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DISEASES OF SHEEP

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DISEASES OF SHEEP

J. A. HOWARTH¹

INTRODUCTION

SHEEP RAISING is one of California's most important agricultural industries; with a sheep population of 3,100,000 and an annual wool production of 22,825,000 pounds, the state ranks among the highest in the United States.² The raising of spring lambs for eastern shipment has in itself become a major enterprise, with a revenue that constitutes an important economic return. The increasing numbers of animals, the decreasing acreage of open ranges, and the high price of land have resulted in the congestion of the sheep population on smaller areas. Naturally, pollution of the soil with infective agents such as bacteria, viruses, and parasites is sure to follow. If mutton, lambs, and wool are to be produced economically and profitably, the health of the animals is the first consideration. The prevention of sheep diseases is far more important than their treatment and cure.

This bulletin is intended primarily as a help in making diagnoses; thus it may aid in the prevention and control of certain sheep diseases. It is also hoped that it will serve as a guide to veterinarians and for this reason the technical descriptions of causal agents are included.

This bulletin does not deal with plant poisoning nor with diseases caused by animal parasites, such as scabies, liver fluke disease, worm infestation, or grub in the head. Publications on these and similar subjects are among those listed at the end of this publication.

ANTHRAX

(Woolsorters' disease, charbon, splenic fever)

Anthrax is an acute infectious disease caused by *Bacillus anthracis*, which affects not only sheep, but cattle, horses, swine, goats, and many other species of animals. Man is also susceptible to it. The symptoms are so variable that even a veterinarian who has had much experience with anthrax cannot definitely diagnose a case without the aid of laboratory facilities. In sheep it usually has the characteristics of an acute septicemia or blood poisoning with hemorrhages from the body openings. It is not usually transmitted directly from one individual to another.

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² U. S. Dept. Agr. Crops and Markets 10(No. 10). 1933.

Infection may occur through wounds in the skin, through the respiratory tract, or through direct inoculation by the bites and stings of insects. Sheep eating foods contaminated by carcasses of animals which have died of the disease, or grazing in pastures, or drinking water similarly contaminated, are the most liable to become infected. This disease is always serious, and recovery is rare.

Description of Organism.—The organism, *Bacillus anthracis*, is a nonmotile sporulating rod, averaging 1.0 to 1.5 microns in thickness and varying from 4 to 10 microns in length. The organism, when grown on artificial media, forms long chains (fig. 1). The ends of the bacillus are usually square cut. The spores of *B. anthracis* are centrally located and will not be found in the blood or tissues unless the carcass has been exposed to air for some time. The bacilli themselves are readily destroyed, but the spores are very resistant and will survive after long immersion in many antiseptics.

Conditions Under Which Anthrax is Likely to Occur.—One of the most noticeable characteristics of this disease is its occurrence in certain areas which, in many cases, residents of the community have learned to recognize. Some farmers call these "anthrax spots" and at certain times of the year keep the animals off such ground. In California, cases of anthrax have been known to occur in nearly all parts of the state; however, it is much more frequent in swampy, low-lying, or poorly drained areas where the soil is rich in organic matter. Such lands are known to be so dangerous that farmers learned early in the settlement of the state not to pasture animals on them during the hottest seasons of the year.

Symptoms.—Symptoms of anthrax are so similar to those of several other diseases and poisonings which cause rapid death, that they cannot be relied upon, except when considered in connection with the previous history of the land with respect to anthrax and knowledge of the conditions under which the animals have been grazing. In sheep, the course of the disease is more apt to be rapid, "peracute" or "acute" than in other animals.

When infection gains entrance through the digestive tract, the manifestations of this disease are hard to detect, because of the sudden onset and the rapid, fatal course it pursues. The peracute and acute forms usually terminate fatally in from 2 to 24 hours. The temperature of the animal affected is high at first (105° to 107°); but before death it may become subnormal, and respiration becomes greatly increased. Labored breathing, blueness of membranes, restlessness, and—toward the end—convulsions or spasms of the muscles are evident. There is usually blood oozing from the body openings. Swellings in the neck region are occasionally observed.

When infection occurs through a wound in the skin, there will be, at the point of entrance, a swelling, which at first is hot and painful but

later becomes cold and painless. This type of localized infection may later assume the septicemic form, which soon proves fatal.

What to do When Anthrax is Suspected.—When animals are suspected of having died of anthrax the carcass should not be opened, because of the danger of human infection and of spreading anthrax spores in the soil, thus permanently infecting the land. It is advisable to submit a specimen to a laboratory for diagnosis. When possible, a veterinarian should be consulted. Being well trained and having the

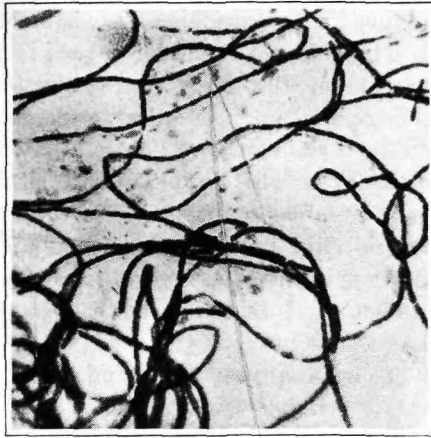


Fig. 1.—Anthrax organisms—a culture from blood of sheep dead with this disease.

necessary equipment for this work, he is able to secure specimens from the carcass without contaminating the soil. Where such services are unobtainable, remove an ear of a suspected carcass, close to the head, wrap it in cloth which has been dipped into a 1:1000 solution of bichloride of mercury, place this in a jar having a tight cover, pack well in a box containing paper or sawdust so that the glass container will not be broken in transit, and send it to a laboratory for examination. Proper disposal of the carcasses is of great importance to the welfare of the community, because infection may be spread to adjoining farms by dogs, cats, buzzards, and insects.

Burning all carcasses of animals dead of anthrax is the most desirable means of ridding the place of infection. All soil contaminated by blood or discharges from the carcasses should be thoroughly and deeply burned over, so as to kill any anthrax organisms that may have penetrated into the soil. Burial of carcasses has been carried out with good results, provided they are buried at a depth of 5 to 6 feet. All knives, clothing, and other objects coming in contact with the infected material

should be placed in full-strength coal tar disinfectants (dip) for several hours and then boiled for a similar length of time. If the hands are contaminated, wash them thoroughly with hot water and soap, and then with a 1:500 solution of bichloride of mercury or other equally strong disinfectant.

One of the most dangerous procedures in outbreaks of anthrax in sheep is an attempt to salvage the pelts. Serious outbreaks spreading from sheep to cattle and man have resulted from this procedure.

Postmortem Lesions.—Many conditions other than anthrax may cause death in sheep and produce symptoms and postmortem appearances similar to anthrax. The changes found in tissues of animals dead of anthrax are oftentimes not absolutely characteristic. In some cases, almost no disease change is found. The following description will apply, however, to the average case in sheep.

Animals dead of anthrax will exhibit gelatinous infiltrations and hemorrhages in the subcutaneous tissues and in the serous membranes. The heart is flabby and dark in color, with pronounced hemorrhages throughout. The spleen is enlarged to several times its normal size; and its pulp is dark and softened. In some such cases, the capsule will be extremely tense; and if it is cut into, the semifluid pulp will drain out almost completely. The blood appears dark and tarry; it shows little or no tendency to clot, but remains fluid-like for a long time after death. The liver and kidneys are congested. The digestive tract shows a severe inflammation with hemorrhagic areas. The intestinal contents may be bloody because of the extensive hemorrhages. The lungs are congested or reddened and exhibit small hemorrhages, while the trachea (wind-pipe) contains great quantities of frothy, blood-stained material. The lymph glands are swollen, reddened, and hemorrhagic. The bladder presents many hemorrhages, and the urine contained therein is reddish in color because of the escape of blood into the organ. The abdominal cavity may contain great quantities of a yellowish-red fluid.

Treatment and Prevention.—Sheep affected with anthrax will expire before treatment can be of any value. Those grazing on infected or contaminated pastures, or those which have been with a band of sheep where losses have been encountered, should be moved to clean areas. The administration of from 5 to 10 cc of anthrax aggressin may produce an immunity sufficient to protect against a natural infection.

The administration of spore vaccines to sheep and goats, even when combined with anthrax serum, has invariably been followed by unsatisfactory results and should never be used. A new product called Carbozoo, however, discovered by Italian workers and recently introduced into the United States, is recommended by its distributors as a safe

immunizing agent for sheep and goats. As yet the author has had no opportunity to observe its use.

"The bacterial vaccine used in immunizing from anthrax is not free from dangerous properties, since it contains living organisms; hence it should never be used except where the disease has already appeared, and only by qualified veterinarians, as improper handling may result in the serious extension of the very disease that it is desired to eradicate."³

When anthrax is known to exist, the law requires that the case be reported to the Chief of the Division of Animal Industry, Department of Agriculture, Sacramento, California.

TETANUS

(Lockjaw)

Tetanus is an infectious disease characterized by spasms of the muscles. This affection can be regarded almost solely as a wound complication in which the organism causing this disease, *Clostridium tetani*, gains entrance through a cut or wound. The infection frequently follows castration, docking, shearing, ear tagging, and difficult lambing, or attacks the navel cord. It may occur without a recognizable wound. The bacteria occur in earth, in putrifying fluids, in manure, and in the intestines of many animals.

Tetanus spores gain entrance into wounds not only from manure and soil, but also from the hands, instruments, and other objects. The infection is much more prevalent in warm than in cold countries. The incubation period in sheep is usually from three to seven days, but may be longer. The symptoms of this disease are caused by a toxin or poison given off by the tetanus bacillus which is produced in the wound and is then transported by the blood stream or along the nerve roots to the spinal cord and brain.

Description of Organism.—The organism causing tetanus is variously known as *Clostridium tetani*, *Bacillus tetani*, or bacillus of Nicolaier. It is a slender, sporulating rod with rounded ends, 4 to 8 microns long and 0.3 to 0.8 micron in thickness. The spore is round and is usually situated at the end, giving the organism a drumstick appearance. This organism usually occurs singly, is motile by peritrichous flagella, and stains gram-positive. It is an anaerobe which grows at ordinary temperature.

Symptoms.—In sheep the first symptoms are nervousness, slight stiffness, rigidity of the neck, slow mastication, and difficult swallowing. Stiffness of the neck muscles causes drawing back of the head. The facial appearance changes because of spasms of the muscles, and the animal looks frightened. The lips tremble and may be drawn or protruded. In

³ Washburn, Henry J. Anthrax or Charbon. U. S. Dept. Agr. Farmers' Bul. 784:1-14. 1931.

sheep the membrane nictitans or third eyelid may or may not be drawn over the eyeball during a convulsion; in some cases the upper eyelid is raised, exposing a large part of the white of the eye (fig. 2). Sometimes the muscles near the wound show spasms. Spasms of the leg muscles are pronounced, and the limbs will be rigid and extended. Gradually the muscles of the body are involved, and the entire trunk and limbs may



Fig. 2.—The lips are drawn and the upper eyelids raised, exposing a large part of the white of the eye and giving the animal a frightened appearance—a condition caused by tetanus (lock-jaw).

be perfectly rigid (fig. 3). The muscles of the abdominal wall may become fixed.

The animal is readily disturbed; sudden noises or external stimuli give rise to sudden convulsive spasms, which may be short or may last for several seconds; but even in the intervals the relaxation is not complete. The animal will show agonizing pain during a spasm, and afterwards blueness of the membranes; and labored breathing is present. The animal retains consciousness. Death occurs during the spasms from heart failure or asphyxia, or results from exhaustion.

Postmortem Appearance.—In tetanus, no characteristic postmortem changes are evident except a few minor changes in the brain and cord.

Prevention and Treatment.—Tetanus frequently occurs in sheep after

docking, castration, and shearing, and causes heavy losses in certain localities. The ground around the ranch barns, lambing sheds, and corrals is a fertile place for tetanus spores. The use of a new location on the ranch or range each time for docking and castration will materially help in preventing animals from becoming affected. This plan can easily be carried out by using temporary wire or wooden corrals; but, if it is impossible, the lambs should not be allowed to remain in the old corrals



Fig. 3.—Lamb affected with tetanus (lockjaw) showing spasms of the leg muscles, causing them to be rigid and extended. Stiffness of the neck muscles causes the head to be drawn back.

any longer than necessary. Losses following shearing can be materially reduced if tincture of iodine or some other good antiseptic is applied to wounds inflicted during shearing. In cases where wounds have not healed properly and there is pus-infected tissue under the scab, the scab should be removed, and tincture of iodine or some other good antiseptic applied.

Treatment of this disease is of little value in sheep, for the time and expense necessary are not proportionate to the economic value of the animal.

The specific action of tetanus antitoxin makes it a valuable prophylactic and a trustworthy preventive. One would be justified, however, in administering a prophylactic dose of tetanus antitoxin (100 units) to lambs before docking or castration only provided their economic value warrants it, as in the case of lambs from great sires or dams, or lambs with show-ring possibilities.

Sheep showing symptoms of tetanus should be immediately killed to prevent further suffering.

BLACKLEG

(Symptomatic anthrax, black quarter)

Blackleg is an acute infectious disease of sheep caused by *Clostridium chauvei*. It is characterized by gaseous, doughy swellings and by a dark, blue-black discoloration of the skin, usually along the abdomen and brisket or on the inner parts of the thigh. In all probability, the infection gains entrance by way of wounds. Although sheep of all ages are susceptible, they have a greater resistance to this disease than cattle. *Bacillus chauvei* is commonly found in the soil, especially where calves have died of this disease. The bacillus of blackleg or its spores may gain entrance into the animal's tissue through wounds following docking or castration in lambs and shearing cuts or other abrasions in older sheep.

Description of Organism.—The organism, *Clostridium chauvei* (*Bacillus chauvei*) is a strict anaerobe and usually stains gram-positive. It is a motile sporulating rod with rounded ends, about 0.5 micron in thickness and from 2.5 to 6 microns in length.

Symptoms and Lesions.—In sheep the disease runs a much more rapid course than in cattle, and death may occur before any pronounced symptoms have been observed. The animal will exhibit signs of great pain and lack of appetite; breathing will be short and rapid. Closer examination reveals a dropsical swelling where the organism has gained entrance into the tissues. The affected part is at first hot and painful, but soon becomes cold and painless, exhibiting a dark, blue-black discoloration of the skin. Occasionally a red, watery fluid oozes from the wound; and if an incision is made into the swollen area the muscles will be found dark reddish-black and spongy. Evidence of gas formation under the skin and between the muscles may be found. Characteristic blackleg odor (sour or rancid) is emitted from the affected tissues. As in anthrax, the carcass rapidly decomposes and bloats to an enormous size after death.

Prevention and Treatment.—Proper care of wounds and lacerations will materially help in preventing this disease. Sheep on areas known to be infected—that is, where calves have died of blackleg—can be successfully vaccinated against the disease by the administration of 2½–3 cc of blackleg aggressin as prepared for cattle. Treatment of sheep affected with blackleg is usually unsuccessful because of the rapid and fatal course of this disease.

MALIGNANT EDEMA

(Gas gangrene, traumatic gangrene)

Malignant edema is an acute infectious disease characterized by crepitating fluid-like swellings and caused by the invasion of the tissues by an anaerobic organism. Infection gains entrance through wounds or breaks in the skin or mucous membranes. The organism is widely distributed in the soil, and infection frequently follows castration, shearing, docking, and difficult lambing, especially when the animal has received help with no regard for sanitary precautions. The organisms causing this disease are confined to the lesions and are seldom numerous in the blood stream during life. This disease is usually fatal in from one to three days. This malady is sometimes mistaken for blackleg.

Description of Organism.—The causal organism, *Clostridium oedematis maligni* (*Vibrio septique*) is a motile sporulating anaerobic bacillus, 3 to 8 microns long and about 1 micron wide. It is motile by means of peritrichous flagella. The spores are usually centrally located but may be found near the end. The organism occurs singly, in pairs, or in long chains. It is gram-positive; occasionally it may appear gram-negative because of the too long decolorization.

Symptoms.—At the seat of infection, the tissue becomes swollen, hot, and painful and may produce a crackling noise when pressed upon. A fetid, reddish-brown fluid may be seen discharging from the wound, the margins of which will usually become necrotic or dead. Animals affected with this condition go off feed, the respirations are rapid, and the temperature rises to from 104° to 106° in the acute stage but becomes lower than normal before death. As the disease progresses, extensive swellings are noticed and may involve the entire side of the animal.

If the infection gains entrance into the reproductive organs after lambing, the vulva and surrounding tissues will be greatly swollen, filled with fluid, and badly discolored. The animal will strain violently, and a foul-smelling discharge will be expelled from the uterus. Prolapse of the vagina and rectum is often a complication caused by the continual straining.

Postmortem Appearance.—If the swelling is cut into, a yellowish-red serous fluid will ooze from the cut surface, and in it will be small gas bubbles that give off a characteristic sour, rancid odor. The fluids will extend down deep into the intermuscular connective tissue, while the muscles may be pale yellow or dark red, brittle, and easily torn.

Varying quantities of a reddish, serous fluid are found in the abdominal cavity. The abdominal organs do not, however, show extensive changes, except the spleen, which is swollen and soft. The blood is darker than normal, and clotting is incomplete.

Prevention and Treatment.—Prompt antiseptic treatment of wounds is always advisable. Clean the surface of the wound and apply tincture of iodine, a weak solution of cresol dip, or some other good antiseptic, to the abrasion. Treating animals affected with this condition has been of little value, not only because of the extensive involvement that has taken place before the animal is found but also because there is no reliable biological agent to combat the toxins produced. A triple anaerobe serum which is on the market at the present time is very effective. This will materially aid in combating both the primary and secondary invaders. Free incision of the infected region, followed by the administration of from 50 to 100 cc of the triple anaerobe serum under the skin and into the muscles, is advisable. Part of the serum should be injected into the healthy tissues around the affected area, in this way blocking off the infected region.

CASEOUS LYMPHADENITIS

(Boils, pseudo- or false tuberculosis)

Caseous lymphadenitis is a chronic infection of sheep and goats characterized by caseous abscesses, especially of the lymphatic glands, and associated, in long-standing cases, with emaciation. Most authors believe that the infection may enter the body by way of the respiratory passages, the digestive tract, wounds, or the navel. This disease is more prevalent among aged and broken-mouthed ewes than among any other class of sheep.

Description of Organism.—The organism causing this affection, *Corynebacterium pseudotuberculosis* (Preisz-Nocard bacillus), is a nonmotile, nonsporulating, pleomorphic rod 0.5 micron in thickness and from 1 to 3 microns in length. This organism stains gram-positive and is classed as an aerobe and facultative anaerobe.

Symptoms.—Affected animals may stay in good condition and the disease be detected only after the animal is slaughtered. Many animals will show no symptoms except a long-standing progressive emaciation and a dry, lifeless fleece; others may exhibit painless tumors of the lymph glands, especially those located in front of the shoulder and hip (fig. 4). Often, when the lungs are involved, sheep will exhibit symptoms of a chronic pneumonia. The respirations are rapid and labored. Occasionally painful coughing and a nasal discharge are present.

Postmortem Appearance.—The carcasses of animals that have died or that have been killed in the advanced stages of this disease will be poorly covered with flesh. The external lymph glands may be greatly enlarged and may contain gritty abscesses which, when cut into, will show a greenish-yellow, cheesy pus. Sandy or gritty particles may or may not be found in the abscess material. The connective tissue capsules

of these abscesses are thick, with a smooth inner surface. It is not uncommon to find one or more of these gritty abscesses in the muscles, such as the muscles of the thigh and between the ribs.

The lymph glands located between the lungs are a common seat of involvement. Abscesses varying from the size of a millet seed up to three inches or more in diameter may be found in the lungs (fig. 5). Other

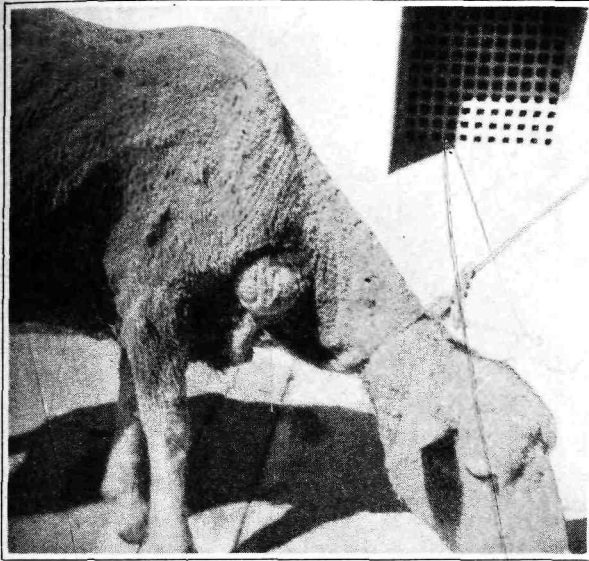


Fig. 4.—Large abscess in lymph gland just anterior to the shoulder, characteristic of caseous lymphadenitis.

lung lesions are usually present, involving great areas of tissue as in the usual pneumonic lesions. In many cases the lungs are attached to the chest wall by fibrous adhesions. The liver, spleen, kidneys, and occasionally intestines, show caseous abscesses.

Prevention and Treatment.—There is strong evidence that the majority of sheep having this disease become infected through the skin. Therefore to prevent the entry of the bacilli through cuts and wounds, especially after shearing, apply tincture of iodine, 5 per cent solution of cresol dip, or other suitable antiseptics to the wounds. When shearing, if an abscess is cut into, the operator should place his shearing blades in a strong solution of cresol (allowing the machine to run) for several seconds, thus helping to prevent inoculation of the organisms into other sheep, should they be cut. The organism causing this disease can often be isolated from the pus present in infected shear-cuts examined.

Soil may become contaminated by discharging lesions and possibly

by the feces. Corrals, lambing sheds, and camp grounds are a source of danger, because of the great amount of feces and litter; and under suitable conditions of moisture and temperature, the organisms may multiply. Infection of wounds after marking and shearing may be greatly reduced if the sheep are immediately placed on clean ground. Sheep



Fig. 5.—Abscesses caused by caseous lymphadenitis. They occur about the size of a millet seed up to three inches or more in diameter, and are located in the lungs and the glands between them.

exhibiting enlarged glands about the head, anterior to the shoulders, or in front of the flanks, should be carefully examined and disposed of if found affected. Many times when this condition is well advanced and the animal shows emaciation, the case is wrongly diagnosed and treated as a heavy infestation of worms. Disinfection of the navel should be a routine procedure in localities where this disease is prevalent. There is no known treatment for this disease.

POLYARTHRITIS

(Stiff lambs)

Polyarthritis, commonly called "stiff lambs," is a chronic arthritis (inflammation of the joints), usually appearing in lambs from two or three weeks to several months of age. The disease presents a chronic

course, with arthritis of one or more joints; lameness, stiffness of gait, lack of growth, and loss of condition are pronounced.

Description of Organism.—The organism causing this disease is indistinguishable from *Erysipelothrix rhusiopathae*, the bacterium causing swine erysipelas. It is a

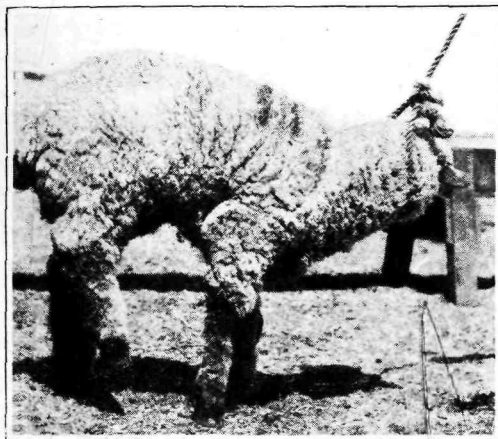


Fig. 6.—Lamb affected with polyarthritis, showing knee and stifle joint of right legs affected; emaciation and unthriftiness are pronounced.

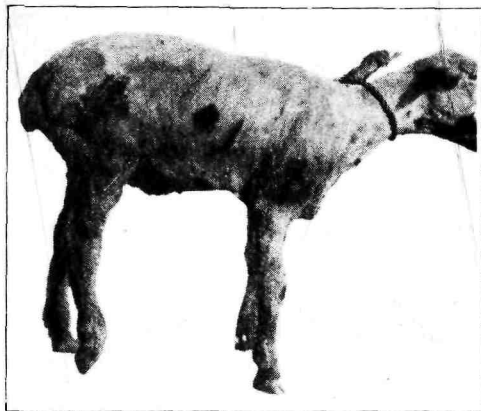


Fig. 7.—Yearling sheep affected with polyarthritis. The condition of the animal shows the inadvisability of keeping lambs affected with this disease.

pleomorphic diphtheroid, gram-positive, nonsporulating, nonmotile, facultative anaerobic rod; the length may vary from 1.0 to 2.5 microns, and the width is 0.2 to 0.5 micron.

Symptoms.—There is usually lameness in one or more legs, and the lamb walks with a peculiar stiff gait, moving only when urged; locomotion

tion gradually becomes more painful. In the early stages of the disease the infection may fix itself in one joint, but more commonly several joints become swollen and tender. No external signs of inflammation appear, for the skin over the joints is not discolored or hot; at this stage the lesions are confined to the synovial membranes of the joints. The progress of the disease in different lambs is variable: many joints may be affected in a short time, or the involvement may extend over a long

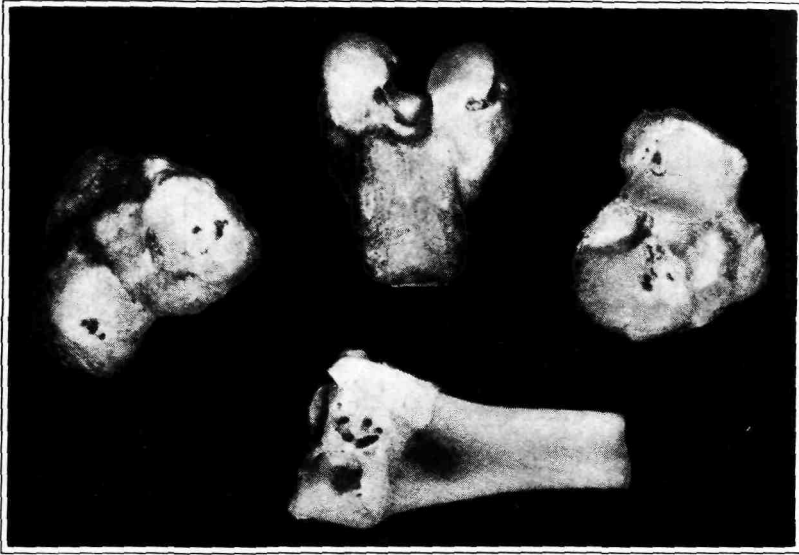


Fig. 8.—Lesions penetrating the articular cartilages and extending into the bone, in a case of polyarthritis in sheep.

period. The pain is severe, and the swellings increase in size. As the disease advances, general unthriftiness, loss of weight, and lessened strength and endurance are pronounced. In most cases where the lameness has been severe, muscular atrophy (wasting away) of the shoulders, hips, or thighs is a prominent symptom (figs. 6 and 7).

Postmortem Lesions.—Lesions are most marked in the knee, shoulder, hock, and stifle joints. If an inflamed joint is opened, there will usually be found a chronic inflammation; it may contain fluid or perhaps a mass of adhesions. Also, there will usually be found degenerative changes in the form of small erosions in the articular cartilages and partial destruction of the bones (fig. 8). Irregularities in the shape of the joints are often seen, but fixation is seldom met with. The muscles most often involved are those of the hind legs, hips, and shoulders. This wasting away of the muscles causes shortening of the muscular fibers—hence the inability of most of these lambs to extend or flex the legs fully.

Prevention.—Experimental and field observations give indirect evidence that this organism enters by way of castration and docking wounds, but in some cases infection may gain entry by way of the navel.

Infection may be materially lessened if the lambs are placed on clean pastures at the time of castration and docking and are not allowed around the corrals until the wounds heal.

General sanitation of the lambing sheds and corrals is the greatest factor in controlling and preventing this disease.

It is not profitable to raise lambs once they show typical symptoms and lesions of polyarthritis.

PARATUBERCULOUS ENTERITIS

(Johne's disease)

Paratuberculous enteritis is a chronic infectious disease causing a thickening and corrugation of the lining of the intestinal tract. An acid-fast bacillus indistinguishable from Johne's bacillus is the causative agent in this disease. The organisms are found to be most prevalent in the affected parts of the intestinal mucosa.

Description of Organism.—This disease is caused by *Mycobacterium paratuberculosis* (Johne's bacillus) and is an acid-alcohol-fast, nonmotile, nonsporulating rod, about 0.5 micron wide and 1 to 2 microns long. The organisms are found singly, in pairs, or in groups or clumps. Johne's bacillus is a very difficult organism to cultivate on artificial media.

Symptoms.—The symptoms are general emaciation, unthriftiness, tucked-up abdomen (fig. 9), intermittent diarrhea, and occasionally an elevation of temperature. A marked reduction occurs in the milk secretions; the appetite does not seem to be greatly impaired. Sheep affected with this disease survive for long periods; some improve at times, only to have a relapse later. The affection is confined mostly to aged sheep. During gestation (carrying of young) the symptoms and lesions seem to be intensified; losses are always greater after lambing time. This disease could easily be confused with a heavy infestation of worms.

Postmortem Appearance.—Postmortem examination usually shows that the carcass is very poorly covered with flesh, the intestinal tract being the seat of greatest involvement. There is a great thickening of the walls of the large and small intestines and, in the more advanced cases, of the cecum or blind gut. The mucous membrane or lining of the intestines is greatly thickened, corrugated, and thrown up in irregular folds (fig. 10). In many cases the inside of the intestines is studded with hemorrhages. The lymph glands attached to the digestive tract are enlarged, greyish in color, and watery or succulent in appearance. The organisms causing this disease are passed off with the feces from in-

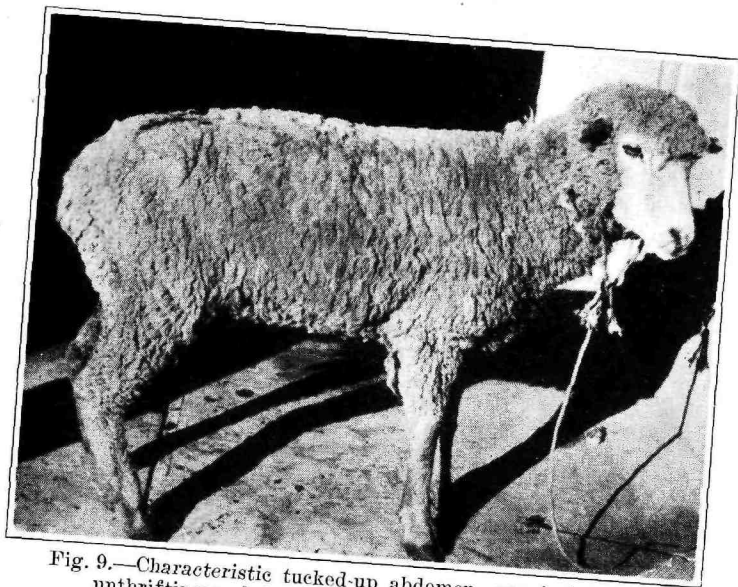


Fig. 9.—Characteristic tucked-up abdomen, emaciation, and unthriftiness of sheep affected with *Johne's disease*.

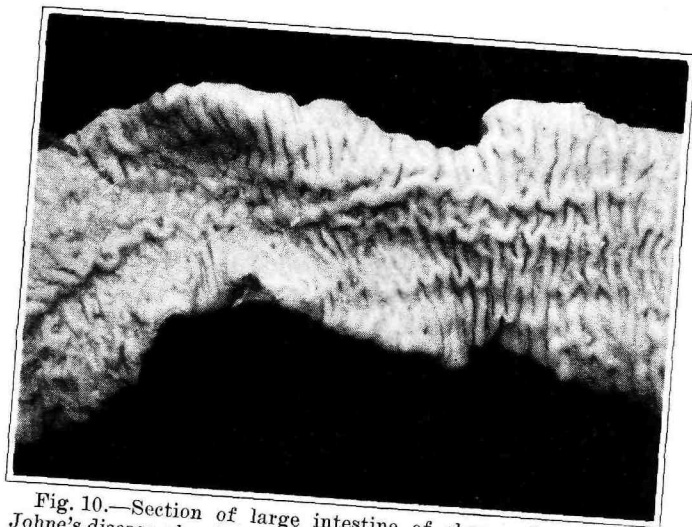


Fig. 10.—Section of large intestine of sheep affected with *Johne's disease*, showing the mucous membrane greatly thickened, corrugated, and thrown up in irregular folds.

fectured animals; in this way the pastures become contaminated and act as a medium of transmitting the disease to healthy sheep.

Differential Diagnosis.—Johne's disease in sheep may be confused with a heavy infestation of gastrointestinal parasites, but in such cases a thorough examination of the digestive system will reveal great numbers of larvae or of adult parasites. Johne's disease and parasitism may, however, exist simultaneously in the same animal.

Sheep, like cattle, react to the intradermal and intravenous injections of Johnin and avian tuberculin. The intravenous method is laborious and impractical; and death often follows because of severe systemic reactions. The intradermal method, using the caudal fold, presents certain disadvantages, but up to the present time is the most satisfactory. Avian tuberculin is as satisfactory as Johnin, or more so, for detecting Johne's disease in sheep.

Prevention.—There is no known treatment for this affection at present. Killing all affected animals and disposal of the carcasses by burning or burial is the most advisable procedure in ridding a band of the disease.

Indemnity for Johne's Reactors.—The Bureau of Animal Industry has been granted authority by Congress to pay indemnity to cattle owners for animals that are slaughtered because of reaction to the Johnin test. No such authority, however, has been given to pay indemnity on sheep reacting to such a test.

"Further details concerning the payment of indemnity on cattle reacting to Johne's disease can be obtained by writing the livestock officials of your State or the United States Bureau of Animal Industry, Washington, D. C."⁴

INFECTIOUS PUSTULAR DERMATITIS

(Doby mouth, sore mouth, pox)

Infectious pustular dermatitis of sheep and goats is a highly infectious disease in which characteristic eruptions and scab formation take place. The affection is observed in sheep and goats of all ages, is most prevalent in lambs and ewes after lambing, and is caused by a filterable virus.

Evidently this disease has been known to sheepmen in the United States for some time under various names, including "doby mouth," "sore mouth," and "pox." The affection, observable in sheep of all ages, is most prevalent in lambs and ewes after lambing. It tends to assume an enzoötic form. Among ewes that have lambs at their sides, practically every animal becomes affected. Usually the disease first affects the ex-

⁴ Lash, Elmer, and William M. Mohler. Johne's disease (paratuberculosis of livestock), U. S. Dept. Agr. Cir. 104:1-8. 1930.

terior of the lips, especially the angles, and the nostrils. Later, the ewes show lesions on the udder, the teats, and the inside of the thighs. In this case, the virus already located in the lesions on the lips and nostrils was most probably carried to the udder and teats either by licking or by an affected lamb's nursing.

Lambs lose considerably in condition because of soreness of the mouth, resulting in a lack of desire to graze, and also because of a decrease in

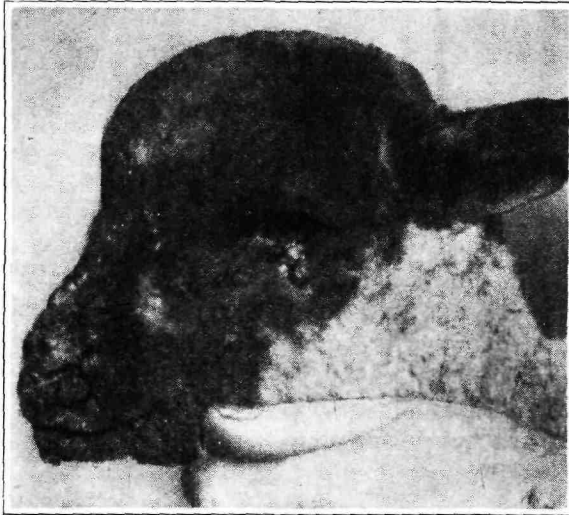


Fig. 11.—Lamb affected with pustular dermatitis, showing affections of the outer surfaces of the face which are more or less free from wool, as the eyelids, exterior of the lips, and inside of the ears.

the amount of milk received when the ewes try to prevent them from nursing. In many cases where the teats and udders are badly affected, the ewes will not claim their lambs; and garget often results because of the retention of milk.

Symptoms and Lesions.—The first lesions are a slight reddening and elevation of the skin, which loses its color on pressure. This is followed by the development of vesicles rising above the surface of the skin with a small depression in the center. The skin around the vesicles is most generally reddened, with a slight swelling of the tissues. As the vesicles increase in size, their contents become filled with pus and advance into the pustular stage, which ruptures, allowing a white-cloudy or yellowish fluid to be discharged. Later a yellowish-brown crust or scab forms; this gradually becomes very dark and drops off by the twenty-fourth day, leaving no scar.

The lesions in lambs are usually located on the lips, nostrils, and neighboring tissues, forming thick crusts or scabs, but, in the more serious cases, may affect the tongue, the gums, and the roof of the mouth.



Fig. 12.—Lamb affected with postular dermatitis, showing lesions confined to the exterior of the lips. These lesions become confluent and form a wart-like protuberance.



Fig. 13.—The mammary glands of a ewe, showing pustules and scab formation in a case of pustular dermatitis.

Some animals show affections of the outer parts of the face which are more or less free from wool, such as the eyelids and the insides of the ears (fig. 11). Occasionally lesions are found under the base of the tail. Some lambs at first show lesions confined to the exterior of the lips; these lesions are in the form of thick crusts or scabs and sometimes appear

like warts (fig. 12). If the scabs are removed, a bleeding elevated surface results.

Continual rubbing and scratching may make the vesicles and pustules hard to observe on the lips and nose. Secondary organisms gain entrance and produce a greater inflammation of the part, followed by swellings and necrosis or death of tissue.

In ewes, the udder shows more typical lesions because of the protection afforded it by its location and because the ewes so affected try to prevent the lambs from nursing (fig. 13). Vesicles and pustules are often found on the inside of the thighs and in some cases as far down as the hocks.

Treatment.—Animals that have recovered from an experimental inoculation and those animals that have passed through an attack of the disease possess a high degree of immunity. Infectious pustular dermatitis may assume enzoötic proportions, and the outlook may appear very grave at first; but if the animals are allowed to go untreated, recovery usually takes place in three weeks to a month.

In severe cases where there is a great amount of scab formation caused by other organisms, remove the scabs and treat the affected parts with a 5 per cent solution of potassium permanganate.

ABORTION

Abortion in sheep is not very common and usually appears in sporadic outbreaks; the disease is seasonal and is apparently confined to a definite area. Although sheep may be experimentally infected with the organism causing cattle abortion, outbreaks among them have not been described as being produced by this organism. The trouble may be of bacterial or nutritional origin, each of which will be discussed separately.

Vibrio Abortion.—Abortion in sheep caused by a vibrio has been commonly observed by many investigators throughout the world. In three outbreaks in California caused by vibrios, the percentage of abortions in the bands varied from 12 to 26 per cent.

Description of Organism.—This organism (*Vibrio fetus*) is "S" shaped, about 0.2 to 3 microns long and about 0.25 micron wide at its center, actively motile, and easily stained with the basic aniline dyes. Natural infection most probably occurs by the mouth because of animals' eating or drinking contaminated feed or water.

With this type of abortion, the ewes will show very slight symptoms, if any, before expelling the fetus. Occasionally one notes soiling of the fleece and a small amount of dark-brownish discharge from the vulva. These symptoms are more pronounced if the fetuses are putrefying before being expelled. Some lambs are expelled dead, while others live only for an hour or two; their sizes vary from that of a rat to larger,

depending on the time they were carried. Many ewes exhibit a dark, chocolate-colored discharge for several days to a week after the abortion (fig. 14). Others may die because of the severe septic inflammation of the uterus.

Ewes aborting either from vibrio or from other bacterial infections exhibit pathological changes, restricted mostly to the uterus. The uterine



Fig. 14.—Following infectious abortion a dark, chocolate-colored discharge persists for many days.

wall is greatly thickened, the mucous membranes being swollen, red-den, softer than normal, and marked with many small hemorrhages. The cotyledons or buttons are enlarged and contain brownish-white pus, while the cavity of the uterus contains varying amounts of dirty-brown or brownish-red fluid and decomposing remnants of the placenta.

In sheep husbandry in California, bands of ewes are customarily moved about to sources of satisfactory feed supply at frequent intervals during the year. This sometimes involves rather rapid changes in

feed and water. The feed supply may consist of rice stubble, barley stubble, natural ranges containing native forage plants, alfalfa, Sudan grass, beet tops, beans, and bean and pea straw fed from the ground after the crops have been harvested.

During the past few years, because of reduced rainfall, the water supply has not always been satisfactory; and animals have sometimes had to drink more or less stagnant water previously used for irrigation. At the higher levels in the foothills, during these dry years, the water has been obtained from dug-outs and from seepage places in the beds of dry rivers, creeks, and springs; these supplies at times are seriously contaminated by decaying organic matter, fecal material, and animal carcasses.

According to investigations, the water has been directly responsible for all the outbreaks of vibrio abortion in California and in other states and countries. After the breeding season, the pregnant ewes should receive pure, not stagnant, water.

All membranes, fetuses, and materials soiled with infected material should be picked up and destroyed. Contaminated pens or corrals should be carefully cleaned and disinfected. No pregnant animal should remain in the inclosures the rest of that season. Ewes showing a discharge from the genital organs or those that have aborted should be isolated till after the lambing season.

Experience has shown that infected sheep do not harbor the infection from one year to the next and are therefore safe to use as breeders the following season.

A Second Type of Bacterial Abortion.—Many organisms have been found to be responsible for outbreaks of abortion in sheep; among these is an organism resembling *Escherichia coli*, previously described by the writer, and also a member of the *Salmonella* group described by European writers. Infection probably results from the eating and drinking of contaminated feed and water.

Description of Organism.—The *Escherichia coli*-like organism is a gram-negative, motile, nonsporulating, aerobic or facultative anaerobic rod, with rounded ends, 0.5 micron wide and 1 to 2.7 microns long. The organism grows well on most types of culture media at 37.5° C.

Symptoms in sheep infected with the *Escherichia coli*-like organisms and those of the *Salmonella* group are slight. Twelve to twenty-four hours before aborting, ewes show uneasiness, stiff gait, loss of appetite, and some blood-tinged discharge from the vulva. After the lambs are expelled, if the placenta is retained, putrefaction is rapid. A chocolate-colored, fetid discharge persists for days and even longer in some of the animals that survive. Most of the lambs are born dead; others do not

survive for many hours. With this type of infection the mortality in the ewes is great.

The lesions and preventive measures are the same as those described under abortion caused by *Vibrio fetus*.

Nutritional Abortion.—This type of abortion is usually caused by the lack of certain nourishing foods—in reality, a starvation. Ewes grazing on land, especially in dry, hot summers, where the feed is short and contains only certain dried grasses known to be very poor in food value, are liable to abort. Although the intake of this dry grass or straw by the sheep may be large, there is very little food value in the form of digestible carbohydrates, proteins, fats, and minerals, or necessary vitamins, for the ewe to live on while producing live, healthy lambs.

Sheep affected with nutritional abortion will show no symptoms except just before the attempt to abort. There is no abnormal discharge before or after lambing. Many of the ewes will be found standing by themselves or lying down, straining. After hours of continual effort the animals become fatigued and, if not able to expel the fetuses, will die. With this condition, the majority of lambs are expelled 3 to 10 days ahead of time. General weakness, underweight, and some scours may be noticed.

With nutritional abortion, very few lesions, if any, are found after the act of aborting unless the placenta is retained. There is no abnormal discharge. The inability to isolate vibrios or other organisms consistently from the fetus, placenta, uterus, or uterine discharges, definitely shows that this condition does not result from infection.

Care should be taken to give enough feed of the proper quality for the upkeep of the ewes and the forthcoming lambs. Dry grass or stubble without other supplementary feed usually lacks certain elements necessary for pregnant animals.

In flocks affected with nutritional abortion, the feed should be changed as soon as possible. A well-cured hay, preferably alfalfa, should be substituted for the poor hay or grass previously obtained; if this arrangement is not practical, other feeds will suffice.

NAVEL ILL

(Joint ill, umbilical infection, omphalophlebitis)

This disease is a pyemic infection of lambs in which the pus-producing bacteria enter the body through the navel. The bacteria may cause merely a local inflammation, death of tissue, or abscess formation. On the other hand, the germs from the local lesion may gain entrance to the blood vessels and be carried into the circulation; they may then be trans-

ported to other parts of the body, especially the liver, lungs, kidneys, and joints, where they give rise to new lesions.

Cause.—Evidence presented by many workers as to the organisms causing navel ill has been somewhat varied, but the majority agree that

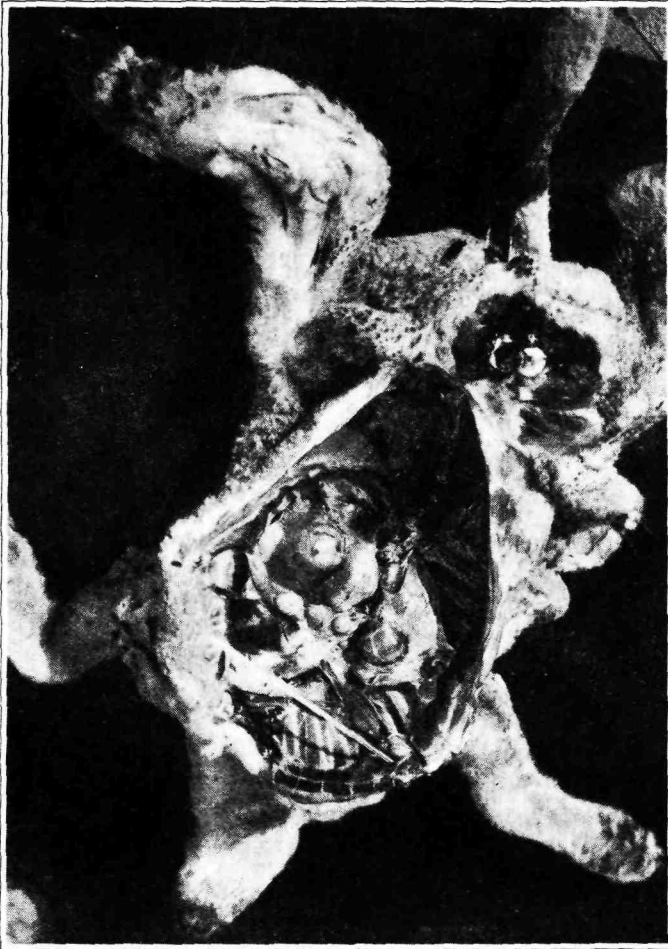


Fig. 15.—Lamb opened to show large abscesses in the liver and lungs, caused by navel ill; one hock joint is greatly enlarged and filled with a greenish pus.

one or more of the pus-producing organisms such as *Staphylococcus pyogenes* or *Streptococcus pyogenes* are the causal factor. Many other organisms have been incriminated, such as *Escherichia coli communis*, *Actinomyces necrophorus*, and organisms of the *Pasteurella* group.

Symptoms.—Symptoms usually appear 6 to 10 days after birth.

Lambs affected will generally show a slight disturbance such as dullness, general depression, disinclination to move, lack of appetite, and slight elevation of temperature (2° to 4°), before any swelling of the joints will be noticed. Occasionally the respirations are more rapid and short, misleading one into making a diagnosis of a lung affection. Lameness suddenly appears, and one or more joints, especially the knees, will be found swollen, hot, and painful. Constipation is present in animals soon after the affection starts, but is generally followed by diarrhea; the feces

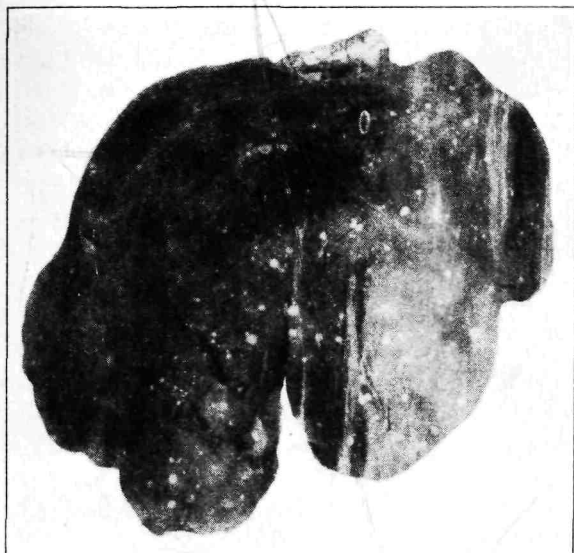


Fig. 16.—Small abscesses scattered throughout the liver in a case of navel ill.

are light colored or clay-like in appearance. Loss of condition is very rapid. The lambs show very little desire to suckle or feed and are found lying down the greater part of the time. The navel may be found wet, and the wool around the part matted and soiled with discharges from the affected area.

Postmortem Appearance.—The navel may be closed and swollen, or it may be only partially closed. The tissues around the part are distended with a fluid; others may show a severe inflammation associated with ulceration and death of tissue. Frequently an abscess will be found deep in the muscles of the abdominal wall. There is an inflammation of the umbilical vein, which is usually plugged with blood clots that act as a medium for bacterial growth. Small portions of these infected clots break loose, pass into the blood stream, and are carried to the liver,

wiped off, leaving a deeply reddened, inflamed area. Sometimes the abdominal cavity contains varying quantities of a clear or cloudy liquid tinged with blood. The lymph glands draining the intestine are generally enlarged, succulent, congested and deeply reddened.

Prevention and Control.—Lambing is carried on in California, as in most other states, either in lambing sheds or in corrals. Because of limitations of land under the now intensive farming system, bands of sheep have lambed on the same ground year after year; the soil is thus polluted with organisms which become so covered with manure and litter that the direct rays of the sun cannot reach and destroy them. The strictest sanitary measures, associated with our knowledge and use of disinfectants, sometimes fail to cope with such situations. Thus, the sheep should be moved to clean ground for lambing and kept there until the lambs are three weeks of age. Not only the soil is responsible for the spread of this disease, but also the ewe, the infected lamb, and contaminated shoes and clothing of the persons whose work at this time causes them to be associated more closely with the sheep. Past and present experimental evidence has definitely proved that the source of infection is not the milk but the teats and udder, which have become contaminated with infected material; and undoubtedly the bacteria enter through the mouth of the lamb at the first nursing. Lambs affected with dysentery become a great source of danger, either by directly contaminating the pasture and corrals with fecal material, heavily laden with bacteria, or by coming into direct contact with healthy lambs under three weeks of age.

Man may act as his own greatest enemy by handling sick or dead lambs, or assisting ewes in lambing, for in this way he may become a carrier and infect healthy lambs. He may also transport the infection to clean land on his shoes or clothing.

Measures for control of lamb dysentery may be summarized as follows:

1. Lambs from the the time of birth to three days old are the most susceptible.
2. Lambs up to three weeks are susceptible.
3. Strict sanitary precautions should be taken, and all lambs dead of this disease should be burned or deeply buried.
4. A ewe that has lost her lamb affected with this disease should not be used as a foster mother, because the udder and fleece have become soiled with the infected material from the lamb that has died.
5. When an outbreak of lamb dysentery starts, move all the ewes that have not lambed to another part of the ranch. Often where the ewes are moved to new lambing ground the disease stops, and no further losses are encountered.
6. The lambs should not be allowed to mingle with the others from the infected area until they are at least three weeks of age.

7. Medicinal treatment of lambs sick with this disease has thus far been impracticable, mainly because the course of the disease is so rapid.
8. Ranchers that have had an outbreak of lamb dysentery should thoroughly clean and disinfect the lambing sheds and corrals with sheep dip in a 3 to 5 per cent solution (1 pint in 3 to 5 gallons of water). The ground around these quarters should be plowed and left vacant for several months.
9. During the next lambing season, the ewes should be moved to clean lambing grounds, somewhere on the ranch, and kept there until the lambs are three weeks old.
10. Placing the drop band in lambing sheds at night is thought by many experienced sheepmen to be a practice that should be avoided unless the weather is most severe. One diseased animal may cause a severe outbreak, either by directly contaminating the bedding or feed by discharges or fecal material, heavily laden with bacteria, or by coming into direct contact with other sheep.

RABIES

(Hydrophobia)

Rabies is an acute, infectious disease caused by a filterable virus. The virus is present in the saliva of infected animals. Sheep usually contract this malady by being bitten by an infected dog or coyote. They become irritable, stamp the front feet, run back and forth, and assume an aggressive manner. In many cases, they become easily excited, refusing to run or be scared by the sheep dog as is usually the custom. They may butt or hit other animals; females will attack their own lambs. The stage of excitement is of short duration, and the animal soon becomes depressed and paralyzed. Death usually results in from 3 to 5 days.

Care should be taken in handling animals thought to be rabid, as man may become infected through any wound soiled with the saliva.

The local veterinarian or the Chief of the Bureau of Animal Industry, State Department of Agriculture, Sacramento, California, should be notified when there is doubt as to the presence of this disease.

TULAREMIA

Tularemia is a highly contagious disease caused by *Pasteurella tularensis*. It is found more frequently in rabbits, squirrels, and other rodents, than in sheep, and may affect man; and it is associated with infestation by the wood tick, *Dermacentor andersoni*.

Description of Organism.—The causal agent of tularemia is *Pasteurella tularensis*, a small gram-negative, nonmotile, aerobic rod, about 0.2 micron in thickness and from 0.3 to 0.7 micron in length. Bacillary and coccoid forms may occur. They stain well with either carbol-fuchsin or gentian violet.

Because symptoms and lesions are not pronounced, the condition might easily be mistaken for some other disease. Affected sheep most commonly lag behind, walk stiffly, show lameness, and lie down the greater part of the time. There is usually an elevation of temperature

(106° to 107.8°). Respirations are rapid, urination is frequent, and scouring generally occurs. Soon the animal is unable to rise, and death may follow in from a few hours to several days.

Since this disease occurs only when wood ticks are active, the appearance of these symptoms plus tick infestation will materially aid one in making a diagnosis.

The name tularemia was adopted because *Pasteurella tularensis*, the organism causing this disease, was first found in squirrels in Tulare County, California.

FOOT-AND-MOUTH DISEASE⁵

Foot-and-mouth disease is an acute contagious disease caused by a filterable virus. The lesions in sheep affected with this condition are confined mostly to the mouth or feet, or both. The pathological changes are in the form of vesicles, resembling blisters and containing a clear yellow fluid. These soon rupture, leaving an erosion in the mucous membrane of the mouth or in the membranes close to the hoof. The mouth lesions are usually observed on the tongue, but may be seen on the lips and the front of the roof of the mouth (dental pad).

The association of lesions, both in the mouth and on the feet aids materially in differentiating this disease from infectious pustular dermatitis or from foot rot.

When in doubt as to the presence of the disease, notify the Chief of the Division of Animal Industry, State Department of Agriculture, Sacramento.

FOOT ROT

Foot rot is a chronic infectious disease of the tissues of the foot, and remains more or less localized to that area. The economic importance of foot rot lies in the severe losses which the owner sustains from the long period of inactivity of the affected animals, from the loss of body weight, from decreased wool clip, from the diminished milk production at lambing time, and finally from the probable infection of the newborn and others. *Actinomyces necrophorus* is incriminated as the causative agent in this affection, but many other organisms (including spirochetes) may be found in the discharges and necrotic or dead tissue of the feet and may have some causal relation to this disease.

Description of Organisms.—The organism *Actinomyces necrophorus* (*Bacillus necrophorus*) is a pleomorphic, anaerobic, nonmotile, nonsporulating, gram-negative rod. It occurs as long, beaded filaments, measuring 100 microns or more in length and 0.8 to 1.7 microns in width.

⁵ For a more complete description of the disease, see: Mohler, John R. Foot-and-mouth disease. U. S. Dept. Agr. Farmers' Bul. 666:1-14, 1929.

The spirochetes found in foot rot are approximately 9 to 11 microns long and present three to five undulations or turns. Their spiral depth is from 0.6 to 0.8 micron; their width, 0.1 micron. The spirochetes are most successfully demonstrated in direct smears by Geimsa's stain or by gentle steaming with carbol-fuchsin for 10 minutes.

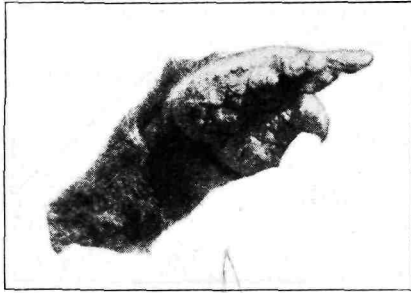


Fig. 18.—The lack of wear on the hoof causes it to be overgrown and distorted, the weight being thrown on the outer wall of the foot.

Symptoms.—At first there is a slight lameness; and, on examination, the foot is found warm, because of the inflammation. Animals badly affected will go on three legs, or, if the forefeet are affected, will rest on their knees, especially while grazing. The lack of wear causes the hoofs



Fig. 19.—The horn becomes undermined and detached from the underlying tissues in old, chronic cases of foot rot.

to become overgrown and distorted, even curling into a spiral, so that the wear comes on the outer wall of the foot (fig. 18). Much of the horn becomes undermined and detached from the underlying tissue; and in cases of long standing the hoof may be shed, exhibiting growths of new inflammatory tissue.

Lesions.—The primary lesion in foot rot shows a redness and swelling, and a most ill-smelling sweat, usually at the arch between the dew claws of the hoof. The skin of the space between the hoofs is laid bare, exhibiting yellowish-white layers and raw ulcerated areas. As the infection goes deeper, it advances beneath the horny layers, affecting the more sensitive structures of the foot. When the disease becomes more chronic, the hoof starts to become detached in places from the underlying tissue (fig. 19), and a characteristic inflammatory discharge having a very offensive odor is given off. This discharge contains an abundance of pus

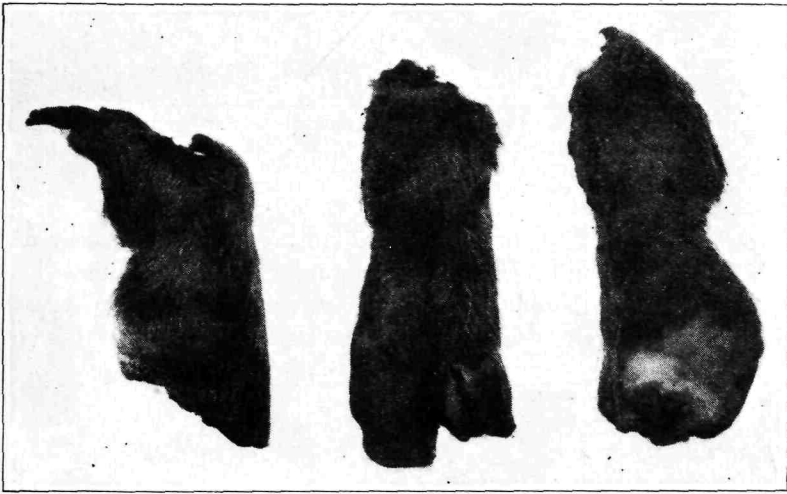


Fig. 20.—In this case of foot rot the hoof has been partially removed to show how the infection has invaded the deeper structures, advancing beneath the horny layers and affecting the more sensitive structures of the foot.

cells, fragments of ulcerating and necrotic or dead tissue, and many different kinds of bacteria.

Treatment.—The feet that are overgrown or distorted must be carefully pared, and all horn that has been undermined and detached from the underlying tissue should be removed (fig. 20). In the more advanced cases, where the deeper structures are extensively invaded, one must be more thorough in removing all dead tissue.

Many chemicals are used in the treatment of this disease. Antimony and potassium tartrate (tartar emetic) has been found to be the most active agent so far used. Good results are obtained from an ointment made by mixing equal parts of lanolin and powdered tartar emetic, making a thick paste; this is rubbed into the foot and between the dew claws after as much of the infected part as possible has been removed. One cannot be too conscientious in the paring and trimming of the feet.

If any of the affection is allowed to remain under the horny part of the hoof, where the drug cannot penetrate, the animal will soon show signs of lameness.

PNEUMONIA

Pneumonia is an inflammation of the lungs. The following forms are commonly found in sheep: pneumonia caused by parasites (*Strongylus refescens* or "lungworms"); pneumonia caused by drenching; and septic pneumonia caused by microorganisms.

Parasitic Pneumonia.—Pneumonia caused by lungworms is a broncho-pneumonia, the small thread-like worms filling up the bronchi (small air passages). The parasites also inflame the lung proper, adjacent to the bronchi, by mechanical injury to the part and also by excreting certain toxins or poisonous products. The extent of the affected part (that area which becomes more or less solid and contains no air) depends upon the number of worms present and the length of time the animal has been harboring them.

The respirations are rapid and are associated with a moist, hacking cough and a nasal discharge. There may be a slight elevation in temperature. The appetite is suppressed, and the animal loses in flesh. If the affection is serious, dropsical swellings will be noticed under the jaw and throat region; occasionally the entire face becomes swollen and dropsical.

On autopsy the animal will be found to be very thin and emaciated. A clear yellow fluid may accumulate in the thoracic cavity around the lungs. The end portions of the lungs usually show the greatest involvement, being more or less solid and darker in color; when that part is cut into and pressed firmly, great numbers of worms will be forced out of the bronchi.

Animals known to be badly affected with lungworms should be destroyed, for treatment is useless. Destroying the animal also prevents the spread of the parasites, as the infested animals discharge eggs in the nasal excretion.

Pneumonia Caused by Drenching.—The so-called "mechanical pneumonia," results from materials, usually drugs, passing down the windpipe into the lungs and producing a severe inflammation of the parts. The drenching of sheep, even by experienced persons, is dangerous.

When material has passed into the lungs after drenching, the sheep soon show signs of distress such as coughing and labored, jerky breathing. They usually stand around and will not move unless urged. The membranes of the mouth become blue or cyanotic. If one places an ear over the side of the body, he may hear a rasping or rattling noise in the

lungs. Occasionally the breath carries the odor of the material that passed into the lungs.

On autopsy the lungs will appear congested and red; a large portion will be solidified; and when the organ is cut into, quantities of liquid may run out or be easily pressed out. Odors of drugs or other materials may be detected coming from the inflamed part. If the animal survives for some time, a gangrenous pneumonia may result.

When drenching sheep, *do not raise the head very high, and give the medicine very slowly.* If the animal starts coughing, release the head, and do not continue the drenching until the choking stops. Treatment is almost useless in sheep where pneumonia is caused by fluids passing into the lungs.

Septic Pneumonia Caused by Microorganisms.—Septic pneumonia is an infectious disorder occurring mostly in older sheep and may be secondary to caseous lymphadinitis (boils). It is subacute in character and gradually becomes worse.

Although many different kinds of organisms are associated with this lung condition, many cases are caused by the organism found in caseous lymphadinitis (false tuberculosis). When the abscesses develop in the deeper-seated glands near the lungs, they produce serious changes in the respiratory system, followed by debility and a very rapid loss of flesh. Probably in most cases the organisms escape from a caseous bronchial lymph gland after rupture of the capsule. This leads to the formation of small pneumonic areas, or an extensive caseous pneumonia.

As a rule, subacute pneumonia progresses slowly. Affected sheep will stand apart from the others or lie down, avoiding all effort. Painful cough, quickened and difficult breathing, and loss of appetite are pronounced. The nostrils may or may not emit a yellowish discharge, which dries around them. A rise in temperature of two to three degrees is not uncommon. As the disease progresses, the animal becomes very thin and emaciated. Complete recovery is rare.

In some cases the greater part of a lung may be affected. In others the changes may be localized to one area or divided into several places, separated from each other by normal lung tissue. Numerous dark-red patches, surrounded by an elevated greyish wall, are seen on the cut surface. Abscesses varying in size from a pea to an orange may be found in any part of the lungs, especially in the lymph glands between them. When cut into, these abscesses will be found to contain a thick, sticky, yellowish-green pus like that found in boils or in caseous lymphadinitis. The plural covering of the lungs is usually thickened and attached to the thoracic wall in many places.

Treatment is very unsatisfactory, and the chances for recovery de-

pend largely upon the extent of the lung tissue involved, as well as on the type of organisms producing the inflammatory process. Dry quarters, an abundance of fresh air, pure water, and nutritious feed are more essential in the treatment of this disease than medicine or biological products.

CONGESTION OF THE LUNGS

Congestion of the lungs is more common in young sheep or in those recently sheared. Sudden changes in the weather and exposure to cold and chilling reduce the natural powers of resistance, making it easier for organisms to enter the tissues, thus setting up an inflammation of the lungs.

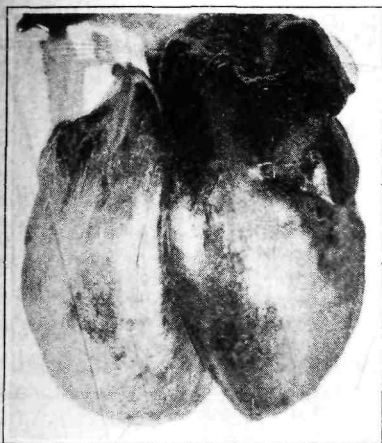


Fig. 21.—Congested lung; dark red in color, heavier than normal, and does not collapse.

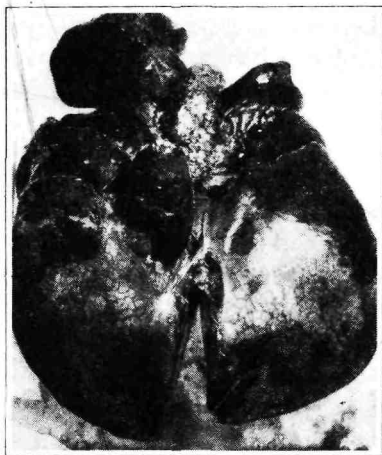


Fig. 22.—Congestion of the lungs, showing certain areas that are consolidated, edematous, heavy, and soggy.

Symptoms.—Sheep with congested lungs usually show a rise in temperature of two or three degrees, fast and difficult respiration, suppressed appetite, and unwillingness to move about. Scouring may be present. The extent of the symptoms depends on the severity of the lung affection.

Lesions.—In this condition, the principal changes are restricted to the lungs. The entire organ is congested and dark red, heavier than normal, and does not collapse (fig. 21). In some cases the lung may show a more severe involvement; certain areas are consolidated, edematous, heavy, and soggy; and a reddish-yellow fluid will escape from the part when cut into (fig. 22).

Prevention and Treatment.—During sudden changes in the weather, especially after shearing, this lung affection should be guarded against.

Cold rains or cold nights after a really warm day, or long journeys either by truck or train, tend to lower the resistance and weaken the animals, thus making them susceptible to this condition. Sudden and complete change of feed also causes a lowered resistance of the body; therefore care should be exercised, and changes should be slow and gradual.

Drugs have little value once the animal is showing symptoms of the disease. Segregate the sick from the healthy ones, and administer 15 grains of sodium cacodylate, injecting it subcutaneously (under the skin) in the region of the neck and shoulders with a hypodermic syringe, daily, till three doses are given.

In all respiratory diseases the animals should not be excited any more than necessary while handling them. Dry quarters, an abundance of fresh air, pure water, and nutritious feed are more essential in the treatment of this disease than medicine or biological products.

HEMORRHAGIC SEPTICEMIA

(Exposure disease, shipping fever, stockyard fever)

The term "hemorrhagic septicemia" is applied to a number of diseased conditions in sheep, commonly called exposure disease, shipping fever, stockyard fever, etc., which are characterized by an elevation in temperature from 104° to 107°, loss of appetite, jerky respirations, a frothy nasal discharge, and a cough. Scouring may or may not be present. It is believed by some to be a specific disease caused by *Pasteurella ovissepticus* but this organism is a frequent inhabitant of the lungs of normal sheep. Possibly when the resistance of the body is lowered by long shipments, bad weather, or sudden changes of feed, the organism becomes virulent, thus helping to produce lesions described as hemorrhagic septicemia. The writer and certain other investigators, accordingly, are of the opinion that so-called hemorrhagic septicemia in sheep may result from a variety of causes and that the organism mentioned is in reality a secondary invader.

Description of Organism.—The organism, *Pasteurella ovissepticus*, is a gram-negative, nonmotile, nonsporulating, barrel-shaped rod with rounded ends, averaging 0.5 micron in width and about 1 micron in length. This organism takes the stain only at the ends, the middle portion remaining unstained. It is an aerobe and a facultative anaerobe and grows well at 37.5° C.

Results of some recent investigations of hemorrhagic septicemia in cattle by J. P. Scott are quoted in part:

A study of the 200 farms affected with shipping fever showed that when biologic products alone were used losses did not stop and were often increased. When the calves were properly fed, watered, and were given adequate shelter and sufficient bedding in dry quarters, losses were reduced to a minimum. In the few cases where

such good conditions prevailed there was no apparent difference between the losses found in vaccinated and unvaccinated herds.

Field and experimental studies show that vaccination of cattle and experimental animals does not produce a satisfactory immunity. In field investigations it was found that when vaccination is practiced during shipment or after arrival at the farm losses are twice to three times as high among vaccinated animals as among untreated animals.

It is shown that hemorrhagic septicemia bacterin and aggrassin produce a negative phase during which the animal is more susceptible to the rigors of exposure.⁶

The investigations of this disease in cattle largely substantiate the findings of the author regarding a condition in sheep thought by many to be hemorrhagic septicemia.

The point of practical interest is that in all outbreaks of so-called hemorrhagic septicemia in sheep observed by the author, the disease was self-limiting, not directly contagious as many people believe. This fact tends to discredit the practice of administering bacterins or aggrassin as a preventive.

Further investigational work will be necessary to prove that the condition in sheep now called hemorrhagic septicemia is a specific disease, and until that time the use of hemorrhagic septicemia bacterin and aggrassin is not recommended.

NASAL CATARRH

(Snotty nose, snuffles)

Nasal catarrh in sheep is an inflammation of the nasal passages and of the associated sinuses of the head, accompanied by a discharge from the nostrils. This discharge may be slimy and of a gray or grayish-yellow color, sometimes tinged with blood. Later, collecting dust and dirt, it becomes dark, thick, and tenacious.

Cause.—Nasal catarrh may be caused by parasites.⁷ The *Oestrus ovis* bot fly larva, commonly called sheep maggot, passes up the nostrils and enters the sinus of the head, where it remains for three to ten months.

Congestion of the lungs, occasioned by cold and chilling, especially after shearing, is another cause of nasal catarrh. In certain districts where the weather is very hot during the day and cold at night, this condition is prevalent.

Nasal catarrh may follow septic pneumonia (caused by organisms) or pneumonia caused by drenching, by dust, or other foreign material.

Symptoms.—The first symptoms noticed are sneezing, snorting, and

⁶ Scott, Joseph P. Results of some recent investigations on hemorrhagic septicemia. *The North American Veterinarian* 14(10):21-26. 1933.

⁷ For complete description, with advice on prevention and treatment of grub in the head, (*Oestrus ovis*), see: Hall, Maurice C. Parasites and diseases of sheep. U. S. Dept. of Agr. Farmers' Bul. 1330:13-15. 1932.

intermittent coughing; then follows a nasal discharge, greyish or yellowish-white in color, occasionally streaked with blood. Increased or labored breathing is sometimes pronounced. This nasal catarrh gradually improves or completely disappears if the lung affections are not severe or do not progress into a fatal pneumonia.

The length of time an animal exhibits a nasal catarrh or snotty nose depends usually upon the amount and duration of irritation. In the case of grubs in the head, it will depend on the length of time the parasites are in the sinuses and the damage done to the mucous membranes. The same is true where the catarrhal condition is caused by other irritants.

Treatment.—Treatment is of little value, if any. Not many sheep, however, die of catarrhal affections of the head.

STIFF LAMBS

(White-muscle disease)

Stiff lamb disease, sometimes called white-muscle disease, is a non-infectious noncontagious malady affecting young lambs from two to eight weeks of age. The cause of this disease is unknown. The condition is characterized by stiffness of the hind legs, although the front legs may be involved, or occasionally both. The affected lambs have difficulty in rising, and walk with a stiff gait. As the disease progresses, the animals will be found lying down the greater part of the time, and because of the inability to stand, will have difficulty in nursing. They become thin and weak and soon succumb unless killed by the owner. Lambs that survive are usually unthrifty and seldom of much value because of the set-back and stunting.

Lesions.—Lambs killed with this disease exhibit lesions confined mostly to the muscles of the hind and front legs, shoulders, and heart. In mild cases the muscles show whitish areas, usually running parallel to the fibers. In the more advanced stages the entire muscle may appear dry and greyish white. It is described by many as having a cooked or veal-like appearance. The lesions are associated with those muscles which showed stiffness. A peculiar characteristic observed is that in a great number of animals examined, the same corresponding muscle on the opposite leg also showed similar lesions. Many times only one or two muscles are affected while the others in direct contact with them are not involved. The heart muscle may show lesions, which, when present, appear as greyish-white areas varying in size from that of small lines to $\frac{1}{4}$ inch in diameter.

Treatment.—Medicinal treatment of lambs sick with this disease has thus far been unsuccessful. Some sheepmen claim good results if the ewe nursing an affected lamb is placed on a different kind of feed.

CONJUNCTIVITIS AND KERATITIS

(Pink eye)

Conjunctivitis and keratitis, commonly called "pink eye," are really two separate affections; in sheep, however, one is seldom found without the other. Conjunctivitis is an inflammation of the membranes that line the eyelid, the nictitating membrane, and other portions of the eye except the cornea (the anterior part of the eyeball). Keratitis is an inflammation of the cornea. Both infectious and noninfectious types occur.



Fig. 23.—Ewe affected with conjunctivitis, showing soiling and matting of the wool, due to lacerimation (watering from the eye).

Cause.—Either of these eye affections may result from injuries by foxtail, thorns, grass seeds, chaff, and other irritants; these conditions may also be caused by bacteria or a virus.

Symptoms.—The first symptom noticed is a flow of tears from the eyes down over the face, soiling and matting the wool (fig. 23). The animal partially closes its eyes in order to avoid as much light as possible. On close examination the membranes of the eye will be found congested and bright red; the blood vessels will appear engorged and will stand out very plainly. As the affection progresses, the cornea becomes involved; instead of being clear and transparent it soon assumes a hazy, blue appearance, later changing to a milky-white opacity (fig. 24). Occasionally ulcers form on the cornea and may even penetrate it, causing rupture of the eyeball. In severe cases, especially in the infectious type, permanent blindness may result.

Prevention and Treatment.—Sheep exhibiting eye troubles should be isolated from the band, except when the trouble obviously results from foxtail or some other injury. In these latter cases the irritant should be removed, and a small amount of a 2 per cent yellow oxide of mercury ointment, or several drops of a 10 per cent solution of argyrol, should be placed into the eye daily. Recovery usually follows within a few days.



Fig. 24.—The eye shows a milky-white opacity, typical of a chronic keratitis.

If the condition is contagious, complete isolation is necessary; otherwise the entire band may become affected. Instillation of 2 per cent yellow oxide of mercury ointment into the eyes daily has proved to be one of the best agents so far used. Care should be taken not to carry the infective material to healthy sheep, on one's person.

ENTROPION

(Wool blindness)

The condition commonly called "wool blindness" is characterized by an inversion or turning inward of the eyelid. One or both eyes may be affected; the lower lid is the one most usually involved. Entropion is classed as an inherited defect.

Symptoms.—Considerable lacrimation or watering is caused by the irritation of the lashes and other hairs of the inverted lid rubbing against the eyeball. An inflammation of the eyeball soon develops (fig. 25); ulcers are often present; and, if the condition is left untreated, rupture of the eyeball sometimes follows. The inside of the eyelid is reddened, congested, and severely inflamed. There is a discharge of pus which soils and mats the wool and hair about the eyes, and in many cases the eyelids stick together so that the animal is unable to open them



Fig. 25.—The eye shows a white, cloudy appearance, caused by irritation of the eyelashes in wool blindness.



Fig. 26.—A lamb with an inversion or turning inward of the eyelid; the wool about the part is wet, matted, and soiled with discharges.

(fig. 26). Lambs thus affected soon lose in condition; the pain associated with the inflammatory changes of the structure of the eye causes them to be uncomfortable and restless and to lie about without obtaining the necessary amount of food for their well-being.

Treatment.—Medicinal treatment alone is sometimes of value, and may even correct the condition. Place the finger just below the inverted

eyelid, press upon the skin in the direction away from the margin, and the lid will come out into its proper place. Apply a small amount of a 2 per cent yellow oxide of mercury ointment upon the eyeball, and gently rotate the lids over the eye. The placing of a 10 per cent solution of argyrol in the eye also gives fair results.

Surgical treatment is the best procedure and should be given as soon as the animal is found affected, thus preventing permanent damage to the eye. While the animal is firmly held or tied, the wool around the affected eyelids should be clipped, and the area cleansed with a saturated solution of boric acid. A small fold of skin is grasped with a pair of forceps, $\frac{1}{4}$ inch below and parallel to the free edge of the lid midway between the inner and outer corners; and then an elliptical piece of skin is removed with a pair of curved scissors (fig. 27). By drawing the two

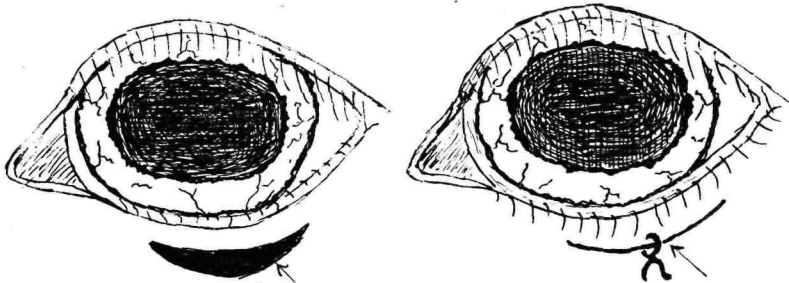


Fig. 27.—Left, elliptical piece of skin removed. Right, a single stitch through the cut edges is taken so as to close the wound.

cut edges together one will be able to ascertain whether or not enough skin has been removed to cause the eyelid to come out into its proper position. Place a single suture or stitch of three to five-day catgut, or of thread, through the cut edges so as to close the wound. Healing will take place with the desired result, but not so rapidly, without suturing the cut edges.

Precaution should be taken not to remove too large a piece of skin; otherwise the lid cannot be closed or may be turned out.

After-Treatment.—The wound will heal rapidly, and then the stitches may be removed. It is advisable to place either several drops of a 10 per cent argyrol solution or a small amount of a 2 per cent yellow oxide of mercury ointment into the eye daily to correct any inflammation of the eye.

GANGRENOUS MAMMITIS

(Blue bag or black garget)

This form of garget, occurring often in sheep and goats, is characterized by a bluish-violet color of the greatly swollen udder; it usually terminates in septicemia (blood poisoning).

Cause.—The causative organism and its way of entering the udder have not been definitely proved. Gram-negative cocci, staphylococci, streptococci, and other bacteria have been found associated with this condition.

Symptoms and Lesions.—The disease first manifests itself by an inflammation; the udder becomes hot, hard, painful, and greatly swollen. In almost all cases the disease is confined to one half of the udder. The

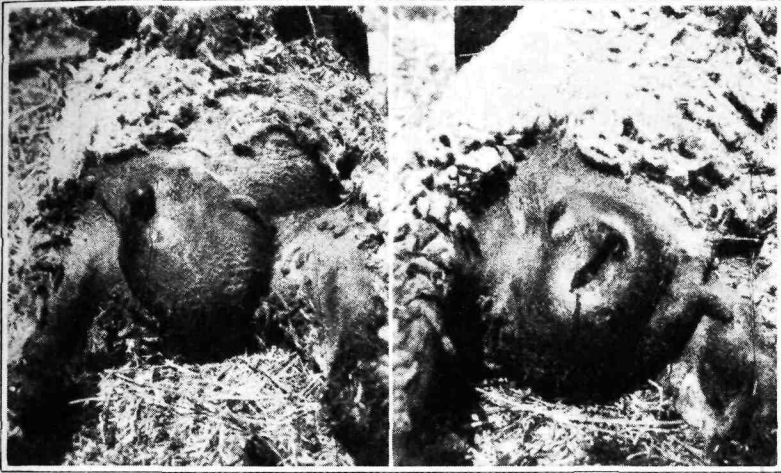


Fig. 28.—Left, half of udder greatly swollen, abnormally cool, insensitive to pain, and dark blue in color, typical of blue-bag (gangrenous mammitis). Right, one teat cut off close to udder, allowing free drainage from the gangrenous area. Same animal as shown at left.

animal appears dull and soon goes off feed, exhibiting weakness, a stiff, straddling gait, and high fever. The peculiar gait usually directs attention to the udder, which shows dark bluish-violet spots. As the condition progresses, half or all of the organ becomes greatly swollen, abnormally cool, insensitive to pain, and dark blue in color (fig. 28). Inflammatory swellings may extend along the lower part of the abdomen; and the ewe will stand arching the back, spreading the hind legs apart, groaning, and grinding the teeth. After the second or third day, in many cases, the udder becomes gangrenous, and its secretions are dark reddish brown and foul smelling.

Treatment.—First remove and segregate the ewes from the other sheep, as the discharges from the affected organ are highly infectious. Take care to prevent transmission by the herder. If the disease has progressed very far, as is usually the case, medicinal agents will be of little value; only the most radical surgery may save the animal's life. Disinfectants, such as 2 per cent carbolic acid solution, injected into the

udder, are useful but cannot penetrate the deeper parts. Camphorated oil, applied externally, has some value. Amputating (cutting off) the teat close to the udder and making a large incision will allow free drainage (fig. 28). Local anesthesia is unnecessary because there is no feeling in the gangrenous area.

After-treatment is unnecessary, with the exception of preventing flies from blowing the part; a coating of pine tar acts as a good fly



Fig. 29.—Same ewe as in figure 28 one year later, following lambing. The remaining half of the udder has enlarged to compensate for the loss of the other half.

repellent. Sloughing of the gangrenous or dead tissue will continue for some time and may leave an extensive wound that heals slowly. The diseased half of the udder will slough away and often leave the other half perfectly healthy (fig. 29).

MASTITIS

(Garget, stone garget)

Mastitis, or garget, is an inflammatory disease of the udder.

Cause.—Various organisms are associated with this condition. Possibly infection enters through wounds or cuts in the teats. Many sheepmen believe that sudden climatic changes may bring about this affection. A greater number of cases appear just before weaning or soon after.

Symptoms.—Ewes in the early stages of the illness may appear dull,

may lose their appetite, and may show lameness in one hind leg. There is usually a rise of from one to two degrees in temperature. The affected half of the udder is swollen, hot, and painful. In some cases, the secretions are watery and yellowish, containing whitish lumps; in others, they are thick and ropy, or thin and pinkish; occasionally, they may be of a dark port-wine color, with or without an offensive odor. Handling the part may reveal hard areas, ranging in size from a walnut to an orange, which later form abscesses.

Treatment.—In the early stages of the disease, hot applications of Epsom salts or poultices to the udder are helpful. Massaging the part and milking out the secretions as often as possible may bring about the desired results. If an abscess has formed, open the udder with a sharp, clean knife, which has previously been boiled or well disinfected. Wash out the abscess cavity with a weak solution of cresol dip, lysol, or potassium permanganate. Cleaning out of the cavity may have to be repeated several times before complete healing takes place. If there are any cuts or injuries to the teats or udder, apply zinc oxide ointment or tincture of iodine.

LAMBING PARALYSIS

(Pregnancy disease of ewes, acidosis, parturient paralysis of ewes, stercoremia, antepartum paralysis of ewes, ketosis)

The exact cause of lambing paralysis is unknown, but there is evidence to support the theory that it is produced by an improper assimilation of carbohydrates. It affects ewes far advanced in pregnancy (10 to 20 days before lambing), which are generally receiving dry feed, insufficient exercise, and which are usually in the best of flesh. The affection occurs in practically all parts of the world where sheep are raised, and may pass unnoticed until a number of ewes are found down.

Symptoms.—The animals appear dull, are inclined to stand around, and take very little exercise. There may be some nervous movements of the head and ears, weakness of legs, unsteady gait, and grinding of the teeth. As the condition progresses, the animals are prone to lie down as if resting and to stay in such a reclining position for hours or even days. Sheep that would formerly rise at the approach of a person will pay little or no attention. They will show difficulty in rising; and when forced to get up, if such an act is possible, may sometimes walk in circles or lean against some object such as a fence or shed. At this stage, the eyesight becomes affected; and, although the eyes show no changes, the animals are unable to see. During this time the ewes do not eat or drink, but continually grind the teeth.

The degree of sickness varies; some may keep on their feet for some time, but the more severely affected go to the ground in from one to four

days, the fattest ewes going down the quickest. When first affected, the animals may exhibit slight nervous spasms; afterwards, they lie stupified and almost motionless for days and finally die. Death usually occurs in about seven or eight days after the first symptoms have been noticed (fig. 30).

Postmortem Lesions.—In general, the lesions are confined to the abdominal cavity, there being an acute fatty degeneration of the liver

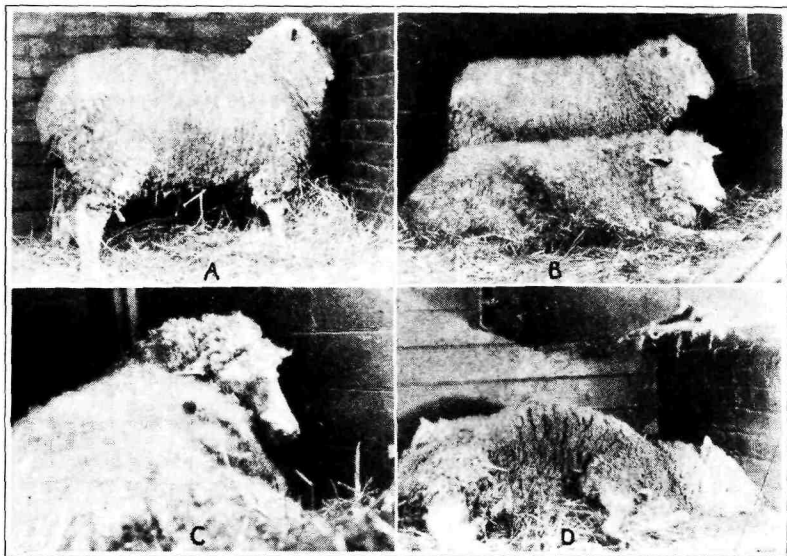


Fig. 30.—A, Ewe in early stages of lambing paralysis; she is dull, listless, and will not eat or drink; there is a continual grinding of the teeth. B, Two ewes affected with lambing paralysis, neither animal showing any inclination to move. The eyesight of both animals is lost. C, Ewe with lambing paralysis in reclining position which she may assume for hours or days. D, Ewe in last stages of lambing paralysis; note unconscious condition.

and kidneys which gives these organs, especially the liver, a yellowish-clay-colored appearance. The spleen and heart appear normal; the lungs may show some congestion or reddening because of the length of time the animals have been on the ground. The stomach and intestines may show slight changes which, in the majority of cases, would pass unnoticed. The uterus, when opened, will show a most constant feature of this disease; that is, the presence of twin or triplet lambs. Another noticeable finding is the great accumulation of fat around the abdominal organs and throughout the body in general.

Treatment.—When this disease appears in a band of sheep, the animals should be placed on green feed. If this is not possible, cut down on the amount of dry feed and make the animals exercise by placing them

on range or pasture where feed is so scarce that they will have to cover a lot of ground in order to obtain it. If the sheep are being hand-fed, one may haul the feed one to two miles away from the barns or corrals so that they will have to travel out and back for their feed and in this way will obtain the desired exercise. In some cases, the animals must be forced to exercise by driving. In districts where this condition has appeared yearly, some sheepmen claim good results by feeding strap molasses on the dry feed and driving the sheep for an hour each day for several weeks before lambing.

IMPACTION OF THE RUMEN OR PAUNCH WITH OR WITHOUT BLOAT

The stomachs of sheep, like those of cattle, have four parts, the largest being the rumen or paunch, located on the upper left side of the abdomen. Impaction of the paunch usually results from overeating of certain roughage or gorging on grain. The overdistention of the paunch causes paralysis of the muscular walls and blockage of the passage to the other parts of the stomach.

Symptoms.—Many sheep stop eating and chewing the cud, while others may continue to feed until signs of discomfort or actual pain are evident. If bloat is associated with the impaction, there will be an excessive amount of gas in the paunch, and the upper left side of the abdomen will become ballooned. The sheep become uneasy; breathing is labored, shallow, and much more rapid. The nose is held forward, and in some cases gases are belched up or vomiting occurs. Some animals may kick at the abdomen or stamp the feet against the ground; others may exhibit convulsions and stagger around until they drop. If the gas is not relieved, the animal will die of suffocation because of pressure against the lungs.

Prevention and Treatment.—Sheep should not be placed on luxuriant growth, especially clover and alfalfa, when they are hungry, or when the feed is wet or frosted. The change from dry to green feed of any kind should be made gradually, only a small amount of the new diet being allowed at first. One should be careful when placing sheep on barley or rice stubble, for there will remain on the ground a great amount of grain, which has been shattered out or has passed out with the straw. The sheep will consume so much grain that impaction of the rumen and even founder may result. Bloat may or may not be associated with this condition. Impaction of the paunch, unaccompanied by bloat, can be treated with fair success by administering 4 ounces of Epsom salts dissolved in a quart of warm water. Care should be used in drenching sheep; elevating the head, as practiced, may cause the fluid to pass down the trachea

or windpipe into the lungs, invariably producing, in turn, a mechanical pneumonia.

When bloat has just started, the animals should be forcibly exercised; and if they show signs of great distress, one should use radical methods such as tapping with a trocar and canula, or sticking with a knife. This operation should be performed with the usual antiseptic precautions. However, if death appears imminent it is better to perform a crude operation rather than to let the animal die while making surgical preparations. The trocar and canula, or knife, is inserted through the left flank midway between the posterior border of the last rib and the external angle of the ilium (hip bone). If the animal's condition is not too alarming, some anti-ferment, such as 1 tablespoonful of formalin in a half pint of water or 1 tablespoonful of bicarbonate of soda dissolved in a half pint of warm water, should be introduced through the canula into the rumen. In some cases the gas will be expelled immediately; in others it will be mixed with the ingested feed so that only a little bubbling of gas follows, with little or no relief, unless a large opening is made at the place tapped.

LAMINITIS

(Founder, autointoxication)

Founder is a peculiar inflammation of the sensitive parts of the foot inside the horny wall. The disease usually affects both front feet but occasionally all four feet or only one foot. It comes on suddenly, with such intense pain that traveling is rendered difficult or impossible.

Cause.—Overeating, especially of concentrates such as barley, oats, rice, beans, and peas, will cause this disease. When sheep have gone for days without water and are then allowed to consume all they want, founder may result. Sheep unaccustomed to long drives sometimes show symptoms similar to this disease and are classed as "foot sore"; some sheepmen, however, call this condition "road founder." A digestive disorder occurs frequently in lambs when they first start to eat fairly large quantities of grass; this condition apparently results from the inability of the different parts of the stomach to accommodate large quantities of vegetation, and causes founder (fig. 31).

Symptoms.—Sheep affected with this disease will exhibit lameness and will keep shifting or raising the feet as though in great pain from the slightest pressure or weight. Many times when the condition is caused by overeating, the animal will bloat. If the paunch is filled with a solid mass of swollen and fermenting grain, the chance for recovery is not so good as when the contents are softer and are associated with more gas.

Treatment.—Mature sheep should receive 4 ounces of Epsom salts in one pint or more of water; smaller animals, doses in proportion. Care should be taken in drenching sheep, as raising the head too high or giving the medicine too fast may cause it to pass down the trachea or wind-pipe into the lungs, where, in turn, it almost always produces a mechanical pneumonia. If the animal is badly bloated and gasping for air, tapping should be carried out at once. Should this not bring about the desired results, a larger opening may be made with a clean pocket knife,



Fig. 31.—Young lambs affected with founder, lying down or resting on knees to relieve pressure on the feet.

into the paunch at the place that was tapped. A solution containing one tablespoonful of bicarbonate of soda dissolved in a half pint of warm water, or one tablespoonful of formalin in a half pint of water should be administered to prevent the formation of more gas.

WOOL BALLS

(Felt balls)

Wool balls are accumulations of wool and plant fibers, generally moulded together in concentric form. These balls may be the result of a condition called "wool eating." Young lambs frequently gnaw the wool of their mothers, especially the parts of the fleece which are soiled with urine or feces. This material, after being swallowed, is converted into balls by the constant movement of the rumen (paunch). The consistency of these spherical bodies reminds one of felt; occasionally mineral deposits are coated over the ball, giving it the appearance of a true stone (fig. 32). In cutting open one of these balls, one sometimes finds in the center a nucleus from which the object originated, such as a grain of barley.

Many sheepmen believe that a plant called turkey mullein (*Eremocarpus setigerus*) may cause the formation of these balls in the paunch. The author was called to see a band of sheep in which 72 head of ewes died from large balls closing up the opening of the paunch. These sheep had grazed for some time previously on a large tract of summer-fal-

lowed land containing very little green feed except turkey mullein and had afterwards been moved to barley stubble. Another band of ewes, which was placed on the barley stubble at the same time but which had not been on the summer-fallowed land containing turkey mullein, did not become affected with these balls.

Symptoms.—The symptoms produced by these bodies resemble those of indigestion or impaction, and the attacks may occur frequently.

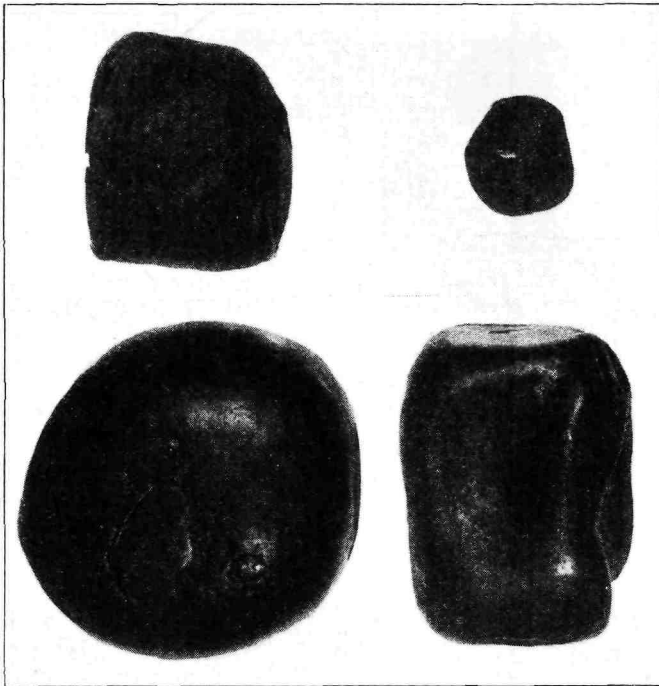


Fig. 32.—Wool balls (actual size) removed from the paunch; the consistency of these bodies reminds one of felt.

Many times bloat and impaction are brought about by the obstruction which these bodies produce. Because of the changing position of the wool balls, different symptoms are exhibited, and a positive diagnosis is sometimes impossible.

Postmortem Appearance.—Postmortem examination shows very few, if any, lesions. If the wool balls have stopped up the lumen of the intestine, there will be a hemorrhagic inflammation; occasionally the part of the intestine surrounding the ball will be dark-green to black, showing that the tissue is necrotic or dead. If impaction is present, there will be an inflammation of the digestive system just anterior to the stoppage.

There will be little, if any, digested feed posterior to the obstruction. Bodies found lodged at the openings of the compartments of the stomach usually prevent the passage of foods from one section to another, and impaction will follow. Smaller balls may be found free in the different compartments of the stomach and intestines.

If the value of the animal warrants it, an incision may be made in the left side into the rumen, and the spherical bodies removed; but this operation should be performed by a veterinarian.



Fig. 33.—Ewe affected with white-skin disease, showing greatly swollen ears that hang in a pendulous manner from the head; the eyelids are also swollen.

FAGOPYRISM

(White-skin disease)

Fagopyrism is primarily an inflammation of the unpigmented portions of the skin; it is believed to be a reaction to light on a part of the skin that has been sensitized by a substance contained in certain plants. This condition was formerly thought to be associated with the eating of buckwheat by animals whose skin is devoid or partially devoid of pigment. In many cases on record, sheep have become affected while grazing on clover, lady's thumb, smartweed, St. Johnswort, knotweed, buckwheat, alfalfa, Sudan grass, etc.

Symptoms and Lesions.—In mild cases there are slight swellings of the ears, eyelids, and lips; the animals show a continual desire to rub the parts affected because of the intensive itching in the early stages (fig. 33). Others show peculiar actions such as shaking the head, jump-

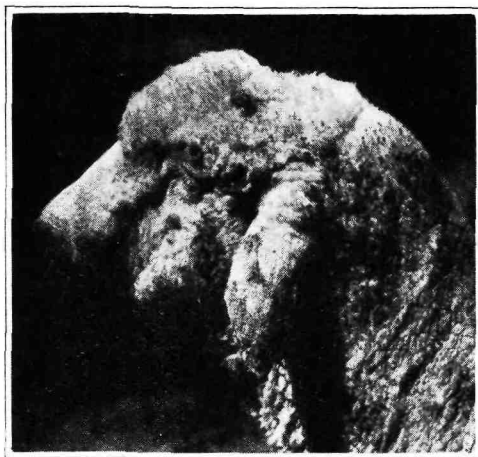


Fig. 34.—Oozing of serum from the affected ears in white-skin disease.



Fig. 35.—The swelling and oozing of serum from the affected parts have subsided, leaving the skin cracked and covered with brown scabs, a typical result of white-skin disease.

ing, violently rubbing the parts against objects, or scratching the ears with the hind feet. In the more severe cases the tissues under the skin of the ears become greatly distended with a clear fluid, which finally oozes out and adheres to the surface (fig. 34). Later the swellings decrease in size, the ears become brownish-red in color, the secretion stops, and brownish-colored scabs can be seen scattered over the surface. Many times the condition becomes more extensive, affecting the greater part of the face, especially the eyelids, muzzle, and lips. These affected parts will swell so that the animal has difficulty in seeing and breathing. Under favorable conditions, if the animals are removed from the pasture where they have been grazing or are placed out of the sun, the secretions are absorbed, leaving the parts cracked, roughened, and covered with brownish scabs, which later fall off (fig. 35). A brownish discoloration of the affected parts persists for some time after recovery.

A similar condition, affecting the back of the animal from the tail to the shoulders, is often observed several days after close shearing. The symptoms and lesions are similar to those previously described. These animals soon recover, the only noticeable after-effects being the loss of wool from the back, followed by reddening of the skin and slight blistering from the direct rays of the sun.

Treatment.—Animals showing symptoms of this affection will, if removed to other pastures or protected from sunlight, generally make a complete recovery. The death rate from such reaction to food is very low, but the economic loss is great because of loss in condition.

SWELLED HEAD

(Big head)

Bighead is a noncontagious, noninfectious disease characterized by edematous or dropsical swellings of the head. This malady usually affects young rams eight months to two years of age.

Cause.—The direct cause of bighead is not definitely known; but many believe that this disease is similar to fagopyrism or white-skin disease and that it is produced in a similar manner (see "Fagopyrism").

Symptoms.—The first symptoms observed are slight dropsical swellings of the eyelids, lips, and lower jaw, finally progressing over the entire face; the ears may or may not be involved. The head may become twice its normal size. At first the animal shows a desire to rub the head against some object or to scratch the part with the hind feet because of the itching in the early stages. The eyes are usually involved, showing a hazy-blue appearance or a milky-white opacity, with a severe inflammation of the other parts of the eye and the membranes that line the lids, followed by a purulent discharge. The swelling may be so severe as to

close the eyes completely. Eating and drinking are difficult because of the swollen and inflamed condition of the lips, tongue, and cheeks. A nasal discharge is frequently observed. An elevation in temperature, ranging from 105° to 107.5° , is always present at the onset of this disease. A light-yellow serum is noticed oozing from the swollen areas, followed by scab formation and cracking of the skin. If the animal survives, loss of wool from the entire body is not infrequent, and blindness in one or both eyes may result.

Lesions.—Animals dead of this disease exhibit lesions confined mostly to the head. There are edematous (dropsical) swellings under the skin of the face, especially around the eyes and cheeks, below the jaws, and under the mucous membranes of the mouth and tongue. This serous or jelly-like fluid may be found between the muscles of the head and neck and around the ears. The lymph glands of the head and neck are enlarged and succulent. Small hemorrhages may be observed in the tissues of the head, the nostrils, trachea, and lungs. Hemorrhages may or may not be present in other organs of the body.

Treatment.—The use of hot applications or poultices of Epsom salts (1 pound to a gallon of water), applied to the entire head, has proved to be the most satisfactory of the many treatments that have been employed.

ECZEMA

(Summer sores, itch)

The condition commonly called "summer sores" is characterized by intense itching; certain parts of the body are finally denuded by continual biting. The disease usually starts in the early summer, gradually grows worse during the hot weather, and subsides or completely disappears during the fall and winter. The areas most generally involved are over the loins, on the sides of the abdomen, behind the shoulders, and occasionally under the abdomen (fig. 36). This disease does not appear to be contagious, for many bands will have only one or two affected animals, and healthy sheep in close contact with those having summer sores do not contract it. Feed and sunlight are evidently not contributing factors as in white-skin disease. Badly affected sheep have been placed out of the sunlight and given different kinds of feed without being benefited. The cause of eczema is unknown.

Symptoms.—In the early stages of this ailment, sheep bite or gnaw at the flank, scratch and rub against some object, or try to scratch certain parts with the hind feet. Occasionally they exhibit an itching or irritation of the ears or legs. The wool over these parts will be wet by the gnawing; but soon raw, bleeding areas appear. The affected parts gradually become larger and are continually irritated by flies.

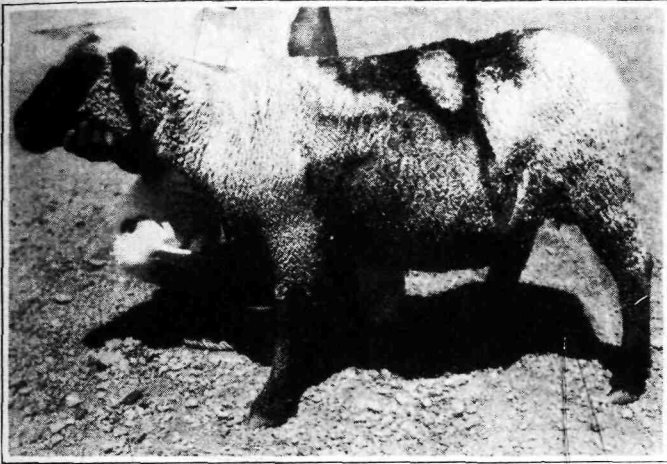


Fig. 36.—Summer-sore sheep showing denuded areas caused by continual biting.

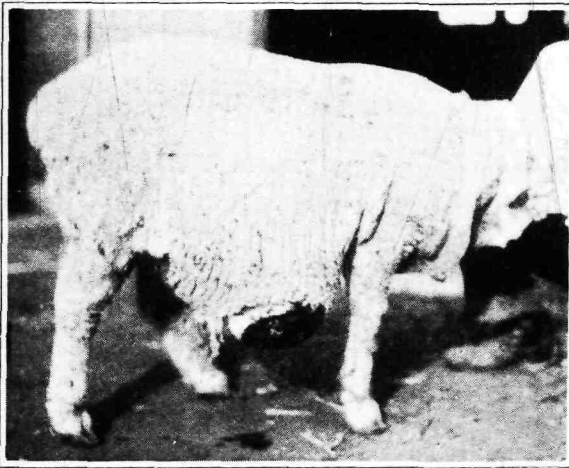


Fig. 37.—Ewe with large hernia or abdominal rupture.

Treatment.—Wash the affected area with a fairly strong solution of cresol dip (one cupful to a gallon of water), allow it to dry, and apply a thick coating of pine tar over the part. The number of times this procedure will have to be repeated will be governed by whether or not the animal is chewing on itself.

ABDOMINAL HERNIA

(Ventral hernia, abdominal rupture)

Hernia or rupture is most commonly found in aged ewes. A rupturing or parting of the abdominal muscles allows the intestines to fall through into a pouch or sack-like enlargement (fig. 37). The size of this enlargement may increase, especially when the ewe is heavy with lamb, because of the greater amount of abdominal contents at that time. This condition usually interferes with normal lambing, as the ewe will have



Fig. 38.—A greatly enlarged scrotum filled with intestines; scrotal hernia is often mistaken for the so-called "big testicle."

difficulty in forcing the lamb out of the uterus. All ewes thus affected should be watched at this time and, if necessary, assisted in delivering their lambs. Ewes having an abdominal hernia should not be kept for breeding, but should be fattened and slaughtered. Many ranchers use this type of carcass for home consumption because such an animal when sold alive will bring only a small sum. When killed and dressed, however, the meat will be found just as palatable as that of any other sheep of the same age and condition.

Operations or medicinal treatments are not successful in this type of hernia.

SCROTAL HERNIA

(Serotal rupture)

Scrotal hernia in sheep is not common, but may be mistaken for orchitis or "big testicle." In this condition a portion of the intestines descends through the inguinal canal into the scrotum. This type of hernia, commonly called serotal rupture, is complicated by the fact that the cord and testicle also occupy the hernial sack. The hernia is nearly always a unilateral condition (found only on one side) (fig. 38). Spontaneous



Fig. 39.—Same animal as in figure 38. The scrotum or bag cut open, exposing many feet of large and small intestines.

disappearance is rare because the intestines adhere to the other contents of the hernia and also because the large pendulous scrotum of the ram affords more space for the hernial contents; not uncommonly, 10 to 15 feet of intestines will be found beside the testicle (fig. 39). Since serotal hernias are thought to be congenital and hereditary, rams so affected should not be used for breeding.

ORCHITIS

(Big Testicle)

Orchitis, commonly called "big testicle," in rams is an inflammation of the testicle. It usually affects only one of the organs, though in old chronic cases both may be involved.

Cause.—Although the true cause is not definitely known, the consensus of opinion is that bruising and injuries cause an inflammation of the part. The large size of the testicles in the ram and the pendulous manner in which they hang down between the legs predispose them to injuries by hitting against the legs, fallen logs, boards, brush, stones, or large weeds while walking or running. Injuries caused by the sharp

barbs of bull thistle, bur clover, and other plants may help in producing this condition in sections where such vegetation is prevalent.

Symptoms.—The first symptom noticed is swelling of one side of the scrotum (fig. 40). As the testicle enlarges, the movements are restricted because of the severe pain. The animal walks with a straddling gait and may be found standing off by itself or lying down the greater part of the

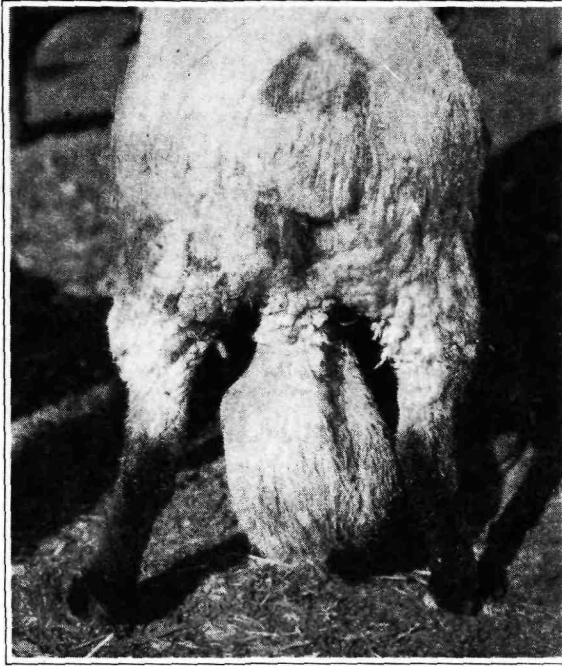


Fig. 40.—Ram affected with orchitis; the scrotum, or bag, is greatly enlarged; the left side is completely filled with pus.

time. Abscesses soon form and if not opened will rupture, allowing the pus to escape to the outside through the skin of the scrotum. Old chronic cases exhibit many scars or fistulous tracts in which abscesses have previously ruptured. The tunics (or covering around the testicle) grow fast to the testicle and scrotum; in some rams, the testicle may have completely degenerated, leaving only a greatly thickened scrotum filled with a greenish-yellow pus (fig. 41).

Treatment.—Where only one testicle is involved and the buck is of great value as a stud ram, an attempt may be made to preserve the breeding powers by an operation. The scrotum should be thoroughly cleansed with soap and water and afterwards with a 2 per cent solution of cresol dip. An incision is made, about 6 inches in length (though this

varies with the size of the animal) parallel to the median line of the scrotum and extending through the skin and testicular coverings. Squeeze off the cord with a burdizzo or emasculator, thus preventing too great a hemorrhage. If neither of these instruments is at hand, ligate or tie off the cord with a heavy string that has previously been

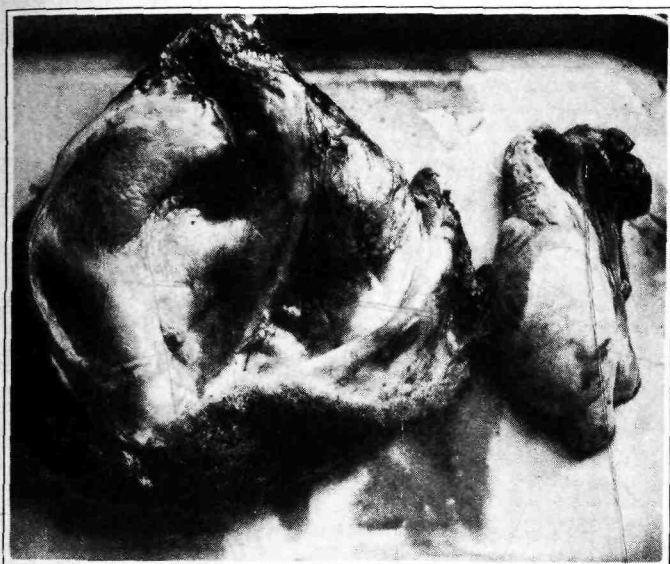


Fig. 41.—The scrotum removed and opened; the left testicle has sloughed away, leaving a large abscess cavity, while the right testicle remained normal.

boiled or allowed to remain in tincture of iodine, before removing the affected organ. Insure good drainage by making the incision to the bottom of the scrotum, being careful not to cut into the other side of the bag that contains the healthy testicle.

If the animal is not an exceptionally good sire, complete castration is the best procedure.

EVERSION OR PROLAPSE OF THE VAGINA AND UTERUS

(Protrusion of the womb)

Prolapse, popularly known as “throwing out of the womb,” may be encountered before or after lambing, and may be partial or complete.

Cause.—Many theories have been set forth to explain the cause of this trouble. The one most commonly accepted, however, is that the ewe, being heavy in lamb, usually carrying twins, and being excessively fat, has little desire to exercise. Since animals in such a condition will hardly rise to urinate, a great amount of urine will accumulate in the bladder.

When the ewe tries to expel the urine, the womb may be forced back over the extended bladder; and continual straining may result in forcing out the vaginal walls, causing a prolapse of the vagina. Prolapse often follows difficult lambing, especially when the ewe is unable to lamb without assistance. A similar condition may follow after the retention of the placenta, because of continual straining to expel the fetal membranes. The author has observed complete prolapse of the womb fol-



Fig. 42.—Prolapse of the vagina and part of the womb.

lowing the washing out of the vagina and uterus with strong antiseptic solutions, and also following contagious abortions caused by infections.

Symptoms.—In many cases where the prolapse has already taken place, no symptoms have been observed. The animal is seen standing off by herself. Intermittent straining is noticed. Pain and discomfort increase because of the protruding mass, preventing the escape of urine and thus distending the bladder to an enormous size. In reality, the wall of the vagina is turned inside out; the mucous membrane is swollen and dark red, and soon becomes edematous or dropsical (fig. 42). Lacerations of the swollen tissues are not infrequent. Blood, dirt, and excrement adhering to the part soon present a repulsive sight. Unless corrective measures are instigated, death usually follows in two to three days.

Treatment.—Success in handling such a condition depends upon early treatment, before the prolapsed membranes have become greatly swollen, congested, lacerated, and covered with dirt and fecal material. First, carefully wash the part with a warm solution of salt (2 ounces of salt to 1 gallon of water, or of 2 per cent carbolic acid), being sure to remove all dirt and debris. Second, raise the hind quarters well off the ground by tying the hind legs to an overhead beam or projection so that the animal's head, neck, and shoulders will rest upon the ground. In this way the abdominal organs will fall forward, allowing the prolapsed membranes to be replaced more easily. Third, after the animal has been placed in this position, thoroughly cleanse the parts and lubricate them, also the hands and arm, with mineral oil or carbolized vaseline; and by steady pressure return the organ to its normal position. The ewe will usually urinate after the replacement of the womb and vagina, thus relieving the pain from an over-distended bladder. The animal should remain in this position, with hind quarters elevated, for an hour; should such a procedure fail to correct the condition, broad sutures should be placed on each side of the vulva and tied across the opening.

PROLAPSE OF THE RECTUM

Cause and Symptoms.—In prolapse of the rectum, the folds of the rectum protrude through the anal opening (fig. 43). If allowed to go untreated, this affection usually causes death. It is found more often in lambs placed on heavy feed or being prepared for show, but occasionally in lambs suddenly changed from dry feed to a succulent green vegetation that causes scouring. It may be found in ewes following difficult lambing, being produced in this case by continual straining.

Treatment.—The animal should at once be placed in a small inclosure and allowed only a little feed and water. High rectal injections of mineral oil should be given daily to lubricate the rectum, thus allowing free passage of manure and preventing straining. This method works well provided the animal is treated before the part protrudes very far or before it is cut, lacerated, or fly-blown. In severe cases, removal of the part will be necessary, and the services of a veterinarian will be required. If the animal is in good condition and suitable for food, slaughtering would probably be the best and most economical procedure.

INFLAMMATION OF THE PENIS

This condition is primarily an affection of bucks, caused by injuries to the penis. Excessive riding of the animals while in the "buck band" will cause irritation to the organ, and small cuts or wounds of the part allow entrance of organisms into the tissues. Cockleburs, bur clover



Fig. 43.—Prolapse of the rectum.

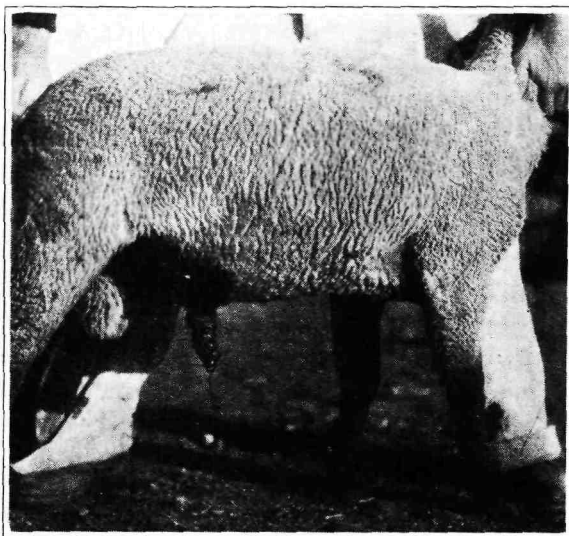


Fig. 44.—Buck with inflamed penis protruding several inches; there is an adherence of dirt and blood clots, also scab formation.

Pods, etc., attached to the hairs and wool about the sheath will produce a similar condition.

Cause.—Irritation and injuries to the organ are the primary cause of this condition. Before such abrasions can heal, however, many different organisms gain entrance into the part, producing severe inflammation. Predominating organisms obtained from many affected animals are *Staphylococcus aureus* and *Albus Streptococci*, *Bacillus pyogenes*, and *Actinomyces necrophorus*.

Symptoms and Lesions.—The animals will show a swelling of the sheath, which later shows inflamed and dead tissue. The penis protrudes for several inches, and the animal is unable to withdraw the part (fig. 44). There is adherence of dirt and blood clots, and bleeding followed by scab formation. Whitish-yellow necrotic or dead areas appear, varying in size according to the intensity of infection. The swelling of the part, associated with the adherence of dirt and other material, many times interferes with urination; and the animal will show continual signs of straining.

Treatment.—Affected animals should be segregated and placed on as clean a pasture as possible; this arrangement will materially aid in correcting the condition. Inflammation of the penis should be promptly treated; otherwise adhesions, deformities, or paralysis may result. Thoroughly wash the part with a warm antiseptic composed of 0.5 per cent solution of potassium permanganate or 1 per cent solution of creolin. After all the necrotic material has been removed and the part thoroughly cleansed, apply carbolized vaseline or a powder containing sodium perborate and iodoform (9 parts to 1). This treatment should be carried out each day until recovery is certain.

URINARY CALCULI

(Gravel, stones)

Urinary calculi in sheep are mineral deposits, usually composed of calcium phosphate or calcium carbonate. Calculi mostly affect wethers and rams. The voiding of urine is interfered with, and in many cases complete stoppage results. Calculi accumulate in the bladder and kidneys and are passed down with the urine, blocking the urinary passage at the extreme end (the vermiform appendage or "worm" of the penis) or become lodged in the urethra at the S-shaped turn.

Cause.—Calculi formation is thought by many to be partly caused by feeding of roots, particularly mangles; by hard water; and by heavy feeding on grain and alfalfa.

Symptoms.—Affected sheep stand around with the back arched. They show frequent straining and attempts to urinate, passing only a few

drops of blood-stained urine. They become dull and lifeless, going off feed or eating very little; as the condition progresses, they have a tendency to lie down the greater part of the time. The wool around the sheath becomes matted and wet, and dropsical swellings usually appear on the abdomen before death (fig. 45). The urine completely or partially retained, is soon absorbed into the system, ruining the meat for use. If the calculi are not removed, rupture of the bladder occurs, followed by death.

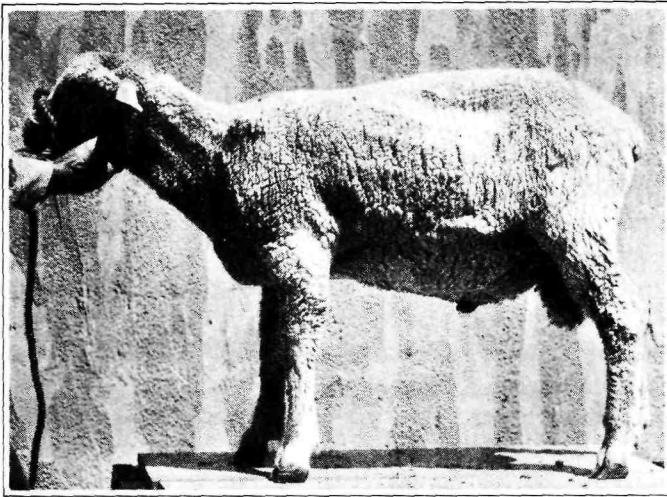


Fig. 45.—Note the soft edematous swelling on the abdomen, running forward to the front legs; there is also dropping of urine from the sheath, in urinary calculi.

Treatment.—Thoroughly cleanse the part with some mild antiseptic; one can be made up by adding 1 tablespoonful of a coal-tar disinfectant (dip) to 1 quart of warm water. The sheath should be syringed out thoroughly, and the penis forced to the outside. Manipulation of the organ with the thumb and finger may serve to dislodge the gravel blocking the “worm.” If such a procedure does not remove the obstruction, cut off the “worm.” When the stone is located higher up, especially at the S-shaped curve, the urethra will have to be opened to remove it; but such an operation rarely saves the animal, as more gravel will soon pass down from the bladder, again blocking the passage.

Prevention.—No definite recommendations can be made for the prevention of urinary calculi. In California this condition is met with while sheep are on bean and pea straw, grain stubble, beet tops, and alfalfa. In certain years this condition is more prevalent than in others; in 1931 serious losses were observed in many bands of bucks and buck lambs on

GOITER

(Enlarged thyroid glands)

In sheep and goats affected with goiter, the thyroid gland, "located in the throat region of the neck just where the head joins," is greatly enlarged (fig. 46). This affection is also found in newborn lambs and kids in certain localities where the soil, herbage, and water are lacking in iodine.

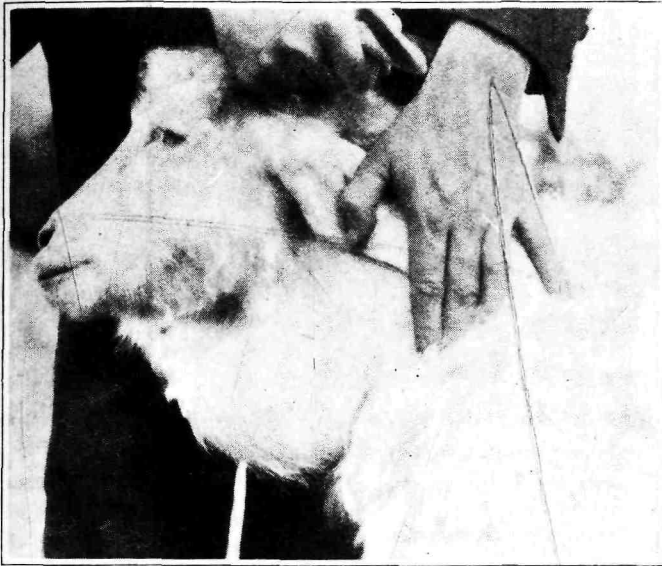


Fig. 46.—Thyroid gland (goiter) greatly enlarged.
(Courtesy, Dr. J. W. Kalkus.)

Symptoms.—The newborn lambs show a great enlargement of the thyroid, which may rapidly increase in size and cause death from suffocation, because of pressure on the pharynx and trachea. Occasionally lambs so affected are born dead or die soon after birth. They exhibit a great enlargement of the gland and may or may not be well covered with wool (fig. 47).

Prevention.—Goiter or enlarged thyroid glands in lambs can be prevented by placing blocks of iodized salt in the corrals or on ranges where the land is known to be lacking in iodine content. If blocks of iodized salt are unobtainable, use the following mixture: 1 ounce of potassium iodide, 2 pounds of common table salt, and 300 pounds of stock salt.

Place this in troughs where sheep will have access to it. The ewes will thus obtain enough iodine to give birth to normal young.

Treatment.—Lambs born with enlarged thyroid glands are given 5 grains of potassium iodide daily by mouth; at the same time, tincture of iodine is applied over the gland until the enlargement disappears.

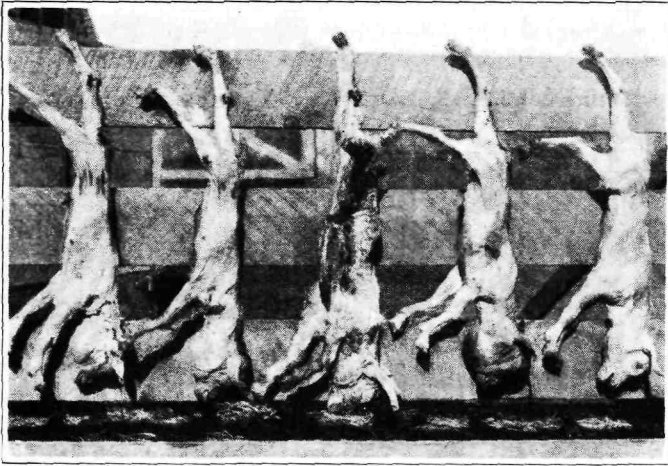


Fig. 47.—Showing hairlessness, often associated with goiter. These kids were born dead. (Courtesy, Dr. J. W. Kalkus.)

ABNORMAL TEETH

Affections and abnormalities of the teeth in sheep are fairly common and may exist for a long time without causing much trouble or attracting the attention of the owner or herder. Teeth that have become de-

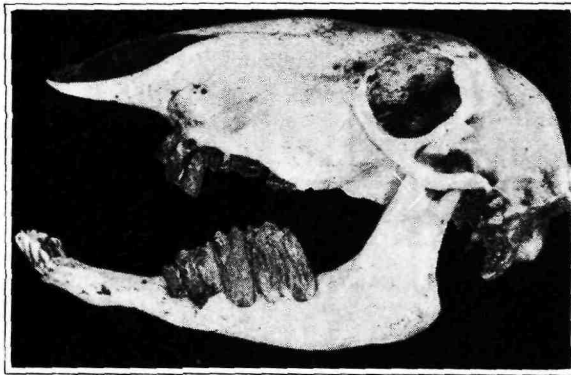


Fig. 48.—Skull of sheep, showing abnormal teeth.

cayed, irregular in shape (fig. 48), or crooked because of faulty development; abnormalities in the number of teeth; or improper shedding of the temporary teeth will soon cause the animal to become unthrifty.

Symptoms.—Sheep with bad teeth have difficulty in chewing their

food because the sharp edges cut the tongue and cheeks painfully during movements of the jaws. Partially chewed food, saturated with saliva, is noticed falling from the mouth. The animal may hold the head to one side when chewing; after feeding, the food usually collects between the teeth and the cheek, causing an enlargement on the side of the face. If this enlargement is examined, one finds a mass of partially masticated



Fig. 49.—Lamb affected with rickets, showing legs badly bent and deformed.

food lodged either between the teeth and the cheek, or in large cavities left by decayed, separated, irregular, or broken teeth. Loss of condition is one of the first symptoms noticed and is often thought to be caused by intestinal worms; examination of the mouth, however, reveals the real trouble.

Sheep with protruding upper jaws (parrot mouth) or with a longer lower jaw (sow mouth) should never be saved for breeding, because this deformity or abnormality is usually transmitted to the offspring.

Treatment.—Loose or decayed teeth are, as a rule, easily extracted with forceps. Elongated or irregular teeth may also be removed. Lasting results should not, however, be expected; and as soon as the animal picks up in flesh it should be slaughtered for food rather than placed in the breeding herd.

RICKETS (Rachitis)

Rickets is a disease of the young, appearing when calcium, phosphorus, or vitamin D is deficient or improperly assimilated. This con-

dition is characterized by a softening and an increase in size of the bones, especially those of the legs and ribs. The legs become badly bent and deformed (fig. 49), so that walking is difficult; thus, the lambs will be found lying down the greater part of the time. Animals so affected should be given a well-balanced diet, including if possible some green feed or cured green alfalfa, plus a teaspoonful of cod-liver oil daily. In lambs still nursing, the diet of the ewe should also be considered.

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