Miscellaneous Diseases of Sheep and Goats

BY M. S. SHAHAN

HERE is a discussion of some 36 or more diseases and injuries to which sheep and goats are subject. Many of them, it will be noted, can be largely prevented by good management, proper feeding, strict sanitation, and care in ordinary operations involving surgery. The author emphasizes the need for sound veterinary diagnosis.

DISEASES OF THE DIGESTIVE ORGANS

Bloat, constipation, diarrhea, and enterotoxemia are included among diseases of the digestive organs. All may be largely prevented or controlled by proper feeding.

Bloat, or the accumulation of gas in the stomach or intestines of sheep and goats from fermentation of their contents, is chiefly the result of feeding green, wet, frosted, or damaged feeds, but it may occur after the eating of any feed in large quantities, particularly one to which the animals are not accustomed. Bloat is an evidence of indigestion and in an acute form it is very troublesome and dangerous. To prevent it, sheep should be given only clean, sound feed in amounts that they can satisfactorily digest. If, through inexperience or accident, the trouble occurs in a flock, all the animals should be immediately removed from access to either feed or water. Kneading the paunch through the abdominal wall in the region of the left flank and slowly driving the affected animal may promote passage of the gas. Elevating the forequarters or placing a gag in the mouth may accomplish the same purpose. If a veterinarian is not available, oil of turpentine (1 to 2 teaspoonfuls) or aromatic spirits of am-

1 M. S. Shahan is Veterinarian, Pathological Division, Bureau of Animal Industry.
monia (½ to 1 teaspoonful) in a half pint of water or milk may be given as a drench. A laxative is generally desirable. When death threatens from extreme distention, an opening into the paunch may be made to permit the escape of the gas. This is usually done by the veterinarian with a special instrument known as a trocar and canula. In an emergency, the operation may be performed by an untrained person, but, whenever possible, instructions should be obtained from a veterinarian before resorting to this. After recovery from acute bloat, the animal should be allowed free access to water but be given only laxative feeds in small amounts for several days.

Constipation, or impaction of feed in the paunch or the other stomachs, may develop as a result of feeding coarse, dry, or indigestible feed or from overfeeding more healthful materials. The remedy is to remove the accumulated feed by means of drugs that stimulate the muscles of the digestive tract, kneading the flanks, introducing water into the stomach through a stomach tube, or, if necessary, by drenching or the administration of appropriate laxatives.

Diarrhea, or watery feces, may be caused by internal parasites such as coccidia or worms, infection by bacteria such as *Salmonella aertrycke* or *Mycobacterium paratuberculosis*, the feeding of green succulent feeds, or excessive consumption of any feed. Prevention and cure depend upon the nature of the underlying cause. Lamb dysentery, paratyphoid dysentery, and Johne’s disease are distinctly different from simple diarrhea and are discussed elsewhere in this article.

Enterotoxemia, intoxication or poisoning of intestinal origin, is probably the most frequent cause of losses of lambs in western feed lots. It differs from the Australian disease of the same name (1), though the two are similar in some respects. Feed lot enterotoxemia results from the overeating of grains or other concentrates. The immediate cause may be the toxin formed in the intestines by the widely distributed germ *Clostridium perfringens* (*Cl. welchii*) (8). A similar condition, known as pulpy kidney disease or milk colic, sometimes develops in sucking or weanling lambs pastured on a lush growth of rich forage (2, 13).

The prevention of enterotoxemia is essentially a matter of management. A sufficient interval should be allowed after placing lambs in the feed lot to permit their digestive organs to become accustomed to the new, rich feed. Different lots of lambs vary widely in their ability to consume feed; what one group will thrive on may be fatal to another. Hence, judgment, skill, and watchfulness are necessary in fattening operations. The ration should be graduated according to the size and condition of the animals being fed, beginning at first with feed consisting chiefly of hay or other roughage, with only a small amount of concentrates, the latter being gradually increased as the animals adapt themselves to the regime. The sheep should be graded according to size and condition, being penned for feeding in as nearly uniform lots as possible.

Once the animals reach the stage of full feed, they should be closely

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2 Italic numbers in parentheses refer to Literature Cited, p. 857.
watched. At this time, any disease in the lot will tend to cut down feed consumption by the sick lambs, leaving excessive amounts for the healthy individuals unless the ration is cut in proportion to the number of animals actually on feed. In flocks that develop milk colic on pasture, it is believed to be good practice to reduce the feed of the ewes and lambs by penning them at night and for a part of the day in a dry, clean lot without feed.

Sluggishness, reluctance to eat, and diarrhea are signs that lambs are going off feed. If the amount of grain is not reduced, considerable losses from death may follow. The animals may be found dead in the pens, a few or many each day, with or without having shown marked signs of abnormality. Sick sheep may be seen with the head elevated, staggering about the pen, running blindly into fences, or in convulsions. Constipation, which may appear early, is usually followed by diarrhea. At post mortem examination, large hemorrhages may be found in the abdominal cavity, along the intestines, in the diaphragm, or in the belly wall. The inside of the fourth stomach may be reddened. The kidneys and liver may be very friable, or easily torn. In animals that die after a brief illness, few significant abnormalities may be found.

Once lambs have been upset by overfeeding, great difficulty is usually experienced in getting them back into thrifty fattening condition.

While treatment of enterotoxemia is seldom successful and generally uneconomical, the veterinarian should be called to establish the diagnosis and for help in handling the flock in order that further losses may be avoided.

**DISEASES OF THE RESPIRATORY SYSTEM**

Respiratory diseases are relatively unimportant in sheep except in connection with shipping, as a result of which hemorrhagic septicemia, or so-called shipping fever, sometimes appears. (See the article on p. 526.) This is an infectious disease attributed at least in part to the germ *Pasteurella oviseptica*, which is a normal inhabitant of the respiratory passages and usually causes disease only under conditions adverse to the animal's resistance. Such conditions occur when sheep, especially lambs, are taken from grass pastures, shipped crowded together, and subjected to prolonged hunger and perhaps cold, frequently arriving at their destination weak and exhausted. They may be driven considerable distances, becoming overheated, and the feed they are given is usually strange. Young shed-dropped or farm lambs sometimes develop a form of pneumonia much like that of shipping fever.

In feed-lot lambs, shipping fever appears usually within the first few days of the feeding period. As many as half the animals in a shipment may become sick, and the death loss may be 10 percent or more in severe outbreaks (7).

Fever, depression, rapid breathing, sneezing, coughing, and discharge from the eyes and nose are common symptoms. In acute cases, death may result within 24 hours after the illness first appears,
and there may be little of diagnostic significance at post mortem examination except perhaps numerous small to large hemorrhages under the skin or within the chest. Chronic cases usually develop into pneumonia, lasting from a few days to several weeks. If death does not intervene, there is a long period of convalescence. Diagnosis of either type of the disease usually depends upon bacteriological examinations.

Improved shipping conditions, including regular rest, feeding, and watering, and protection from severe weather and overcrowding tend to lessen the likelihood of hemorrhagic septicemia in sheep. The disease occurs irregularly, however, from season to season and year to year, and it may develop no matter how well the animals are handled.

Animals may be somewhat protected against the disease by vaccination with hemorrhagic septicemia bacterin, preferably administered some time before they are to be shipped. During years when the disease is prevalent, anti-hemorrhagic-septicemia serum may be given as a preventive. This has a quicker but less prolonged prophylactic effect than bacterin. The decision as to which if any biological product is to be used in each case should be left to the veterinarian familiar with all the circumstances.

Treatment of the disease is generally uneconomical, though serum may be used in selected cases with good results. Prompt isolation and good nursing of affected animals are advantageous.

Chronic progressive pneumonia, so-called lunger disease, is discussed elsewhere in the Yearbook (p. 927).

Exposure of sheep to cold after shearing or dipping may cause pneumonia. Other forms of pneumonia occur as a result of invasion of the lungs by various parasites or bacteria.

Nasal catarrh, or snuffles, is a common condition in sheep, especially those ranging on dry, sparsely vegetated land or traveling dusty trails. The ailment is generally negligible unless it becomes marked, as in pneumonia, severe cases of grub in the head, or specific local infection. Control and treatment under these conditions depend upon the nature of the cause.

**DISEASES OF THE NERVOUS SYSTEM**

Listerellosis (listeriosis), rabies, meningitis, enterotoxemia, paralysis, and gid infection (see p. 874) are included among diseases of the nervous system.

Listerellosis, or circling disease, in sheep consists essentially of an inflammation of the brain caused by the germ known as *Listerella monocytogenes*, or *Listeria*. The symptoms of the malady include nervous disorders, inflammation of the eye, and occasionally abortion. Dullness, fever, and strange, awkward movements, such as staggering, pushing the head into fences, and walking in circles, are observed. Paralysis, finally ending in death, follows in most cases.

It is not known how the disease is spread, and there are no proved means of prevention or treatment. Diagnosis depends upon laboratory examinations, since autopsy does not reveal characteristic changes in the body.
Rabies, which may affect any species of mammal, is discussed elsewhere in the Yearbook (p. 1109). It is referred to here to emphasize that when a nervous disease appears in goats or sheep, the possibility that rabies is the cause should be considered by the veterinarian. Small ruminants with rabies behave much like any other animal affected with the disease, and the symptoms commonly include those seen in other nervous diseases. Licking or gnawing at the site of the bite, stamping of the feet, and bleating are frequently observed. Some animals become belligerent before the final paralysis that ends in death. The prevention of rabies in sheep or goats is essentially the same as in the case of other animals.

Meningitis consists of an inflammation of the meninges, or membranes, which cover the brain within the cranial cavity. It generally accompanies encephalitis, or inflammation of the brain, to a greater or less extent, regardless of the cause of the latter. It is not a specific disease like cerebrospinal meningitis of man but may be caused by any of several micro-organisms. Pus-forming Staphylococcus, Streptococcus, and other organisms are responsible in some cases. These organisms frequently gain entrance to the body at the time of docking and castration or through the navel at birth and may become localized anywhere in the body. When they become established in the brain or spinal cord, symptoms of nervous disorder, including paralysis, may occur. Such cases are relatively infrequent and may be prevented almost entirely by proper technique in handling the animals during the operations mentioned. Determination of the exact cause of meningitis requires bacteriological study. Treatment is seldom practical.

Paralysis, or loss of the ability to move a part of the body, particularly the legs, rarely occurs except in the course of the diseases mentioned, although it is a common symptom of pregnancy disease and milk fever. Paralysis is sometimes attributed, however, to a toxin or other substance in certain ticks that feed upon sheep. Removal of the ticks usually leads to prompt recovery, as is also true in some cases of tularemia, or rabbit fever, which may be conveyed to sheep by infected ticks. Severe blows, falls, or other injuries sometimes cause fracture or dislocation of the vertebrae, leading to paralysis.

**DISEASES OF THE SKIN**

The commonest cause of abnormalities of the skin of sheep is scabies, or scab, discussed elsewhere in this Yearbook (p. 904). Other conditions that may affect the skin directly or indirectly include purulent dermatitis, ringworm, pox, contagious ecthyma, maggot infestation, filarial dermatosis, and actinobacillosis.

Purulent dermatitis, as here considered, consists in the invasion of the skin and underlying tissues by pus-forming micro-organisms. The organisms may be introduced by penetrating awns and other parts of grasses and other plants, such as foxtail, needlegrass, wild oats, and alfilaria, or through shearing cuts and other wounds. In severely affected animals, the abscesses formed as a result of the bacterial infection may occur deep in the underlying muscles or even
in the abdominal cavity and may lead to pyemia, a form of general poisoning. Prevention consists in avoiding, or limiting as far as possible, objects on the pasture or in feed which may collect in the wool and are capable of penetrating the skin. Shear cuts and other wounds should be treated immediately with tincture of iodine or some other suitable antiseptic.

Ringworm is relatively rare in sheep. It may be due to various species of fungi that require laboratory study for identification. The disease should be distinguished from so-called lumpy wool due to Actinomyces dermatomonus (3), a fungulike organism that produces lumpy wool, as the name indicates, but little or no abnormality of the skin except as a secondary manifestation.

Sheep pox is caused by a filtrable virus resembling but not identical with that which causes smallpox in man.

Sheep pox is characterized by the formation of dark-red papules, which turn into blisterlike formations, or vesicles, chiefly on the bare or thinly woolled parts of the body. The vesicles break and become infected with pus-forming germs, which frequently cause death through septic infection. Fortunately, the disease has not become established in the United States.

Contagious ecthyma (p. 835), maggot infestation (p. 898), and filarial dermatosis (p. 890) are discussed elsewhere in the Yearbook.

Actinobacillosis (see also p. 549) is an infectious disease caused by the germ Actinobacillus lignieresi. As it has been observed in sheep, the infection enters the body through the punctures made by the awns or other parts of certain plants, such as needlegrass and prickly-pear. Small pockets of pus form in the tissues beneath the skin, sometimes discharging their contents onto the skin and matting the wool in the regions affected, and sometimes leading to generalized lesions in the internal organs.

Diseases of the skin usually cause more or less itching, manifested by scratching or biting of the affected part. Attending this, there are more or less loss of wool and varying degrees of inflammation of the skin. The exact determination of the cause of the trouble usually requires the services of a veterinarian, who should be consulted as soon as the trouble is first noticed. It can then be determined whether the disease is contagious, and if so, its spread can be limited or entirely prevented.

**DISEASES CONNECTED WITH REPRODUCTION**

Abortion, the pregnancy toxemias, metritis, mastitis, prolapse of the genital organs, venereal infection, and orchitis are among the diseases connected with reproduction.

Abortion signifies the expulsion from the womb of either living or dead young before the normal time of birth. Damaged feeds, especially those that are moldy, are sometimes held responsible for abortion, and some cases are attributable to generalized infection, toxemia, injury, or undernourishment. Infectious abortion of sheep, unlike that of cattle, is rarely attributable to germs of the Brucella genus, being most often caused by *Vibrio fetus*, *Salmonella*, *Pasteurella*,
Listerella, or coliform organisms which infect the fetus and the fetal membranes. Goats, on the other hand, may suffer from infection with any of these organisms, including Brucella. With or without abortion, brucellosis in goats is more dangerous for man than brucellosis in any other animal species.

The interval between infection and abortion varies somewhat with the type of germ causing the trouble and may differ in individual outbreaks. Abortion early in the development of the fetus invariably means a dead lamb or kid. When it occurs later, near the normal time of birth, living young may be born, but they are usually so weak that they live only a few days.

Symptoms indicative of impending abortion may or may not be observed. The disease may develop slowly during the gestation period, finally resulting in depression and loss of appetite just before abortion takes place. There may be a rusty-colored discharge from the vulva, but usually there are no other symptoms. After abortion, an abnormally bloody discharge sometimes persists for a variable period. There may be serious losses due to septicemia, but generally the females return to apparent good health after a few days. The infection, depending on the type, often remains in the uterus, however, either preventing conception at the next breeding period or jeopardizing subsequent pregnancy.

No treatment is effective in preventing abortion once the infection has become established, but much may be done to prevent the spread of the disease within the band. Animals infected with Brucella, and sometimes the other types of organisms responsible for abortion, may be identified by means of agglutination tests. Animals so discovered should be so handled as to prevent exposure of other animals on the premises. This means isolation pending recovery or slaughter. Females showing symptoms of impending abortion and those that have aborted should be immediately isolated from the rest of the flock. The aborted fetus, membranes, and contaminated bedding should be completely burned. The quarters used by aborting animals should afterward be thoroughly cleaned and disinfected. Proper handling of the infected animals, including douching of the genital tract when this is advised by the veterinarian, may decrease the duration of infectivity. Those that have aborted should not be bred until no evidence of active infection remains. Many outbreaks of abortion in ewes caused by Vibrio fetus have been definitely associated with stagnant or filthy drinking water, through which the infection has been presumed to spread. Feed free from spoilage, as well as clean running water, should be supplied if possible.

Pregnancy toxemia includes two diseases, pregnancy disease and milk fever, which so closely resemble each other in their symptoms as to appear identical in many cases. Pregnancy disease, which is discussed elsewhere in the Yearbook (p. 923), occurs prior to lambing. Milk fever may occur just before, just after, or as long as 6 weeks after lambing. Milk fever, also called parturient paresis, occurs much more rarely than pregnancy disease. The symptoms of milk fever in ewes resemble those in cows, described elsewhere in the Yearbook (p. 533), where treatment is also discussed.
Metritis is defined as inflammation of the uterus. Caused by various types of infection, it accompanies and follows abortion or may develop after dystocia, or difficult parturition. Once it appears in a flock of lambing ewes, it may spread like wildfire unless great care is taken.

The symptoms include a brownish or blood-tinged, sometimes foul-smelling; discharge from the vulva. Depending on the severity of the infectious inflammation, there are varying degrees of fever and depression. The appetite is poor or is lost altogether. The back is often arched, and straining sometimes occurs. Death may follow from severe general intoxication, or septicemia. Less severe cases recover after a time, but fertility may be lost.

To prevent metritis, abortion should be controlled and lambing should be carried out under hygienic conditions. The sheds or barns for lambing are best used for this purpose only and should be thoroughly cleaned and disinfected after the conclusion of operations each season and left unoccupied thereafter. In mild weather, lambing on the range or in the pasture may be preferable to lambing indoors. Attendants of ewes with lamb, especially those assisting at lambing, should keep their persons and clothing meticulously clean.

Treatment, except for nursing, should be left to the veterinarian, as douching of the genital tract with medicinal agents is not without danger. General medication also should be given only by the veterinarian.

Mastitis, mammitis, or garget, signifying an inflammation of the udder, may be caused by one or more of several types of organisms (Staphyloccoccus, Streptococcus, Pasteurella-like, and colon-type organisms). The disease may occur during the lambing season or on the range when the lambs are 3 to 4 months old. It usually develops rapidly and is accompanied by fever, loss of appetite, systemic disturbances, and reddening, swelling, and tenderness of the udder. The milk secretion becomes thick, yellowish, and flaky and is sometimes stained with blood. Abscesses may form in the gland, or gangrene ("blue bag") may develop. Many severely affected animals die, especially if neglected. In those that recover, one or both sides of the udder often fail to function thereafter. When the disease occurs early in the nursing period, lambs whose mothers are affected become undernourished and are likely to die unless given special attention.

Field observations indicate that, like metritis and arthritis, the disease is promoted by insanitary conditions in sheds, corrals, or bed grounds. Older lambs may injure the udder by butting when nursing, making it more susceptible to infection. It is advisable to remove the affected ewes from the flock and hand-feed the lambs or place them with a foster mother. Sheds and corrals should be thoroughly cleaned and disinfected. On the range, bed grounds should be frequently changed. When the type of infection is definitely determined bacteriologically, bacterins or toxoids may aid in prevention.

In the early stages of the disease, the sick ewe may be given a saline cathartic (Epsom or Glauber's salts). The udder may be gently milked out several times a day by hand, and it may be bathed 3 or 4 times a day with a very warm solution of Epsom salts (½
pound in 1 quart of water) applied with cotton or cloths. Internal medication may be prescribed by the veterinarian. Drainage of abscesses or amputation of the udder may become necessary.

Mastitis in milk goats is somewhat different from the disease in ranch or range goats or sheep. Because of the relatively close confinement and the contact between animals, the disease may spread rapidly through the milking herd. Isolation of affected animals, strict hygiene in milking operations, and the other general principles of prevention and treatment of the disease in cattle (p. 518) are usually applicable.

Prolapse of the genital organs (eversion of the vagina or uterus) may occur before or after lambing. Excessively fat, closely confined females, those carrying twins or triplets, or those that are thin and undernourished are more likely to evert the uterus or vagina, usually the latter, than those in a normal, thrifty condition. Ewes or does that have had a difficult or delayed parturition or have been roughly treated in attempts to assist in delivery of young are prone to the condition.

The organs protrude from the vulva as a reddened, shining mass. If the condition is neglected, severe swelling, injury, and infection of the misplaced tissues inevitably develop. In such cases the condition is sooner or later complicated by retention of urine and feces and general intoxication. Delay in treatment until this stage is reached invariably results in the death of the animal.

The remedy is to replace the organs as soon as possible after their eversion is discovered. This usually requires the skill of a veterinarian. If one is not available, the parts may be gently bathed with warm physiological salt solution (a heaping teaspoonful of table salt to a quart of boiled water) and then sprinkled with cold boiled water or ordinary granulated sugar, either of which tends to shrink the congested tissues, thus aiding replacement. Return of the organs is sometimes facilitated by slowly bandaging them from behind forward, thus pressing out the blood and reducing the swelling. Replacement is effected by gentle folding and pressure along the course of the genital passage. Suturing (stitching) of the lips of the vulva or application of a trusslike bandage over the vulva may be required to keep the organs in place.

Venereal infection, as the term implies, is an infectious disease of the genital organs of ewes and rams believed to be spread principally by breeding. The condition, commonly referred to as foul sheath in rams, was for years considered to be a form of necrobacillosis, discussed later in this article, but a filtrable virus has lately been defined as the primary cause (15). Ulcers and scabs form on the penis and at the orifice or inside the sheath of the ram and on or about the lips of the vulva in the ewe. Uncomplicated cases recover in several days with few or no serious consequences, but when secondary infection occurs, severe swellings of the affected parts, with pus formation, ulceration, and even gangrene, are not uncommon. In males urination may be greatly restricted, and when this occurs a general septic infection and death may follow.

If begun early in the course of the disease, mild antiseptic treat-
ment is generally beneficial. Neglected or improperly treated animals may be so seriously affected as to warrant destruction. Immediate isolation and treatment of affected animals and thorough cleaning of corrals and disinfection of barns and sheds are advocated for the control of the disease.

Orchitis, or inflammation of the testicle, leads to more or less swelling and tenderness of the organ, with or without systemic disturbance, and sometimes results in impotence or death.

The affected buck walks with a stiff, straddling gait. The testicle becomes acutely inflamed or may be infiltrated with serum or pus. Gangrene may develop.

In large bands of rams the condition arises from injuries caused by fighting, or it may be due to excessive service or infection. Prevention is implemented by sanitation, limiting the ewes for each ram to a reasonable number, regulation of the diet, exercise for rams during the interbreeding season, and finally the separation of fighting animals and their grouping in small lots whenever practicable.

Treatment of orchitis in sheep or goats depends upon the character and extent of the inflammation. Acute injuries may be remedied by confinement, rest, laxative feed, and local applications of a saturated solution of Epsom salts or cold or hot water. If pus forms, it may become advisable to lance the organ, following with antiseptic treatment. In case of gangrene, castration may become necessary. Septicemia resulting from orchitis usually requires general medication.

Bacterins and other biological products may be applicable as preventives in flocks in which the type of infection has been definitely determined.

DISEASES OF THE EYES

For practical purposes, diseases of the eyes of sheep are of two classes—traumatic (that is, due to injury) and infectious.

Traumatic affections include wool blindness, entropion, and injuries caused by foreign bodies. The first occurs in sheep with heavily wooled faces. The wool grows over the eyes, obscuring the vision and sometimes injuring the eye tissues. The obvious remedies are to breed sheep without this characteristic or to trim the wool around the eyes periodically.

Entropion consists in an inversion of the eyelid over the eyeball, in consequence of which the eyeball becomes inflamed. This condition is suspected of being hereditary in nature, in which case it could be avoided by careful selection of breeding animals. The remedy is surgery, involving removal of a part of the eyelid, then suturing the organ, or—a more practical procedure—placing a stitch in the lid or tying a fold of the lid with a ligature in such a way as to prevent inversion.

Dust, plant particles, and other foreign substances cause inflammation when they become imbedded in the eye tissues. Healing can be effected only after first removing the offending object.

Infectious keratitis, or pinkeye, is generally considered as an infectious disease that may spread rapidly from one animal to another in a flock or may be carried from one flock to another. There is first
a watery discharge from the eye, attended by swelling, reddening, and
tenderness of the lids. The conjunctiva (the membrane covering the
front surfaces of the eyeball and the inside of the lids) is acutely in-
flamed, the blood vessels standing out clearly owing to congestion.
The discharge later becomes purulent, and the lids are more or less
stuck together. The cornea (clear portion of the eye) becomes opaque,
appearing smoky or grayish, and at this stage the sheep is blind. This
continues for a week or 10 days, when the eye usually clears up if it
has been properly treated; otherwise the condition may progress to
ulceration of the cornea, which tends to persist and usually results in
total blindness. Some animals then die of thirst, hunger, or secondary
infection.

To be distinguished from pinkeye is the condition in goats and
sheep brought about by a diet low in vitamin A, in which, in addition
to unthriftness and urinary calculi, there may be symptoms of night
blindness and sometimes opacity and ulceration of the eye (9).

Animals affected with infectious keratitis should be isolated from
the rest of the flock in clean, darkened quarters, from which it is best
to exclude flies if possible. Water and laxative, nutritious feed should
be readily accessible. A solution or an ointment containing boric acid
may be placed in the eyes twice or oftener each day. The same medi-
cation may or may not be suitable after removal of foreign bodies or
an operation to correct entropion, depending on the nature of the case.
In many cases of keratitis confinement and simple medication will
suffice to forestall serious complications leading to permanent loss of
sight, but it may be preferable to use stronger antiseptics, which should
be prescribed by a veterinarian. Since the exact nature of the in-
fected agent that causes the disease is unknown, there are no specific
biological agents for prevention or treatment, but bacterins are some-
times used in attempts to limit the severity of the disease.

OTHER INFECTIOUS DISEASES

The following infectious diseases deserve special consideration, in
addition to those discussed directly or indirectly in this article or
elsewhere in the Yearbook.

Arthritis, or inflammation of the joints, sometimes referred to as
joint ill, occurs most commonly through infection of the navel stump
at birth, or through wounds caused by castration, docking, shearing,
or earmarking. According to available information, the disease is not
common in goats. In lambs, streptococci, other pus-forming organ-
isms, and Erysipelothrix rhusiopathiae (the cause of swine erysipelas),
are the organisms usually involved.

The symptoms depend on the type of infection present, occurring
within a week after birth or the operation or several weeks later.
The joints, particularly the knee, hock, elbow, and stifle, are more or
less swollen and painful. There may be mild to extreme lameness.
Fever, with or without the formation of pus in the joints and ab-
scesses in the internal organs, is a fairly regular symptom. Acutely
affected lambs may die after a brief illness. In such cases loss of
appetite, diarrhea, and progressive weakness are a part of the clinical
picture. Most cases due to *Erysipelothrix rhusiopathiae* tend to become chronic. Recovery from the acute lameness is common, but in such instances more or less damage to the joints and general unthriftiness usually remain.

No treatment can be generally recommended, prevention being the mainstay in combating the disease. Three practices should be assiduously followed, especially on premises long used for sheep or other livestock: (1) Maintenance of sanitary conditions for lambing, (2) disinfection of the navel as soon as possible after birth, and (3) avoiding unclean instruments or insanitary methods in castration, docking, and earmarking, afterward turning the lambs out into fresh pasture whenever feasible.

An effective method of preventing infection through the navel is to hold a small, wide-mouthed bottle containing tincture of iodine over the stump of the cord, then turn the lamb over on its back with the bottle held in place, and allow the bottle to remain for a minute or two before releasing the lamb.

Black disease, or infectious necrotic hepatitis (4, 10, 12), is an acute malady affecting mature sheep in good condition. The disease is due to the germ *Clostridium novyi* type B (*C. oedematiens*) in the presence of liver flukes, and it may occur wherever flukes are present, which is usually on swampy, poorly drained land. Black disease is most prevalent in the late summer and early fall.

The onset of the disease is sudden and acute. The first evidence of the existence of the malady in a flock is usually the finding of dead sheep in the morning, although everything appeared to be in order the night before when the animals were penned or bedded down. The dead animals show no evidence of having struggled and appear as though they had died in their sleep. Bloody foam may come from the nose. If the flock is closely watched, stragglers may be observed lagging behind the rest of the flock or lying down instead of feeding. When aroused, such an animal will quickly start away, only to stop and stand quietly or lie down again after having rejoined the band. There may or may not be moderate fever and slightly increased respiration. Death may occur within an hour after these symptoms are first seen. Because of the difficulty of recognizing the disease from the symptoms alone, it is not known whether affected animals ever recover, but the mortality is probably very high and recovery rare.

At autopsy, if the animal has not been dead too long, a peculiar sweetish odor may be detected on opening the carcass. This will not be in evidence if post mortem decomposition and bloating have taken place. When affected animals are skinned, the inner surface of the pelt usually has a blackish appearance, from which the common name “black disease” arises. Since the discoloration is due to congestion of the skin, it is not necessarily characteristic of black disease only but may be observed in one form or another in other diseases. The lungs, though sometimes slightly congested, are usually essentially normal. The lung and peritoneal cavities and the heart sacs usually contain considerable quantities of clear straw-colored or slightly blood-tinged fluid. Some of this may become clotted or
congealed, forming jellylike masses. Small hemorrhages may be present on the inner surfaces of the heart. The liver is thickened, darkened, and friable and contains one to many areas of necrosis, grayish yellow in color and varying from one-fourth inch to an inch or more in diameter. Hemorrhages beneath the liver capsule and minute punctures of the capsule by young flukes may be found. Numerous very small flukes may be found in the liver tissue, but full-grown flukes are seldom present in this disease. The inner lining of the fourth stomach, or abomasum, is frequently slightly inflamed, being of a deep pink color. If examination of a sheep that has just died in a region where liver flukes abound discloses the lesions described, black disease may be strongly suspected. Effective post mortem examination of sheep can be made only if decomposition and bloating have not reached an advanced stage. If decomposition is marked, the changes due to disease may be somewhat, if not entirely, obscured. Post mortem examination of several dead animals is frequently desired by the veterinarian, and laboratory examination may be advisable.

_Clostridium novyi_ apparently does not of itself produce black disease; initial damage to the liver by flukes is required before the organism increases and forms its death-dealing toxin. Hence, control of liver flukes is of primary importance in preventing the disease. Treatment of sheep with carbon tetrachloride or other fluke-killing drugs after the germ has grown and produced its toxin in the liver cannot be expected to cure the sheep. Such medication is rather to be considered as a part of the basic fluke-control program (see p. 892), through which black disease can be effectively prevented. Once infectious necrotic hepatitis becomes established in a flock through the agency of acute fluke infestation, there is little that can be done except to move the sheep to fluke-free land. Losses may then continue until the acute stages of the fluke invasion have passed. Other trouble, however, still threatens from chronic fluke infestation and pasture contamination.

_Bacterin_ (anaculture), toxoid, and antitoxin, prepared in the laboratory from cultures of _Clostridium novyi_-type B, have been reported to be of value in the prevention of black disease (14, 16). These biological products have not been commonly adopted in this country, perhaps owing to the general use of fluke-control measures.

Caseous lymphadenitis, sometimes called pseudotuberculosis, is a widespread chronic infectious disease of sheep and goats caused by _Corynebacterium ovis_ (Preisz-Nocard bacillus). The germ is a very resistant organism, capable of surviving for months in the dust of barns, shearing sheds, and corrals. Infection may take place through contaminated feed, inhalation of contaminated dust, or wounds (considered later).

The disease affects the body lymph nodes chiefly but may invade the lungs or other organs, depending upon the route by which the infection is acquired and the length of time the animal has been affected. Greenish-yellow or gray cheeselike, pasty, or sandlike pus is formed in the affected organs. In some cases the lesions resemble
those of tuberculosis, actinomycosis, coccidioidomycosis, and other granulomatous diseases (characterized by tumorlike formations).

In the early stages of the infection, the animal appears not to be materially affected. Indeed, disturbance of general health does not often come before the time for discarding the animals as breeders. Then progressive loss of flesh and weakness, finally leading to death from exhaustion, may occur.

There is no practical method of treatment of the disease. On first thought it would appear to be an insignificant ailment, but considerable numbers of seriously affected sheep are condemned on account of it under meat-inspection regulations. Moreover, species other than sheep and goats are affected, including cattle, horses, rodents, and even certain wild animals.

Prevention of the disease is promoted by general sanitation and by special care when shearing, docking, castrating, or earmarking. (See wound infections, p. 854). Animals discharging pus from the abscesses of pseudotuberculosis should be isolated, care being taken to dispose of the discharges properly.

Dysentery consists in the frequent passage of liquid feces with varying amounts of blood and mucus owing to inflammation of the bowels. Aside from parasitic dysentery, the disease appears chiefly in three forms, paratyphoid dysentery, lamb dysentery, and Johne's disease, or paratuberculosis, each of which will be considered separately.

Paratyphoid dysentery (?) is comparatively rare, having been reported in this country in a few instances only, in lambs after shipment from the range to feed lots. It is caused by the germ Salmonella aertrycke, which is believed by some authorities to be a normal inhabitant of the bowel of some sheep, producing disease only when the animals have been long deprived of feed.

Affected animals are depressed and refuse feed; there is some fever, and the feces become watery and sometimes bloody. Death may come quickly after slight scouring, or profuse dysentery may develop, in which case the illness lasts longer. Losses in three reported outbreaks in the last decade ranged from 2 percent to about 7 percent (?)

In the opinion of some who have studied it, animals kept in good condition and fed regularly during transit should not develop serious cases of the disease. Accordingly, it is recommended that preparations be made to feed sheep at as frequent and regular intervals as possible during transit. If the disease develops, affected animals should be immediately segregated from the well ones. A laxative such as castor oil may be given, and this may be followed by intestinal medicaments and general stimulants. A light but nutritious diet should be provided during convalescence.

Lamb dysentery, sometimes called white scours, is a disease of the newborn that occurs within 48 hours or sometimes as long as a week after birth, the lambs meanwhile appearing normal. There is a very fluid, grayish diarrhea with an offensive odor, accompanied by great depression, and the lambs stop nursing. Many lambs die within 24 to 48 hours after the first symptoms appear, but those surviving this period may slowly recover. In severe outbreaks 20 to 40 percent of the lamb crop may die.
The disease is essentially filth-borne, and is attributed to several factors, including the micro-organisms known as *Clostridium welchii* and *Escherichia communior* (5, 6). Cold, wet, stormy weather during which lambing must take place in barns and sheds is conducive to the disease if the shelters have been allowed to become filthy. Such places must be frequently cleaned and freshly rebedded with clean bedding if danger of lamb dysentery is to be avoided. Some operators use elevated slatted floors with no bedding in lambing shelters. On warm sunny days, lambing may better be carried out on clean pasture or range. Tagging of the ewes—clipping the long wool from about the udder and the inside of the thighs to provide cleanly conditions for the nursing lamb—before lambing is recommended.

It is often impractical to treat lambs affected with lamb dysentery. Medicinal treatment is usually of no avail. In England anti-lamb-dysentery serum is sometimes used, but neither this nor the other biological products commonly used there with reported success have been generally adopted in the United States. Cultured milk, which consists of sterilized, skimmed cow's milk seeded with *Lactobacillus acidophilus*, has been used with reported success as a treatment by some investigators (11). Acidophilus milk can be properly prepared only in the laboratory, and its use is preferably, if not necessarily, undertaken with a veterinarian's supervision.

Johne's disease, or paratuberculosis, is a chronic disease caused by *Mycobacterium paratuberculosi*s. This infection causes a chronic inflammation of the intestines, leading to dysentery and gradual weakening and loss of weight. The disease may be fatal in a few weeks or months, or it may be more prolonged.

Exact diagnosis is made through application of johnin, a biological product resembling tuberculin, or through finding the organisms in the feces or tissues in the laboratory. As with cattle (p. 512), it is recommended that affected animals be slaughtered under veterinary supervision. Animals suspected of having Johne's disease should be isolated pending diagnosis. After their removal from the flock, pens, sheds, and troughs used by them should be thoroughly cleaned and disinfected. Contact between cattle and sheep should be prohibited. Repeated testing of the flock and the slaughter of reacting animals are usually necessary before the disease is eliminated.

Necrobacillosis consists in the invasion of the body by *Actinomyces necrophorus* (the necrosis bacillus). This organism is capable of producing disease in many species, including man. In sheep, it is of chief importance in sore mouth, venereal infection, navel infection, and foot rot. So far as is known, the organism is incapable of penetrating normal tissues, but once it has gained entrance through lesions caused by a virus or other infection, or through external accidental wounds, it frequently becomes established in the body. The effect is necrosis, or death, of the invaded tissues. What would ordinarily be a mild or inconsequential process without *Actinomyces necrophorus* becomes a serious disease.

Lambs thus infected through the navel or through sore mouth lesions frequently develop multiple necrotic and abscessed areas in
the internal organs that lead to serious illness and in many instances to death. In the same way, secondary infection of lesions of venereal disease, caused primarily by a filtrable virus, leads to serious complications resulting in death or an extended convalescence.

Though not a very resistant organism in the ordinary sense, Actinomyces necrophorus appears to be able to survive for months in poorly drained, wet, filthy corrals and barns. Its elimination requires drainage, exposure to air and sunshine, and thorough cleaning and disinfection. These constitute the principles accepted as the basis for prevention of necrobacillosis.

The treatment of affected cases is often unsatisfactory. If the foci of infection are so located in the body as to permit exposure to the direct action of antiseptics, recovery may be effected. Otherwise little can be done aside from systemic nonspecific medication, which is generally unsuccessful.

Wound infections in the aggregate cause an enormous loss, which could be largely prevented. Castrating, docking, and earmarking involve surgical wounds, and wounds commonly occur when shearing is done too hurriedly or in a careless manner. The rupturing of the umbilical cord at birth, severing the lamb or kid from the blood supply of its dam, creates a wound that is particularly open to infection. Dog bites and other accidental wounds also provide entrance for disease-producing germs.

Many germs, such as Staphylococcus, Streptococcus, and other pus-producing organisms, may be considered as everywhere present. Clostridium chauvoei, the cause of blackleg in cattle and in sheep, persists, in spore form, for years in certain sections and on individual farms. Other germs of the genus Clostridium, such as Cl. septicum, the cause of malignant edema, Cl. tetani, the cause of tetanus, or lockjaw, and others that produce gas gangrene, are more or less widely distributed and are potential killers of sheep. All these and various other micro-organisms may cause trouble through wound infection.

The emphasis here is on the fact that wounds should be prevented as far as possible and accidental wounds should be properly cared for. Even castration can be performed without causing a wound in the external tissues by means of the so-called Burdizzo forceps, or emasculatome. This technique is preferred for that reason alone by many operators. The chief drawback is that it requires judgment and experience that not everyone has. Also, the emasculatome must be precisely constructed for uniform results. Ordinary castration, involving incision and the removal of the testicles, as well as docking and earmarking, should be considered as a surgical procedure requiring cleanliness and the use of sterile instruments. Docking may preferably be done with a hot iron. In all cases, lambs are much less likely to contract infection through operative wounds if, weather permitting, they are afterward turned out to pasture or range instead of being kept in a corral or barn. Shearing can be so humanely done that cuts and scratches are rare. When they occur, they should be immediately touched with tincture of iodine or some other suitable antiseptic. Shearers might well be required to clean and dip their
clippers into 3-percent compound cresol solution or some other disinfectant before starting on another sheep. If dipping is planned after shearing, it is best to wait a few days to give wounds and scratches time to heal.

The symptoms that develop following wound infection depend upon the type of organism involved. Pus-forming organisms may become localized or may cause septicemia or pyemia (blood poisoning). Some germs of the genus Clostridium produce so-called gas gangrene infections that are usually fatal. Edema and gas are formed at the site of infection, and death results from toxemia. Tetanus, or lockjaw, results from the formation of toxin by the organism Cl. tetani. Symptoms may occur a few days after infection has taken place, but usually the interval is 1 to 2 weeks or longer. By then the wound may have healed externally. The symptoms consist of a stiff, stilted gait with bending of the neck and back to one side or upward or downward. The entire muscular system may become tense, giving the animal a saw-horse appearance.

As indicated, nearly all wound infections can be prevented by hygienic procedures, but on especially heavily infected premises where certain types of infection have previously caused trouble, prevention may be aided by the use of specific bacterins, vaccines, toxoids, or antitoxins. Intelligent use of these depends, of course, upon accurate diagnosis.

GOITER

This is a constitutional disease associated with enlargement of the thyroid glands, which are situated one on either side of the windpipe at its upper extremity near the angle of the jaw. Caused by lack of iodine, it is discussed in the article on Nutritional Diseases of Farm Animals, p. 332.

URINARY CALCULI (SAND OR GRAVEL)

Concretions (hard lumps) or deposits of mineral salts in the kidneys, ureters, bladder, or urethra sometimes cause considerable death loss. The calculi vary in size and consistency from small sandlike particles to large, rough or smooth rocklike or spongelike formations. The trouble is almost entirely confined to males. In the early stages of their development, these materials cause little or no trouble, but if the condition continues there are uneasiness and frequent urination. Later the animal stands and strains in an effort to urinate, and eventually the condition commonly referred to as water belly develops. The abdomen swells, owing to accumulated fluid in the cavity, the bladder is distended, urine dribbles from the prepuce, and dried salts appear in the wool about the opening. Without relief, death invariably follows.

The cause of the condition is not exactly known, though certain feeds, such as mangels, sugar beet pulp or tops, corn fodder, wheat bran, and linseed or cottonseed meal, especially when given in large amounts, are conducive to the trouble. There is experimental evi-
dence to indicate that lack of vitamin A (9) and possibly infection of the urinary tract are responsible in some instances. In some cases, responsibility may be placed on the presence of large amounts of mineral salts in the water supply. Again, scarcity or lack of ready access to water may promote the accumulation of sand or gravel in the urinary tract.

The chemical composition of the concretions appears to depend partly upon the mineral constituents of the feed and water. Thus they may be comprised chiefly of phosphates, oxalates, or other ingredients which may be modified by internal medication or change of diet; but this or any other treatment is seldom practicable. In some instances in wethers or rams, in the beginning of the trouble, the small wormlike appendage (processus urethrae) at the end of the penis may be removed, thus permitting passage of the obstruction. Some cases may be relieved by passage of a catheter or sound to dislodge the stones. Finally, the special value of some animals may warrant a surgical operation for removal of the concretions from the urethra. Often, however, serious trouble from calculi does not develop until near the end of the fattening period, and the lambs may be continued on full feed without too serious loss for the short time remaining before they are finally finished.

STIFF LAMBS (WHITE-MUSCLE DISEASE)

The term "stiff lambs" is commonly applied by sheepmen to any condition causing lameness, paralysis, or a similar abnormality without distinction as to cause, such as arthritis, listerellosis, or tetanus. As here used, the term is given to a specific disease of unknown cause characterized by a peculiar degeneration of the muscles that occurs usually in lambs 3 to 10 weeks old. It is generally agreed that the disease is not infectious. Nutritional deficiencies and autointoxication have been suspected. The disease appears usually among winter or early spring lambs, which because of inclement weather and other conditions are often somewhat confined and restricted in diet. It seldom if ever occurs in lambs born and run on the range.

Although there is no known successful treatment, the trouble can be prevented to some extent by proper feeding and management, including provision for exercise and supplying feed for the ewes that satisfies nutritional requirements, especially as to minerals and vitamins. Diagnosis of the disease is best made through post mortem examination, which reveals characteristic white or grayish streaks in the muscles—those of the legs especially.

WOOL AND DIRT EATING

Young, nursing lambs sometimes eat wool, litter, soil, and other more or less indigestible substances that may lead to the formation of balls of wool or other material in the stomach. The foreign substances lead to indigestion, and, in many cases, to death, through stoppage of the exit from the stomach. Toxins are absorbed from the
digestive tract, and the lambs show stupor, cease eating, and usually die within a few days.

In some cases the habit of eating indigestible substances such as wool may be attributed, at least in part, to close confinement and idleness, but field observations generally indicate that the basic cause of the trouble is a depraved appetite caused by lack of necessary minerals, especially phosphorus. The lambs thus instinctively nibble on anything at their disposal. To provide the needed substances, nutritious green pasture may be provided, and sometimes ground grain or bran may be placed in troughs in creeps readily accessible to the lambs.

Treatment is generally ineffectual, since intoxication due to stoppage of the digestive tract has usually progressed considerably before marked symptoms are observed. The indications are, however, that the trouble can be forestalled in most instances by feeding the ewes a well-balanced ration during gestation and the nursing period.

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At the time this book went to press, the drugs and other materials mentioned in various articles—chiefly as disinfectants, insecticides, and anthelmintics—were still available for veterinary and medical use. Under war conditions, however, it is possible that some of these materials may become scarce or unavailable. In that case, the reader should obtain professional advice from the Department of Agriculture, the State experiment station, a local veterinarian, or the county agent as to available substitutes.