei.*
2. Q. How does the *Sarcoptes scabiei* produce mange?
   A. It burrows into the skin where channels are formed in which the parasites live and reproduce.
3. Q. How does it reproduce?
   A. The female lays eggs which hatch in two or three days, the young parasites being known as larvae.
4. Q. What is the length of time that elapses before the larvae develop into mature parasites and are capable of laying eggs?
   A. A female is ready to lay eggs nine to fifteen days after it is hatched.
5. Q. Are the parasites and eggs easily killed?
   A. The parasites are relatively easily killed by a suitable parasiticide, but the eggs are very resistant.

6. Q. Has this any bearing on control measures and treatment?
   A. This is a most important factor since suitable measures must be taken to kill both parasites and eggs in the pens where the affected foxes are kept. Because it is not possible to kill both parasites and eggs on the bodies of affected foxes, parasiticides (which kill the parasites but not the eggs) must be applied sufficiently often to kill recently hatched larvae and never give them time to develop and, in turn, lay eggs.

7. Q. Is skin mange of foxes a serious disease?
   A. Yes. Not only does the disease destroy the value of the pelt but it even brings about the death of the affected animal.

8. Q. Is skin mange of foxes the same disease as ear mange?
   A. No. Ear mange is an affection of the skin of the ear passages only, and never attacks other parts of the body. It is caused by the *Otodectes cynotis* (Figs. IV and V), a different parasite from the cause of skin mange.

Ottawa: Printed by J. O. Patenaude, I.S.O., Printer to the King's Most Excellent Majesty, 1936.