THE DAIRY INDUSTRY IS OBLIGATED to supply the consumer with milk that has a low bacterial count and is free of antibiotics, pesticide residues, and abnormal secretions. The milk regulatory authority and the dairy industry are jointly responsible for this and should use all available resources and techniques to eliminate abnormal milk from the supply. Indicator tests for the detection of excessive numbers of leucocytes in milk are recommended as an adjunct to existing tests to provide the consumer with a safe, high-quality product consistent with the production of wholesome dairy products. The Grade A Pasteurized Milk Ordinance of the 1965 recommendations of the United States Public Health Service (USPHS) emphasizes the use of screening tests to determine the presence of abnormal milk. The National Conference on Interstate Milk Shipments recommends that a program for the control of abnormal milk should be implemented by successive steps.
The three phases of the control program, to be effective July 1, 1967, July 1, 1968, and July 1, 1970, are outlined below. The remainder of this circular discusses screening tests for mastitis and interpretation of these tests, the economic effects and causes of mastitis, and general herd, milking, and sanitation practices to help prevent mastitis from developing.

Phase I—Effective July 1, 1967

The agreements of the National Conference on Interstate Milk Shipments state that "Effective July 1, 1967, laboratory examinations or screening procedures for the presence of unwholesome, altered mammary secretions, whether of an inflammatory, infectious, physiological or environmental origin, in raw milk for pasteurization, shall be made at the same frequency as specified for bacteriological tests." The milk producer is to be notified of all test results. The official indicator test should be conducted by an approved laboratory utilizing the official indicating tests for the detection of abnormal milk published by the USPHS and subjected to the State Laboratory Certification Program.

Phase II—Effective July 1, 1968

After July 1, 1968, only those interstate milk shippers certified to be following an indicating test program will be listed in the quarterly publication, "Sanitary Compliance and Enforcement Ratings of Interstate Milk Shippers."

After this date the following procedure is to be followed when a herd milk sample tested by an approved laboratory indicates the presence of 1,500,000 or more leucocytes per ml. of milk:

1. A warning letter will be sent to the producer notifying him of the high leucocyte count. This letter will also list the principal causes of high leucocyte counts.

2. Following a second test indicating a count of 1,500,000 or more leucocytes per ml. of milk an inspection is to be made by an official sanitarian or a person designated by him.

3. If a third milk sample still indicates a high leucocyte count, the milk regulatory authority can require the producer to have milking equipment analyzed by a milking-equipment serviceman and have individual animals ex-
examined by a veterinarian. Cows producing abnormal milk are to be milked separately and the milk is not to be included in the milk supply.

Phase III—Effective July 1, 1970

On July 1, 1970, a penalty clause for noncompliance with leucocyte standards will become effective. Under this clause, if three out of five tests show that a producer's milk has a leucocyte count of 1,500,000 or more per ml., the producer's permit may be suspended. Court action may also be taken against the producer in accordance with the Grade A Pasteurized Milk Ordinance. The penalty will be applied if excess leucocyte counts are corroborated by a direct microscopic leucocyte count or the equivalent as approved by the USPHS and the state Laboratory Certification Program.

Basic Principle of Screening Tests

The basic principle of screening tests is to measure or estimate the number of leucocytes in milk. Whenever bacteria, viruses, fungi, or other foreign substances or agents are present in the udder, or when tissue damage or injury occurs, leucocytes are transported by the bloodstream to the affected area to combat the irritant. The number of leucocytes present in the udder is an indication of the degree of injury or infection. When a herd mastitis problem exists, large numbers of leucocytes will be present in a composite milk sample from the herd. Bloody milk, colostral milk, milk from cows late in lactation, and milk from sick cows can give positive results to screening tests. But when high results are obtained on herd milk samples, mastitis is almost always the major problem.

Reporting and Interpretation of Screening Test Results

It is essential that the dairyman understand the significance of the test results. The Illinois Mastitis Council, an industry-wide organization established for the purpose of coordinating the mastitis control program in Illinois, recommends the use of one of three screening tests. These are the Wisconsin Mastitis Test (WMT), the Catalase Test (CAT), and the Direct Microscopic Count
The following table may be used for the interpretation of results from these tests. The California Mastitis Test or paddle test (CMT) is also included since it is frequently used in the barn to detect individual animals with high leucocyte counts.

**Interpretation of Screening Test Results in Terms of Leucocytes per Ml.**

<table>
<thead>
<tr>
<th>Leucocytes per Ml.</th>
<th>WMT</th>
<th>CAT</th>
<th>DMC</th>
<th>CMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-500,000</td>
<td>0-15 mm.</td>
<td>Less than 20 percent</td>
<td>Read direct in leucocyte numbers</td>
<td>Negative-trace</td>
</tr>
<tr>
<td>500,001-1,000,000</td>
<td>20-25 mm.</td>
<td>20-29</td>
<td>oxygen</td>
<td>1</td>
</tr>
<tr>
<td>1,000,001-1,500,000</td>
<td>30 mm.</td>
<td>30-35</td>
<td>percent</td>
<td>2</td>
</tr>
<tr>
<td>1,500,001-2,000,000</td>
<td>over 30 mm.</td>
<td>36-40</td>
<td>oxygen</td>
<td>3</td>
</tr>
<tr>
<td>2,000,001-5,000,000</td>
<td>Over 30 mm.</td>
<td>Over 40</td>
<td>oxygen</td>
<td>3</td>
</tr>
</tbody>
</table>

--- ACCEPTABLE --- QUESTIONABLE --- UNACCEPTABLE ---

**Economic Effects of Mastitis**

Mastitic milk reduces the yield, decreases the quality, lowers the grade or score, and has an adverse effect on the flavor, body, and texture of cheeses. In fluid milk, mastitis causes a yellow sediment, lowers milk-fat production, reduces solids-not-fat, increases body cells and bacteria, and alters the physical properties of the milk. In addition, the indiscriminate use of antibiotics in the treatment of mastitis can result in condemnation of milk as well as interfere with making of cheese.

The producer suffers the greatest economic loss from mastitis through decreases in milk production. The average loss in production in individually affected quarters can be measured by using the California Mastitis Test. When production of CMT-reacting quarters was compared with opposite negative quarters in the same cow, average production in studies in Washington and Louisiana decreased as follows:

<table>
<thead>
<tr>
<th>CMT</th>
<th>Loss in Production (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T (trace reaction)</td>
<td>6.1</td>
</tr>
<tr>
<td>1 (slight reaction)</td>
<td>14.6</td>
</tr>
<tr>
<td>2 (strong reaction)</td>
<td>27.6</td>
</tr>
<tr>
<td>3 (very strong reaction)</td>
<td>44.3</td>
</tr>
</tbody>
</table>

When composite samples of CMT tests of all four quarters were compared with production records of
3,785 cows in a California study, losses in pounds per year ranged from 2,178 for a trace reaction to 4,572 for a very strong reaction. Thus the average producer is milking one cow in ten just to pay the annual cost of mastitis. The average cost of mastitis is estimated at $30 per cow per year.

Definition and Causes

Mastitis is an inflammation of the udder. It may be either infectious or noninfectious in origin. About 75 percent of all mastitis is nonclinical, or not apparent to the dairyman. About 24 percent is apparent but mild and only about 1 percent is severe. The majority of mastitis cases go undetected unless a special test is used to identify the affected animals. Approximately 50 percent of all cows have mastitis organisms present in one or more quarters.

The microorganisms that cause mastitis usually enter through the teat canal. Entry is aided by injury or other factors affecting the teat. Milking techniques and sanitation strongly influence the teat canal and its ability to act as a barrier against mastitis-producing organisms. When a herd mastitis problem exists, inadequate housing, poor milking practices, and faulty milking equipment must be corrected to make significant progress against the disease.

Housing, Sanitation, and General Herd Management

Many mastitis-causing organisms are present in the environment and can find their way into the udder if hygienic measures are not applied before and during milking. Adequately paved concrete pens and barns to keep cows out of mud, combined with good lot drainage and barnyard sanitation, are important. Manure should be removed frequently and lots should be free of rocks and other debris.

In stanchion barns, stalls should be large enough to facilitate manure removal and keep cows comfortable and clean. Cows in loose housing should be provided with at least 60 square feet of loafing area each. Free stalls should be 4 feet wide and about 7 to 7 1/2 feet long. The cows should have adequate bedding at all times to help keep them clean. It is very difficult to do a thorough job of washing a cow's udder at milking time if it is extremely dirty.
Raise herd-replacement heifers from cows with good, well-attached udders that are less likely to be injured. Keep calves separate after feeding milk until the urge to nurse has passed. Mastitis-causing organisms can be transmitted to the udder of small heifers by the nursing act.

**Milking Practices**

The preparation and stimulation of the udder is important. To save milking time, get more milk, and reduce teat and udder irritations, follow a routine that the cows can expect at each milking. Handle them gently so that they associate milking with a pleasant experience. The udder should be washed with a clear warm-water spray or with warm water containing a sanitizer. A disposable paper towel should be used. Massage the teats and udder for at least 20 seconds to stimulate milk let-down. Cloth towels and sponges, as used by most dairymen, should not be used for sanitizing the udder. A strip cup should be used to look for abnormal milk. When abnormal milk is found, it must be withheld from the milk supply and properly disposed of. The dairyman must adhere to a strict routine for best results in the preparation and stimulation of the cow.

The milking machine should be applied to the cow about a minute after washing and massaging. The time interval and the routine should be kept consistent. One man should be limited to two bucket-type units, or three units with a pipeline. Undivided attention should be given to the milking procedure and the average time per cow for milking the herd should be 3 to 5 minutes. There may be exceptions with individual, slow-milking cows. However, if the average time required is excessive, milking practices or equipment may need to be improved. Machine-stripping time should be limited to 10 to 20 seconds with a downward pressure on the claw to prevent crawling. When the cow is milked out, the machine should be removed by turning off the vacuum and breaking the vacuum seal at the base of the teat by gently pressing in just above the teat cup. Not allowing the teat cups to fall to the floor will help keep them clean.

Sanitizing the teats and teat cups following milking is helpful in preventing mastitis. All four teats should be dipped in a cup containing a sanitizing solution to remove bacteria and residual milk, and the teats and udder should be examined for irritation or injury. The machine
should be sanitized before milking the next cow by using a clear-water rinse and dipping the teat cups in a sanitizing solution. To be sure air is not trapped in the cup, open the valve of the claw, dip two inflations at a time on a pipeline system, or tip the suspended unit vertically.

**Milking Equipment**

Modern milking equipment is complex. It requires a thorough understanding of the principles of milking and milk handling. Regular inspection, testing, and service by a competent serviceman is of definite value in correcting equipment faults that may lead to mastitis problems.

Teat-cup liners should be free of cracks, milkstone, and ballooning, and should have good resiliency. Keep two sets of rubber parts for the milking machine. Soak one set in a lye solution or a suitable commercial solution for a week while the other is in use. This helps remove butterfat and prolongs the useful life of the teat-cup liners. Machines should be properly cleaned, sanitized, and stored after each milking.

The vacuum line should be 1¼ inches or more in diameter and free of dead ends. Milk lines and air hoses should be free of air leaks. PulSators and the vacuum pressure in the vacuum line should conform to the rate and range recommended by the manufacturer. There should be vacuum stability in all sections with no more than a 2-inch drop and a 2-second recovery.

Vacuum stability at the teat-cup claw should be tested when all milker units are operating. The fluctuation from start to finish of one cow should be no more than 2 inches, and should be no more than about 2 inches below the value registered on the line. There are some general signs of equipment inadequacy such as (1) milk-line flooding (excessive foaming and milk entering the jar in spurts), (2) an unsteady flow of milk from the unit to the pipeline, (3) flooding of the teat cups and claw, (4) slow milking, (5) teat damage, (6) a resistance of the cow to the application of the milker, (7) milk rising in the pipeline, (8) clogging of inline filters, and (9) teat cups dropping off, especially when other machines are first connected on the line. Periodic checks can be made with a simple vacuum gage, but a reliable milking-machine serviceman should give the milking system a thorough check at least every 6 months.
the next cow by using the teat cups in a sanitized lot trapped in the cup, two inflations at a time, and suspended unit vertically.

Diagnosis, Treatment, and Control

The veterinarian has the major responsibility for diagnosing infected quarters, establishing the type of infection, and prescribing treatment and control programs. The California Mastitis Test is valuable for detecting both clinical and nonclinical mastitis cases on the farm. The test is useful in identifying infected cows and in defining the extent of the herd problem. It can also be used to measure progress against the disease in the herd. Badly infected cows or cows that fail to respond to treatment should be sold for slaughter. Other cows can be treated by selecting a drug that is most effective against the particular type of organism involved. In many respects, treatment is a salvage procedure and must be persistent, even though milk from treated quarters must be withheld.

Treatment in eliminating mastitis organisms is more effective during the dry period. The regular use of the California Mastitis Test will help single out cows that need attention. Cows that have had clinical or nonclinical mastitis during the lactation period should be treated during the dry period.

Vaccination has recently received some attention. There have been claims of good results. However, additional controlled experiments and more experience are needed in order to evaluate the use of vaccines.

Treating infected animals as mastitis cases occur is helpful in reducing losses, but this is not the ultimate answer. Control must depend largely on the prevention of new cases by instituting better management along with milking and sanitation practices, and by using improved milking equipment. Frequently it takes 6 months to a year to correct herd mastitis problems, especially if mastitis has been present in the herd over a long period of time.

This circular was prepared by G. W. Meyerholz, Extension Veterinarian, and L. R. Fryman, Extension Dairyman.