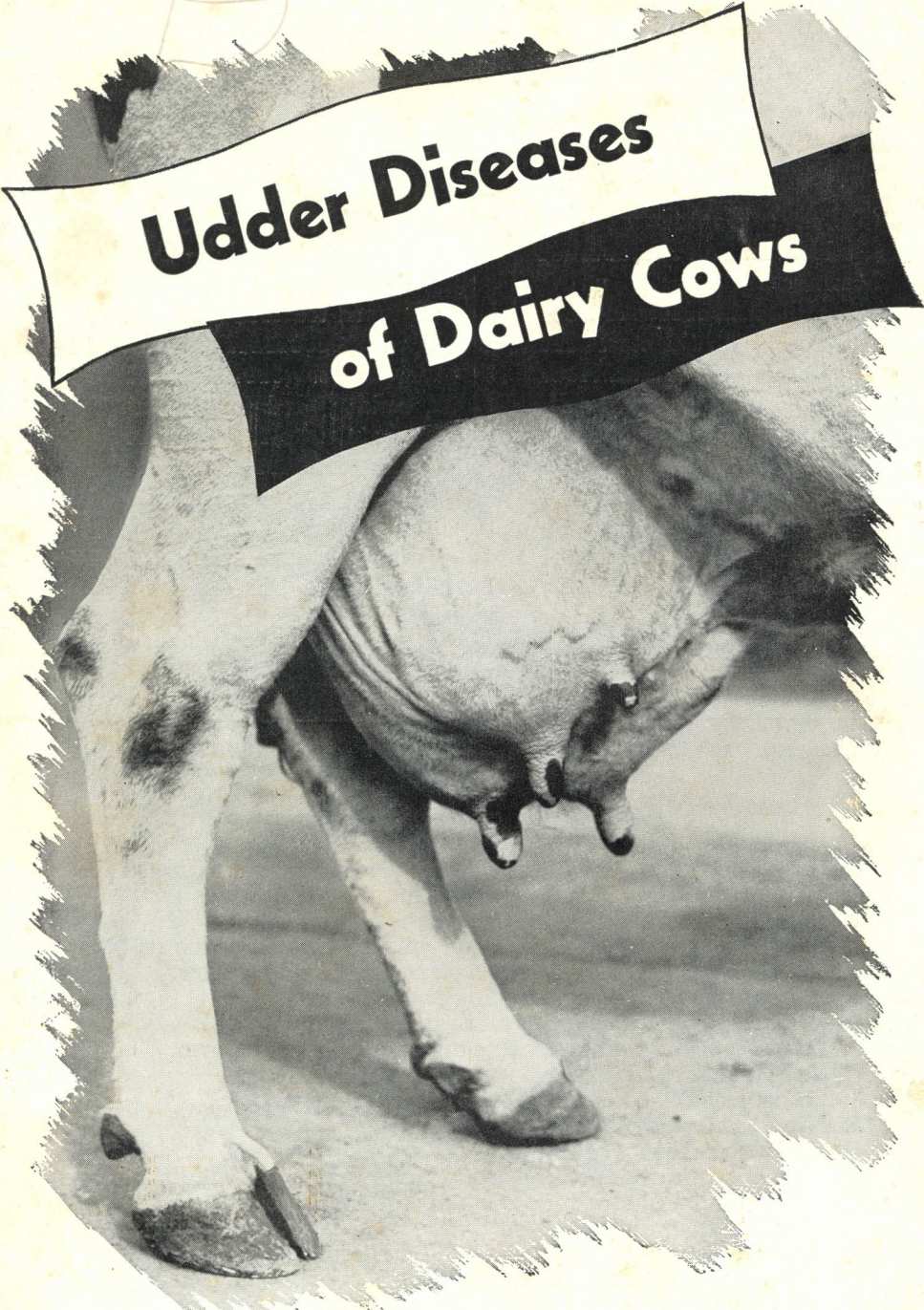


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Udder Diseases of Dairy Cows

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DO'S AND DON'TS OF MASTITIS CONTROL

1. Have all first-calf heifers and newly acquired cows examined for mastitis before placing them in the milking line.
2. Milk clean cows before infected cows.
3. Wash the udder, before milking, with a warm chlorine or quaternary ammonium solution, using a clean towel for each cow.
4. Use the strip cup before milking each cow.
5. Keep hands and equipment clean when milking.
6. Do not attach milking machine until the milk is let down.
7. Remove teat cups as soon as the animal is milked out.
8. Do not leave excessive quantities of milk in the udder.
9. Avoid excessive variation in routines.
10. Provide adequate bedding in stalls, barns, or sheds.
11. Prevent injuries to the udder by avoiding such conditions as slippery floors, mud holes, high door sills or similar obstructions, and contact with strong disinfectants.
12. Have udder and teat injuries treated immediately.
13. Have cows affected with mastitis treated, but do not rely on treatment alone; sanitation and good management are important in controlling mastitis.

COVER ILLUSTRATION: Udder showing result of mastitis.

Udder Diseases of Dairy Cows¹

By RICHARD W. BROWN, *Veterinarian, Animal Disease and Parasite Research Division, Agricultural Research Service*, and W. D. POUNDEN, *Chairman, Department of Veterinary Science, Ohio Agricultural Experiment Station.*

CHARACTERISTICS OF THE UDDER

THE DAIRY cow's udder (fig. 1) has been highly developed by centuries of careful, selective breeding. It is complex in its structure and physiology.

The secretory tissue of the gland is made up of great numbers of alveoli or hollow balls composed of milk-secreting cells which are microscopic in size and grouped like clusters of grapes around the ducts (fig. 2). The milk is formed in the alveoli and travels down through the ducts to the gland cistern and teats. The size of the passageway through the teat is greatly reduced at its lower end. This constriction prevents escape of milk from the udder and acts as a barrier against entrance of micro-organisms.

Each quarter of the udder is separate and milk is being continually secreted in active glands. Much of it, however, is only forced down,

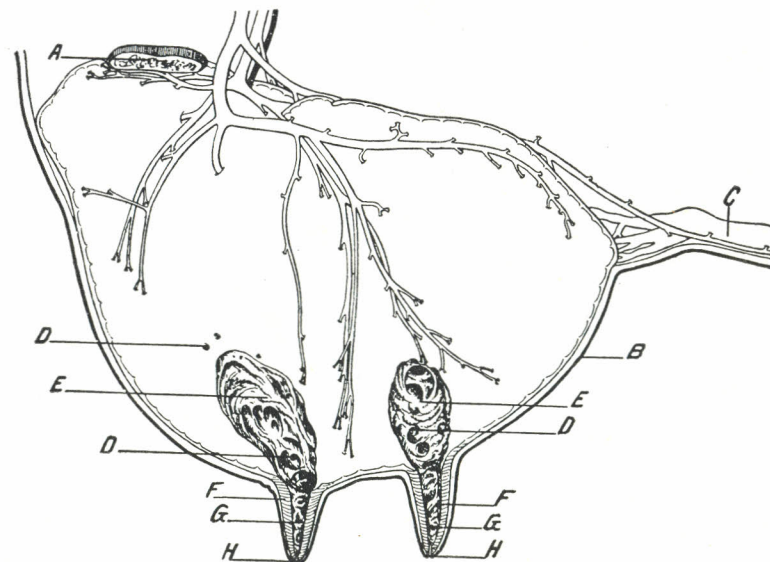


FIGURE 1.—Diagram of one-half of the udder of the cow (adapted from H. C. Wilkie): A, Supramammary lymph gland (in section); B, skin; C, subcutaneous abdominal vein (milk vein); D, openings of the milk ducts, of which there are a very large number opening into the milk cisterns; E, milk cisterns; F, walls of the teats; G, teat cistern; H, orifice or opening of the teat.

¹ Revision of former editions by H. Bunyea and W. T. Miller (both deceased).

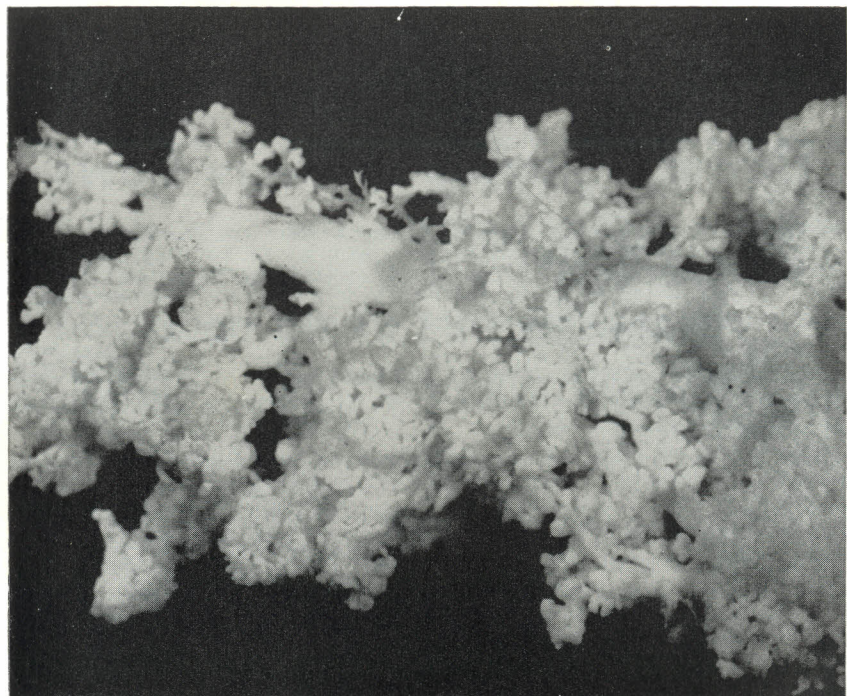


FIGURE 2.—Latex cast of a small part of a normal cow's udder magnified to show the grapelike clusters of alveoli and collecting ducts.²

or as more usually stated "let down," to the larger ducts and cistern and teats when stimulated to do so by such things as the suckling of a calf, washing, hand milking, or application of a milking machine.

The udder functioning under high tension in milk production during most of the adult life of the cow is subjected to very great physical strain, with small opportunity for rest or repair. The extra tax on the udder involved in the birth of calves and prolonged milk production often counterbalances the rest allowed between lactation periods.

The great development of this organ and its complexity are factors which render most difficult the treatment of abnormal conditions of the udder of the dairy cow. All things considered, it is always advisable, when a disease or injury is observed, to undertake treatment only under the advice of a veterinarian.

MANAGEMENT AND UDDER HEALTH

DRYING OFF THE COW

Heavy-milking cows are more productive if allowed a rest period of from 6 to 8 weeks before calving. There are several ways commonly used in drying off cows, of which the most rapid method and considered by many to be the best, is to stop milking abruptly. This can

² Figures 2, 3, and 4 are used through courtesy of School of Veterinary Medicine, Agricultural Experiment Station, University of Minnesota.

usually be done without too much discomfort to the cow if she is producing less than 20 pounds of milk a day. However, in some instances of heavy producers it may be necessary to milk out the udder partially one or more times to relieve any great distension or congestion. To assist in the drying off process, the ration should be reduced, especially in those cows still giving a large yield at the time of drying off. This can be accomplished by feeding an inferior hay, removing any succulent feed from the ration and reducing or stopping feeding of grain. In some instances it may also be necessary to reduce the amount of water intake. After the cow is dried off, a normal ration should again be fed.

Frequently during the drying off period or the subsequent dry period, quarters will show clinical evidence of mastitis. These should be treated immediately under the supervision of a veterinarian.

CALVING TIME

It sometimes happens that just before calving time the udder of the cow becomes greatly distended, which may cause the animal pain owing to pressure, weight, and the stretching of the skin. In exceptional cases it may be necessary to relieve the condition by milking or applying alternately hot and cold packs and massaging the udder. Ordinarily, however, it is best not to interfere with this condition, which is a normal one. To milk the udder out at this time is not desirable because it removes the first milk or colostrum, which contains a great concentration of specific antibodies. These antibodies are very important to the calf because they give temporary protection against certain diseases until the calf is able to develop its own immunity.

SEPARATING COW AND CALF

Under ordinary conditions the cow should be removed from the calf not later than 24 hours after calving. In exceptional cases, it may be advisable to postpone this separation, but it should not be unduly delayed if injury to the udder is to be avoided. As a rule the calf will have received at the end of 24 hours enough colostrum and attained sufficient strength to grow satisfactorily under the usual hand-feeding methods. Some recommend milking out the remainder of the colostrum after the first feeding and giving this to the calf at the feedings to follow.

If the dam is allowed to remain with the calf, the udder may be subjected to injury during nursing as the calf grows stronger. The practice of permitting the calf to nurse as a means of breaking up congestion of the udder during an attack of mastitis after calving is not desirable. It apparently serves no purpose that cannot be accomplished more satisfactorily by proper treatment with less damage to the udder and discomfort to the cow.

VICE OF SUCKING

Some calves acquire the habit of sucking the udders of other calves, a vice which should never be tolerated. In the first place it may tend to the formation of an ill-shaped and pendulous udder, and hence seriously detract from the beauty and value of the animal in afterlife.

Secondly, the gland may become infected with mastitis-producing bacteria. Organisms, such as staphylococci, can cause acute mastitis in calves resulting in a damaged quarter. Also, milk from infected cows should never be fed calves unless it is pasteurized, because organisms such as *Streptococcus agalactiae* can be introduced into the calf's udder by sucking and lie dormant until the udder is fully developed.

To overcome the vice of sucking, the milk ration of calves may be followed by a handful of grain or it may be necessary to tie or stanchion them for a time after feeding. Calf weaners can also be used to prevent this habit, although they should be used only as a last resort.

PREVENTION OF DISEASES AND INJURIES

Many of the udder conditions which frequently occur in the dairy cow are avoidable. Deviation from regular and established practice in the care of the animal is the frequent forerunner of serious consequences. Lack of care in the use and cleansing of milking machines, teat dilators, and milk tubes may result in permanent injury of one or more quarters of the udder.

Briar cuts, barbed-wire cuts, and bruising or crushing of the teats by other cattle stepping on them (often due to bad stall construction) are usually avoidable. In some instances, self-inflicted teat injuries may result from bad stall construction. These injuries may lead to leaky quarters, fistulous teats, mastitis, and possibly to loss of function. Also, exposure of the udder to cold wet surfaces when lying down can be substantially avoided by supplying sufficient clean dry bedding. Udder troubles of cows are sometimes directly or indirectly traceable to rough treatment by attendants. Horned animals also inflict injury on their fellows, which may involve the udder as well as other parts of their bodies.

DISEASES AND CONDITIONS AFFECTING THE UDDER

MASTITIS (GARGET, CAKED UDDER)

Mastitis means inflammation of the udder. It is a serious and widespread disease, particularly in dairy cattle. The disease can be transmitted from diseased to healthy cows. The continuous spread of mastitis in dairy herds results each year in an enormous loss to the dairyman. Milk from diseased cows does not contain the usual amounts of butterfat, milk sugar, and other elements present in milk from healthy udders. On the other hand, it may contain large numbers of bacteria, leucocytes (white blood cells), and other products resulting from the disease. Consequently, such milk is low in nutritive value and is sometimes rejected because of high bacteria and leucocyte counts.

In addition to losses from this source, cows with mastitis cannot produce as much milk as they could otherwise. This decrease in production may amount to as much as 25 percent or more, and necessitates early disposal of diseased animals. Mastitis is, therefore, one of the chief causes for the heavy turnover in dairy herds.

Micro-organisms causing mastitis

Many kinds of bacteria or micro-organisms are capable of producing mastitis when they become established in the udder. The streptococci (*Streptococcus agalactiae*, *Streptococcus dysgalactiae*, *Streptococcus uberis*) and staphylococci (*Staphylococcus aureus*) are the most important causative agents of chronic mastitis. In the past, *Streptococcus agalactiae* was considered to be the principal cause, but now other bacteria, in particular the staphylococci, have assumed a greater role. Other micro-organisms causing mastitis are *Escherichia coli*, *Aerobacter aerogenes*, *Pseudomonas aeruginosa*, *Corynebacterium pyogenes*, *Proteus* species, and yeasts. More than one kind of micro-organism can cause mastitis within the same herd and even in different quarters of the same cow.

Among the varieties of bacteria occasionally found in mastitis are several which may be harmful to man. At one time tuberculosis of the udder was a common cause of the disease. However, because of the progress made in the eradication of tuberculosis from cattle of this country, mastitis from this source is extremely rare. Cows affected with brucellosis, although rarely showing any clinical mastitis from the infection, frequently shed the bacteria in the milk. If milk containing *Brucella* organisms is consumed raw, the disease known as brucellosis, or undulant fever, may result.

Other diseases, such as streptococcal sore throat which may be caused by drinking raw milk, may result from contamination of the milk after it leaves the cow or to a case of mastitis. In either instance the infection is the result of contact with a diseased handler or milker. The presence of these bacteria can be recognized only by bacteriological examination of the milk. Fortunately the occurrence of these bacteria other than *Brucella* in milk is very infrequent. Most of the varieties of bacteria found in mastitis are harmless to the consumer and when milk is properly pasteurized, practically all danger is eliminated.

The bacteria that cause mastitis are usually carried from diseased cows to the teats of healthy cows on the hands of milkers or in the teat cups of milking machines during milking. In some instances bacteria can also be spread by flies or by contact with contaminated bedding or floors. The bacteria then enter the opening in the teat, pass up the teat canal, and establish themselves in the milk cistern or lower part of the quarter. From this point they spread slowly or rapidly, depending upon circumstances, to other parts of the organ. When disease-producing bacteria have thus become implanted in the udder, they sometimes remain there for the rest of the life of the animal if they are not removed by treatment.

Environment and heredity in mastitis

Among the causes or combinations of causes that are considered capable of arousing active cases of mastitis and in some instances favoring bacterial invasion of the udder are: Exposure to cold or wet weather; sudden changes of temperature; blows; kicks, bruises, or abrasions of the udder; wounds of the teats; infrequent, irregular, or incomplete milking; introduction of contaminated foreign bodies

such as milk tubes, waxed teat plugs, or pieces of straw into the teat canal; or any systemic disturbance of the animal's health.

Nutritional levels and feed variations repeatedly have been thought to play some part in both the stimulation and inhibition of mastitic conditions. Many of the later setbacks in production in animals which have been pushed for extreme production are frequently thought to be the result of mastitis. Efforts have been made to check the suspected influence of various feeding programs such as liberal provision of high-protein feeds or rations composed of a high percentage of corn, but adequate answers have not been obtained. Marked increases in the incidence of attacks occasionally have been encountered shortly after radical feed changes, such as those that take place when cows are first turned out to pasture. There is also some indication that freshly cut legume grass forage stimulates attacks of mastitis to a greater extent than the same forage fed in the form of silage.

Heredity is considered in mastitis within limitations. Some cow families are more susceptible to the disease than others. In teat and teat cistern normality, and in potency of the bacteriostatic substance in the udder, inheritance may enter the picture. Conformation of the udder can also be considered since large pendulous udders are more prone to injury and consequently to infection.

Chronic mastitis

As a result of the persistence of these bacteria in the udder, mastitis is a chronic disease in the majority of cases. Acute cases occur from time to time in individual animals, but for the most part they are flare-ups of already established chronic cases and should be regarded as such in the management of the disease. The symptoms of the disease are somewhat difficult to detect, and it may become widely disseminated through the herd before its presence is recognized. Similarly, many cows affected with chronic mastitis undoubtedly are purchased to replace animals which have been sold on account of the disease. Of the symptoms associated with mastitis, changes in the milk, such as the presence of flakes or clots and a watery or unusual appearance, are most frequently observed. Other symptoms may be occasional slight swellings in the udder for a day or two, a more rapid decrease in milk production than is generally expected, the so-called short milker, persistent inflammation in the udder after calving and at the end of the lactation period, and high bacterial counts in the milk.

The decrease in milk secretion is caused by the continued irritant effect of the bacteria upon the alveoli and the formation of connective or scar tissue in the infected quarter (fig. 3). The resulting changes appear in the form of hard circumscribed areas or diffuse hardening of the gland, which can be detected with some experience when the empty udder is manipulated.

Acute mastitis

Unlike the chronic form of the disease, acute mastitis is readily detectable and is the form most familiar to the cattle owner. The acute form can be caused by any factors which tend to aggravate certain types of chronic mastitis or stimulate activity of an infection already present. In some cases it follows recent invasion of the

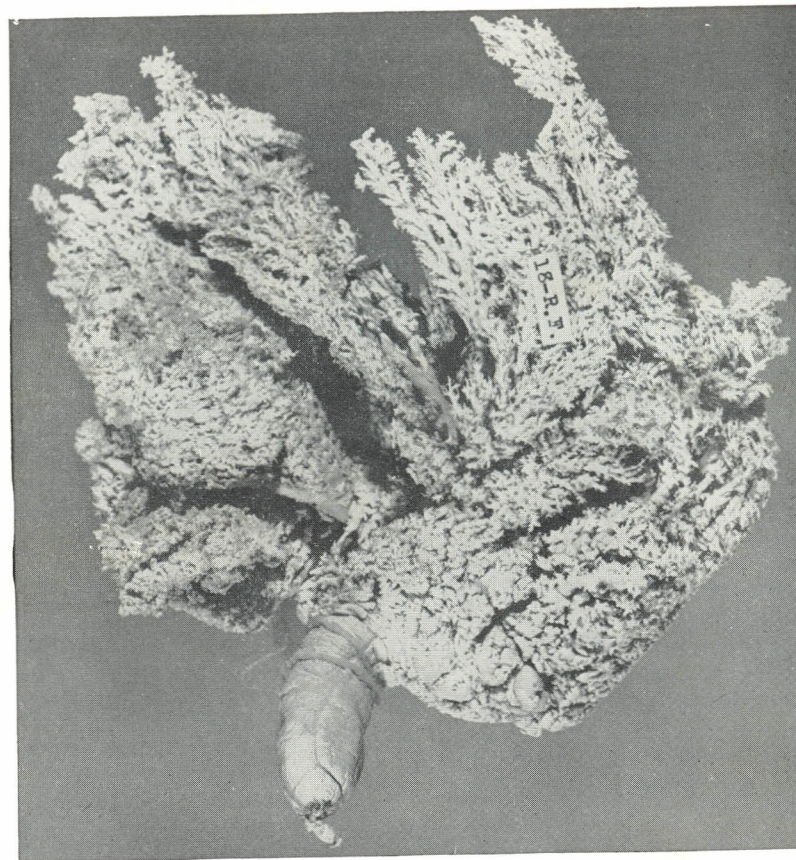


FIGURE 3.—Latex cast of a quarter in which a considerable portion of the secretory tissue (alveoli) has been destroyed as a result of mastitis.

udder by mastitis bacteria. The symptoms are characteristic. The affected part is hot, tense, very hard and tender, and the animal moves with reluctance and some difficulty because of the soreness of the udder.

Milk secretion is largely or entirely suspended, and what there is of it is lumpy or stringy and in some cases appears as a straw-colored fluid, occasionally tinged with blood, and containing yellow clots. When certain kinds of bacteria are involved in an acute attack the secretion may even be purulent and offensive. At times these common symptoms may be accompanied by a general systemic disturbance such as depression, rough coat, dull eyes, loss of appetite, suspended rumination, and possibly constipation. There may or may not be fever and, occasionally, a dropsical condition under the skin of the abdomen.

Although this form of disease may appear any time, it usually occurs more frequently at calving time or at the end of the lactation period and should not be confused with the normal swelling of the udder which also occurs at calving time. With appropriate treatment, the acute symptoms subside in many cases, and the udder resumes its usual appearance. The milk also appears normal although the yield may not return to its previous level. However, recovery

from an acute attack is more apparent than real since the bacteria responsible for the mastitis frequently remain in the udder and are capable of producing further attacks under favorable conditions. Finally acute mastitis may result at times in atrophy or drying up of the quarter (fig. 4), the formation of abscesses, or gangrene. When an acute abnormal condition occurs in an udder, a veterinarian should be consulted as soon as possible as to suitable treatment in order to avoid unnecessary loss.

Control of Mastitis

As previously mentioned, mastitis is caused by a variety of different micro-organisms. At present only *Streptococcus agalactiae* infection can be eradicated from a herd since this organism exists only rarely in any place except the udder of the cow and does not readily survive for long outside. Also, it is more susceptible to treatment with antibiotics. Hence, if we are able to destroy the reservoir of infection by treating all infected quarters and removing any infected cows which do not respond to treatment, this type of infection can be completely eliminated from a herd. However, the other organisms listed normally exist outside the udder, and complete eradication is not possible from a practical standpoint. Therefore, they can cause mastitis even though good control measures are practiced. Mastitis is a very complex disease problem and one which, even under the best of working conditions, cannot be eliminated completely with the knowledge available today. The success of a mastitis program depends largely upon an accurate diagnosis, proper treatment, and adequate sanitary and management practices with close cooperation between the dairyman and his veterinarian.

Diagnosis

To begin with, quarter samples of milk from each cow, obtained aseptically in a sterile screw-cap jar or vial, should be submitted to a laboratory for a bacteriological examination. This should be done before any treatment is attempted. After an accurate diagnosis is made of the kind of infection present, a program of treatment should be undertaken along with the adoption of good sanitary and management practices.

Following identification of all infected cows and the elimination of cows which are too seriously diseased to warrant treatment, the herd should be divided into healthy and infected groups and milked separately, although the two groups may be stabled in the same barn if necessary. Since the disease is frequently spread during milking it follows that the healthy cows must be milked first each time, the ones suspected of having mastitis next, and those having the disease last. When first-calf heifers are added to the milking herd, they can be included in the healthy group unless definite evidence of mastitis is observed at the time of calving. However, there is still the danger that they may be infected without showing symptoms. Therefore, the milk from all quarters of heifers and cows should be examined bacteriologically after parturition, as well as that from any lactating cow which is obtained from another herd, before they are placed in the regular milking line. Any member of the healthy or suspected group which develops mastitis must be immediately placed with the

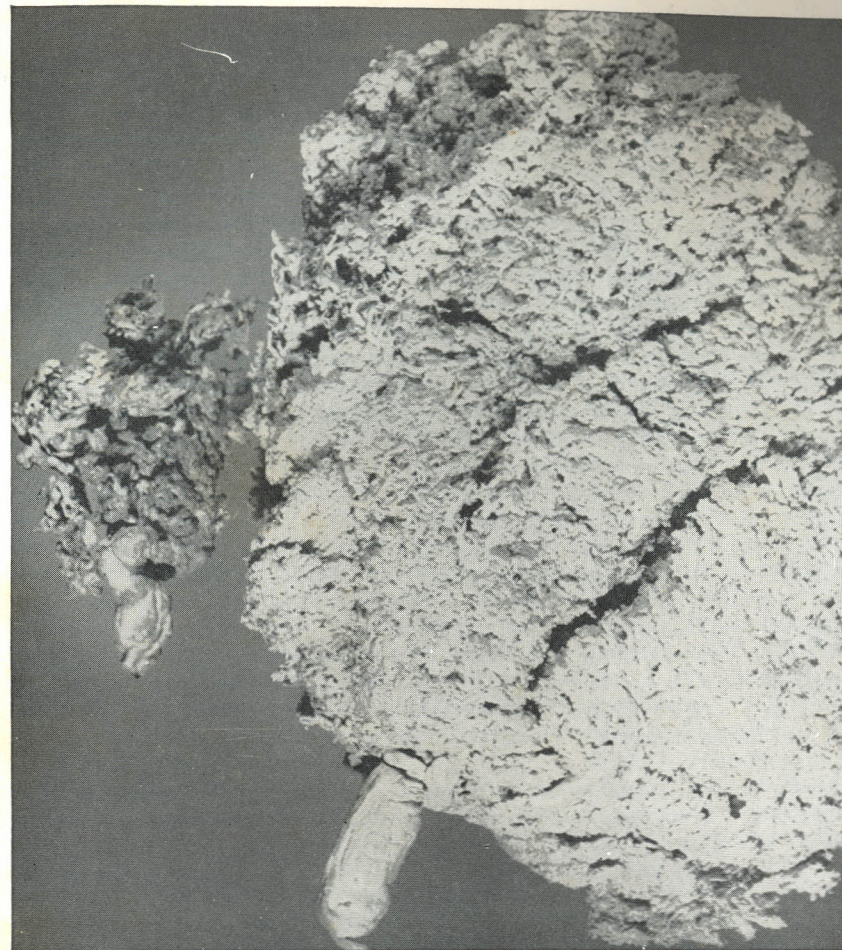


FIGURE 4.—Latex cast of a normal lactating quarter (right) of cow's udder, showing the extensive development of ducts and secretory tissue. On the left is a cast of an atrophied or blind quarter showing only a small amount of secretory tissue, the result of acute mastitis.

diseased animals or at least milked last. Such an animal can often be recognized by the abnormality of her milk or changes in the udder.

Probably the most practical test for the dairyman to use in detecting mastitis is the strip cup. There are several types of strip cups; one is simply a tin cup covered with a fine wire screen or black cloth; others are pans with black colored plastic or metal plates. Two or three streams of milk from each quarter are drawn onto the strainer or plate immediately before the animal is milked. Any quarter producing abnormal or clotted milk is affected with mastitis. However, these changes do not appear regularly in the milk of all cows having chronic mastitis. Consequently, repeated use of this test is necessary to detect every diseased animal. For greatest effectiveness, the strip cup should be used before each milking.

A second method which can be used in the dairy barn is the bromthymol blue or "thybromol" test. This procedure requires more

equipment and a great deal more experience in its interpretation than the strip-cup test. The test is carried out either with a dye solution and test tubes or with papers impregnated with dye solution. A definite quantity of milk from one quarter is added to a measured quantity of dye solution in a test tube, or a few drops of milk are placed on the paper containing the dye. The color resulting from this mixture depends upon the degree of acidity or alkalinity of the milk. Milk from healthy quarters gives a yellowish-green shade, whereas that from quarters affected with mastitis is predominantly green or, in exceptional cases, a bright yellow. Although this test detects a somewhat larger number of diseased animals at any one time than the strip cup, it too should be used at frequent intervals to find every affected cow, although not necessarily at every milking.

Another method of testing for abnormal milk is the Whiteside test. The test consists of adding 2 drops of a 4-percent solution of sodium hydroxide to 5 drops of milk on a glass plate. The mixture is stirred with a glass rod for 20 seconds and then examined. Normal milk shows no change, whereas abnormal milk will show varying changes from a slight precipitate to a thick viscid mass. The results indicate the degree of irritation in the udder. This procedure is considered more reliable than the bromthymol blue test for detecting chronic mastitis. Neither the bromthymol blue nor Whiteside tests should be used during the first several weeks of lactation or when the cow is almost dry, because false positive reactions may occur.

These various tests detect changes in the milk caused by bacterial activity in the quarter, but they do not reveal the kind of bacteria present. Although in most cases mastitis bacteria remain in the udder at all times, abnormal changes in the milk may not occur regularly. Consequently, failure to find evidence of mastitis in cows previously shown to be diseased does not mean that the animals are no longer affected. Therefore cows which have had mastitis at any time should be handled as diseased animals until a bacteriological examination of the milk can be made.

Prevention

Before milking and using the strip cup, clean all udders thoroughly. A practical method is to cut small hand towels in half and place the pieces in a chlorine solution (250 to 400 parts of chlorine per million parts of water) or a quaternary ammonium solution. Remove a towel from the solution, which should be at a temperature of 110° to 120° Fahrenheit, wring out the excess fluid, and wipe the udder thoroughly, using a separate towel for each animal. This helps stimulate the "let down" of milk, cleanses the skin, and leaves it comparatively dry. After each milking the towels should be washed, boiled, and if possible, dried in the sun. If milking is done by hand the milker should wash his hands in warm, soapy water or disinfectant solution and dry them before milking the next animal. After milking, the ends of the teats of each animal should be dipped in fresh chlorine or quaternary ammonium solution to cleanse and disinfect them and remove any milk which remains on them.

The best method of teat disinfection is to take up a small quantity of the disinfectant solution in a drinking cup, immerse each of the four teats, and then discard the solution. If the milking machine is used, rinse the teat cups between cows in clean cold water, and then submerge them in a quaternary ammonium or chlorine solution. The

water and disinfectant solution should be changed frequently. It is desirable to have the teat cups immersed in the disinfectant solution for several minutes, which would necessitate an additional milking unit. In using a milking machine, extra precautions must be taken to see that all the rubber inflations and hoses are kept clean and in good repair and that the manufacturer's instructions concerning the rate of pulsations and inches of vacuum are followed correctly. Between milkings the machine must be thoroughly cleaned and disinfected. Teat-cup liners that are dirty or in poor repair, worn out or improperly regulated pulsators, too high or too low vacuum caused by plugged lines, leaky stall cocks, and faulty regulators lower the efficiency of the machine and often cause injury to the teats—thus predisposing the udder to mastitis.

Handle cows so that they will properly "let down" their milk, because attacks of mastitis apparently can be brought on when milk is retained or not properly removed from infected udders. Avoid irritating incidents at milking time, follow regular procedures, and remove the machine as soon as the cow is milked out. Teats exposed to the action of milking machines when milk is not flowing through them are in danger of injury and are likely to become painfully sensitive. The teats of many cows cannot withstand having the teat cups quickly jerked off without first releasing part of the vacuum. Injuries and irritations resulting from this practice should be avoided both because of the increased sensitivity of the teats which may cause faulty "let down" and visible injury that may permit entry of infection. Probably one of the most helpful things in the control of mastitis is to have people working with the cows who are willing to put time and effort into doing the job correctly—people who like cows, and are liked by cows.

Inasmuch as any injuries to the udder cause it to be more easily attacked by mastitis bacteria, as much care as possible should be taken to prevent such injuries. This may be done, in part, by providing properly constructed stalls which allow adequate space for each cow, stall partitions to prevent cows from treading on one another's teats, and a well-bedded, dry floor. The generous use of lime or superphosphate in the stable helps to keep the floor dry. Injuries to the udder and teats can also be reduced by housing cows in a pen-type barn.

Reasonable feeding schedules and balanced rations are helpful in maintaining udder health. The provision of adequate good quality roughage is important.

Many of the factors that influence the incidence of mastitis are still unknown or cannot be controlled with the knowledge available today. Nevertheless, if the foregoing procedures are strictly followed, there should be a reduction in the severity of the disease in the affected group. However, successful operation depends entirely upon daily observance of all of the points mentioned. Finally, adequate veterinary supervision of the herd should be maintained at all times.

Treatment

The principal therapeutic agents available today for the treatment of mastitis are the sulfonamides, nitrofurazone, and antibiotics such as tyrothricin, penicillin, streptomycin, Aureomycin, Terramycin, neomycin, bacitracin, polymyxin, and Chloromycetin. Also, newer treat-

ments are being developed continually. The choice of therapeutic agent should depend on the infecting organism, since no one drug is effective against all the different organisms associated with mastitis.

To overcome this deficiency, combinations of the various antibiotics and sulfonamides are being widely used. These combinations not only broaden the range of activity but in some cases actually increase the activity of some of the antibiotics against certain species of bacteria. The amount of drug administered and the length of time it is given must be considered. Thus, in most cases of chronic mastitis, it is important to maintain an adequate amount of the drug in the mammary gland for several days. Many of the antibiotics are available in various vehicles such as ointments and water-in-oil emulsions, and are designed for intramammary injection. This aids in maintaining an adequate therapeutic level of the antibiotic in the udder for 24 to 48 hours after one injection.

The use of drugs in the treatment of mastitis does not take the place of sanitation and good management. Treatment alone may give temporary relief insofar as the treated cows are concerned, but it will do little towards solving the problem in the herd. Antibiotics and sulfonamides have been a great help in controlling mastitis, but they do not cure all infections caused by some of the bacteria and yeasts. There is always the danger of introducing these resistant microorganisms into the udder while treating for another type of organism, with the result that a more severe form of mastitis may develop. This is often due to faulty technique in preparing the teat for injection, or to contamination of the instruments, drug, or vehicle.

Treatment consists in injecting the drug, available in the various vehicles, into the infected quarter through the teat canal. Your local veterinarian will be in a position to suggest the drug and dosage most likely to give best results. As none of the drugs now used are effective in curing all cases of mastitis, it is desirable to have two or more bacteriological examinations made of the milk following the first treatment or series of treatments. In this way cows which did not respond favorably may either be re-treated or eliminated from the herd. It should be emphasized that cows which have been freed from udder infection may become re-infected if the infection remains in the herd or on the premises. After a herd has been shown by test to be free from a specific type of mastitis, it is advisable to have a retest made several months later as insurance against the possible recurrence of the infective organism.

Cows having severely diseased udders, as evidenced by hardening of the udder tissue, are poor risks for treatment because they do not respond readily to drug therapy and seldom prove to be economical producers even if the infection is eliminated. Such cows should be detected by having a veterinarian experienced in this type of work make a physical examination of the udders at the time the milk samples are obtained and before any treatment is used.

In treating acute systemic mastitis it is desirable to administer the above mentioned drugs either intravenously, intramuscularly, or subcutaneously, besides giving intramammary injections. However, frequent milking of the quarter along with application of ice packs at the beginning of the attack will often be helpful in preventing excessive swelling until veterinary treatment can be obtained. After the infection has been overcome and the cow no longer shows marked

symptoms, such as fever or loss of appetite, the application of hot packs to the udder, along with gentle massage, is often valuable in bringing about a more rapid recovery. The application of heat is also indicated in those cases wherein a quarter becomes moderately swollen but the cow shows no apparent systemic symptoms.

Antibiotics in milk

Antibiotics and sulfonamides can enter the milk supply by the following routes: The treatment of cows for mastitis with intramammary preparations; the parenteral (intramuscular, intravenous, or subcutaneous) injection of these drugs for the treatment of mastitis or other diseases; the oral administration of antibiotics in feeds at levels higher than are now recommended, or the oral administration of sulfonamides for the treatment of diseases; and illegal addition of antibiotics to milk for the preservative effect.

Antibiotics in milk are considered adulterants. Penicillin in milk is a particular public health hazard not only because many persons are already allergic to it, but also because of the possibility of sensitizing persons to it. Antibiotics are also a problem in the manufacture of cheese because they inhibit cheese-starter cultures.

The labels of all intramammary mastitis preparations carry a warning to withhold milk from treated cows for 72 hours after the last treatment if the milk is used for human consumption. The disregard of this warning is probably the principal cause for the presence of antibiotics in market milk. Another cause, which may be overlooked, is the oral or parenteral administration of these drugs to treat acute mastitis and other diseases, such as foot rot, metritis, and pneumonia. **It is essential, therefore, that whenever antibiotics or sulfonamides are used to treat diseases of lactating dairy cows, the dairyman should follow explicitly the directions of the veterinarian, the directions on the label of the product, or the recommendations made by local agencies which pertain to the withholding of milk from treated cows.**

COWPOX AND PSEUDOCOWPOX

True cowpox is a disease very seldom found in this country. It probably occurs only when a person who has been recently vaccinated against smallpox with vaccinia (cowpox) virus comes in contact with cattle, such as during the act of milking. However, there is a disease commonly called "cowpox" which occurs frequently, but which is not caused by the true cowpox virus. The cause of this latter condition is not definitely known and may have more than one causative agent. *Actinomyces* species or fungi have been isolated from such lesions and there are indications that it may be caused by a virus. Therefore, this condition is more suitably referred to as "pseudo-cowpox."

These conditions are spread primarily by the act of milking, and consequently lesions usually occur only in milking cows, although nonmilking heifers, dry cows, and bulls may become infected. The lesions are usually confined to the teats and udder and appear at first as small red papules or nodules. These develop into vesicles or blisters in true cowpox and then to pustules which dry up and form scabs. Such lesions are frequently ruptured during the act of milking,

leaving raw, tender areas which may become infected with bacteria. Pseudocowpox differs from true cowpox in that the pustules do not develop pits and the lesion is not surrounded by a marked inflammatory zone.

When either of these diseases appear, segregate the affected animals promptly and see that the infection is not carried to the other cows. The diseased animal should be milked last, all milking utensils thoroughly cleaned and disinfected, and the milker's hands washed with soap and water immediately after milking an infected cow. Both infections are transmissible to man, the lesions usually developing on the hands.

Sores on the udder and teats make milking somewhat painful to the cow; consequently, this should be done gently and with as little discomfort to the animal as possible. Keep the diseased parts clean and apply a sulfonamide or antibiotic ointment after each milking. An application of tincture of iodine to all affected and adjacent areas can be used at the onset of the disease.

CHAPPED TEATS

Chapped teats are caused by an irritation, such as sudden chilling after sucking by the calf; "wet milking" by the attendant; damp or filthy conditions in the stable; exposure to strong disinfectants, sun rays in summer, or freezing in winter. The skin is first rough and inclined to scale; later wrinkles are formed, which may become hard and deep and presently break into raw fissures.

Favorable conditions, such as dry quarters and bedding, cleanliness of the udder and teats, and "dry milking" are essential for the prevention of this trouble. Anoint the teats with a teat ointment containing a healing and softening agent, such as lanolin, after each milking to keep the teats soft and less tender. The use of ointments containing sulfonamides or antibiotics is also advisable, particularly if the teats become infected.

WARTS

Warts on the teats and udder are an annoying disfigurement as well as an obstacle to milking. While perhaps harmless themselves, they may lead to abrasions or fissures and thus expose the skin to infections of various kinds.

Long warts may be removed by tying a silk thread tightly about the base of the growth. The wart will eventually slough off.

Repeated applications of glacial acetic acid or other caustic to the body of the wart have removed such growths successfully. Care must be taken, however, to restrict this treatment to the warts, as these chemicals are very injurious to healthy skin. As a precaution, the normal area around each wart may be previously coated with petrolatum. A safer treatment is to paint the warts with collodion containing salicylic acid.

Some warts require surgery for their removal. In such cases a veterinarian should perform the operation and prescribe the after-treatment.

HARD MILKING

Hard milking may be due to lesions in either the teat cistern or the teat canal. Lack of sufficient elasticity of the closing mechanisms of the teat may cause hard milking. This sometimes is the result of injury or continuous irritation.

External lesions, such as warts, teat erosions, and scabs that have resulted from injuries or infections, can cause hard milking. The term "teat erosion" refers to rough, wartlike growths around the teat orifice or opening. Suction produced by milking machines on the end of the teat with subsequent eversion and irritation to the lining of the teat canal sometimes is responsible for the eroded condition.

Internally, obstructions causing hard milking may be the result of enlargement of the folds or the development of growths on or in the region of the folds at the internal opening of the teat canal. Connective tissue growths in the teat cistern may appear as membranes, small wartlike growths, or large diffuse growths which almost close the entire cistern. Most of these growths are the result of an injury, infection, or a combination of the two.

ATRESIA (BLIND OR IMPERFORATE TEATS)

Atresia, or lack of opening in the teat, may be congenital, or may result from the formation of connective tissue following an injury. When the animal is born with the condition, it is seldom discovered until after the heifer has freshened. The owner's suspicion is first aroused when a quarter becomes abnormally large and milk cannot be gotten from the teat. Examination usually reveals that the teat does not have an opening. Occasionally there is no opening from the gland cistern into the teat, in which case the teat is flabby and contains no milk. Treatment calls for surgery by a veterinarian. Also teats may have no cistern, being filled instead with a solid mass of tissue. In this case there is no treatment.

LEAKY TEATS

Persistent loss of milk through teat leakage is not only annoying but unprofitable. In addition, such cows are very frequently subject to mastitis, and if infected, spread the infection by continually contaminating their environment.

Chronic leaking, in most cases, is due to weakness of the closing mechanisms of the teat orifice, to the effects of a previous operation for the relief of stricture or other obstruction, or to a fistula of the teat. The structures involved in keeping the teat canal closed are muscle bundles, elastic fibers, and a valve-like structure at the internal opening of the teat canal known as Furstenburg's rosette. Therefore any weakness or injury of these structures may result in a leaky teat.

Teat fistula, due to injuries, constitutes a common and annoying form of teat leakage. Such lesions can usually be successfully treated by a surgical operation. This should be attempted only by a veterinarian, since surgical skill and cleanliness, proper restraint, and anesthesia are absolutely necessary. Even at best there always remains the danger of establishing a serious infection of the gland. Efforts to reduce a teat fistula had better be postponed, if possible, until the

animal has been dried off. However, if a cow in full flow of milk should receive a severe laceration or other injury which would develop into a fistula, the correct procedure is to have a veterinarian suture the wound immediately rather than to await the drying off of the animal.

Rudimentary extra teats should never be removed from a mature animal unless for a compelling reason, as such an operation, if improperly performed, may result in a leaky quarter. If these teats are to be removed, this should be done during calthood to decrease the possibility of establishing a fistula. However, if it is necessary to remove them from a mature cow it should be done during the dry period.

WOUNDS

Because of its anatomical position and function, the cow's teat is exposed to considerable manipulation and risk of injury. Wounds of the teat should be cleansed as thoroughly as possible with a non-irritating antiseptic solution. An antiseptic ointment, powder, or liquid may then be applied and the teat bandaged. This keeps the wound clean and permits more rapid healing and a minimum of infection. Injuries should be treated immediately and deep lacerations sutured. Deep lacerations and many of the more serious conditions affecting the teat, such as fistula, atresia, and tumorous growths require the services of a veterinarian for treatment.

In conditions such as severe teat erosions or infections around the teat orifice, the teat ends should be kept in an antiseptic pack until the condition improves and milking becomes easier. As follow-up treatment to a surgical operation and in other conditions, it is sometimes necessary to use milk tubes or dilators to remove the milk or to prevent closure of the end of the teat during healing. It cannot be overemphasized that the use of these instruments always entails the danger of introducing infection into the udder; consequently, they should only be used when really necessary. Whenever instruments are inserted into the teat, or when drugs are injected, cleanliness is essential.

Milk tubes and metal dilators should always be thoroughly clean and free from dried milk, pus, or dirt before being sterilized. To sterilize the clean instruments, immerse them in boiling water for 15 minutes, or for a longer period in a good disinfectant, such as a quaternary ammonium compound. Usually, such treatment is sufficient to kill most pathogenic bacteria. After sterilization, take care not to touch that part of the instrument which will be inserted into the teat. When used, dilators should be taped in the teat to prevent any undue contamination from manure and dirt.

Before insertion of any instrument, wash the teat and orifice free of dirt. Then cleanse the teat orifice with a pledget of cotton soaked in a suitable disinfectant. If the end of the teat is very sensitive to such manipulation, the teat can be immersed for several minutes in a disinfectant solution in a cup. Wipe off any excess fluid remaining on the end of the teat with cotton. In conditions where a scab has formed over the orifice, it is advisable to soak the teat in a warm salt solution, a solution of magnesium sulfate (Epsom salts), or a suitable antiseptic for 15 to 20 minutes thus facilitating its removal with a minimum of damage. Scab formation frequently can be prevented by

taping on the teat between milkings a pack containing an antiseptic ointment.

Whenever the end of a teat has been seriously injured, or when instruments are used inside the teat, it is advisable to maintain in the quarter a therapeutic level of an antibiotic, such as previously mentioned for the treatment of mastitis.

BAD FLAVORS AND ODORS OF MILK

Bad flavors and odors of milk may be due to bacterial contamination, feed, or disinfectants.

Bacterial contamination causing off flavors and odors may come from utensils, feed, water, or udder conditions. A salty flavor in the milk is always present in severe cases of mastitis and in some cases a bad odor may be present. If the cause is an udder condition, the animal should be treated. If contamination is caused by utensils, feed, or water, such causes should be removed and all utensils thoroughly cleaned and disinfected or sterilized.

If cows are to eat feeds which give an undesirable flavor to the milk they should have access to them immediately after a milking, and not just before a milking. Cattle on impoverished pasture may yield bitter milk as a result of consuming quantities of some weed. If the milk of all the cows is off flavor, the feed is probably the cause, and the condition can be corrected by changing either the feed or time of feeding.

Milk may absorb obnoxious odors when volatile disinfectants such as cresylic disinfectant are used in the stable. This can be avoided by the use of nonvolatile disinfectants.

BLOODY MILK

The colostrum and milk of a cow may be bloody for a short period after freshening. Bloody milk may also be caused by the following conditions: Mastitis, mechanical injury to the teat or udder, and leptospirosis (a specific bacterial infection).

Bloody milk is due to the presence of either normal or hemolyzed erythrocytes (red blood cells) or blood clots. If the erythrocytes are not damaged, they will impart a pinkish color to the milk and if the milk is allowed to stand they will settle to the bottom of the container along with any blood clots. If the erythrocytes are hemolyzed—that is, if the cells are damaged and the hemoglobin escapes—there will be no observable settling out of the cells, and the color will remain diffused throughout the milk.

Before treatment is attempted, a determination of the cause is essential. Frequently at calving time the colostrum and milk from one quarter or more will contain blood for several days. This is more usual in heifers with their first calf and is caused by the rupture of the greatly distended small blood vessels. If bloody milk is the result of mastitis or leptospirosis, specific treatment is necessary. In gangrenous mastitis, there is a dark red serous exudate which contains hemolyzed blood. If mechanical injuries to udder or teats are not aggravated, the condition will usually disappear in a short time. It may be necessary to use a milk tube in some teat injuries, if the act of milking continues to cause bleeding. As a means of preventing mas-

titis, the injection of a suitable antibiotic into the teat cistern after any injury to the udder or teats is advisable. The condition of bloody milk which follows calving or injury may be sufficiently relieved in some cases by applying ice packs to the udder and by not giving the cow an excessively rich diet. Should the hemorrhage persist, the advice of a veterinarian should be obtained.

Redness of milk which does not appear until several hours after milking is probably due to contamination of the milk with one of the chromogenic (color-producing) bacteria. Thorough sterilization of utensils and proper care and cleanliness in handling milk should prevent this effectively.

ROPY MILK

At times stringy or slimy milk is obtained from the udder and is caused by mastitis. Such milk should be boiled or treated with a disinfectant to kill any bacteria present, and then discarded. Likewise the utensils into which the milk is drawn should be thoroughly cleaned and disinfected or sterilized. The animals should be treated, as outlined for mastitis.

What is known as "ropy milk" is due to bacterial contamination after the milk is drawn. It usually appears after milk has been standing for several hours. To eliminate this condition, remove the cause; clean and sterilize all utensils to prevent further contamination.

AGALACTIA, OR SUPPRESSION OF MILK

The abnormal condition known as agalactia, or suppression of milk, is not infectious in cattle and is not common. Occurring, as it usually does, at calving time, agalactia seems to be influenced by such predisposing causes as indigestion, loss of appetite, mastitis, insufficient or unsuitable feed, plant poisoning, severe insect stings on the udder, thirst, enforced driving, fear or excitement, or the removal of the calf.

The animal, if a heifer, should first be examined for the possibility of atresia, or imperforation of the teats. This possibility eliminated, the attention should be directed toward determining, if possible, the contributing causes, which should receive prompt attention.

The animal should be kept quiet and surrounded with an environment most conducive to her comfort and complete satisfaction. She should be supplied with an abundance of fresh, clean, drinking water and have a generous allowance of a ration calculated to stimulate milk secretion. Milk secretion may be assisted by internal medicinal treatment. Massaging the udder with an ointment may assist in bringing her to her milk. Efforts should be made to milk her twice a day at regular milking time even though the efforts are unrewarded. If the calf is brought to her side shortly before milking time, this additional appeal to her maternal instinct may exert a favorable influence. Treatment with hormones may also be indicated.