

SHEEP DISEASES IN CANADA

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A flock of healthy sheep

Animal Pathology Laboratories

Health of Animals Division

CANADA DEPARTMENT OF AGRICULTURE
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FOREWORD

Over a considerable number of years the Animal Diseases Research Institute have been carrying on investigations into disease conditions affecting sheep. In addition, a large number of post-mortem and other examinations have been carried out with a view to determining the nature of diseases affecting sheep in different parts of the country. On the basis of this experience there has been assembled information which it is believed has a special application to conditions in Canada. This bulletin is not a treatise for veterinarians but has been prepared especially for persons who are interested in sheep raising under Canadian conditions.

SHEEP DISEASES IN CANADA

INTRODUCTION

Efficient sheep production depends to a considerable extent upon the maintenance of a healthy flock. While the value of an individual sheep in a commercial flock may not be great, the protection of the flock against disease begins fundamentally with that individual. All measures of prevention of disease must apply therefore to every animal in the flock. The smaller the flock, the easier it is to make careful and accurate observations of the sheep and provide the necessary treatment in case of trouble. With large commercial flocks it is much more difficult to observe each individual animal and in that way to notice the early symptoms of disease. Failure to detect the presence of disease at its onset is often one of the great weaknesses of sheep management.

Sheep are susceptible to many diseases, some of which may affect only part of a flock, whereas others, being highly infectious, may spread through the flock and may be carried to neighboring flocks, thus producing extensive outbreaks.

In considering diseases of sheep, one must remember that disease is often the result of interaction of several factors, only one of which is the disease-producing agent. Diseases of young lambs may occur because of lambing in sheds where adequate sanitation is impossible. The spread of infections may be facilitated by holding bands of sheep on the same ground night after night; and sheep may suffer from parasitism through lack of abundant good feed, from infrequent change of grazing ground, or from neglect in the use of a suitable vermifuge.

The purpose of this bulletin is to inform the sheep owner of the characteristics of the more common diseases and infestations in order that he may intelligently use the most approved methods of combating them. It is in no sense intended to replace the service and advice of the trained veterinarian.

EXTERNAL PARASITES

Various species of insects attack sheep, resulting in considerable annoyance, loss of condition, and in some instances, death. For the most part this suffering and economic loss is preventable through a knowledge of the habits of the parasite, the symptoms of the disease, and the application of sound control measures. The important conditions caused by external parasites are discussed below.

Lice

Two kinds of lice may infest sheep—the biting louse, and the sucking or foot louse. In Canada only the biting louse is of importance. This insect may occur on any part of the body, but is usually found on those parts covered with wool. The irritation associated with an infestation of lice may be so severe as to seriously interfere with feeding and resting. As a result animals may fail to put on condition, and young sheep particularly may be stunted in growth. Most important, however, is the fact that infested animals constantly rub against objects and scratch and bite at themselves, and as a result the wool becomes ragged and torn.

Once present in a flock, lice spread very rapidly. Undoubtedly most of the infestation occurs through direct contact with lousy animals, but clean sheep may become infested from buildings used to house lousy animals. As all lice live continuously on their hosts, the main emphasis in treatment must be placed on the affected animal. Despite this it is always advisable to clean out the bedding when control measures are undertaken.

A variety of commercial preparations are available for the treatment of sheep infested with lice. These depend for their effectiveness upon a number of different drugs including rotenone, DDT, lindane, methoxychlor, and others. The manufacturer's instructions, particularly in regard to amounts, must be followed exactly. Many new preparations are becoming available, and care should be exercised in their use.

Sheep Ked

The sheep ked is a wingless insect, and is commonly but incorrectly named "the sheep tick". This parasite is prevalent wherever sheep are raised. It lives in the wool, especially in the regions of the neck, shoulder, belly, and thigh. The insect feeds on blood, which it secures by piercing the skin with its mouth parts. Heavy infestations cause unrest and consequent unthriftiness. Keds also cause breakage in the wool fibers, resulting in soiled wool and losses from low grading.

Like lice, the sheep ked spends its whole life upon the sheep, and is incapable of breeding elsewhere. The adult ked, however, has been known to live as long as 18 days when detached from the sheep, although usually the survival period is not so long as this. Here again, as is the case with lice, sheep may become infested either by direct contact with other sheep, which no doubt is the chief method of spread, or from sheds and paddocks that have housed infested animals.

In general, preparations used against lice are effective against keds. Dip and spray preparations are most effective but dusts may also be used. The key to the effectiveness of dips and sprays lies in the addition of a wetting agent that carries the active chemical through the wool, into contact with the skin. When a dip is used it is advisable to add a disinfectant to the dipping solution. This destroys disease-producing agents that grow in the dipping solution when it becomes dirty. Cresols are very good for this purpose.

DDT has the advantage of low cost, relative safety, and residual effect. It is used at the rate of 8 pounds of 50 per cent wettable powder per 100 gallons of water. With a box of wetting agent (any common laundry detergent) added, pressures as low as 75 to 100 pounds are satisfactory. Each animal is wetted thoroughly using a maximum of two quarts per animal, making sure to get coverage on the back and around the neck. One treatment, applied preferably after shearing, is usually effective. However, a second treatment within 14 days will ensure destruction of the new keds emerging from puparia. When the flock is cleaned up, treatment every two or three years is sufficient.

The Nostril Fly

This is an insect pest of some importance in all parts of Canada. A true warble fly, related to the warble flies of cattle and the bot flies of horses, it is active during the summer depositing its larvae, or maggots, on or near the nostrils. These flies keep sheep in a somewhat frantic condition, and, to keep the fly from attacking, an animal will hold its nose in the dust or against other sheep. This interferes with feeding and resting, and prevents the animal from thriving.

Once deposited, the maggot makes its way into the nasal passages and communicating sinuses, irritating the lining membranes. An intense purulent discharge passes down the nostrils, sometimes in such quantities as to interfere with breathing, hence the term "snuffles". Deaths attributed to this parasite have been found usually to be due to diseases that are more difficult to recognize. Nevertheless in heavy infestations peculiar nervous symptoms are sometimes seen and heavy losses may occur.

Various methods of controlling these flies have been tried, such as smearing the nostrils with pine tar, but none of these is very satisfactory. The most effective method of dealing with this parasite is to inject into each nostril approximately one fluid ounce of a 3 per cent saponified cresol solution, using a special pressure tank containing 35 to 45 pounds of air pressure. Sheep are easily restrained for treatment, and a thorough irrigation of the nasal passages is assured when the animals are placed on their backs with their noses slightly elevated. To prevent strangulation the animals should be released promptly.

Treatments are made in the fall, after the fly season, to destroy larvae in the nasal passages that would otherwise winter over in the sinuses of the sheep.

Blow Flies

These insects, although not a major pest in Canada, do cause trouble in some regions. They produce a condition known as "fly strike", which is an infestation of the skin and subcutaneous tissues by the larvae, or maggots, which feed upon these tissues during their period of growth. They cause great suffering, and often lead to subsequent infection.

Various species of flies may be attracted to sheep by the odors from decomposing fecal matter or discharging wounds, and will deposit eggs or living larvae in these areas. Sheep are struck most frequently in the breech and around the tail where the wool is soiled by urine and feces. Other parts of the body may become affected, especially if wounds are present as the result of accidents or operations, and such cases of strike may follow castration and docking. The affected sheep usually stands with its head down, refuses to feed and becomes poor and weak. Examination shows a patch of discolored, grayish-brown moist wool beneath which may be found a large ragged wound exuding a foul-smelling liquid. The larvae, or maggots, can be seen burrowing into the tissues where they produce extensive damage. If the disease is allowed to progress, death from the absorption of toxins may follow within a few days.

The affected parts must be treated in such a way as to kill off the maggots, promote healing of the wound, and prevent reinfection. It is advisable to clip the wool from the area, remove as many of the maggots as possible, and apply a larvicidal dressing. To remove maggots gasoline, benzene, or chloroform may be used. After the maggots have been removed pine tar may be applied as a dressing.

Australian workers have done considerable experimental work on the development of repellent agents against body-strike, which is a serious problem there. Promising results were obtained from 1 per cent DDT and 0.05 per cent gamma BHC applied to the backs of sheep with a hand spray under 100 to 150 pounds pressure. These insecticides, when used at the rate of $\frac{1}{4}$ to $\frac{1}{2}$ gallon per animal, gave excellent protection from strike for periods of 3 to 5 weeks.

Probably the most satisfactory method of reducing susceptibility to strike is to prevent the occurrence of scouring during the fly season by administering suitable worm remedies.

Other methods that render sheep unsuitable for striking include selective breeding for the elimination of susceptible body types, the introduction of surgical practices such as fold-removal operation, prompt attention to wounds, and the destruction of blow flies concerned in strike.

Paralysis Tick

In Western Canada sheep may become infested with the Rocky Mountain spotted fever tick. These ticks are capable of causing a disease known as tick paralysis, recognized by progressive, often fatal, paralysis of the limbs. These ticks have been reported prevalent in British Columbia and have been responsible for paralysis in sheep. In recent years the paralysis tick has extended its range across southern Alberta and deep into southern Saskatchewan.

Since many species of ticks spend their early life on rodents and other small animals, their control becomes rather difficult. Sheep should be isolated from known tick-infested areas as much as possible, and periodically inspected for the presence of these parasites. Sprays and dusts of some of the new insecticides, such as lindane, have been found to protect sheep for the entire tick season.

INTERNAL PARASITES

Internal parasites have always been one of the major causes of losses in sheep flocks throughout the world. In Canada, failure to give effective treatment for the control of internal parasites has been one of the most general causes for lack of thriftiness in growing lambs, and in many cases of heavy infestation, has resulted in loss through death. This has been particularly so in Eastern Canada. This loss can, however, be prevented. The long Canadian winter helps to clean the pastures of the young infective worms, making control much easier than it is in almost any other part of the world.



Figure 1—A heavily parasitized sheep.

There are approximately 25 different kinds of parasitic worms that affect sheep in Canada. Only the few that are responsible for harmful disease conditions are discussed below.

Nodular Disease or "Pimply Gut"

This disease is caused by young nodular worms picked up with the grass from contaminated pastures. The worms enter the walls of the sheep's intestine, where nodules or knots are formed. When present in great numbers these interfere seriously with the health of the sheep and may ruin many of the flocks in Eastern Canada. This disease may also be found on the West Coast and might become a problem on irrigated land in the midwestern region where there is sufficient moisture to favor the development of young worms on pasture.

The eggs and young worms on the contaminated pasture lands are destroyed by the long winter frost and weather conditions; but in the animal host, that is, in the intestines of the sheep, the nodular worms develop to maturity during the winter months and begin laying the eggs that contaminate the pasture each spring. To prevent this recurrence and thereby protect the lambs from developing nodular disease, the egg-laying worm in the adult sheep must be destroyed before the animals reach the pasture in the spring. Phenothiazine is the only known drug capable of destroying all or most of these worms.

Stomach Worm Disease

This disease, caused by large numbers of the twisted-wire worms in the fourth stomach or abomasum, occurs chiefly in lambs in midsummer. The young worms are picked up from the grass in the same way as are the nodular worms. Most, but probably not all, of the eggs and worms on the pasture are destroyed by winter frosts. The winter or spring treatment for nodular worms will remove the adult stomach worms, but on farms where large flocks of sheep are kept, it may be necessary to treat the lambs at the beginning of July.

The first signs of this disease are symptoms of anaemia caused by the loss of blood due to the blood-sucking activities of the parasite. The animal becomes unthrifty, the membranes of the eyes and mouth become pale and in some prolonged cases swellings develop under the jaw. This is referred to as "bottle neck". Constipation frequently accompanies these symptoms. Fecal pellets become hard and dark in color. This condition is found in Eastern Canada, in sections of British Columbia, on irrigated land, and, during wet seasons, in the midwestern provinces.

Black Scours

This condition occurs, in its most pronounced form, among large flocks where the acreage of pasture is limited and when pastures become dry and unnutritious in the autumn. It is caused directly by many thousands of almost invisible worms in the intestine. Like the nodular and stomach worms these tiny parasites are picked up from the grass. Some of the eggs and young worms are able to survive through the winter months and consequently the pasture may be partially infested in the spring. Therefore, on badly infested farms, the spring treatment with phenothiazine tablets is not entirely effective in preventing this disease.

The onset of the disease is slow, the first symptom being diarrhea with the resulting dirty hind quarters. The wool becomes coarse and dry and the animal gradually loses in flesh. This disease is often complicated by the presence of hookworms, which tends to cause similar symptoms.

Other Worm Parasites

The large-mouthed bowel worm (*Chabertia ovina*) is known to cause a severe scouring disease in sheep in the interior of British Columbia and perhaps in other areas as well. Treatment consists of large doses of phenothiazine. The lesser stomach worm (*Ostertagia*), which is also removed by phenothiazine, sometimes produces disease in breeding stock when present in very large numbers, especially when the diet is deficient.

Tapeworms are common in most regions, but appear to be harmless. Research has shown that most of the troubles blamed on tapeworms have been found to be due to other worm parasites, such as stomach worms and the worms that cause black scours.

Lungworms are thought to cause disease in some regions. In most cases, however, they are present as a complication of other parasitic diseases and when these are treated the lungworm problem is not serious. Infestation with this worm is controlled by keeping sheep on dry pastures.

Liver flukes occur in a number of small areas in various parts of British Columbia, Ontario, Quebec, and Newfoundland. Although these flat worms may cause considerable damage when present, they are not common in most of the sheep-raising areas. Special drugs such as hexachlorethane are available for the treatment of infected sheep. However, this solves only part of the problem and before it can be completely overcome extensive control measures must be undertaken to destroy snails that carry the immature stages of the parasite.

Control Procedures with Phenothiazine

In attempting to control internal parasites of sheep it should be remembered that the most harmful parasites survive the winter inside the adult sheep and that the pastures have been cleaned of many of the young infective worms by the severe winter weather. The most effective control is, therefore, to remove the worms that would reinfest pastures when the sheep are turned out in the spring. Phenothiazine is the most effective winter treatment for the control of stomach and intestinal worms in sheep. This is usually administered in the form of tablets.

The method of control is as follows:—

(1) All sheep that have been carried over the winter should be treated at any time between the first of February and one month before lambing, or between five days after lambing and 24 hours before they are turned on pasture. It is important that all sheep be treated at the same time. If for any reason one or two sheep cannot be treated with the rest of the flock they should be kept indoors and not allowed on grass with the rest of the flock until 24 hours after they have been treated. If the season of heavy frost has passed, care should be taken to keep the flock off any grass-covered land before they have been treated. If this is not done the untreated animals will infest the grass, and the young worms that develop will infest the sheep and lambs after they are turned out. This is the main cause of unsatisfactory results in using this method of controlling sheep parasites.

(2) Although this treatment usually prevents stomach worms and nodular disease of lambs, signs of the stomach worm should be watched for in July, August, and early September. Infested lambs will show the symptoms described under Stomach Worm Disease. Pale eye membranes should be watched for especially. When such signs appear the lambs should receive a small dose of phenothiazine or a drench of bluestone and nicotine. This should be repeated in one month if necessary.

(3) Symptoms of diarrhea in the autumn months are advance signs of future unthriftiness. Affected animals should be treated with phenothiazine, and if the grass is dry and sparse, supplementary feed should be provided.

Instructions for Using Phenothiazine Tablets

The following procedure should be followed carefully when giving this treatment.

Winter or Spring Treatment

(1) Treat all adult animals, including the ram.

(2) The number of tablets to be given depends upon the weight of the sheep as follows: (a) up to 100 lb., 3 compound tablets ($12\frac{1}{2}$ grams each); (b) over 100 lb., 4 compound tablets ($12\frac{1}{2}$ grams each).

(3) In Eastern Canada, the number of tablets recommended should not be reduced, particularly in flocks in which the nodular worm is prevalent. In most regions of Western Canada where nodular disease does not occur, this dose may be reduced to 2 and 3 tablets.

Summer and Autumn Treatments

(4) Flocks subject to diarrhea or scouring in the autumn should be treated in September or at the first sign of diarrhea in young animals, as follows: (a) grown animals, 3 compound tablets ($12\frac{1}{2}$ grams each); (b) lambs, 2 compound tablets ($12\frac{1}{2}$ grams each).

(5) For stomach worms in summer, give 1 to 2 tablets.

How to Administer the Treatment

The treatment will be safely and efficiently given if a veterinarian is employed. Where the services of a veterinarian are not available, the following instructions should be closely followed:—

(1) Pen the sheep quietly and securely for treatment.

(2) Do not fast sheep before or after dosing.

(3) If treatment is given just prior to turning the animals to summer pasture, hold the flock for at least 24 hours to give the drug a chance to act. There will then be no danger of contaminating the summer pasture.

(4) Have an assistant hold the sheep between his legs in such a way that the neck, not the shoulders, is between the knees. Avoid slippery floors, and place the sheep's hind-quarters in a corner against the wall. The main object is to prevent the animal from sitting down, from moving the body from side to side, or from swinging its head sideways.

(5) Use a mouth spreader with a spread of about $2\frac{3}{8}$ inches to $2\frac{1}{2}$ inches, to hold the mouth open. Administer the tablet when the animal is not struggling violently. The person giving the tablet opens the animal's mouth and inserts the mouth spreader so that the tongue is held forward underneath the lower bar of the spreader. The tablet, held between the thumb and the first two fingers, is then brought well down to the root of the tongue with the fingers, where it is released and pushed over the "hump" of the tongue with the center finger. To facilitate swallowing, the spreader is quickly taken out of the mouth and the pressure released from the sides of the head and neck so that the animal can lower its head. The operation is repeated carefully for each tablet.

With experience the tablets can be administered very rapidly.



Figure 2—Left: administering a phenothiazine tablet. Right: administering a drench. Note that the upper part of the neck, and not the shoulders, is held between the legs.

Note:—Careless or inexpert dosing may result in the accidental introduction of a tablet into the larynx, or windpipe; in such a case, the sheep should be given a drench of water and should be shaken with its head down. Always keep handy a drenching bottle filled with water. Each person usually develops his own method of administering tablets. Instead of using the fingers a “balling gun” made of a short piece of rubber hose pipe, $\frac{3}{4}$ -inch inside diameter, with a simple wooden plunger may be used.

Precautions

Phenothiazine has been used for many thousands of sheep in Canada and has proved to be remarkably safe and efficient for general use. However, in common with all drugs, it must not be used promiscuously; and when it has not been used before on a certain flock, it is better to treat two or three animals first in order to be sure that no peculiar conditions are present and that the mechanical part of the dosing can be done easily.

Do not treat pregnant ewes nearer than one month to lambing.

Discoloration of Wool

The urine of treated animals contains large amounts of a red stain for four days after dosing. In the case of ewes that are not shorn, if precautions are not taken a part of the fleece may be permanently stained. The flock should be kept in a well-bedded pen or yard. Bare floors or yards with a heavy clay or otherwise impervious surface should be avoided. If the flock can be shorn and then treated 24 hours before being turned to summer pasture, danger of wool stains will be avoided. The young lambs are likely to become stained with urine in varying degrees, depending upon how they nurse. Stains on lambs are not serious, as they will grow out and will not be noticeable by midsummer.

Note:—The treatment of large range flocks may present special problems. Here, good judgment must be used and professional advice sought. Under certain conditions the continual use of phenothiazine and salt mixtures during the pasture season as an additional measure may be of value. Here, too, professional advice should be obtained.

The "Cunic" Drench for Stomach Worms

This treatment may be preferred by some for the removal of stomach worms and while it is not so effective as phenothiazine it does remove a very large percentage of these worms. However, it is not recommended as a substitute for phenothiazine in the removal of the harmful worms found in the intestine.

Directions for Preparing the Solution

<i>Ingredients</i>	<i>Large flocks</i>	<i>20 sheep or less</i>
Crystals of copper sulphate (Bluestone)	3 oz.	$\frac{3}{4}$ oz.
40 per cent nicotine sulphate	2 fluid oz.	$\frac{1}{2}$ fluid oz.
Soft (or rain) water	1 Imp. gallon	1 Imp. quart

Be sure that the copper sulphate crystals are clear and blue; and discard whitened crystals. Using a vessel that is not bare metal, heat a quantity of the water to dissolve the bluestone, then add water up to full quantity. This solution will keep indefinitely in a glass, enamel, or earthenware container, but it is better to add the 40 per cent nicotine sulphate only when it is about to be used.

The Doses

	<i>Fluid ounces</i>
Adult sheep	2
Well-grown lambs	1
Small lambs	$\frac{1}{2}$ - $\frac{3}{4}$



Figure 3—Method of examining the eye of a sheep for anaemia due to stomach worms.

No fasting before or after treatment is necessary, but it is better to keep the animals away from water for a few hours after the dosing. For weak animals the dose should be reduced rather than increased.

Method of Dosing

A suitable drenching bottle should be prepared so that the correct dose can be quickly and accurately measured into it. The sheep should be brought quietly into a small enclosure and the operator should dose each one by holding the head of the animal between his knees, thereby restraining it but not raising the head too high. A full half minute is needed for each animal; a strong flow of the liquid might cause some of it to enter the lungs with serious results.

Do not treat pregnant ewes that are within one month of lambing time. Do not treat lambs less than six weeks old. Sheep must always be handled gently.

DISEASES CAUSED BY BACTERIA**Enterotoxemia****(Feed-lot Disease, Overeating Disease, Pulpy-Kidney Disease)**

Enterotoxemia has been referred to as feed-lot disease, overeating disease, and pulpy-kidney disease. It is an acute intoxication resulting from the elaboration of toxin by a bacterium known as *Clostridium perfringens* Type D; an organism widely distributed in nature and known to be present in the alimentary tract of a percentage of normal sheep.

Available information suggests that enterotoxemia is a combination of a nutritional problem and an infectious disease. A sudden alteration in the food supply, usually from a poor to a rich one, or the ingestion of large quantities of highly nutritive feedstuffs, appears to be necessary to initiate the disease. Heavy feeding activates the organism by providing an excellent environment for its multiplication.

Lambs on luxuriant pasture, feed-lot lambs on heavy grain rations, and young lambs nursed by heavy-milking ewes are those most generally affected. Lambs stricken with enterotoxemia usually die suddenly and symptoms are not frequently observed under field conditions.

The most frequently observed symptoms are diarrhea, listlessness, inco-ordination, convulsions and coma. On occasion an affected animal will rapidly become progressively weaker and show signs of disturbance of the central nervous system such as circling, throwing back the head, or pushing against an object. Death usually occurs within eight hours after the onset of symptoms. Mortality of affected lambs is nearly 100 per cent, and a flock loss of 25 per cent is not uncommon.

Post-mortem examination may reveal an excessive amount of straw-colored fluid in the sac surrounding the heart, haemorrhages on the heart, and moderate congestion to areas of acute inflammation on the bowel. If autopsy is delayed for a few hours the kidneys will be soft and pulpy, hence the name pulpy-kidney disease.

Enterotoxemia may be mistakenly diagnosed as hemorrhagic septicaemia, coccidiosis, and plant or chemical poisoning. Therefore, an accurate field diagnosis must be based upon the history of sudden deaths in lambs exposed to rich feed and the demonstration of the afore-mentioned conditions.

Feed consumption may be regulated to control losses caused by enterotoxemia, but such a procedure is not without danger, particularly in certain groups of lambs that seem to be more susceptible than the average. Moreover, a system involving regulated feed consumption is more costly than the utilization of self-feeders.

The effectiveness of enterotoxemia biologics for the prevention of the disease has been amply demonstrated by workers in several countries. A thorough understanding of the specific values and limitations of each of the available products is necessary for successful results. For this reason a veterinarian should be consulted.

Vaccination must be confined to healthy lambs over two months of age. Lambs under two months of age may not respond to immunization. The practice of vaccinating the pregnant ewe one to two months before lambing is reported to provide protection to the baby lamb for one or two months. Lambs that have undergone a long shipment and lambs that have been freshly shorn are not good prospects for immunization. In either case an interval of at least two weeks should be allowed before vaccination. It should always be remembered that even a successful immunizing procedure is no substitute for sound management.

Contagious Foot Rot of Sheep

The disease known as "Contagious Foot Rot of Sheep" has been recognized in Canada for many years. While the term has been used to include other inflammatory and necrotic processes of the foot associated with lameness, it is used here with reference to a specific contagious disease, the responsible agent of which has been considered to be *Spherophorus necrophorus*.*

During the wet weather of spring and fall, and in low wet pastures or muddy corrals, the tissues of the feet become macerated or soft. If the infectious agent is in the soil, it is therefore more readily able to penetrate these softened tissues. Muddy conditions alone do not cause the disease but rather predispose to it. The causative organism must also be present in the soil. Contamination of the ground occurs when infected animals are introduced.

The soft tissue between the toes is usually affected first with a mild inflammation which may spread around the junction between the hoof and the skin. The skin then breaks and the infection spreads downward under the wall and sole followed by separation of these structures from the foot. A characteristic foul odor accompanies the process.

Lameness is usually the first symptom noted. If the disease is allowed to progress, loss of condition follows.

Before treatment is undertaken, it is necessary to differentiate foot rot from other conditions causing lameness such as injury and foot abscesses.

Treatment of affected animals is begun by washing the feet free of mud and then trimming and paring away all of the diseased tissue, a step which is absolutely necessary. Following this, one of several recognized treatments may be employed.

Affected feet may be dipped in 10 per cent formalin solution for about ten seconds, or if many animals are to be treated they may be run through a foot bath containing a 5 per cent solution.

Another treatment is that of walking the affected animals through a saturated solution (30%) of copper sulphate in a foot bath. This treatment has the disadvantages of staining the wool as well as occasionally resulting in copper poisoning.

Probably the most effective agent so far reported is the use of a 10 per cent solution of chloromycetin in methyl alcohol or in propylene glycol. After thorough preparation of the feet, as described earlier, the solution is carefully applied with a one-inch paint brush, preferably one with short bristles to avoid waste. After treatment, the animals should be turned into a hard dry

*Formerly known as *Actinomyces necrophorus*.

yard which has not had sheep in it for at least two weeks. When the feet are dry, the animals may then be turned into a pasture or corral which also has not been occupied by sheep for at least two weeks.

The unaffected group should be kept under close observation for a month to detect possible new cases. The feet of the treated group should be examined and, if necessary, re-treated at weekly intervals for a month. Very severely affected cases, animals with badly misshapen feet, and those which have not responded to treatment after a month should be considered for slaughter. In these cases treatment may not be economical and their presence greatly increases the risk of carrying over and spreading infection. Treated animals should not be returned to the main flock until it is certain that the cure is complete. This would require at least a month of freedom from the disease.

Infected pastures and corrals should be kept free of sheep for at least fourteen days, preferably for a month if the ground is wet. By this time the organisms in the soil will be dead and the pasture may be considered to be clean.

Once a flock is free from foot rot it can be kept free. To prevent introduction of this disease, all newly purchased sheep should be carefully examined, passed through the foot bath even if apparently healthy, and kept by themselves for two to four weeks. If they remain normal, they may then be added to the flock.

Hemorrhagic Septicaemia

(Pasteurellosis, Pneumonia, Shipping Fever)

In sheep, as in other species, conditions are encountered that involve infection with a bacterium known as *Pasteurella multocida*, the causative agent of hemorrhagic septicaemia. The infection has also been referred to as pasteurellosis of sheep, pneumonia in sheep, and shipping fever of sheep when the condition occurs as a disease of transport. In parts of Canada the causative agent is *Pasteurella hemolytica*.

Hemorrhagic septicaemia occurs in all countries and causes considerable loss especially among lambs. The disease develops more or less spontaneously, and is probably introduced by carriers, which may harbor the organism in their upper air passages. Animals become affected with the disease when their natural resistance has been lowered by unfavorable conditions, such as exposure to cold or wet, disturbances of nutrition, etc.

In the acute form of the disease there are usually symptoms of a severe general infection, manifested by debility, a rise in temperature, loss of appetite, increased thirst, difficult breathing, and muscular tremors. An autopsy carried out on a victim of the acute form of the disease will usually reveal a gelatinous material under the skin of the fore part of the body and an inflammation of the lining membranes of the respiratory passages and intestine. Haemorrhages may frequently be noted on the kidneys, and in some cases the lungs will show dark brownish red or grayish red areas.

Chronic cases of the disease are much less common and they are characterized by symptoms of a severe chronic affection of the lungs. The animal coughs frequently, breathing is labored, and a purulent discharge may be noted around the eyes and nose. Post-mortem of such cases will usually reveal large areas of pneumonic lung tissue.

In addition to the acute and chronic forms of the disease, pasteurella organisms have been recovered from sheep manifesting clinical symptoms characteristic of a disturbance of the central nervous system. One or more nutritional factors were believed to be contributory in the course of the disease.

Affected animals should be separated from the others, their surroundings thoroughly disinfected, and their condition of life improved. They should be well fed and protected from cold.

For treatment, anti-hemorrhagic septicaemia serum should be employed. Maximum dosage should be used for sheep that are sick, and smaller amounts for the, as yet, unaffected members of the flock. Symptomatic treatment with calcium gluconate and camphorated oil may be employed and, in addition, one or more of the sulphonamides may be used orally. It is believed that sodium sulphamethazine administered intravenously is helpful in that it is conducive to speedy recovery.

Protective inoculation is advisable but, because of the time required to produce active immunity, aggressins and bacterins should be given at least ten days before danger of exposure. Their use is not recommended in exposed or infected flocks, in animals intended for immediate shipment, or in animals that have recently been in transit.

Gas Gangrene Infections

Gas gangrene infections in sheep include (1) a disease resembling blackleg in cattle, (2) a systemic type of infection that does not resemble blackleg as usually seen in cattle, (3) braxy and (4) malignant oedema. Malignant oedema results from wound infection; it is highly fatal and is characterized by gassy, gangrenous swellings spreading from the site of the wound. The other three conditions are very acute, rapidly fatal systemic infections, which usually cannot be differentiated except by a veterinarian.

Malignant oedema is caused by castration, docking, shearing and other wounds becoming infected with one or more gas gangrene organisms. Filth, poor sanitation, carelessness during shearing, and failure to exercise antiseptic precautions in castrating and docking are predisposing causes. Animals of all ages may be affected.

Systemic infections are due either to *Clostridium septicum* or *Clostridium novyi*, rarely to *Clostridium chauvei*, the common cause of blackleg in cattle. The incidence of systemic infection is inclined to be somewhat higher following shearing and dipping and it is believed that infection may sometimes occur through wounds. Usually there is no evidence that this is so and it appears likely that infection enters the system in most cases through the digestive tract. Animals of all ages may be affected.

Braxy is a special type of systemic infection caused by *Clostridium septicum* that occurs in the fall and winter (any time after the first frosts) as a result of sheep overeating on aftermath or other frosted feed. Sheep over three years of age are rarely affected.

The gas gangrene organisms cannot grow and multiply in the presence of air. Offsetting this apparent weakness, they form spores that are very resistant to air, drying, sunlight, and heat. The spores are able to survive for long periods—often many years—in the soil. Sometimes gas gangrene organisms are found in the digestive tracts of normal animals and for this reason the organisms tend to become concentrated in barnyards, feedlots, paddocks, and corrals. In any case it is known that once the soil becomes infected the danger of infection persists thereafter.

Natural factors, such as flooding, which tend to bring the spores to the surface and deposit them on vegetation perhaps play a part in determining the incidence of gas gangrene infection from year to year.

Malignant oedema, being a wound infection, requires no further description.

In braxy, death occurs so rapidly that stricken sheep are seldom seen alive. Affected animals leave the flock, do not eat, have a high fever (106° to 108°F.), appear somewhat bloated, and are restless. Bloating becomes more marked and then the animal collapses, lapses into coma, and dies within a few hours.

In systemic infections, onset is so sudden and the course of the disease so rapid that affected animals are usually found bloated and dead often showing bloody discharges from the mouth, nostrils, and anus. When animals are coming down with the disease they stop eating and may be found away from the flock. Characteristic symptoms are swelling of the head and throat, and lameness. There may be noticeable swelling in one or more legs or over body muscles but this is not constant. Gas under the skin as in blackleg in cattle is not usually observed before death. Gas under the skin of dead sheep should not be taken as indicative of disease. The wool covering holds heat which favors decomposition within the carcass and hence, no matter what the cause of death, sheep carcasses decompose rapidly, often with bloating and collection of gas under the skin.

When many losses occur suddenly (over night for instance or within the course of one or two weeks) a qualified veterinarian should be consulted. Systemic gas gangrene infections are difficult to differentiate from each other and from certain other diseases (anthrax, enterotoxemia, etc.). For exact specific diagnosis a laboratory examination is necessary. When the owner cannot take an entire sick animal or recently dead carcass to a veterinary laboratory he should engage a veterinarian to collect and send specimens. In gas gangrene infections, carcasses are teeming with infectious organisms and spores, which, if the carcass is skinned or opened without giving thought to contamination, find their way into the soil, thereby increasing the problem for the future.

Because gas gangrene infections are so rapidly fatal it is practically impossible to begin treatment in time to save affected animals. Vaccination with a mixed bacterin made from *Clostridia chauvei*, *novyi* and *septicum* is to some extent effective in reducing losses in the field. The value of vaccination, however, is difficult to estimate, because gas gangrene infections are inclined to be unpredictable and erratic in occurrence, due no doubt to the play of various predisposing factors.

Carcasses of dead animals should not be skinned or opened except as directed by a veterinarian. Preferably they should be buried deeply on the spot or else burned. Carcasses left on the surface may be devoured, dismembered and the dismembered parts carried about by dogs, coyotes, and carrion-feeding birds. Outbreaks of systemic gas gangrene infection have occurred after farm dogs have dragged limbs of dead carcasses from neighboring fields into stable yards.

Prevention of braxy involves the close supervision of sheep to prevent overeating on aftermath in the fall after frosts have begun to occur.

Malignant oedema can be prevented by exercising care, cleanliness, sanitation, and antisepsis when clipping, castrating, docking, and vaccinating sheep.

In general, the fundamental principles of prevention are: (1) take all precautions to avoid adding to the amount of infection already present in the soil and the environment of sheep, and (2) take all precautions to forestall the entry of infection into the animal system.

Tetanus

Tetanus or lockjaw is a highly fatal disease occurring as a result of wounds becoming infected with a specific organism, *Clostridium tetani*. The

nervous system is involved and the symptoms are very characteristic. Muscular spasms occur and during spasms the whole body is stiff and rigid. The muscles along the back being stronger, the head and tail are drawn back. The jaws are clenched and the eyes are rolled and show much of the white part.

Tetanus is a soil-borne infection. The germ is a spore former. Since it is capable of occurring in man, the disease has public health aspects, and when cases in animals are suspected the advice of a veterinarian should be sought without delay.

Mastitis, Blue Bag (Inflammation of the Udder)

Mastitis occurs rather commonly in both farm and range flocks. It is caused by infection in the udder.

The commonest causes are the pus-producing organisms known as *Staphylococcus aureus* and *Corynebacterium pyogenes*. In southern Alberta and Saskatchewan the cause frequently is *Pasteurella hemolytica*, an organism that also may cause haemorrhagic septicemia. Predisposing causes include damage to the udder, sore teats, and a concurrent outbreak of sore mouth in ewes.

One or both halves of the udder become swollen, hot and painful. In a few days swelling may extend along the floor of the belly in front of the udder. There is little milk secretion and what there is is abnormal. Abscesses very often develop. If the disease is not arrested, gangrene of the udder (blue bag) sets in. The milk becomes a thin reddish fluid and the udder turns first a dark bluish color and finally black. Eventually it sloughs off. Death may occur within three days of onset. On the other hand many affected ewes recover slowly.

Frequently stripping and bathing with warm water are of value. Medicinal treatment, sulphonamide or antibiotic, is also of value in many cases. Abscesses may be syringed out with antiseptic solution.

There is no treatment for gangrenous mastitis. Amputation of the udder may save the lives of animals that would not ordinarily recover. When the udder and affected areas of skin have sloughed off without amputation local applications are of value. A fly repellent such as pine tar is indicated.

There is no vaccine that will prevent mastitis. It is desirable to cull all ewes with diseased udders from the flock. Sore teats should be given attention. If a lamb is not sucking, the udder should be kept milked out and the ewe permitted to dry off slowly.

Arthritis in Lambs

Arthritis in lambs occurs in two forms. The one form (suppurative arthritis) is caused by pus-producing bacteria, (streptococci, staphylococci and *Corynebacterium pyogenes*), the other (non-suppurative arthritis) by the swine erysipelas organism (*Erysipelothrix rhusiopathiae*). Both forms are common under certain conditions.

In arthritis in lambs predisposing causes are more important than the specific infective agents. Infection usually takes place through the navel of the lamb shortly after birth and the commonest predisposing cause is lambing ewes in dirty, contaminated surroundings. Arthritis may also develop from infection through wounds, especially when young lambs are ear-marked, tagged or tattooed in surroundings contaminated by sheep.

The symptoms are characteristic—lameness, swelling of joints (swelling may be absent in non-suppurative arthritis), carrying a leg, fever, listlessness, and depressed appetite.

In erysipelas arthritis, most lambs recover without treatment within a month, but some develop a chronic lameness and do not recover.

In suppurative arthritis there is marked swelling of affected joints, with the presence of pus in joint cavities. Joints are hot and painful. Frequently systemic infection is present with abscesses scattered throughout the body. Pneumonia is a common complication. The mortality rate is high and the chances of recovery poor. Recovered animals are usually left permanently crippled.

A satisfactory treatment has not been discovered. Antibiotic and sulphonamide treatment in dosages recommended by veterinarians may be of value in some instances. Vaccination is not effective in preventing the trouble. Where the arthritis in a flock is definitely established by laboratory diagnosis to be of the non-suppurative form, the passive immunization of lambs shortly after birth with anti-swine-erysipelas serum is definitely of value. The serum is not effective against suppurative arthritis.

Ewes about to lamb should not be placed in sheds that have been recently occupied by the flock unless its structure permits easy, thorough cleaning and disinfecting prior to lambing. In preventing arthritis it is important that ewes be lambed where there is no contamination by sheep of the ground and litter under foot. Moveable lambing shelters may be used and these moved to clean ground at lambing time. When possible, parturient ewes may be turned to grass on clean ground away from old sheep camps; a temporary fence may be erected for this purpose. Tincture of iodine may be applied to the navels of new-born lambs.

Precautions should be taken to avoid wound infection. Castrating, docking, vaccinating and any other operations should be carried out in a temporary enclosure on clean ground, and animals kept on clean ground until wounds have scabbed over. Similar precautions should be taken when ear marking, tattooing, or tagging sheep. When carrying out various operations, instruments used should be previously sterilized by boiling for 10 minutes and a container of disinfectant solution kept at hand in which instruments are rinsed frequently.

DISEASES CAUSED BY VIRUSES

Contagious Ecthyma (Sore Mouth)

This infection of young sheep and goats is caused by a filterable virus, and is usually observed where large groups are assembled at feed lots and fattening pens. It does occur, however, in farm flocks and range bands on some occasions and spreads rapidly.

Early symptoms are somewhat reddened and swollen lips. Later small vesicles or watery blisters appear. These soon become pustules that rupture in a few days becoming open raw bleeding sores. Scab formation occurs, as a result of which, depending on the severity of infection, the animals may have difficulty in nursing or taking food and water from the troughs.

If secondary infections do not develop from contamination with other bacteria or fly larvae, the scab formation will gradually dry up, falling off in 15 to 20 days without leaving any scar formation.

In nursing dams infection may develop on the udder and teats. An infection of this nature may prevent the young from nursing and in addition result in cases of caked udder and mastitis. In severe outbreaks lesions have also been observed on the ears, under the tail, and inside the thighs.

Human infection may occur where exposure to infected animals has resulted in the virus entering through the broken skin of the hands and face.

Actual infection rarely produces death, except in some instances when complications develop from secondary infections. However, severe infection may prevent the proper intake of food during the important growth stage.

Thus malnutrition may lead to unthriftiness and stunted growth, and such poorly developed individuals become unsuitable for marketing.

Since no medicine is available for specific treatment of this disease, prevention of infection by proper sanitation and vaccination is essential.

In outbreaks of sore mouth the scab dropping from the lesions contains the virus and may remain infective for many months. Thus thorough cleaning and disinfection are important in sheds, barns, and corrals. Infected pastures or ranges should, if possible, be kept free of animals for at least one year.

Animals that have recovered from sore mouth are immune for one or more years. In areas where the disease is common, vaccination is frequently carried out at the time of castration and docking. The vaccine is prepared from dried scab from infected animals and applied by means of a swab over a lightly scratched area inside one thigh. This produces a localized infection and stimulates immunity. The scab from a vaccinated animal is just as infectious as that from a natural infection, so that vaccinated animals should not be in contact with unvaccinated animals for at least three weeks.

Since sore mouth is a highly infectious and contagious disease, caution must be exercised in the use of the vaccine. For this reason it is advisable to consult a qualified veterinarian for information and assistance in handling a flock that is infected or exposed to infection.

Scrapie

Scrapie is a fatal, chronic, wasting disease of sheep, characterized by an extended period of incubation, intense itchiness, progressive weakness and impaired gait. It was diagnosed in Canada for the first time in 1938. "La tremblante" or "prurigo lombaire" are terms used in the French literature to designate the disease.

It is believed that all breeds of sheep, either purebred or crosses, are susceptible even though some breeds appear more so than others. Sex is not a factor. On account of the long incubation period, infected sheep do not show symptoms before 18 months of age. On the other hand, there would seem to be no age limit among older animals.

Many theories have been advanced as to the cause of scrapie. It is considered by most workers to be a filterable virus. Experience has shown that a ram can become infected through either parent and develop symptoms when about two years old, or later. This occurs even when the ram has been castrated or has not been used for breeding purposes. A ram may also become infected from mating with infected females.

Infection can be conveyed by the ram to a healthy flock, the disease appearing in its progeny or in previously healthy females although the ram itself may or may not ever show symptoms. Ewe lambs can bring the disease into a clean flock and not show symptoms until lambing time. A proportion of their progeny may act in the same way and others never show symptoms of the disease. Some authorities are of the opinion that infection may be transmitted through the medium of the pasture.

The long period of incubation is one of the peculiarities of this disease. It is seldom less than 18 months and can be as long as two or three years. In general, the tendency is for the ewes to show clinical signs shortly before or after lambing, while most rams appear to be affected soon after mating.

One of the first symptoms is a loss of bloom on the outer surface of the fleece which assumes a peculiarly dull brownish blue. Later, there is an intense itchiness causing the animal to rub against objects. This thins or

entirely removes the wool, often first on the crown of the head and around the eyes; and afterwards from the lumbar region and the posterior part of the rump. If the itchiness extends to all parts of the body, very large denuded areas may develop. Scratches and abrasions of the skin are caused by the animal scratching. Frequently these become infected and abscesses may occur. In the more acute scrapie cases animals die early and little wool is lost.

If the skin of an infected sheep is rubbed or scratched, especially over an area devoid of wool, the animal will extend its neck, elevate the head and show tremors of the lips. The term "scratch reflex" is applied to this particular symptom.

At the onset of the disease an animal may appear very nervous, frequently get up and lie down or change its position. When approached, it has a startled look and the pupils appear dilated. Excessive movements of the jaw are often observed. Close observation, either in a field or pen, reveals the presence of muscular tremors and nervous twitching of the ears and eyelids. The voice may be altered to a nervous trembling bleat. There is grinding of the teeth. Some sheep when caught develop convulsions so severe they are unable to stand.

Infected sheep have a tendency to move in an aimless and stupid fashion. The gait resembles that of a donkey, the forelegs move in a stiff manner and the animal has difficulty in getting over low obstacles. Later, the hind feet drag slightly on the ground and there may be knuckling at the pasterns and fetlocks.

Frightening or chasing scrapie sheep can promote convulsions, with subsequent loss of consciousness and sometimes frothing at the mouth. These fits last only a few minutes and may recur after a short interval. If the animal does not die following a convulsion it eventually becomes partially or completely paralyzed, with death following in a matter of hours or days. Some animals die without ever exhibiting symptoms of any kind.

Early in the disease, the appetite and rumination remain normal, although thirst is increased. Later, the animal does not eat, rapidly loses weight and becomes emaciated. There is no temperature increase. The disease has an average duration of two to six months, some animals dying within two weeks. Occasionally, an animal has been known to survive for as long as a year. Mortality is high with practically no recovery. Morbidity averages between 4 and 30 per cent.

Autopsy of a scrapie sheep does not reveal specific lesions. The carcass is usually thin and emaciated, with little or no natural fat present. Scab formations and abscesses of the skin caused by secondary infections are sometimes present.

Diagnosis is based on clinical manifestations supported by the results of microscopic examination of certain parts of the brain for the presence of lesions which are considered to be indicative of scrapie.

Two other diseases, scabies and listeriosis, may on occasion be confused with scrapie. Scabies is a parasitic disease of the skin, caused by a mite, and can be controlled by appropriate treatment. When scabies is present usually many animals are affected at the same time whereas with scrapie only a limited number are involved at one time. Listeriosis is a disease of bacterial origin. Infected sheep have a tendency to throw their heads to one side and circle in one direction. Compared to scrapie, the course of this disease is rapid.

There is no known treatment for scrapie. If the disease is suspected, it should be reported immediately to the local veterinarian or to the nearest officer of the Health of Animals Division.

DISEASES OF UNKNOWN CAUSE

Lunger Disease

Lunger disease is a term applied to a chronic fatal proliferative pneumonia of sheep. In Canada the disease occurs predominantly in range sheep in the Western Provinces, where it has been known for many years. The disease is rare in farm flocks. Sheep of all ages may be affected, but the disease is not common in animals younger than three years of age. Most death losses from lunger disease occur in sheep four years old or older. Affected animals are called "lungers" by sheepmen and there is no prospect of recovery.

The cause of lunger disease is not known. Attempts to transmit the disease experimentally have not yielded conclusive results. Diseases that appear to be similar have been reported from South Africa, the United States, England, and Iceland.

If the Icelandic sheep disease is identical with that occurring in other countries, it is of particular interest, because in Iceland it was observed to spread rapidly, after its introduction in 1933, causing great losses; and workers were able to produce the disease in healthy sheep by placing them in contact with affected animals. The severity of this disease in Iceland may have been due to the fact that, since it had never occurred there before its introduction in 1933, the sheep population was highly susceptible. Conversely, the infection may be widely prevalent in other countries, including Canada, and the sheep population as a result highly resistant.

Whatever the cause of lunger disease in Canada, its tendency to occur in range sheep and not to any extent in farm flocks suggests that factors inherent either in the range country itself or else in range management, or both, contribute in some way to its onset. Such predisposing factors may include methods of handling range sheep, irritation of the lungs by dust, and others.

The onset of lunger disease is insidious and it is not known exactly how long animals are affected before symptoms appear. It is generally believed however that the asymptomatic period may extend over several months or even years. The first noticeable symptom is rapid breathing after exercise. Breathing becomes progressively difficult, and respirations more rapid. Affected animals start to lag behind the flock, and when they get out of breath take several hours to recuperate. Heavy labored breathing by older sheep in a range flock is probably the most prominent symptom of the disease. In the final stage, affected animals show heavy flank breathing even when at rest.

Early in the course of the disease animals cough occasionally. Later there are often prolonged, spasmodic spells of coughing. As the disease progresses the facial expression becomes dull. There may or may not be a nasal discharge but usually there is none.

At no time is there an increase in body temperature unless an acute secondary lung infection sets in. There is no loss of appetite; yet affected sheep lose flesh and eventually become extremely emaciated and weak. The disease progresses steadily from the time symptoms are first observed over a period of a few months to over a year.

Eventually death occurs. A few days prior to death, occasionally a secondary infection of the lungs sets in and affected animals may show an increase in body temperature at this time.

Changes caused by the disease are confined largely to the lungs. When the chest cavity is opened the lungs do not collapse but completely fill the cavity, and are rather firm and pale. The lungs may be attached by adhesions to the thoracic wall and there may be an excess amount of pleural fluid.

Usually an accurate diagnosis can be based on the symptoms and post-mortem findings described. When there is doubt, however, a qualified veterinarian should be consulted.

There is no known specific treatment. Although life can be prolonged considerably by good nursing, the desirability of doing so is questionable.

On general principles, although scientific proof is lacking, it seems wisest at present to regard lung disease as infectious and to base control measures upon this premise. In flocks where the disease is definitely known to occur, animals showing symptoms should be removed and slaughtered. A flock owner having trouble with the disease might also plan to market animals before they reach the age when symptoms begin to appear. In buying stock—particularly old ewes—beginners in the sheep business and those contemplating expansion of their flocks should be careful not to introduce lung and other diseases into their flocks.

Pinkeye

So-called pinkeye in sheep is apparently a contagious inflammatory affection of the eyes. Primarily a disease of range sheep, it may also occur in farm flocks.

The specific cause of the disease in Canada has not been fully worked out. It seems probable that a number of different infective agents may be capable of causing pinkeye. In Australia, South Africa, India and other countries, it is considered to be due to an organism known as *Rickettsia conjunctivae*.

Predisposing factors such as irritation to the eyes by wind, dust, wild barley awns, spear grass seeds, etc., appear to be of considerable importance. A watery discharge from the eyes is the first symptom, and on examination the eyelids appear swollen and the lining of the eyelids very red and inflamed. Animals are sensitive to light. As the disease progresses a whitish film forms over the clear part of the eyes causing impairment of vision. The discharge becomes thick and creamy or yellowish in color, gathering in the inner corners of the eyes, and sometimes glueing the eyelashes together. In the summer-time the discharge attracts flies which might play a part in the spread of the disease.

In severe cases, ulcers form on the clear part of the eyes, the film becomes dense, animals become blind, wander aimlessly, and often starve to death. The condition, no doubt, is painful and animals may show fever and loss of appetite. Mild cases recover in less than a month but severe cases may result in permanent blindness.

There is no specific treatment. The application of mild antiseptic lotions, creams or ointments in the eyes is beneficial in checking severe cases. For this purpose, preparations such as penicillin ointment, boric acid solution, 2 per cent yellow mercuric oxide ointment, 10 per cent argyrol, 2 per cent silver nitrate, and others may be used. Perhaps 2 per cent yellow mercuric oxide ointment applied sparingly by gently rubbing into the eyes once daily is as effective and easy to apply as anything. Cases should be removed from the rest of the flock when first noticed and placed, if possible, in darkened quarters. Removal of the early cases helps prevent spread of the disease.

DISEASES CAUSED BY PHYSIOLOGICAL DISORDERS**Ketosis****(Toxemia of Gestation, Lambing Paralysis, Pregnancy Toxemia)**

Pregnancy disease is a very serious problem wherever sheep are raised. The condition is widespread and the high mortality rate renders the condition a costly one for the sheep breeder.

Early studies suggested an infectious cause and at one time faulty elimination was thought to be the chief contributing factor but it is now generally agreed that the disease stems from the lack of adequate carbohydrate in the diet. Failure to take into account the growing demands for carbohydrate as pregnancy advances, and lack of adequate exercise are the two most important contributing factors. Ewes carrying twin lambs are more likely to develop the disease.

Ewes in advanced pregnancy (invariably those carrying twins or triplets) may twitch the ears, have muscular spasms, and show other manifestations of nervousness. The affected sheep lacks appetite and remains outside the general flock. As the disease progresses the affected individual may walk in a circle or stand with the head pressed against some object. It eventually goes down, usually lying with the head turned to one side. Coma finally develops.

After death the liver of affected animals has the color and consistency of butter. This is the most important post-mortem condition.

Treatment of affected animals depends upon such factors as numbers involved, the availability of veterinary assistance, and the stage of the disease.

If the affected animals are still eating, sugar may be added to the ration in the form of molasses ($1\frac{1}{2}$ pounds for big ewes, $\frac{3}{4}$ to 1 pound for medium ewes, and $\frac{1}{2}$ to $\frac{3}{4}$ pound for small ewes). Molasses may also be provided in the form of a drench. A daily dose of 250 to 500 cc. of 25 per cent glucose solution is in order for animals showing early symptoms. One half of the glucose solution should be administered intravenously and one half of the solution should be introduced under the skin.

British workers have reported favorable results using glycerin in the treatment of pregnancy disease. Affected ewes may be drenched with two to four ounces of a solution containing equal parts of glycerin and water. If the treatment is administered early in the course of the disease (24 to 36 hours after the first sign of sickness) one dose of the glycerin solution often effects prompt recovery. In others, two or more doses are required.

The drench is not difficult to give since the glycerin solution is highly palatable to sheep. Advanced cases do not respond to treatment and usually die. As the name implies, the disease is associated with pregnancy. Animals carrying twins or triplets are more commonly affected. An affected ewe able to give birth to her lambs usually recovers promptly and is out of danger from the condition. The disease may recur at later pregnancies.

A well-balanced ration and exercise are the two most important preventives, especially during the last two months of pregnancy. Most cases of pregnancy disease occur in ewes in poor condition on a diet that is insufficient either in quality or amount. Pregnancy disease does not occur in ewes fed for any length of time on good legume hay supplemented with a good grain ration.

DEFICIENCY DISEASES

Stiff Lamb Disease

(White Muscle Disease)

This is a disease that occurs in a number of localities and is characterized by degeneration of the muscles of the legs. Frequently death or severe stunting results unless the animal is treated.

The condition is seen in lambs of one to eight weeks of age when turned out to pasture, and the best lambs in the flock are usually affected. The disease has seldom been reported in lambs born in late May or June, and hot-house lambs have never been known to develop the disease.

All evidence suggests that a nutritional deficiency is the cause. Lack of vitamin E, and in some cases phosphorus, has been involved. Some authorities believe that, while a deficiency of vitamin E is the immediate cause of the disease, a nutritional deficiency of phosphorus may result in incomplete assimilation of the Vitamin E present in the ration. Both agents have been found to have a curative effect.

At first, the affected lamb shows difficulty in rising and following the ewe. This quickly develops into paralysis and inability to rise. The legs may be drawn up into the flexed position due to contraction of the muscles, but apparently it does not pain the animal to manipulate the limbs. General symptoms such as depression, loss of appetite, and fever are notably absent. When a paralyzed lamb is raised up into position it will actively suckle and take milk.

Post-mortem examination usually reveals whitish streaks in the muscles of the affected limbs, which are also dryish and rather firmer than normal muscle. Occasionally similar changes are found in the walls of the heart.

On occasion, this disease has been confused with the infections that cause arthritis, joint ill, or tetanus. However, the absence of general symptoms of sickness helps differentiate between this and other diseases causing stiffness and paralysis.

A proper diet for the ewe with the inclusion of liberal amounts of wheat-germ oil and creep-fed rations have been successful in preventing this condition. One diet that proved effective for ewes consisted of mixed timothy and clover hay, corn silage, and grain mixture with two parts of oats to one of bran.

Trace Mineral Deficiencies

In some districts the soil is lacking or deficient in certain trace mineral elements. Although only a very small quantity of these minerals is required by animals, sheep grazing on such soils show deficiency symptoms unless their diet is adequately supplemented. Iodine, cobalt, and copper are some of these so-called "trace minerals".

Iodine deficiency causes a condition known as goiter in lambs. This condition is not apparent in the adult animal but affects the lambs of animals deficient in iodine. The lambs may be dead at birth or may die soon afterwards. Those that live are weak. The wool has the appearance of hair, and the thyroid gland at the throat is enlarged. In areas where goiter is prevalent this condition is controlled by giving each pregnant ewe one tablespoonful per day of a solution of $\frac{1}{4}$ ounce of potassium iodide in one Imperial gallon of water. This may be administered in the drinking water. If desired, the iodine may be included in the mineral mixture outlined below.

The condition known as "sway-back" is caused by a deficiency of copper. In this disease, too, the adult animals appear healthy and the wool normal. The lambs from deficient mothers, however, show signs of this condition. They are weak and are unable to nurse. Death usually results from starvation. Lambs from mothers that are only partly deficient in copper develop weak bones that are easily fractured. In areas where copper deficiency occurs, four ounces of powdered copper sulphate should be well mixed with the mineral mixture described below.

Cobalt is another mineral that may be deficient in some areas. Sheep affected by this deficiency fail to put on weight, become very thin, and eventually die in an emaciated condition. Animals deficient in cobalt may be given one tablespoonful per day of a solution of $\frac{1}{4}$ ounce of cobalt sulphate in a quart of water. This should be given for a week and then only two or three times a week. The condition may be prevented by providing cobalt in a mixture such as outlined below.

In most districts additional supplies of such common minerals as salt, calcium, and phosphorus are necessary, as a supplement to other feed, to promote maximum growth and development. The following mixture is intended to supply these minerals and to prevent some of the deficiencies described above.

Feeding bonemeal	62	lb.
Ground limestone	5	lb.
Salt	33	lb.
Potassium or sodium iodide	0.3	oz.
Cobalt sulphate	2	grams

Mix the first three ingredients, then dissolve the iodide and cobalt in water and sprinkle it over the mixture. If bonemeal is not available 37 pounds defluorinated monocalcium phosphate and 25 pounds ground limestone may be substituted. Leave this mixture in front of the animals at all times. If desirable, a commercial mineral mixture as prepared for dairy cattle may be used.

PLANTS POISONOUS TO SHEEP

Every aboriginal people has had a sound practical knowledge of the poisonous plants indigenous to its tribal area. In modern civilization this primitive knowledge has become lost to most individuals. Instead, the livestock owner of today receives considerable protection, as far as poisoning by plants and plant products is concerned, through legislation relating to feed-stuffs, and through being, in nearly all instances, within consulting distance of a qualified veterinarian or other advisory service. Consequently no attempt will be made here to present a detailed account of plant poisoning in sheep. Certain broad principles will be outlined and a few of the plant poisonings that have innate importance or are of special interest will be briefly discussed.

Plant poisoning is not likely to occur on carefully cultivated ground or well-managed range or pasture. It is more likely to occur when animals are put to graze on wild land—western ranges, wild meadows, along streams, and in sloughs and woods. As a general rule the poisonous plants are unpalatable and livestock do not eat them when wholesome forage is abundant. There is special danger in the spring because after winter rations sheep and other herbivores have an increased appetite for green growing plants. Often poisonous species put up tempting green shoots before grass becomes green

and animals may eat these and be poisoned. Overgrazing constitutes another special hazard; it encourages the increase of weeds and poisonous plants, which because of lack of grass, hungry animals are compelled to eat. The effects of drought are similar to those of overgrazing.

Good judgment should be used when turning animals to pasture in the spring; in areas where plant poisoning is likely to occur it is probably best to wait until there is ample green grass. Overgrazing should be avoided at all times. As a safeguard against drought, a supply of feed for a year ahead can usually be kept.

Loco Weeds

The loco weeds constitute a group of a few species of plants belonging to the pea family that grow chiefly in the plains and mountain areas of Western Canada. For half a century or more prior to 1910 loco weed disease took a heavy toll of livestock and then suddenly disappeared. In recent years the condition has not been observed.

Camas (*Zygadenus* spp.)

From the standpoint of plant toxicology these plants fall into two groups, (1) the so-called white camas, and (2) the death camas. Two species of white camas occur in Canada, one *Zygadenus chloranthus* Richardson is an eastern species, the other *Zygadenus elegans* (Pursh) Rydb., a western species. Compared with the death camas the white camas are but mildly poisonous and are not a problem with sheep.

The death camas are western species occurring from southwestern Saskatchewan to the Pacific Coast. *Zygadenus gramineus* Rydb. is the species common in southwestern Saskatchewan and southern Alberta while *Zygadenus venenosus* S. Wats is the commoner species in British Columbia. Death camas are very poisonous and most of the sheep losses from poisonous plants in Western Canada occur as a result of grazing where these plants grow.

Death camas grow in meadows and on coulée hillsides among grass, and the plants may be thinly scattered or more numerous in patches. In the spring before flowering camas appear, to the untrained eye, to be grass, but unlike grass grow from bulbs. The species common in Alberta and Saskatchewan blooms early (May or June). The death camas commonest in British Columbia comes into blossom later. The greenish-yellow or greenish-white flowers are borne in elongated clusters (racemes) at the top of the flower stem and are quite showy. The flower stems reach a height of from eight inches to over two feet.

All parts of the plant are poisonous, the seeds being particularly toxic. For the most part, sheep losses occur among animals grazing the green leaves early in the spring. It should be remembered, however, that death camas are deadly at all times and losses may also occur throughout the summer and fall.

Affected animals nearly always froth at the mouth, are nauseated and often vomit. At this stage breathing is quickened and there are signs of muscular weakness, distress, and excitement. Often these early symptoms are not observed, and the first indication of death camas poisoning is the finding of sheep dead or else lying down, in a state of stupor, and unable to rise. This sudden collapse is characteristic. After collapse breathing is slower, but periods of quiet are broken at intervals by spells of rapid breathing, panting, and struggling that last for a few minutes. Fatally poisoned animals lie quietly and breathe heavily. They may lie for many hours or even days without eating or drinking. Ewes in this state will continue to recognize their

lambs. In the more acute cases, however, death without any spasms takes place within from two to six hours. Sheep not fatally poisoned recover rapidly. Some that collapse will regain their feet within a short time and recover uneventfully.

There is no known treatment for death camas poisoning. Prevention consists in keeping sheep away from places where the plant grows. Sheep owners should be able to recognize the plant in its various stages of growth so that they can avoid it. If it should be necessary to drive a flock of sheep across an area where the plant is abundant, the animals should be well fed before starting since hungry animals are more likely to be poisoned. Even then there is some risk because the plant is so highly toxic.

Water Hemlock (*Cicuta* spp.)

The water hemlocks are the most poisonous plants occurring in Canada but fortunately seldom cause losses in sheep flocks. One or more species occur in every province. All are equally poisonous and similar in habits of growth, and hence can be considered as a group. The plants grow in water or close to water in sedgy sloughs, lakes and ponds, wet meadows, and swampy places in general. Water hemlock belongs to the parsnip family and the inexperienced person is likely to confuse it with certain other wild plants belonging to this family, especially the water parsnip.

The plant grows two to five feet high or higher, and has compound heads (umbels) of tiny white flowers. The root is characteristic and perhaps the easiest way for the non-botanist to identify the plant is to examine the root. If the rootstock (the part just below the stem) is cut lengthwise, it will be found to be divided into narrow transverse chambers, separated by narrow partitions. The roots, attached to the outside of the rootstock, may be thick and fleshy or thin and fibrous, depending on the species of water hemlock.

The rootstock and roots are poisonous at all times. The young shoots are also poisonous. In the heat of summer the tops are somewhat less poisonous and may even be innocuous. This is due to the fact that the poisonous principle, cicutoxin, is very sensitive to temperature change, being polymerized by heat.

Poisoning of livestock usually occurs in early spring, when alternate freezing and thawing has heaved and loosened the roots. At this time the roots are likely to be pulled up by their spring shoots and eaten by grazing animals.

In water hemlock poisoning death may occur in less than an hour; the poisoned animals found dead show signs of agonized struggling. The first symptoms are frothing at the mouth and signs of colicky pain, followed rapidly by violent intermittent convulsions ending in death.

There is no treatment for water hemlock poisoning. Prevention consists in keeping animals away from the plants. The plants can be fenced off or they can be pulled, allowed to dry, and burned. As they are seldom present in large numbers and are easily dug up, the cost of clearing a farm of the plant is seldom excessive.

Cyanogenic Plants

A number of species of plants when eaten by sheep cause a rapidly fatal poisoning due to release of prussic acid in the stomach after the plants are eaten. Such plants include the various *Prunus* spp.—choke cherry, pin cherry, wild black cherry, etc.—and arrowgrass. From the standpoint of sheep husbandry they are of little concern.

Lupines

Although several poisonous species of lupines occur in the area extending from the foothills of the Rocky Mountains to the Pacific Coast, these plants seldom give rise to a stock poisoning problem. On the contrary they are considered nutritious grazing plants. However, on occasions sheep are poisoned by eating lupines.

The plants are most poisonous when in pod. Since the poisonous principle in lupines is very rapidly eliminated by the animal system—chiefly in the urine—poisoning does not occur unless a considerable amount is eaten quickly. Thus an amount that would result in fatal poisoning if eaten within an hour, is quite harmless if eaten over a period of several hours. A sheep eating slowly throughout a whole day can safely consume much more than the fatal amount.

Symptoms include drooping of the ears, excitement often bordering on frenzy, and butting or pushing the head against other animals or objects. Death may occur very suddenly or not for two or three days. In mild cases of lupine poisoning animals breathe heavily and have a sleepy appearance.

There is no treatment. Prevention of lupine poisoning consists in keeping sheep from lupines when they are in pod.

Selenium Poisoning

Certain soils in Saskatchewan, Alberta, and British Columbia contain small concentrations of the poisonous chemical element selenium. Selenium exists in these particular soils in too low a concentration for most plants to pick up. A few plants however are able to take up and store selenium in large amounts. When such plants die a high concentration of the element is left, and in a seleniferous area where selenium-concentrating plants are numerous the soil accumulates a concentration of selenium easily available to crop and wholesome forage plants. The latter may then take up sufficient selenium to be harmful to animals. In addition, grazing on selenium-concentrating plants may result in acute selenium poisoning.

The commoner selenium-concentrating plants in Western Canada include two-grooved milk vetch, pectinate milk vetch, timber milk vetch (British Columbia), salt bush, gum weed, poverty weed, and others. However the occurrence of any of these species in an area does not mean that either the plant or the soil necessarily contains selenium. On the contrary, the various selenium-concentrating plants are quite common on non-seleniferous soils within their geographic range. This explains why some plants are considered poisonous to livestock in one area and not in another.

Vegetation containing selenium is unpalatable and not eaten unless wholesome forage is scarce or lacking. Hence this form of poisoning is commoner in dry years and on overgrazed pastures. Consumption of forage with a relatively low selenium content over a period of a few months usually leads to a condition of general unthriftiness. Acute selenium poisoning known as "blind staggers" may occur from grazing the "concentrating" plants. Since symptoms in the acute form of poisoning derive from paralysis—the parts paralyzed varying somewhat from animal to animal—they tend to vary. Leg weakness and difficult, noisy breathing have been observed in sheep poisoned by timber milk vetch. Impairment of vision has also been described.

Treatment of the chronic form consists in changing animals to non-toxic pasture or fodder. In the acute disease, strychnine given by hypodermic

injection has given good results. Dissolve 1 gram of the drug in 2½ ounces of water and give 1.0 cc. every two hours for three or four doses. Also drench the affected animals with warm water.

Prevention includes avoiding overgrazing of pasture, changing to selenium-free feed, and keeping a feed supply ahead to tide over drought years.

Colorada Rubber Weed

This plant, *Hymenoxys Richardsonii* (Hook) Cockerell, is common on dry plains in Saskatchewan and Alberta. Although evidence as to its toxic characters is lacking in Canada, in the United States it is considered by some authorities one of the more important plants poisonous to range stock. It grows one to three feet high and has very narrowly divided leaves. Each plant forms a cluster topped by many showy yellow flowers.

Sheep are likely to be poisoned by grazing the tops in early spring or fall (in summer in overgrazed range). However since the plant is very unpalatable animals will eat it only as a last resort.

Sweet Clover

Sweet clover is a valuable, nutritious legume. It should be mentioned, however, that moldy or spoiled sweet clover in the form of hay or silage, or damaged tufts in pastures, may contain dicoumarin, a substance capable of causing delay in clotting of blood. Wounds sustained by animals receiving sufficient of this substance may bleed freely or fatally. It is therefore good practice to withhold the feeding of sweet clover for a period of two weeks before performing surgical operations, such as castration or docking. The feeding of obviously *moldy* or otherwise *spoiled* sweet clover has so frequently resulted in fatal haemorrhages that in view of its potential danger it cannot be recommended for the feeding of livestock. It is emphasized that these remarks do not refer to the plant which has been properly cured.

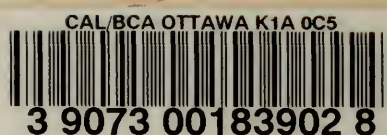
CHEMICAL POISONING

In the everyday pursuits of modern agriculture more and more chemicals that may, under certain conditions, be poisonous to animals are coming into common use. These include substances like lead arsenate and various complex compounds used for killing plant and insect pests, calcium cyanide used for killing animal pests, carbon tetrachloride used for killing animal parasites, and many others. The greatest care should be taken in handling such substances. The labels on the containers of such products should be read carefully and partly used packages and empty containers should not be left where sheep can gain access to them.

A few of the more common poisonings will be discussed in detail here.

Lead Poisoning

This is the most common form of poisoning in farm animals. Various lead compounds widely used around the farm have caused death. Among these are the various lead-containing paints, and lead arsenate used in insect sprays. Animals are often poisoned by chewing the paint off old paint cans that have been thrown in fields or on garbage dumps, or by eating grass under trees that have been sprayed with lead arsenate. It is interesting to note that the toxic action of lead arsenate is due to the lead rather than the arsenic. Old storage batteries have also caused lead poisoning.



In severe cases the affected animal may stagger or may go down and be unable to rise. Nervous symptoms are usually observed. The animal may be excitable and hard to control, it may walk in circles, bump into obstacles as though blind, and bleat as if terrified. Diarrhea may develop. Mortality in such cases is high.

Arsenic Poisoning

Until fairly recently arsenic compounds were commonly used on farms as insecticides, weed killers, rat poisons, and in animal remedies, and the misuse of these preparations was responsible for the loss of many animals. Paris green, which is an arsenical compound, is still a rather frequent cause of poisoning.

Poisoning has occurred when animals have had access to containers left carelessly in the field or have licked buckets in which the material has been mixed. Only a small quantity may be fatal; as little as one-half ounce of arsenic can kill a sheep.

The death of one or two animals is often the first thing that attracts attention. On examination of the flock other sick animals may be found. The symptoms consist of staggering, twitching of muscles, difficulty in breathing, restlessness, and excessive salivation. If animals have not consumed a very large dose, they may live for a number of days and develop a diarrhea that may be bloody.

Handling of Cases of Suspected Poisoning

Where poisoning is suspected a veterinarian should be called immediately. If the cause of the poisoning has not been definitely determined a careful search should be made of the pasture and other places where the sheep may have been in order to determine the exact chemical involved in the poisoning, as specific treatment will depend upon the chemical involved. For example, dilute sulphuric acid or sulphates are used to treat lead poisoning, while sodium thiosulphate and ferric hydrate are used to treat arsenic poisoning. Until the cause of the poisoning has been found it is advisable to move the rest of the flock from the premises where the poisoning occurred.