A Dairy Action Program
for Missouri
Including the Dairy Industry 8-Point Program
for 1944 and 1945

THE DAIRY INDUSTRY 8-POINT PROGRAM

1. Grow more legume hay, pasturage, and grain.
2. Fertilize to increase quantity and quality of feed.
3. Feed to avoid summer milk slump.
4. Feed cows liberally during their dry period.
5. Keep as many cows as feed and labor permit.
6. Market whole milk whenever possible.
7. Produce good quality milk and avoid waste.
8. Breed for better herd replacements.

GENERAL OBJECTIVE FOR DAIRYING IN MISSOURI

A. C. RAGSDALE

The general objective for dairying in Missouri is to secure the maximum production of good quality milk and milk products consistent with good farm and dairy practice and by proper care and processing to make possible the utilization of this production so as to approximate its maximum nutritional possibilities.

Important points in the program may be outlined as follows:

1. A balanced farm program. Plan and organize farm operations—with dairy cattle numbers, labor and equipment fitted to your farm needs and thus tend to assure maximum production.

2. Increase your total feed supply. Adopt practices that improve the yield and quality of crops. Fertilize—use a good crop rotation.
   A. Develop year-round pastures by improving permanent pastures and providing suitable supplementary pastures.
B. Provide plenty of good quality hay and silage.
C. Use approved harvesting and storage practices.
D. Grow your own grain to the extent land is available.

3. Use feeds most effectively.
A. Condition heifers and cows for calving.
B. Feed roughage liberally. It is usually the most economical source of nutrients and the principal source of vitamins and minerals.
C. Feed a suitable grain ration in proportion to milk produced.
D. Prevent summer slump by providing adequate feed, especially pasture, including water and salt.

4. Develop a constructive breeding program.
A. Select herd sires with desirable proved close-up ancestry or themselves already proved.
B. Use cooperative bull clubs or artificial breeding associations in suitable situations.
C. Artificial breeding may be used advantageously in many herds and to meet special needs.

5. Adopt a herd record system and a production testing plan as aids to herd improvement.
A. Keep complete herd records.
B. Keep the best producers—replace low producing cows.
C. Raise calves from the best cows—cull the poorer calves.
D. Adopt some form of production testing—Dairy Herd Improvement, Herd Improvement Registry or Advanced Registry as best fits your situation.
E. Use records as a basis for selecting breeding stock.

6. Keep the herd healthy. Healthy cows give more milk and reduce herd replacements.
A. Adopt a strict sanitation program.
B. Watch closely for evidence of disease—test regularly for Tuberculosis, Bang’s Disease, Mastitis.
C. Follow through on all breeding troubles.
D. Consult your veterinarian and use proper diagnostic tests and treatment.

7. Housing and equipment.
A. Provide a well planned barn and milk house. Remodel or provide new construction as needed and conditions permit.
B. Expand use of labor saving machinery and equipment.

8. Quality of raw materials.
A. Healthy cows and attendants.
B. Produce good quality milk and cream—adopt sanitary methods.
C. Keep milk and milk products away from undesirable odors.
D. Avoid undesirable feed flavors.
E. Save food by proper cooling and care of milk and cream.
F. Deliver milk daily and cream three times each week.
9. **Procurement problems.** Adopt methods which will be most efficient and result in best quality of product.

10. **Processing.** Improved methods, strict sanitation, proper equipment and laboratory control.

11. **Marketing.** Determine most profitable types of market for milk and milk products and effective methods of distribution. Apply Federal and State standards and grades.

12. **Educational.** Cooperate in local and national programs presenting the nutritional values of milk and milk products. (Educational and research institutions, Dairy Councils, American Dairy Association, Breed Associations, etc.)

**Summary.** Carefully plan all farm operations for maximum production; use approved herd management and improvement practices; strive for a superior product; meet public health requirements; reduce waste; make the best use of labor—a well arranged farm suitable buildings and equipment make the job easier; save time and transportation; procurement methods resulting in high quality raw product, effective processing and marketing mean more and better products; sell the public on the merits of your product; utilize milk and milk products in the form to best meet war-time need.

**THE AGRICULTURAL OUTLOOK AS IT MAY AFFECT 1944 MILK PRODUCTION IN MISSOURI**

GORDON B. NANCE

The year 1944 promises to be a good one for farmers. The demand for goods in general and farm products in particular will be higher in 1944 than it was in 1943. The number of men in our armed forces will be higher; the territories occupied by allied forces will increase and add to the peoples to be fed by us; increases in ships built, in the effectiveness of the defense against submarines, and the opening of the Mediterranean to allied shippings, will increase the amounts of goods that can be carried by allied ships. Also, domestic consumer income is the highest in history and still increasing.

It is estimated that the requirement for agricultural products for our armed forces, the minimum nutritional requirement for domestic consumers and that part of the minimum nutritional requirement of our allies and peoples in occupied countries that can be transported in the ships available, would total from 10 to 20 per cent above 1943 production; and also, that without rationing and if it were available at present prices, American civilians would buy 30 per cent more animal food products and canned goods than they bought in 1943. This is the demand picture for 1944.

Farm production in 1944, with average growing conditions, is expected to vary little from 1943 in total amount, but it may be greater in terms of human food because of shifts to crops consumed directly—such as wheat, beans, peas, potatoes, peanuts, etc. The
trend will be toward those products that yield the largest amount of human nutrients per unit of resources used.

Prices of agricultural products, with such supply and demand conditions, will rise as rapidly as price control measures will permit and some rise is almost certain.

Cash farm income in 1944 is expected to be 10 per cent above 1943, the highest in history, 40 per cent above 1919—the highest year in the last war—and three times that of 1939.

The prices received by farmers are expected to be about as high, in relation to the prices paid by farmers, as in any year since 1910.

Prices of Missouri farm lands rose some 10 per cent in 1942 and probably rose twice that much in 1943.

These conditions of demand, supply and prices are expected to continue until the end of both the European and the Pacific phases of the war, and for a year or two thereafter.

The Dairy Outlook

Dairymen have shared in the increases in general agricultural income since 1939, and are expected to continue to share in the prospective future increases. The year 1943 was a good one for dairymen. The income from the sale of dairy products in 1943 is estimated to be 20 per cent above that of the previous year and the highest in history. The number of cows kept for milk increased 2 per cent and the price of milk cows advanced 25 per cent last year.

Costs of production also rose. Grain prices rose some 37 per cent during the last 12 months and farm wages about 30 per cent. Therefore, increases in the net profits of dairymen, especially during the latter part of the year, may have been considerably less than indicated by the above figures.

It is understood, of course, that the above comparison of 1943 and 1942 are for the United States as a whole and may not reflect the conditions in a particular community or in a particular dairy business.

Another good year is expected for dairymen in 1944. The income from the sale of dairy products is expected to be at least 10 per cent above that of 1943 and dairymen will probably have their first three-billion-dollar year. While feed and labor costs are also expected to increase, they are expected to rise only half as much as they did in 1943.

High dairy prices and high dairy income are expected to continue at least a year or two after the end of the war, or probably through 1946 or 1947—for the reasons given earlier in this discussion.

There is an additional reason for believing that prices of dairy products will be maintained at levels relatively profitable to dairymen. The importance of nutrition and especially of the protective foods, in civilian production and military achievement, is receiving
increased recognition at home and abroad. Since dairy products are important protective foods, and since it is felt that dairy production will not be maintained at its 1943 level with present prices of dairy products, it is believed that Government price policies ultimately will be such as to increase production. These price measures may be increases in prices for dairy products, increases in subsidies to producers, or both, but to be effective, they will have to increase the profitableness of dairy production.

The danger spot in the dairy outlook is the feed situation. This will be discussed more fully by others but the seriousness of the situation justifies any repetition that this may constitute.

Our feed concentrate supply per animal unit is about 14 per cent below last year and the lowest since the drought year of 1937. Prices of feed are markedly higher than a year ago, but even this is not the most serious phase of the problem. The gravest consideration is not the probable price of dairy feed, but it is whether or not we will be able to get feed at any reasonable price. At present prices of grain and hogs, many farmers who ordinarily sell corn, will feed it in 1944. They will prefer to sell corn through hogs at $1.25 to $1.50 per bushel rather than as cash corn at $1.16 or less.

I suggest that it will be wisdom on the part of dairymen to (a) produce all of the feed they can; (b) be forewarned in the purchase of additional feed required and available; (c) use feed to its utmost efficiency; and (d) balance dairy cow numbers to the feed available to them.

In summarization, may I repeat that we expect the next three or four years to be both worrisome and profitable years for good dairymen. For poor dairymen they will only be worrisome. Poor dairymen have no profitable years.

OUR 1944 FEED SUPPLY
J. E. Crosby

Our 1943 production of feed grains was 7 per cent smaller than in 1942. Total supplies of high protein feeds are 1.8 per cent larger than a year ago. Livestock numbers probably are 10 per cent higher than last year. The supply of feed concentrates per grain consuming animal unit is estimated at 0.96 tons this feeding season as compared with 1.08 tons last season, a reduction of 11 per cent.

Hay supplies for the 1943-44 feeding season amount to 112,941,000 tons as compared to 116,555,000 tons a year earlier. This is a reduction of 3 per cent and smaller still in terms of total live stock production.

Pasture seldom meets requirements and any increases in supply will reduce the need for cured roughage and concentrates.

Next winter's feed supply will depend even more than usual upon current production. Availability of feeds to Missouri dairymen may depend largely upon home production.
The supply of dairy feed for Missouri in 1944-45 may be increased by the general adoption of plans which balance feed requirements and supplies. Such results will depend upon the adoption of these plans by a large majority of Missouri dairymen.

Dairy plant fieldmen can contribute importantly to this program for more satisfactory feed supplies by acquainting farmers with methods of analyzing their feed needs and production possibilities. The Missouri College of Agriculture has developed a form which facilitates balancing seasonal pasture requirements and supplies and another which analyzes roughage and concentrate requirements and production. These forms, known as "Pasture Production Check Sheet", Form BF-2b and "Feed Balance Sheet", Form BF-10, are available through the Agricultural Extension Service and may be used in estimating feed requirements and supplies.

PASTURE, HAY AND SILAGE CROPS FOR DAIRY CATTLE
J. R. PAULLING

No less than three important facts present themselves justifying your interest in roughages for dairy feeding:

1. Roughages supplied some 75.4% of the feed consumed by dairy cows in this country during the period 1938-40, according to U. S. D. A. Circular 670. Is it not logical that a class of feed which plays so important a role be given major attention?

2. Certainly no one knows better than the dairy plant fieldman how the volume of receipts swells with the onset of the pasture season and shrinks with the decline in pastures.

3. Perhaps most important of all, whatever the advantages of heavy grain feeding, it is more costly than a system that makes the optimal use of roughage, in all the capital elements, viz., land, labor, equipment and even the cattle themselves. Moreover, the poorer the land the more expensive is grain feeding.

Even slight familiarity with feeding methods in the older livestock producing sections of the world strongly suggests that fuller use of roughage has decided advantages in economy, permanence, profit and over-all satisfaction. By comparison it would appear that we are "growing up" in our feeding methods in Missouri—at least our feeding practices are approaching the sounder methods generally associated with maturity of experience of the older regions. In short, we are moving from a Grain-hay (Silage)-Pasture system of feeding to a Pasture-hay (Silage)-Grain system.

In such a program the pastures bear the major burden of total annual feed production. The silage is properly regarded as "canned" pasture, to be relied upon particularly for succulence, along with its other nutritional values during the interval when the pasturage is inadequate, regardless of the season. The hay is the feed backlog—splicing one pasture season with the next. And the grain assumes
its righteous place in this set-up. It is literally the concentrate—simply enriching the total ration. With such a system the quantity of grain fed usually declines, the feeding cost is reduced, production remains surprisingly near if not equal to or even above former levels, and in most instances profits increase.

Since all our pasture crops have their good and "off" seasons, a most important consideration is the development of a pasture system. It is much more necessary than simply improving pastures. From the variety of good pasture crops we have that are well suited to Missouri conditions, we can fit together acreages of several in such manner as to provide 9 to 10 months of good pasture instead of the usual 5 or 6. Space and time do not permit detailed treatment, but the following are some generalities:

Sweet clover grown in rotation with small grain would provide excellent fall and spring grazing even on very poor land if limed, phosphated and if the seed is inoculated.

Permanent grass pastures are to be relied on from about mid-April to late June—and then again for winter grazing.

Small grain, grown in rotation with sweet clover and lespedeza, affords spring and fall grazing.

Lespedeza and sudan provide summer grazing.

For hay, alfalfa, of course, is standard and should be the chief reliance on well drained soils, well limed and fertilized. Under other conditions soybeans and lespedeza, properly handled, will produce practically as good hay and can be relied on anywhere in Missouri.

For silage—corn, Atlas sorgo, sweet clover and the small grains each will serve well. Expansion, especially in the use of sweet clover for ensilage, seems probable in view of the economy in soil and labor and its high production of a protein-rich product.

**HARVESTING AND PRESERVING CROPS FOR SILAGE**

H. A. HERMAN

An abundant supply of good quality roughage—pasture, hay and silage—produced at low cost, is one of the most important factors in profitable dairying. Our roughage feeding program calls for an increase in the use of silage. The methods of preserving corn, sorghums and similar crops in the silo are well known and little difficulty is experienced in obtaining good silage from these crops. The preservation of cereal grains and grasses and especially leguminous roughages has presented new problems. The increasing use of leguminous forage crops, however, has stimulated studies relating to methods of preserving these crops in the silo. Several practical methods for the successful preservation of these crops have been perfected and are in wide use by dairymen and live stock raisers generally.
Advantages of Legumes, Grasses and Cereal Crops for Silage

1. Legume or grass silage may be made in periods unfavorable for the field curing of hay. This is especially applicable to the first cuttings of alfalfa and sweet clover. Other legumes, grasses and cereals may likewise be converted into silage.

2. A greater proportion of nutrients is conserved by ensiling the crops, and losses caused by rains, sun bleaching, shattering of leaves, etc., are materially reduced.

3. An early season crop stored in the silo may be fed out as "summer silage", thus supplementing short pastures and preventing the usual summer decline in milk production. The silo may then be refilled for fall and winter use.

4. Ensiling often proves practical in handling a damaged or weedy crop of legume hay or cereal grains. Most weed seeds are destroyed by the fermentation processes which occur in the silo.

5. The carotene content (responsible for the yellow color of milk fat) of the green crops is preserved more efficiently in the silo than in field curing. This is of considerable importance in winter feeding as dry roughages of low quality are often low in this factor.

6. Silage reduces storage costs. A cubic foot of grass silage weighs 8 to 9 times as much as a cubic foot of loose hay and contains about 3 times as much food value.

7. Silage from legumes, grasses and cereals fits into a soil conservation program and lessens the necessity of growing soil depleting crops for silage purposes.

8. Silage is good "drought insurance" and is a valuable feed to be held in reserve for time of feed scarcity.

Crops for "Grass" Silage

Any crop that can be utilized as dry hay or roughage can be made into silage. The crops most commonly used for "grass" silage in the midwest are legumes, grasses and cereals.

Mixtures of legumes, grasses or cereals may be used. Silos may be filled partly with one crop and completed with another if more convenient and the necessary precautions are taken.

The yield of silage obtained from legumes, grasses and cereals varies greatly. Legume crops such as alfalfa or soybeans, yielding 1 to 2 tons of cured hay per acre will furnish approximately 4 to 8 tons of silage. Sweet clover usually yields somewhat more, often producing 6 to 10 tons of green material per acre.

Experience with wheat, barley and rye, capable of yielding 18 to 20 bushels per acre, indicates that about 5 to 10 tons of silage per acre may be expected from such a crop. The grasses, timothy, etc., will usually yield from 3 to 6 tons and even greater amounts of silage per acre.
As a general rule, since most silages contain about 25 per cent dry matter and well cured hays about 90 per cent, the yield of silage will ordinarily approximate 3 to 4 times the tonnage of the cured crop.

**Time to Cut—Stage of Maturity**

Legumes and grasses should be harvested for silage purposes at the same stage of growth as they would normally be cut for the best quality hay. Young plants are most palatable, highest in protein and minerals, contain less fiber, and are highest in digestibility at the bloom stage or before. While the chief object is to obtain the greatest amount of nutrients per acre, there is often a tendency to cut legumes, grasses and cereals too late for the most nutritious silage.

As a rule, alfalfa should be cut when the new shoots below the top growth are on the average about 2 to 3 inches long. Sweet clover should be cut before it is big enough to be very woody. Another rule is to cut both alfalfa and sweet clover when the field is about one-fourth to one-half in bloom. Red clover and alsike should be cut not later than full bloom. Soybeans should be cut when the pods are formed and one-third to two-thirds filled.

Timothy and grasses in general should be cut not later than full bloom. Prairie grasses should be cut before the plants begin to turn brown from dry weather or maturity.

Cereals should be cut as soon as headed out, or when in the milk stage, but no later for best results.

**Harvesting and Ensiling**

The best method for harvesting will depend upon the crops and machinery available. A mower and side-delivery rake are commonly used for legume and non-legume hays. When available, special machinery for cutting and loading directly into the wagon or truck is very satisfactory. A grain binder is commonly used when cereal grains are to be put into the silo and has been used with good results in handling barley and wheat used for silage at this Station.

The ordinary silage cutter may be used advantageously for cereal crops. Where loose green hays are handled, however, a cutter especially designed with rollers and conveyor is most satisfactory. Such choppers are also adaptable for use with such crops as corn and sorgo and are carried in stock by farm machinery companies.

For legumes and grasses, some increase in operating speed of the cutter may be necessary, particularly for high silos, in order to prevent clogging of the blower pipe.

**Preserving Grass Silage**

Grass silage has commonly been made with the aid of molasses or mineral acids as preservatives. War-time defense needs have created a scarcity of both and even where they are available the cost is likely
to be more than they are worth for this purpose. Alternative methods of preserving silage must take their place.

There are three practical methods of making grass silage under existing conditions: (1) the use of ground corn, corn and cob meal, or other cereal grains; (2) the use of dry or green sugary crops such as sorgo, corn fodder, or other dried roughages; and (3) the use of no preservative but allowing the crop to wilt so the moisture content is approximately 65 per cent.

Corn or other cereal grains make a very satisfactory preservative, although not quite so good as molasses or acid. The sugars of cereal grains break down to form preservative acids similar to those of molasses. For legumes such as alfalfa, sweet clover, or lespedeza, use 150 lbs. of ground shelled corn or ground barley per ton, or 200 lbs. corn and cob meal or other cereal grains such as wheat, rye, sorghum grain, or head chop. For soybeans use 200 lbs. of ground corn or barley, or 250 lbs. of corn and cob meal or other cereal grains. Mixed legumes and grasses require about 125 lbs. of ground corn or barley or 150 lbs. of corn and cob meal or other cereal grains, while for ordinary grasses and cereals about 75 lbs. of ground corn or barley, or 100 lbs. of corn and cob meal or other cereal grains is recommended.

The corn or cereal grain preservative should be added as the crop to be ensiled passes over the feed table. A hopper arranged above the cutter box and equipped with a stop to regulate the flow of grain so that the approximate amount per ton is added will save much labor and result in a more uniform silage.

The use of dry or green sugary crops.—Various combinations of legumes and non-legumes may be satisfactorily ensiled. Where good quality dry sorgo fodder, dry corn fodder, or other dry roughage is available, about 300 lbs. mixed with each ton of grass silage as it goes through the cutter will furnish the necessary sugars for preservation. Green sorgo or corn fodder, or other green non-legume grasses or cereals may also be used and in this case one load of such crops to two loads of alfalfa, soybeans, sweet clover or lespedeza will make good silage. Sorgo is a better preservative than corn because it contains more sugar. If storage facilities permit, farmers might well plan on growing and storing each year sufficient sorgo for their next year’s grass silage program.

The use of no preservatives—this method is not as safe as the use of corn or other cereal grains but gives good results when the crop is allowed to wilt and when great care is used to reduce the moisture content to about 65 per cent (or raising the dry matter content to approximately 35 per cent instead of the 18 to 22 per cent commonly found in freshly cut hay). The time of wilting will vary with the stage of growth and weather conditions. As a rule, the heavy legumes require from 3 to 4 hours but on a dry windy day the crop may be loaded almost as soon as it is cut. There should be just sufficient moisture.
in the stalks to exude to the surface when a handful is twisted with moderate pressure. The difficulty of determining the dry matter content of crops to be ensiled by wilting has been the chief drawback to this method. However, this difficulty has been largely overcome by means of a simple home-made pressure device developed by the Bureau of Dairy Industry, United States Department of Agriculture, and described in Missouri Agricultural Experiment Station Circular 234. *Salt and bacterial cultures* have been recommended for ensiling legumes and other crops. Investigations do not prove that these materials can be relied upon to give good results and proper preservation.

**FACTORS INFLUENCING THE QUALITY AND NUTRITIVE VALUE OF ROUGHAGES**

H. A. HERMAN

Quality in roughages generally means “feed value.” High quality roughages are those possessing the *physical and chemical characteristics commonly associated with palatability and an abundance of feed nutrients*.

The most important physical factors of quality that may be gauged in a practical way are (1) stage of maturity when cut, (2) percentage of leaves, (3) green color, (4) amount of heating, spoilage, etc., (5) size and pliability of stems, (6) aroma, and (7) freedom from foreign material.

Quality in roughage, from a chemical standpoint, refers to the dry matter, protein, carbohydrates, crude fiber, mineral and vitamin content.

The chemical composition of roughages depends upon (1) the variety of plant (botanical make-up), (2) the stage of maturity, (3) the climatic conditions (rainfall, temperature), (4) the type and fertility of the soil, and (5) the method of harvesting and conserving the crop.

The quality or feed value of roughages is really measured by growth, milk production, gains in weight, and reproduction of the animals consuming them. The actual feeding value of a roughage, however, can be determined only by *feeding trials* in which the digestibility or utilization of the food nutrients is measured. *Chemical analyses alone are inadequate to gauge quality, because we are left in doubt as to the digestible portions*. Generally speaking, the physical factors and the chemical composition are sufficiently in agreement that a *high grade roughage* as judged by its maturity, leafiness, color, aroma, and other physical factors will likely furnish the greatest quantity of nutrients.

The effect of the various factors affecting quality and nutritive value are briefly summarized as follows:

**Variety (legume vs. non-legume).—**The fact that legumes are higher in protein and minerals that non-legumes is so widely recog-
nized that this fact need not be stressed here. A good comparison is afforded when the analyses of alfalfa and timothy hay are compared:

(Percentage composition*)

<table>
<thead>
<tr>
<th>Plant</th>
<th>Dry Matter</th>
<th>Protein</th>
<th>Fat</th>
<th>Crude Fiber</th>
<th>N. F. E.</th>
<th>Ash*</th>
<th>Ca*</th>
<th>P*</th>
<th>Digestible Protein</th>
<th>T.D.N.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>90.4</td>
<td>14.7</td>
<td>2.0</td>
<td>29.0</td>
<td>36.4</td>
<td>8.3</td>
<td>1.43</td>
<td>0.21</td>
<td>10.6</td>
<td>50.3</td>
</tr>
<tr>
<td>Timoth</td>
<td>88.7</td>
<td>6.2</td>
<td>2.4</td>
<td>30.1</td>
<td>45.0</td>
<td>5.0</td>
<td>0.27</td>
<td>0.16</td>
<td>2.9</td>
<td>46.9</td>
</tr>
</tbody>
</table>

*Taken from Morrison's "Feeds and Feeding", 20th edition.

Stage of Maturity.—There is a great difference in the composition and feeding value of immature and mature plants. Immature, actively growing plants contain less fiber, are higher in water content, richer in protein, have more calcium and phosphorus and greater quantities of vitamin A, when compared on a dry matter basis, than the fully matured plant often cut for hay. These differences in composition have been reported by numerous investigators, including Deetz in 1873. In 1915 Waters and associates of the Missouri Station reported exhaustive studies on the value and effects of harvesting timothy in the early bloom stages and also observed that dairy cattle and beef cattle invariably preferred the early cut hay. Practically all of our common roughage and pasture crops have been studied from the standpoint of changes in composition and digestibility of the constituents at various stages of growth, and without exception early harvesting—so far as commensurate with the maintenance of good vigorous stands—is universally recommended. It has been found that such practices result in a roughage higher in palatability, giving more digestible protein per acre, more carotene, a higher mineral content, and generally less fiber and lignin content which so markedly affect digestibility.

The difference in feeding value of early cut and late cut forages is often much greater than the chemical composition would indicate because as plants mature the percentage of cellulose and lignin increases greatly. Along with increased lignin content we have chemical changes occurring which tend to "bind" or render less digestible the plant nutrients. Studies on the barley plant show these progressive changes.

Composition of Barley Plant (Dry Basis)

<table>
<thead>
<tr>
<th>Age (days)</th>
<th>Ash (%)</th>
<th>Protein (%)</th>
<th>Pentosan (%)</th>
<th>Cellulose (%)</th>
<th>Lignin (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>16.48</td>
<td>38.0</td>
<td>9.3</td>
<td>19.0</td>
<td>2.31</td>
</tr>
<tr>
<td>86</td>
<td>7.49</td>
<td>3.7</td>
<td>23.9</td>
<td>31.6</td>
<td>7.74</td>
</tr>
</tbody>
</table>
Alfalfa cut in the various stages also illustrates this point.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Protein</th>
<th>Coefficient of Digestible protein</th>
<th>Digestible Protein</th>
<th>Fiber</th>
<th>N.E.F.</th>
<th>Starch Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-bud</td>
<td>25.3</td>
<td>84</td>
<td>21.3</td>
<td>22.1</td>
<td>38.13</td>
<td>52.8</td>
</tr>
<tr>
<td>In Bud</td>
<td>20.4</td>
<td>76</td>
<td>15.5</td>
<td>23.9</td>
<td>42.22</td>
<td>50.8</td>
</tr>
<tr>
<td>In Flower</td>
<td>17.2</td>
<td>74</td>
<td>13.0</td>
<td>29.7</td>
<td>39.35</td>
<td>42.4</td>
</tr>
<tr>
<td>Average</td>
<td>14.2</td>
<td>74</td>
<td>10.5</td>
<td>29.5</td>
<td>40.9</td>
<td>33.0</td>
</tr>
</tbody>
</table>

Studies dealing with the digestibility and nutritive value of Korean lespedeza by Swanson and Herman (Missouri) indicate a similar picture. Early cut Korean lespedeza hay is about 90 to 95 per cent as effective as good alfalfa hay for growth and milk production, but matured lespedeza hay is poorly digested as evidenced below, and in maturing it undergoes lignification much in excess of the condition commonly found in alfalfa.

**COMPOSITION OF THE DRY MATTER OF LESPEDEZA AND ALFALFA LEAVES AND STEMS**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Portion</th>
<th>Lignin</th>
<th>Cellulose</th>
<th>Other Carbohydrates</th>
<th>Crude Protein</th>
<th>Ether Extract</th>
<th>Mineral Matter</th>
<th>Crude Fiber</th>
<th>Nitrogen-free Extract</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
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<td>Stems</td>
<td>17.52</td>
<td>34.54</td>
<td>33.26</td>
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<td>38.49</td>
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<td>23.43</td>
<td>25.17</td>
<td>20.75</td>
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<td>4.11</td>
<td>7.44</td>
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<td>9.90</td>
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DIGESTION COEFFICIENTS OF LESPEDEZA HAY

<table>
<thead>
<tr>
<th>Ration</th>
<th>Heifer No.</th>
<th>Dry Matter</th>
<th>Crude Protein</th>
<th>Crude Fiber</th>
<th>Ether Extract</th>
<th>Nitrogen-free Extract</th>
<th>Cellulose</th>
<th>Lignin</th>
<th>Other Carbohydrate</th>
<th>Total Digestible Nutrients</th>
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<tr>
<td></td>
<td></td>
<td>%</td>
<td>%</td>
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<td>24</td>
<td>56.43</td>
<td>48.27</td>
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<td>Interm-les-</td>
<td>26</td>
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<td>56.06</td>
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<td>84.91</td>
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<td>Late les-</td>
<td>47</td>
<td>42.35</td>
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<td>51.15</td>
<td>13.38</td>
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<tr>
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<td>13.30</td>
<td>75.47</td>
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<tr>
<td>Average</td>
<td></td>
<td>43.44</td>
<td>41.03</td>
<td>49.92</td>
<td>10.18</td>
<td>46.03</td>
<td>56.34</td>
<td>10.60</td>
<td>74.01</td>
<td>37.43</td>
</tr>
</tbody>
</table>

In this study, matured Korean lespedeza contained only 37.93 per cent total digestible nutrients, whereas the earlier cut averaged 52 per cent and compares favorably with alfalfa. This helps us explain why late cut lespedeza won't make milk! The practical solution, of course, is to harvest such hays early.

Climatic Conditions (rainfall, etc.).—The amount and distribution of rainfall are paramount factors affecting the yield and chemical composition of forages. Dry matter, protein and mineral content are influenced. Alfalfa grown in a humid climate generally has a higher phosphorous content than that grown in an arid area. During droughts the decreased phosphorus content of herbage is a matter of concern and on range conditions outbreaks of malnutrition among cattle have been reported.

Eckles and Associates report these variations in prairie hay from the same farm:

<table>
<thead>
<tr>
<th>Year</th>
<th>Rainfall Inches per year</th>
<th>Calcium %</th>
<th>Phosphorus %</th>
<th>Magnesium %</th>
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<tbody>
<tr>
<td>1923</td>
<td>17.49</td>
<td>5.70</td>
<td>0.173</td>
<td>0.377</td>
</tr>
<tr>
<td>1924</td>
<td>21.98</td>
<td>6.18</td>
<td>0.275</td>
<td>0.408</td>
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</tbody>
</table>

During the winter of 1923 many cases of depraved appetite among cattle on this farm were reported, but they were far less frequent the winter of 1924.

The New Mexico Station found that generally the forage was highest in minerals in the spring and summer but tended to decrease as the plants matured. Since moisture is generally the limiting factor in pasture production, it is evident that the soil type (Midgley,
Type and Fertility of the Soil vs. Feed Quality.—Plants are materially affected by the mixture or make-up of the soil on which they are grown. The literature on this subject is voluminous. Lawes and Gilbert (England, 1900) report at length upon the wide variation in the mineral content of forages. As early as 1861 mineral deficiencies among cattle kept in certain low areas along the Rhine were reported. Similar cases of malnutrition have been reported from many parts of the world and in badly leached or swampy areas of the United States. Early work as reviewed by Eckles (1926) stresses the relationship of mineral content of feeds to the moisture content of the soil.

There is a preponderance of evidence, however, that if soils are high in available plant nutrients, it will be reflected in the chemical composition of the plants and likewise in the yield and number of animals supported per given area. Not only does the yield of forage increase when soils low in plant nutrients are fertilized and limed, the amount of nitrogen, phosphorus, calcium, etc., show marked gains as measured by analyses of the dry matter. Superphosphate applications have been found to increase the phosphorus content of the dry matter of plants as much as 40 per cent. Likewise, the use of phosphorus fertilizer on alfalfa grown on land rich in calcium but low in available phosphorus, gave increased yields of hay with an increased phosphorus content.

Soils rich in nitrogen produce luxuriant growth when sufficient moisture is available. Nitrogen fertilizers increase the protein content and decrease the crude fiber content of plants. One of the most pronounced effects of applying fertilizer seems to be the increased yield of dry matter and the added palatability of the growing crop which is higher in water content, more tender, and readily chosen by animals over plants growing on less fertile areas. The soil composition also markedly affects the type of vegetation it will support—for instance, it is a common observation that clover increases following phosphate treatment of pastures.

Soil fertility also plays an important role in the carotene content of plants. Nitrogen fertilizer increase the carotene content of plants and potassium seems to decrease it, according to some workers. In general, there seems to be a definite correlation between the protein and carotene (Vitamin A) content of roughage.

Data regarding the relation of available mineral content of the soils to the mineral composition of the forage grown thereon are voluminous and somewhat contradictory from a practical standpoint. This can be easily understood when the effect of stage of maturity at harvest, method of conserving and management of livestock grazed or fed on these areas are taken into account.
This entire problem is one of national concern to dairymen because often a man is told that his cows “need minerals”. All too often he falls a victim to a fast talking mineral feed salesman. Yet even these salesmen find a well kept farm and thrifty livestock usually owned by a man smart enough to have “sales resistance” for such arguments. Then too even the best of dairymen succumb to the argument that the cows are not breeding or are not carrying their calves full term because of mineral deficiencies. Extensive experiments have shown very little relation between breeding troubles and mineral feeding except in cases where the deficiency of minerals is so great as to actually result in marked malnutrition. Too, ailments such as “milk fever” and acetonemia are sometimes charged to the poor nutritive value of roughages grown on a given farm. Again this is not borne out by facts as one will readily observe. “Milk fever” attacks only the highest producing cows, and in the best herds, which are usually on the best farms and likewise receive better than average management. Scientists have found that in “Milk fever” there is a temporary upset in calcium mobilization following calving. The blood calcium is low, as is the phosphorus, but if properly treated these cows recover and in a few days the blood minerals are at a normal level, the cow rises to her production peak following recovery and continues normal throughout her lactation. This she could not do if she had collapsed because of a mineral shortage. The lack of properly balanced hormonal stimulus concerned with parturition and initiation of lactation as it affects the parathyroid gland (concerned with regulation of calcium in the body) seems to offer a more plausible theory. Milk fever is generally unpredictable and no correlation between diet and its onset has been observed among research men nor practical dairymen.

Acetonemia or “false milk fever” generally occurs within the first six weeks following calving. It does not seem to be associated with the mineral picture at all, but results from a rapid removal of sugar from the cow’s blood and an inability of the cow’s body to fully oxidize fats. Administration of soluble sugars generally relieves the trouble.

The soil type seems to exercise its greatest effect on the roughage portion of the plant. Seeds or grains are little if any altered in composition by this factor alone. Also of considerable interest is the fact that the soil type, or the roughage grown thereon, aside from its vitamin A and D content, has no effect on the composition of milk. Attempts to alter the composition of milk by feeding various conglomerations of minerals have universally failed, although where iodine is added to the diet its increase in the milk is rather striking.

Where soils are low in minerals (phosphorus is usually the element most deficient), the addition of wheat bran to the ration is very
important. Likewise the feeding of 1 to 2 per cent steamed bone meal in the grain ration is recommended. The calcium and phosphorus from these sources even though they are of inorganic nature are readily utilized. Improvement in the soil building program by adequate use of fertilizers, lime, manure, etc., should not be overlooked.

Harvesting—Conserving the Crop.—Irrespective of the above named factors, the nutritive value of roughages depends upon the nutrients conserved during harvesting and storage. Unfortunately, there are many areas and many occasions where it is impossible to make good hay or silage because of weather conditions.

Effect of Rain upon the Composition of Alfalfa Hay

<table>
<thead>
<tr>
<th></th>
<th>Crude Protein</th>
<th>N. F. E.</th>
<th>Crude Fiber</th>
<th>Crude Fat</th>
<th>Ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not rained on</td>
<td>18.71</td>
<td>38.71</td>
<td>26.46</td>
<td>3.94</td>
<td>12.18</td>
</tr>
<tr>
<td>Rained on 1.76&quot;</td>
<td>11.01</td>
<td>33.64</td>
<td>38.83</td>
<td>3.81</td>
<td>12.21</td>
</tr>
</tbody>
</table>

The losses in dry matter and in nutrients are very great in the harvesting of hay under adverse conditions. Rains leach out much of the soluble carbohydrates and proteins. These losses may be as great as 50 per cent in extreme cases. There are also many mechanical factors such as leaf loss which affect the nutritive value. The leaf generally contains from two to three times as much protein, minerals and vitamins as the stem portion of our common forages harvested for hay.

Hay which heats during storage undergoes a terrific loss of nutrients, both the protein and the sugar is reduced, figures indicating that these losses may range from 20 to 75 per cent. In severe cases much of the fat and all of the carotene is destroyed.

Irrespective of how hay is handled much carotene is lost during the curing process (Vitamin D, however, increases because of the action of sunlight). Carotene is also lost progressively while hay is in storage. Old hay nearly always contains less carotene than recently stored hay. Chopped hay loses carotene as well as green color faster than long hay and baled hay retains its carotene content better than loose hay. Preliminary reports indicate that Korean lespedea is richer in carotene and retains this valuable vitamin material longer than alfalfa under storage conditions. The matter of carotene (vitamin A) is of concern in practical animal feeding. The vitamin A content of milk depends directly upon the quantity
of carotene in the feed of the cow. While animals also require vitamin D and exposure to the sunlight increases this vitamin in the roughage, cattle which are exposed to the sun during the summer and as winter weather permits usually obtain sufficient amounts without depending upon the feed as a source.

The use of the silo may reduce losses in conserving forage crops as legumes and grasses may be stored with a loss of only about 10 per cent dry matter.

In summary, it must be emphasized that the quality and nutritive value of roughages are dependent upon a number of interrelated factors. Normally we obtain our best roughages from legumes, grown on fertile soils, cut while as immature as continuance of the stand will permit, harvested with a minimum of leaf loss, and sufficiently cured to prevent heating and molding in storage.

DAIRY RATIONS—MAKING USE OF AVAILABLE FEEDS—NEW FACTS ABOUT SIMPLIFIED RATIONS

A. C. RAGSDALE

A desirable ration for dairy cattle supplies the necessary amounts and kinds of nutrients, is palatable, succulent, slightly laxative and economical.

The available roughages should receive first consideration. Differences in the kind and quality of the roughage influence the amount of protein, mineral constituents, vitamin content, physiological effect and amount consumed. Luxuriant pasture, early cut and properly cured legume hays and silage are the most desirable and economical. Good quality roughages tend to produce more milk and reduce the amount of grain required.

A grain mix is then selected which will best supplement the roughages used to assure a desirable ration. The season of the year, availability of individual feeds and relative costs influence the choice. There is no best feed or combination of feeds and substitutions may be made rather liberally.

Changes in the Rumen

New knowledge of ruminant digestion indicates we are on the verge of important changes in feeding practices. Protein has been a magic word in nutrition studies. Unlike such simple feed ingredients as water or salt, the chemical composition of which is simple and un-varying, protein includes a group of compounds, each complex and varying from the others. We know that at least 22 amino acids, sometimes called the building stones of the proteins, enter into their composition. Some of these are termed essential because they cannot be manufactured (synthesized) in the body and therefore must be supplied in the feed. Some feeds such as milk provide all of the essential amino acids while others such as corn do not. Much has therefore been said about proteins of good and poor quality and in selecting
rations it has been considered important that a variety of high protein feeds be provided to assure an adequate supply and balance of all the essential amino acids.

Most significant of new developments in ruminant nutrition is the discovery that high quality proteins have no special value to the dairy cow or other ruminants and that needed proteins may be synthesized from cheap non-protein nitrogen such as urea and ammonium salts. High quality proteins may be very important to the man who tries to find and buy them, but little of this protein in the form fed to ruminants ever reaches the true stomach.

Why are these things so? In the rumen, bacteria of many kinds, yeast cells and protozoa grow in profusion. These tiny organisms not only help to break down the coarse fibrous and bulky material to the extent of obtaining some 30 per cent of its energy, but they influence in an important way protein and vitamin nutrition. They take the protein material in the feed eaten by the animal and convert it to their own use, altering the high quality proteins and building new proteins from such simple nitrogenous substances as urea and ammonium salts already mentioned. Further along in the digestive tract (true stomach and intestines) these organisms are digested and so the cow gets her protein. Obviously, this peculiarity of ruminant digestion has far reaching implications.

Abundant experimental evidence now exists to show that milk production and well-being of dairy cattle are not dependent in any marked degree upon the kind, quality or variety of protein in the grain ration. A single grain such as corn, when fed with good legume hay, or a simple grain mix such as corn, oats and gluten meal or feed (poor quality protein) will give comparable milk production with a grain mix to which other high protein feeds such as linseed meal, soybean meal, cottonseed meal, etc., have also been added, when fed with simple roughages such as silage and either mixed or legume hays. As this knowledge becomes more widely appreciated, substantial savings may be made by the dairyman utilizing single high protein feeds which may be available and cheapest in price in each locality. This will result in more simple grain mixes.

When good vegetable protein feeds and especially animal and marine proteins are high priced and certainly in times of war and scarcity—this knowledge also permits us to release more of these quality proteins to non-ruminants such as hogs and poultry which do require them. It should also be noted that the rumen in the very young calf is not sufficiently developed that the changes described occur; therefore, calf starters or meals fed to replace milk in the rations of young calves should contain proteins of good quality.

Perhaps after the war we may go even farther as chemical plants are converted to civilian use and urea and other nitrogen compounds become available in quantity. It has been demonstrated that urea may
be substituted for high protein feeds. In Wisconsin trials for example, 15 cows averaging 7855 pounds of 4 per cent milk on a basal ration containing 10 per cent protein, produced 8988 pounds of milk when the protein equivalent was increased to 18 per cent with urea and 9355 pounds when linseed meal was used to make a 18 per cent ration. These latter differences were not considered significant. These workers recommended urea (46 per cent nitrogen) be fed at the rate of 1 per cent of the dry matter in the ration or 3 per cent of the grain mix.

**Vitamins**

Vitamins are not ordinarily a serious problem in the feeding of dairy cattle. At least six of the vitamins of the vitamin B complex and vitamin K are synthesized in the rumen. The vitamin A and D requirements for mature animals are met by the usual roughages (hays and silage) and pasture, although in feeding young calves possible deficiencies of these vitamins should be taken into account. The quality of the roughages is the important factor. Fish oils are the most widely used commercial source of vitamins A and D. Vitamin C is largely destroyed in the rumen but this is not important. There is no evidence to show that vitamin E need be added to the rations of dairy cattle.

**Minerals**

*Salt* must always be supplied.

*Phosphorus* is the mineral most likely to be deficient in the rations of dairy cattle. Supply it especially to cows on pasture, to cows fed largely on legume hays with little or no grain and to cows even when on a full grain ration if the mix contains less than one-third high protein or wheat milled feeds. A special feeding grade of steamed bone meal is recommended. Deflourinated phosphates may be used if guaranteed to contain *less than 0.1 per cent of fluorine*. (Feed at the rate of 1 to 2 per cent of the grain mix).

*Calcium* is rarely deficient when legume or early cut hays are fed and may be supplied by steamed bone meal or finely ground limestone fed as above.

No proof exists that other minerals need be added to dairy rations under Missouri conditions.

**Selecting the Ration**

Observing the simple precautions and recommendations described will ordinarily assure a satisfactory ration. Keep in mind this new knowledge and refer to Missouri Agricultural Experiment Station Circulars 193 and 249 and Agricultural Extension Service Circular 405 for further information on a choice of specific rations suitable for feeding under various conditions.
Examples illustrating the kind of grain mix suited for feeding with various roughages, subject to minor modifications, are:

1. **Non-legume roughages only**:
   - Ground corn, barley or similar carbohydrate feeds ..... 400 lbs.
   - Wheat bran or ground oats ........................ 300 lbs.
   - High protein concentrate .......................... 300 lbs.
   - Steamed bone meal ................................ 20 lbs.
   - Salt ............................................. 15 lbs.

2. **Mixed legume and non-legume roughages or pasture**:
   - Ground corn, barley or similar carbohydrate feeds .... 600 lbs.
   - Wheat bran or ground oats ........................ 250 lbs.
   - High protein concentrate ......................... 150 lbs.
   - Steamed bone meal ................................ 15 lbs.
   - Salt .......................................... 15 lbs.

3. **Legume roughages only**:
   - Ground corn, barley or similar carbohydrate feeds .... 700 lbs.
   - Wheat bran or ground oats ........................ 250 lbs.
   - Medium or high protein concentrate ................. 50 lbs.
   - Steamed bone meal ................................ 10 lbs.
   - Salt ............................................. 15 lbs.

**FEEDING SPRINGING HEIFERS AND DRY COWS**

M. J. REGAN

Heifers over 15 months of age are comparatively easy to care for but should not be neglected. At this age the heifer is growing rapidly and responds to good care and management. Heifers should not be kept fat but rather growing rapidly so as to be sufficiently developed for freshening at the normal age for the breed.

From 10 to 22 months of age the heifer may be fed mostly on roughages, including pasture, legume hay and silage. During the summer months green pastures furnish excellent and well balanced feed for growth. Unless the pasture or roughage is unusually good, however, a little grain feed is recommended. Early spring, during hot, dry weather, and during the fall months when pastures are short, hay and silage in addition to grain should be provided. Heifers over 12 months of age will eat from 5 to 10 pounds of hay daily and from 5 to 15 pounds of silage, the silage replacing some of the hay. Legume hays such as alfalfa, clover, soybean and cowpea, or a mixture of these hays and non-legumes, are excellent for growing heifers. This form of roughage is rich in minerals and vitamins necessary for growth. Roughages are fed free choice and just enough grain supplied to keep the heifers growing well. Three months before freshening feed more grain. Get the heifers in good condition before freshening. At this time in addition to roughage 3 to 5 pounds of grain mixture should be
fed each day. Where plenty of legume roughages and silage are available the following grain mix is desirable.

- Ground corn ..................... 300 lbs.
- Ground oats ..................... 200 lbs.
- Wheat bran ..................... 100 lbs.

Where only non-legume roughages such as corn stover, timothy hay, straw, etc., are available, a grain mixture higher in protein should be fed. In such cases the following ration will be satisfactory:

- Ground corn ..................... 100 lbs.
- Ground oats ..................... 100 lbs.
- Wheat bran ..................... 100 lbs.
- Steamed bone meal ............. 3 lbs.

Age for Breeding Heifers.—The age at which heifers are bred depends upon their growth and development. Jerseys and Guernseys mature somewhat earlier than Holsteins, Brown Swiss or Shorthorns and should usually be bred at 15 to 18 months of age. Holsteins, Brown Swiss and Shorthorn heifers should usually be bred at 17 to 19 months of age. Delay of breeding past the recommended age where a heifer has attained normal development and growth is not usually justified by a sufficient increase in production to warrant the practice. On the other hand, a small weak heifer should not be bred until she has attained approximately normal size. The strain of lactation after a small, weak heifer has freshened usually retards growth to a considerable extent.

The Dry Cow

The amount of milk a cow gives after she calves is influenced greatly by the length of dry period and the condition she is in at calving time. Each cow should be dry 6 to 8 weeks before calving, and fed liberally. The way to turn a cow dry is to quit feeding the milk-producing ration, put her on dry prairie hay or timothy hay, and restrict the water. Quit milking the cow immediately and do not milk her at any time after you decide to turn her dry. The udder will swell up a little until reabsorption takes place, the milk in the udder will then be reabsorbed, the swelling will go down, and the cow will be dry. Then feed from 3 to 8 pounds per day of the following ration, depending on the condition of the cow:

- 60 pounds ground corn ........... 7.5 pounds soybean meal
- 80 pounds ground oats .......... 2.5 pounds bone meal
- 40 pounds wheat bran .......... 2.5 pounds salt
- 7.5 pounds cottonseed meal

Just before freshening, the cow should be fed on a bran mash instead of the grain ration and this mash should also be fed for two to three days after freshening or until the inflammation and swelling
has gone out of the udder. In some cases this may be longer than the two or three days after freshening. Then gradually return to the regular dairy ration.

FITTING THE DAIRY PROGRAM TO THE INDIVIDUAL FARM

M. J. REGAN and B. H. FRAME

Dairy farm management is farm management applied to a farm on which the production of dairy products is the main project. Farm management on any kind of farm consists in utilizing the available resources of land, labor and capital to produce the greatest net income. This always requires more or less adjusting of the various resources to a complete pattern which may leave some particular resource less fully utilized than it might be, but which aims at producing a larger net income than any other possible pattern. The actual story of a Camden County farm illustrates how the factors of production have been put together into a pattern which increased the net income from $795.00 to $2375.00 in a 4-year period during which there was little change in the general price level.

Land and its utilization may be taken as the basic factor which cannot be as easily adjusted as the other factors. Therefore, the owner of the above farm started with the physical factor of his farm. Out of 390 acres of land, only 82 acres were judged to be fit for cultivation, none of which could be row-cropped. Besides the 82 acres of crop land, 75 acres were available for permanent pasture, and 115 acres would eventually be available as timber pasture. An actual re-arrangement of what had been 19 fields produced 5 fields besides a garden plot and orchard. It was decided that these 82 acres, with the other pasture available, could with the proper crop system and soil management be made to produce sufficient pasture and roughage and part of the grain required for 20 dairy cows. Only 11 cows had previously been kept.

Pasture was considered of primary importance so that the new system was planned to produce pasture for all his livestock needs as many months of the year as possible. Before the change was made, sufficient pasture was produced only during April, May, and June. The new system met his pasture needs during all but three months, January, February, and March. In fact, during most of these 9 months, the excess of pasture over needs furnished a comfortable margin of safety.

Good dairy farm management does not necessarily mean the elimination of other livestock enterprises. The above farm has, during the entire reconstruction period, largely supported a good flock of poultry, about 30 head of ewes, and various numbers of hogs. At the beginning of 1943, besides 21 milk cows and 11 yearling heifers, there were 6 head of beef cattle, 10 sows (more than usual number on account of the war-time need for meat), 27 ewes and 50 goats.
This was much more than the number of livestock planned so that $2015.00 worth of feed was purchased and used. The original plans called for the purchase of some of the grain and concentrates needed. Although the records for 1942 and 1943 have not been fully analyzed, a rough calculation shows the net income during these 2 years to have averaged about $2800.00. However, since the price levels of farm products has been higher these 2 years than for the 4 years previous, not all this increase can be attributed to increased returns due to management.

But, how has this farmer adjusted his labor supply to this new system? Mainly by replanning the physical layout of the farm and by revising his cropping system to reduce the labor requirements per unit of output. In 1942 and 1943, his average hired labor bill was only $77.00 per year aside from labor hired to build a new dairy barn erected in 1942. Besides the labor of himself and wife, the home labor supply consists of a 15 year old daughter (1943), an 11 year old son and a 9 year old daughter.

A PLANNED BREEDING PROGRAM—SIRES—ARTIFICIAL BREEDING

H. A. HERMAN

The success of a herd building program depends upon the dairyman's ideas concerning the producing ability and conformation of the animals he desires to eventually make up his herd. Therefore, sound ideas concerning production and type are a prima requisite on the part of the breeder in establishing a breeding program. Far too many dairymen do not have a definite goal and thus do not follow a particular plan in their breeding operations. Some goal, even though it may be simply to have a 300 pound fat average or a 400 pound fat average, etc., is better than just following random methods. The adoption and following of a constructive breeding program and the practice of feeding and management methods which permit favorable development of the animals is absolutely essential in attaining this goal.

Dairy cattle produce milk and butterfat in accord with their inherited ability and the environment in which they work.

The breeder can influence the inherited characters of the animal in his herd only by the practice of selection and mating systems which tend to increase or decrease certain characters. Selection is one of the oldest and most valued breeding methods used.

The successful operation of a breeding program depends upon complete and accurate records of milk and butterfat production, breeding efficiency, progeny, and length of life of each animal. With-
out records the dairy breeder is at a loss in the intelligent culling of his herd. Therefore, the keeping of complete herd records and the adoption of some form of production testing such as Dairy Herd Improvement Association, Herd Improvement Registry, Advanced Registry, etc., is of first importance. A breeder must also have a herd free of disease so that the results of his breeding program may be realized.

Almost every herd has a few cows, often in advanced age, that have produced consistently year after year and calved regularly, so that two or three generations of their offspring are in the herd. Often it is from these cows that a start may be made without going to the expense of buying new stock. In general the process of improving a herd by breeding will come from the saving of offspring from a meritorious sire and carefully selected dams whose ability as "brood cows" has been demonstrated by their offspring.

The greatest problem of most breeders is to select sires which will continue to improve the herd production. The safest sire to use is the one which has demonstrated his transmitting ability as measured by the performance of his progeny at the pail (at least five daughters from different dams tested for milk and butterfat production). A good measure of a successful sire is his ability to sire daughters which produce higher than their dams and above the general breed and herd average when handled under comparable conditions. The proved sire offers the safer plan for insuring herd improvement, but unfortunately only a few such sires are available and many of these are too high in price for the breeder with a small herd.

Where a proved sire is not available and the majority of the sires selected must of necessity be unproved, the following plan of selection is found to be most satisfactory in the long run: First, select only the son of a good proved sire and out of a dam whose sire is proved and which not only has a good record herself but preferably has two or more production tested daughters that are of acceptable type. In selecting a sire by pedigree, particular attention should be focused on the first three generations. The productive ability of all the ancestors and all their offspring should be carefully noted.

"Cattle are bred in the barnyard", and the most inspiring pedigree combinations come to naught unless the breeder has a well defined goal as well as ability and long time knowledge of the cattle being mated.

An investment in a better herd sire today will pay large dividends in a more economically producing herd two or three years from now. Should the war be prolonged such a sire may contribute to the immediate war effort.
The pedigree of a recently selected young sire in the University of Missouri herd illustrates these principles:

**PEDIGREE of KANOWA MINERVA POSCH ORMSBY**

**SIRE**

**MAN-O-WAR**

- 59th
- 619004
- 434047
- 41 ARSO Dtrs. Ave: 354345
- Milk 21366#; Fat 749.5#;
- Days 303; Age 4-2;
- M.E. 700# fat

**DAM**

**KANOWA MINERVA POSCH DUCH.**

- Has ARSO Rec. of: 168445
- CL Days Age Milk Fat M.E.
- B 355 3-2 19177 634.6 774
- B 355 4-7 21294 811.6 877
- C 305 6-11 18783 574.7 833
- 3 ARSO Dtrs; 4 reeda.) Ave: 169445
- Milk 12,954#; Fat 484.4#;
- Days 320; Age 3-6; Test 3.6% M.E. 818# fat, Cl. B.

**SIR PIET ORMSBY MER.**

- 37th
- 64 ARSO Dtrs. Ave: 110160
- Milk 20,412#; Fat 728.0#;
- Days 349; Age 4-9;
- M.E. 738# fat

**MAN-O-WAR 59th**

- 619004
- 434047
- 41 ARSO Dtrs. Ave:
- Milk 21366#; Fat 749.5#;
- Days 303; Age 4-2;
- M.E. 700# fat

**GRAH. COL. KAREN SEGIS**

- ARSO Rec. Cl. B. 429975
- Milk 25,903#; Fat 877.0#;
- Days 365; Age 3-6;
- M.E. 763# fat, Cl. B.
- Has 1 proved son, to left.

**KAREN SEGIS OF GRAMHOLM**

- ARSO Record: 157470
- Milk 19,146#; Fat 690#;
- Days 365; Age 6-2;
- M.E. 704# fat, Cl. B.

**DUKE PIET ORMSBY MER.**

- 15th
- 25 ARSO Dtrs. Ave: 138441
- Milk 17,635#; Fat 807#;
- Days 337; Age 4-3;
- M.E. 706# fat, Cl. B.
- Has 12 AR sons & 16 dtrs. with AR progeny.

**BADGER PONTIAC KORNDYKE**

- Has “old style” 353513
- AR record of:
- Milk 469.2#; Fat 17.8#;
- Days 7; Age 6-11

**HAZELWOOD MER. POSCH ORMSBY**

- 15 ARSO Dtrs. Ave: 156495
- Milk 15,686#; Fat 561#;
- Days 315; Age 4-0;
- M.E. 753# fat, Cl. B.

**KANOWA MINERVA POSCH ORMSBY**

- 819975
- Has 1 ARSO Dtr. with M.E. of 793# fat, to left.
Artificial Breeding

The idea of impregnating animals artificially is not new. Spallanzani (1780) is reported to have used artificial breeding on the dog, and records further indicate that centuries ago the Arabs were using artificial insemination in breeding their horses. It is only since the First World War, however, that improved techniques in collection (artificial vagina), storage, transportation and utilization of bull semen have made this method of breeding dairy cows practical on a much larger scale than formerly.

Advantages of artificial insemination:

1. The usefulness of superior sires may be increased many-fold. A proved sire with ability to transmit characters for high milk and butterfat production may be used to breed several hundred cows annually. Where cooperative breeding organizations are formed, the use of such bulls may be extended to a large number of dairy herds.

2. Owners of small herds who would of necessity have to buy a bull (often of mediocre breeding) within their means may dispense with the keeping of a bull and through the use of artificial insemination participate in the use of a bull of outstanding merit at a lower cost.

3. The transmitting ability of a bull may be determined quickly and effectively. Young unproved bulls should be used sparingly until their transmitting ability has been demonstrated. Where sires are used cooperatively this is easily accomplished and no one dairyman will have more than a few daughters of such a bull in his herd.

4. The danger of spreading genital diseases (such as trichomonads) is materially reduced.

5. Valuable sires, which because of injury are unable to serve cows, may be continued in service.

6. Yearling heifers and small cows may be bred to large heavy bulls without danger of injury.

7. Because of the regular examination of the semen, infertile bulls are detected sooner than with natural breeding. Likewise, abnormalities of the cow's genital tract which may lead to shy breeding may be discovered earlier.

8. In most cases more accurate breeding and calving records may be kept. This is particularly true in organized breeding units where one man is responsible for these records.

9. Linebreeding and the development of certain large families of superior dairy cattle within a community is made possible.

10. Outstanding individuals, although located hundreds of miles apart, may be mated.

11. The participation in a breeding program and the study of breeding problems by a large number of cooperating dairy farmers should bring forth the best community spirit for the advancement of the dairy cattle industry.
Some disadvantages of artificial insemination—there are certain disadvantages connected with artificial insemination of dairy cattle which should be recognized by any person planning the use of this method.

1. Successful artificial insemination requires a well trained operator and special equipment.

2. It requires somewhat more time than natural service, which tends to limit its use to large herds or well organized cooperative projects.

3. All equipment and instruments used must be clean in order to prevent the spread of infection. Therefore, proper facilities for cleaning instruments must be available.

4. The extended use of sires by this method may result in fewer purchases of bulls by breeders of small herds and breeding establishments may consequently suffer loss of income.

The technique of the artificial breeding of dairy cows, including semen collection, storage, shipping, and the insemination of the female has been thoroughly investigated at this Station and full details are described in Missouri Agricultural Experiment Station Bulletin 407.

RAPID MILKING
C. W. TURNER

Milk rapidly, get more milk, by having the cow help you and save time, at least a minute per cow each milking, often more.

As the result of experimental work conducted at the Missouri Station, we have advocated the merits of milking cows more rapidly for some years. Now war-time labor shortages have encouraged increasing numbers of dairymen to turn to this method. Cows can actually be milked in less time than was thought possible; they are getting as much or more milk and fat, the udders are just as healthy.

Representatives of the milking machine companies are to be congratulated on the educational program which they are carrying on in this connection. However, whether one has a milking machine or milks by hand, the advantages of rapid milking are the same.

The steps in rapid milking may be outlined as follows:

1. Massage the cow's udder in the process of washing it with warm water. This causes release of the hormone which prepares the cow for milking.

2. Start milking about one minute later. The milk will now be available for rapid removal. The milk should be removed in 3 to 4 minutes. If milking by machine, strip the cow by pulling down on the teat cups with one hand while massaging the udder with the other hand. Some cows may require hand stripping after the machine is removed. Strip rapidly.
3. Stop milking or remove the machine as soon as the milk stops flowing.

To understand why rapid milking is better than slow milking, the process going on in the cow at this time should be understood. It is now known that all the milk is present in the udder at milking time. None is secreted during milking. At the time the cow's udder is washed off with warm water preparatory to milking, a hormone is discharged into the blood which causes the muscles of the udder to contract, forcing the milk down into the cistern of each quarter. The milk pressure reaches a maximum in about one minute and at that time the milk can be removed very rapidly from the udder. Soon the hormone in the blood becomes inactivated, the muscle cells relax, and the milk pressure declines. If the milk removal is not completed, the milk in the finer ducts and alveoli will not be obtained at that milking. This explains the need of speed in removing the milk while the milk pressure in the udder is at a maximum.

If rapid milking is practiced, cows will become accustomed to this process and will develop good milking habits. This is especially true of heifers. It is possible that a few cows which have developed slow milking habits will not respond to the rapid milking program. Their elimination from the herd at the first opportunity is suggested.

KEEPING THE HERD HEALTHY—REDUCE CALF LOSSES—A SANITATION PROGRAM
H. A. HERMAN

The successful dairyman is ever on the alert and follows a program of management which prevents livestock losses. He well knows the old adage "an ounce of prevention is worth a pound of cure" and would rather pay his veterinarian to help him keep the herd healthy than to treat the sick animals.

I. Important Factors in Maintaining Herd Health

1. Be a good caretaker—the human equation, or the personal efforts of a herd manager in observing and handling the animals in his care, is often the difference between success and failure. The good herdsman is constantly on the lookout for such conditions as the cow off feed, showing a rough coat, failing in milk production, failing to settle, not chewing her cud, droppings of wrong consistency, bloated appearance, a hard quarter, irregular breathing, physical injuries, signs of aborting, etc. Unfortunately some men are simply not endowed with the "cow sense" to quickly detect an animal which is not up to par. Experience, however, can be a very dear teacher.

2. Adequate housing and isolation quarters—most of the ailments of dairy cattle, whether diseases or of the physical injury type, can be lessened by adequate and properly arranged housing
facilities. This does not mean elaborate and fancy barns but that the cows must be comfortably housed. Overcrowding is to be avoided. Stall platforms and stanchions must fit the cow. Slick floors, unusually deep gutters, high barn door sills, etc., are all hazards.

The barn must be well lighted and ventilated, adequately drained and easily disinfected. Manure should be disposed of daily and not piled where cattle have access to it.

There must be sufficient maternity pens to permit each cow to calve and clean up before being returned to the herd. There must also be isolation quarters for the diseased animals so that they may not endanger the remainder of the herd—preferably located so far away from the main herd that the hired man is too tired to go there.

3. Regular testing for T. B., Bang's disease, etc.—regular testing of the herd for disease must be a part of the good dairyman's religion. At least once a year for T. B., twice or three times a year for reactors to the blood test for Bang's disease, if no trouble is being experienced. If the herd is infected with Bang's disease, a test every 30 to 60 days and prompt isolation or disposal of reactors is necessary.

Mastitis takes a heavy toll in the milking herd, but medicinal treatment, generally, is the wrong approach. A constant watch must be maintained to detect abnormal milk, bruised quarters, inflammation, etc. The use of the strip cup and occasionally the Hotis test, plus an everlasting watch on the physical condition, will enable the dairyman to guard against mastitis. If mastitis does occur, the infected animal should be isolated and given proper veterinary attention.

Breeding troubles and particularly trichomoniasis and vaginitis cause great loss of milk and in some cases valuable cattle. Care and caution should be exercised in adding old bulls to the herd. The keeping of complete breeding records, including heat dates, keeping on the alert for cows which return some 65 to 120 days after breeding will aid in detecting these breeding troubles early and proper treatment may be inaugurated immediately.

4. Sane feeding and management—our dairy cattle are being constantly improved for milk and butterfat production. Judgment and care in keeping the herd healthy are closely associated with management. Some pertinent factors are:

A. Good feeding practices—plenty of pasture and succulent feeds.
B. Keep the cows out of doors when the weather permits—at least get cows out a little while every sunshiny day in winter.
C. Avoid long confinement periods in box stalls. Give the pregnant cow exercise even though she is close to term.
D. Provide adequate space per cow for feed bunks, etc. Keep and feed separately all undersized and weak cows. Preferably de-horn all cows.
E. Provide safe, clean water. Don’t drain the barnyard into the pond.

F. Keep the bull separate. Provide him with a comfortable shed and about an acre of good pasture.

G. Keep fences in repair and avoid “break-outs”, etc., which inevitably occur when feed is short or cattle are dissatisfied, with the resultant cut teats, etc.

H. Exercise caution in pasturing such crops as sudan, clovers and alfalfa until it is certain they are safe and prussic acid poisoning or bloat does not occur. Send the cows out to graze the first time with a full paunch of dry feed and these crops cause little trouble.

I. Foreign bodies—too many good cattle die every year from “hardware”. Pick up nails, bits of wire, etc., and dispose of them in a safe place. Don’t use old wire to stop ditches in meadows and pastures. Construct grain bins, truck beds, etc., so the nails are not pulling out into the feed.

J. Beware of poisonous paints on fences and buildings. Cattle will lick lead paints with fatal results. Non-poisonous paints are available.

5. Sanitation—disinfecting the barn and premises.—The aim of every dairyman should be to prevent disease by an adequate system of sanitation.

Properly constructed (concrete floors, etc.) barns may be cleaned and disinfected. Every outbreak of infectious disease is caused by living germs.

Sunlight is a good destroyer of germs, but dark barns and dirt and filth escape the sun’s rays. Cleaning is an important part of disinfection. Animals kept in contact with manure and filth are less apt to escape disease. Disinfectants cannot substitute for careful cleaning. In choosing a disinfectant, consult your veterinarian or agricultural college. A disinfectant that kills one type of germ may be worthless for another. One of the most economical and effective disinfectants we have is made up of one 13 ounce can of lye dissolved in 15 gallons of hot water. Lye destroys many germs but is not effective for T. B. organisms.

Whitewash and paint are effective in disinfecting properly cleaned walls. Lime or superphosphate on the clean floors kills some germs and reduces odors and is a part of the sanitation program on every well managed dairy farm.

Proper drainage, fencing off of swampy areas, etc., is a part of any sanitation program. Prompt isolation of all diseased animals as described in part II is the keynote of an adequate sanitation program.

II. Reducing Calf Losses

The feeding and management of the dairy calf is fully described in Missouri Agricultural Experiment Station Bulletin 377, but there
are a few pertinent points in successful calf raising that may well be emphasized here:

1. Give the calf a clean safe start by placing every cow, before calving time, in a well cleaned, disinfected maternity pen. Use fresh clean bedding. Clean up the pen between cows. Make a fresh bed daily.

2. When the calf is born, wipe it dry and disinfect the navel with tincture of iodine immediately.

3. Before the calf nurses the first time, thoroughly wash the cow's udder and hind quarters with soap and water and wipe dry. Then go over the udder and hind parts with a cloth dipped in chlorine solution (about 200 to 400 parts available chlorine per million). This is very important and prevents the calf getting an infection before it has any resistance built up.

4. See that the calf receives the colostrum or first milk. This first milk contains antibodies which give the calf immunity against disease. It also contains from 30 to 100 times more vitamin A than normal milk. It protects and fortifies the calf as nothing else can do.

5. Follow proper milk feeding methods and avoid overfeeding. "A hungry calf is a live calf." Common scours are controlled by proper feeding and management. If white scours are prevalent the only solution is to take the calf to clean quarters the moment it is born. A better plan is to have the calf born in a barn where white scours have not made their appearance. In the summer months a small separate pasture is an excellent place for cows to calve. No medicines are generally effective in curing white scours and even if the calf survives it is generally greatly retarded in development.

6. Keep the calf in a well bedded pen free of drafts. Dry cold does not seem to hurt a calf but drafts, dampness, etc., generally lead to pneumonia. Sick calves should be isolated from the calf herd promptly. This applies even to common scours, which may be the forerunner of something worse.

HERD RECORDS FOR THE DAIRY FARMER
H. A. HERMAN

Complete records on the dairy herd provide the key for most efficient management. Without some form of record keeping, dairying is largely a matter of guesswork. The value of records may be more fully realized by calling attention to the following points:

1. The detecting of unprofitable cows by keeping milk and butter-fat records and the cost of feed is the first step in building up a profitable dairy herd. 2. The selection of cattle in the herd for improved production is based largely upon the results of records. 3. The herd sire is "proved". Costly mistakes may be reduced if the bull is a poor transmitter. 4. Better feeding and milking practices are stimulated. 5. The sale value of tested animals and their offspring
is materially increased. 6. Records interest the family and the hired man.

The most important records to keep are production records, feed records, breeding and calving records, health records, and sales records. Some breeders, particularly those raising cattle for sale, will find it advantageous to keep growth records. Irrespective of others, records of milk and butterfat production are the most important for all dairy farmers to keep.

Milk and butterfat records.—The chief reason for keeping accurate records of milk and butterfat production is to enable the dairyman to discard his unprofitable cows. In addition, offspring from the higher producing cows may be retained for replacements, thereby contributing to a general increase in the production level of the herd. Cows differ widely in their producing ability.

Milkers often believe they can tell a good producer from a poor one without keeping records but this certainly has not proved to be true. We are all likely to remember the day a cow milked 40 lbs., but it is the yearly production of a cow that determines her worth. Herd records show that the cow which milks at a consistent level, even though in moderate amounts, throughout the year is usually more profitable than the cow that produces unusually large amounts for only a few months.

The keeping of milk weights serves as a guide for feeding grain. Feeding by guess is poor management and not only is it uneconomical, but the really good cows are usually underfed. By the use of a milk sheet, a feed chart can be made up at regular intervals and the amount of feed given each cow based upon her production. Some dairymen do not like to keep daily milk weights because of the labor involved, and depend upon monthly weighings of the milk. For all practical purposes, as our Dairy Herd Improvement Association and our Herd Improvement Register tests on purebreds well demonstrate, this system is satisfactory. The man who goes to the trouble of keeping daily milk weights, however, receives his reward. For one thing, the feeding program for each cow may be more closely regulated. This is an important factor where real efficiency is desired.

The best way for a dairyman to obtain production records is through some form of organized testing. For the man with a strictly commercial herd, where the sale of breeding stock is of little consequence, the Dairy Herd Improvement Association provides a most economical means of obtaining accurate production, feeding and breeding records. The cost of obtaining such records, kept of course by a disinterested party, is usually less than four dollars per cow per year. It is a service which pays for itself many times over. Often the elimination of a few unprofitable or "boarder" cows saves enough feed and labor to more than pay the costs of obtaining records on the entire herd.
The breeder of purebred cattle will probably find it best to follow some form of official testing as well as Dairy Herd Improvement Association testing. The Herd Improvement Register test, a part of the Advanced Register of the purebred associations, is an excellent test for the average progressive breeder.

Sales history indicates that production records do contribute to the selling price of cattle and their offspring. C. M. Cummings of the American Guernsey Cattle Club found that during the year of 1936 some 1525 Guernsey females were sold at public auction at an average price of $298.39. Four hundred and fifty of these cows, however, had Advanced Register records and averaged $372.55. Six hundred and fifty head, with no records and out of untested dams, average only $218.93 per head. The additional selling price because of the records thus amounted to over $150. Guernsey bulls over 2 years of age and out of Advanced Register dams averaged $430.00 each. Bulls over 2 years old, with no daughters in the Advanced Register and not out of an Advanced Register dam, averaged only $82.50. Bulls under 2 years of age from tested dams averaged $257.71; while those from dams with no Advanced Register records averaged $95.21. Similar studies show a parallel condition existing in other breeds.

Feed Records.—To determine the profit made by a cow, feed costs must be kept. Usually feed costs represent about half the cost of production. Feed records are kept as a part of the information in the Dairy Herd Improvement Association and are easily interpreted. The efficient dairyman should check his feed records often since the expenditures along this line so directly affect his net profits.

Breeding and Calving Records.—These are highly essential and must be kept in order to manage the herd effectively. Cows should be bred so as to calve according to demands for milk, and also in case of official testing, to qualify for certain Advanced Register classes. Unless the exact breeding date is known some cows will be milked too long while others will be dried up too soon.

Breeding and calving records are invaluable in detecting the slow breeder or sterile cow. They are also a most important part of the information necessary for registering and transferring purebreds.

Health Records.—Records of all tuberculosis, Bang’s disease, mastitis and other tests should be kept in a permanent form. As a rule a complete health record may be kept on each cow by simply using a card and a filing system for each animal in the herd. These records may also be kept as a part of the breeding and calving records. The two sets of records supplement each other to a marked advantage.

Sales Records.—Records of each sale transaction are valuable for future reference and also provide a directory of persons who might be interested in further purchases. Disputes and errors are often avoided by accurate sales records. The purebred business is, of course, founded on the reputation and reliability of the breeders concerned and the safeguarding of a breeder’s integrity is greatly assisted by
proper records.

From the standpoint of sales, adequate and accurate records create confidence on the part of the buyer and seller as well. Nothing is so disastrous in a purebred livestock sale as mistakes and errors which leave the identity of the animal in doubt. Likewise, breeding and calving information as well as production records are of the utmost value in all sales transactions.

How May Permanent Records be Kept?—There are three general ways of preserving permanent records. Individual preference and conditions will determine which is best suited in each case. These three general methods are (1) a permanent herd record book, (2) loose leaf books, cards or files; and (3) envelopes.

The necessary forms for keeping permanent herd records can be procured from the leading dairy breed associations, farm magazines dealing with dairying, and the various agricultural colleges.

HERD REPLACEMENT PROBLEMS

E. T. ITSCHNER

Need for replacements:
1. Aged animals.
2. Animal lost from disease.
3. Low producing cows.
4. In addition it may be said the herd growth in size and efficiency is largely dependent on the herd replacements.

Normal turnover: The average life of a cow in the milking herd is about five years. In order to maintain itself, a herd of 20 cows should bring four heifers into milk annually. Normally the herd will produce about 18 calves, of which 9 should be heifers. This permits culling of heifers more or less severely as conditions indicate.

Sources of replacements:
1. Purchase.
2. Bred and raised on the farm.
3. Farmed-out plan.

Advantages of raising replacements:
1. Purchase of cows is expensive.
2. There is danger of introducing disease through purchased animals.
3. There is no assurance of high production, even if top prices are paid.
4. A breeding program is essential to high herd efficiency.
5. To build production and type you must produce your own as there is no other safe, reliable and practical source.

Disadvantages of raising replacements:
1. Young stock complicates farm management.
2. When milk and feed is high priced, considerable expense is involved in raising heifers.

3. Additional feeds are required for calf raising. However, most of feed expense is for feeds that can be produced at home.

Practical and progressive dairymen should produce own replacements: The advantage of raising herd replacements far outweigh the disadvantages for the average dairy farmer. In special cases, if the dairymen is content with average or lower herd efficiency, it may be advisable to buy replacements, yet even in those cases the problem of disease must be dealt with. Experience has indicated that from a practical standpoint, there is no substitute for raising replacements on the farm for the average dairymen.

Farmed-out plan: In some cases a dairymen or a group of dairymen may find it advisable and profitable to arrange for young stock to be raised on a near-by specialized farm, set up for that purpose. This would enable the herd owner to carry on a breeding program and not be bothered with the young stock.

Such specialized farms have not seemed to survive in enough cases to be an important factor at this time. They are, however, a possibility. Much skill and care are needed in the production of young stock to insure good growth and disease-free replacements.

Important points in producing replacements: A breeding program should be adopted:

1. Use best herd sire possible.
2. Select heifers to be raised from best cows. Both sides of family are important.

The feeding and management of young stock should aim at:

1. Normal growth.
2. Freedom from disease.
3. Proper handling to develop a tractable animal.
4. Breeding at proper age to a good sire.

Grade herds: By the use of purebred bulls of one dairy breed and the selection of heifers from the best cows, marked improvement is possible in grade herds.

A beef bull is often used in grade herds as a "cow freshener", with the idea that calves will be more valuable. This is not recommended. A dairymen's business is to produce milk and dairy animals, not beef. Especially in times of high prices and scarce milk a dairymen should not raise any more young stock than is required for his herd replacements and breeding program. There is often the temptation to keep heifers of a good cow from beef bulls, hoping the heifer will milk like her mother. This is a poor gamble at best. When a beef bull is used there is no future in the dairy business.

Small herds: In small herds the cost of a good bull and his keep is often a considerable item. There is still little hope for improvement unless a breeding program is followed and heifers produced.
Artificial breeding offers a new outlook for such small dairy herds and its advantages are summarized elsewhere in this publication.

Why dairy plants are interested in herd replacements: Present high prices for dairy products have influenced many marginal dairy farmers to go into milk production. On the basis of such an increased supply plants have expanded and some new plants are being set up.

What will happen if and when dairying becomes relatively less profitable than beef or some other enterprise?

If the herds have been developed into efficient dairy herds with good producing dairy animals, the enterprise may be able to survive adverse conditions. However, if the dairymen and the industry are content with herds of low efficiency and high cost, with the use of beef bulls and common cows, with poor methods and poor returns, then when that time comes, and it may come, the source of supply may quickly disappear. Dairy plant operators can well afford to encourage farmers in a good breeding program. In fact, they should offer every service and inducement toward:

1. The use of good dairy bulls.
2. Artificial breeding service.
3. Raising of young stock as replacements that will insure the continuance of a dairy herd of increasing efficiency and profit.

WHY QUALITY MILK AND MILK PRODUCTS ARE IMPORTANT

W. H. E. Reid

The entire dairy industry is in a very enviable position as relates to quality and quantity of milk and milk products.

During the past three years the National Nutrition Committee has classified all types of foods as to their nutritional values. Milk and milk products are now classified among the seven basic foods available for men and women in service and for our civilian population. Such a classification is invaluable to the dairy industry and places a greater obligation upon all individuals who are concerned directly or indirectly in the production of milk and cream and the manufacture and merchandising of milk products.

Millions of pounds of evaporated and condensed milk, butter, cheese, dehydrated whole milk, defatted milk solids and dehydrated ice cream mix have been and continue to be shipped to every part of the globe where allied forces are participating in this war. These milk products are served daily to men and women behind the fighting lines and are also an important part of the rations carried by men on actual fighting fronts. Letters received from large numbers of men tell of the carrying milk products which they carry in their packs as they move forward into actual battle. If these milk products did not contain those important nutrition elements so necessary to sustain life under the most trying conditions known to men they would not be included. The quality of the milk products which the men and women in our fighting forces receives is causing them to formulate a favorable or
unfavorable opinion of milk products. In most instances the opinion formed has been favorable. However, in other instances the quality of milk products has been questionable due perhaps to lack of refrigeration or improper care of the products. The quality of original milk and cream from which these milk products was manufactured reflects directly on quality of these products when they arrive at their destination.

The civilian consumption of milk and milk products has shown a gradual increase each month since we entered the war. The volume of milk and milk products consumed would have shown even a greater increase had it not been for the restrictions placed upon these products by our governmental agencies so as to assure an ample supply for lend-lease and for our armed forces.

Millions of individuals, who prior to the war, did not appreciate the nutritional value of milk and milk products are now daily consumers of these products. These additional consumers in addition to our armed forces and our allies have issued a tremendous challenge to the dairy industry of this nation. That challenge is to produce and manufacture a larger volume of milk and milk products.

The underlying fundamentals which make it possible to meet this challenge are briefly these:

1. The application of sound, practical and sanitary methods in producing milk and cream on the farm.
2. Thorough cleansing and efficient sterilization of all equipment and utensils used in producing milk at the farm.
3. Rapid and efficient cooling of all milk and cream at the farm.
4. Quick delivery of milk to the plant or some central point.
5. Delivery of cream to a creamery or cream station at least three times each week and more often where practical.
6. Protect milk and cream while in transit from farm to plant against contamination, dust, heat or extreme cold by use of tarpaulin or wet sacks made for that purpose. Insulated and tight body trucks may be used when transporting large volumes of milk or cream.
7. Furnish adequate and sanitary conditions to protect milk and cream at the manufacturing plant, cream or milk station.

The application of these fundamental methods will help to assure an adequate supply of high quality milk and milk products for men and women in our armed forces and for the civilian front.

The responsibility of doing this job in an efficient and satisfactory manner rests with our fieldmen, territory superintendents and the managers or executives of our milk and milk products plants who should not only carry this message to each individual producer of milk and cream but should also apply the necessary methods to carefully protect the milk and cream after it leaves the farm and until it reaches the ultimate consumer.
PRODUCING QUALITY MILK AND CREAM—ESSENTIALS
E. R. GARRISON

The buildings and equipment required for the production of quality milk and cream are reasonably inexpensive and the essential operations are comparatively simple. Good milk can be produced by any person with practical dairy experience and willingness to give careful attention to the necessary details.

Towns and cities in Missouri, especially those of 10,000 or more persons, have quite generally adopted the U. S. Public Health Service Milk Ordinance (Public Health Bulletin 220, U. S. Public Health Service, Washington, D. C.) which specifies in detail the conditions necessary for the production and care of milk to be used as fluid milk or cream. Similar regulations have been adopted jointly by the State Board of Health (Milk Regulation Book V, Part VII, 1940) and the State Department of Agriculture (Milk Regulation, Volume 38, No. 8, 1940).

The program here outlined sets forth the important requirements or essentials for the production of quality milk, which should be complied with on all farms producing milk and cream for sale. These somewhat less stringent standards are permitted where the milk or cream is sold to a processing plant but the program should always be pointed toward the public health ordinance requirements referred to above.

Healthy, Clean, Properly Fed Cows

Health.—Keep only healthy cows. Test annually for tuberculosis unless in modified accredited county. Semiannual testing for Bang's disease is recommended with 60 to 90 day retests in infected herds. Use approved tests for mastitis. Discard all abnormal milk.

Cleanliness.—Cow's body clean when milked—brushed daily. Flanks, udder and teats washed clean and wiped dry before each milking.

Feeding.—Remove cows from pastures, that impart off-flavors to milk, several hours before milking. Grain may be fed at milking time; feed hay and succulent feeds after milking. Discard milk with pronounced weed or feed flavor.

Clean Milking Barn and Cow Yard

Floor.—Construction of concrete or other impervious material is recommended—must be kept reasonably clean and dry.

Walls and ceiling.—Must be reasonably smooth and clean. White-washing at least once each year or painting not less than every second year is desirable. Ceiling should be tight if feed is stored above.
Light and ventilation.—Window space should be sufficient to adequately light all portions of the floor, with artificial light for night milking. Provide sufficient ventilation to remove odors and keep barn dry.

Cow yard.—Graded sufficiently to facilitate drainage. A concrete or gravel approach to barn doors is desirable. Should be maintained in a clean condition, with no manure or trash piles. The cow droppings should be removed frequently.

Manure disposal.—Manure should be removed daily from barn and stored where it is not accessible to cows. During warm weather manure should be handled so it will not provide a place for fly breeding.

Milk House

A milk house or milk room should be provided with floor construction of concrete or other impervious material, graded for proper drainage. It should have smooth walls and ceiling, be well lighted and ventilated and effectively screened.

Toilet Facilities

A conveniently located, sanitary type toilet is desirable.

Adequate Supply of Safe Water

Sanitary quality.—No contamination from surface drainage. Deep well water is desirable.

Accessibility.—Easily available in adequate volume where needed.

Clean Sterile Utensils

Construction.—Smooth, rounded surfaces with flush seams and joints. Small mouth milk pails are recommended. All utensils should be kept in good repair—no rusted spots, dented areas or broken solder joints.

Cleanliness.—Utensils should be thoroughly washed after each usage—no milkstone deposits. If a milking machine is used, it should be properly cleansed and sterilized.

Sterilization.—Utensils should be given adequate exposure to hot air, steam, hot water or chlorine solution, and rinsed with chlorine solution or hot water just before being used.

Storage.—Inverted on a rack in a place protected from contamination.

Healthy, Clean Milkers

Health.—Free from communicable diseases.

Cleanliness.—Outer garments reasonably clean while handling milk.

Hands should be washed at beginning of milking and thereafter when necessary, preferably after milking each cow. Milking should be done with dry hands.
Care of Milk

Handling.—Milk containers must be covered while standing in barn. Precautions should be taken to prevent contamination—no exposure to flies, dust or odors.

Straining.—Straining should be done in a protected place. Use single service cotton disc filter.

Cooling.—Cool milk immediately after milking to 65°F or lower—use sufficient water to obtain prompt cooling. Mechanical refrigeration is desirable. Hold milk at 65°F or below until delivered.

Delivery.—Protect milk from dust and high or low temperatures during transit to the plant—truck with enclosed body is desirable.

Additional Requirements for Producing Cream

Separation of Milk.—Locate separator in a clean, dry place that is free from dust, flies and odors.
Complete disassemble bowl, wash and sterilize all parts after each usage.
Spread out parts on a protected shelf to dry.
Set milk or cream screw to obtain cream testing 35 to 40 per cent fat.
Separate as soon as possible after milking is completed.

Cooling and Storing Cream.—Use only approved containers for cream (easily cleaned, no exposed copper, free from rust, not granite or enamel).
Cool freshly separated cream below 65°F by placing container in cold water—stir occasionally.
Store in a covered container in a clean place relatively free from odors—maintain temperature below 65°F.
Always cool fresh cream before adding to cold cream from previous separations.

Delivery.—Market cream at four day or shorter intervals. Protect cream from warm air during transit to market.

WHY MILK AND CREAM TESTS VARY

ERIC W. SWANSON

A situation of no little concern to many dairymen is the variation in the fat test of their milk and cream. Some of the observed variation may at times be due to careless or unscrupulous techniques of the tester, but the forces of Nature and herd management are responsible for most of the variations.

Natural factors, such as temperature, weather and drought are beyond the influence of the herdsman, yet they are paramount in causing fluctuations in fat tests. All breeds test lower in summer than in winter, and the higher the average test, the greater will be the seasonal variation. High testing months are November, December and January, following which there is a steady decline in fat tests.
to the low months of June and July. In extremely hot and dry summers the August tests may be as low or lower than the July test, but usually the tests begin to rise again in August. The greatest causative factor of these seasonal variations is temperature. Temperature changes of even short duration will likewise cause sharp fluctuations in the fat tests. A few very cold days result in high tests, and warm days cause lower tests. Another contributing factor to low tests in periods of drought is the poor quality of feed usually fed.

A well known cause of milk test variation is the stage of lactation. The milk the first three months is usually lower than average in test, and thereafter the fat percentage gradually and steadily increases to the end of lactation. After a cow has been pregnant about five months, a decided drop in milk production is often noticed, accompanied by a similarly sharp increase in the fat test. The influence of stage of lactation appears more in herds in which all cows freshen at the same season.

Some of the ways the dairyman may affect fat test variations are through feeding and milking practices. While it is generally agreed that it is not practicable to raise the fat test through feeding; nevertheless, feeding natural feeds high in fat such as flaxseed, soybeans and cream will result in higher tests but these are only temporary in most cases. Feeding fish oils results in a decided decrease in fat test, which remains as long as such feeding is continued. The level of protein feeding has no effect upon fat tests.

One way to turn feed into higher testing milk is to feed the dry cow well. A cow calving in good condition will milk fat from her body and produce a much higher testing milk for at least one month after calving than she would have calving in poor or normal condition. Cows calving in poor condition will test lower than normal. Underfeeding a cow that has some bodily reserve will result in a sharp decrease in milk production and an increase in fat test. If the underfeeding is continued for an extended period the fat test also declines. This situation undoubtedly occurs during and following droughty periods when the forage is sparse and of low quality. The average test of a consistently underfed herd may be increased slightly by proper feeding, but the greatest change will result in the milk yield rather than the test. Turning cows to early spring pasture may result in an increase in fat test as well as milk yield if the cows were in good condition before the pasture season. A cow usually loses weight at the same time, hence the extra fat is probably taken from her bodily reserves under the milk-giving stimulus of fresh pastures. After a few weeks on pasture the test will return to normal or below. Cows which are in poor condition or which are giving very little milk usually do not increase in fat test when turned to spring pasture.
Milking methods may cause great variations in fat tests. Since the last milk contains a much greater percentage of fat than the first milk, getting the cow completely dry at every milking will result in a higher average test than incomplete milking. The cooperation of the cow in giving down her milk is necessary for complete milking. Unfavorable influences such as excitement, strange handlers or surroundings, slow milking, and ill treatment result in incomplete milking and low tests. Irregular intervals between milkings will result in irregular tests, the higher test resulting from the shorter interval. Evening milk usually tests higher than morning milk.

The health of the cow may also affect the fat test. When sickness occurs the milk yield is reduced and the fat test generally rises. Chronic mastitis may not affect the fat test noticeably, but it usually causes a reduction of fat test as well as milk yield. Cows with ovarian malfunction occasionally test very high. Ordinary heat periods cause increased fat tests in some cows but many are not affected.

In addition to these many factors causing fat test variations, there are the well known obvious ones of individual cow and breed variation.

Cream test variations occur for two reasons, milk test variations and mechanical irregularities of separation. If the cream or skim-milk screw of a separator is not changed the well operated separator will consistently deliver a certain percentage of cream and the rest skimmilk. An efficiently operating separator will always get all of the fat, however. So if the milk tests high, the cream will test high; and if the milk test varies, the cream test will vary correspondingly. Thus cream tests may show seasonal variation and other variations because of the richness of the milk.

Mechanical factors affecting the cream test, besides the regulation of the cream screw, are speed of the machine, temperature of the milk, rate of inflow, dirt or slime in the bowl, and amount of water used for flushing. Fast turning of the machine gives less cream of high test and slow turning gives the opposite. Two people may turn the separator only slightly differently, yet produce a decided difference in cream tests. The faster the milk is put through the separator, the lower will be the cream test because the bowl is overcrowded and some of the skimmilk is pushed over into the cream zone. Excess dirt or slime in the bowl usually result in lower testing cream because it blocks the exit of the skimmilk forcing much of it out with the fat. Cold milk causes cream to stick in the bowl and outlets which reduces the rate of flow of the cream, resulting in less cream and a higher test.

One of the most disturbing variations in milk tests is the variation between the D.H.I.A. herd average and the plant composite tests.
Because of the great possibility for daily variation it is inconceivable that these tests should very often agree. However, many farmers have noticed that their plant test is invariably lower than their herd test. Some of this discrepancy is due to unavoidable losses of cream during dumping of the cans, such as more or less cream sticking to lids and necks of cans. Much of the difference, however, is due to careless sampling of the milk and improper handling of the composite samples. The cream may not be thoroughly mixed with the milk before sampling, and the same may occur in testing the composites. In addition, the correct application of the Babcock test including strict use of the water bath before reading should be followed. The plant tester with his conscience clear about his sampling and testing techniques can more effectively explain the many variations in milk and cream tests which will occur as a result of the environment and management of the dairy herd.

SELECTION AND GRADING OF MILK AT THE PLANT INTAKE

E. R. GARRISON

Various tests may be used at the dairy plant for selecting and grading the milk received from the individual producers. Milk is seldom if ever taken into a plant without subjecting it to one or more of these tests while other tests may be applied at intervals or as occasion demands. Each test selected for use usually serves a definite function and supplies certain specific information about the milk. Information can easily be obtained by platform inspection that may be useful in the following ways:

1. Determine if milk is suitable for the use intended.
2. Ascertain cause of defective or poor quality milk.
3. Grading producers milk in quality improvement program.
4. Detect addition of water or preservatives to milk.

The producer should be immediately informed of any defect found in his milk in order that he can correct the condition causing the milk to be unsatisfactory.

Odor and Taste

Milk has long been judged by odor and taste and these tests are regularly used today for selecting or rejecting milk at the plant intake. The amount of odor or abnormal flavor permitted in milk before it is rejected varies with different plants and with the use to be made of the milk. When used for fluid milk and cream the grading is usually somewhat more rigid than when the milk is to be converted into certain dairy products.

The procedure followed in many plants is to note the odor of each can of milk soon after the lid is raised and to accept all cans without a detectable odor; cans with a pronounced odor are rejected while those with a slight odor are tasted and then accepted or rejected. Some plants, however, prefer to taste each can of milk and accept or reject it only on the basis of flavor.
The principal odors and flavors occurring in raw milk may be classified as weed, feed, barn, rancid, salty and bacterial. The odor or flavor defect should be indicated on the can tag when milk is returned to the producer.

**Sediment Test**

Dairy manufacturing plants in Missouri are required to make sediment tests on the milk of each producer once each month. The test is made by using a sediment tester which draws one pint of milk from the bottom of the can of unstirred milk and collects the sediment on a cotton pad 1 ¾ inches in diameter. The sediment pad with the grade denoted is then sent to the producer. If the sediment grade is No. 4, according to the Missouri Milk Sediment Chart, the milk is rejected and the sale of milk from that producer is discontinued until the sediment grade is improved.

The amount of sediment in milk delivered at the plant intake is determined mainly by the sanitary conditions under which the milk was produced and by the efficiency of the strainer used in removing dirt from the milk.

A good sediment test on milk, therefore, denotes that the milk was produced under clean conditions or that the dirt was removed by straining.

**Temperature Test**

It is important to know the temperature of each patron's milk when delivered at the plant intake, since milk will deteriorate rapidly at temperatures above 65° F. High temperature of the milk, particularly of the evening's milk when delivered the next morning, is a common cause of a short methylene blue reduction test and bacterial odors and flavors in milk. Morning's milk does not need to be cooled when delivered to the plant within two hours after milking is completed since no appreciable deterioration would occur in this time interval.

A hand thermometer can be used to determine the temperature of the milk in the cans or an indicating thermometer can be installed on the weigh tank with a stem and bulb that reach nearly to the bottom of the tank. The temperature of each patron's milk can be read from the dial and recorded when the milk is poured into the tank for weighing. If the producer receives a report of the temperature at regular intervals he will give more attention to the cooling of his milk if this is needed. Milk is sometimes rejected at dairy plants if warmer than a certain specified temperature, usually 70° F.

**Acidity Test**

The acidity test is made by placing 9 cc. of milk in a beaker or white cup, adding a few drops of phenolphthalein indicator and then adding a 0.1 normal solution of sodium hydroxide from a burette until the color turns pink. The number of cubic centimeters of alkali used in the titration is divided by 10 and the result is equal to the percentage of acidity in the milk.
The titratable acidity of milk when drawn from the cow varies considerably and depends upon the amount of proteins and acid salts present. The acidity of fresh herd milk may vary from 0.12 to 0.22 per cent but the average value for most herds is near 0.15 per cent. Any increase in acidity after the milk stands is due to the formation of lactic acid by bacteria from the lactose in the milk.

The variation in the acidity of fresh milk from different herds should be taken into consideration when milk is graded or rejected on the basis of the acidity test.

**Methylene Blue Reduction Test**

This is a fairly simple test that is widely used for grading milk at dairy plants. An electrically heated water bath with a thermostat control is very convenient to use but an air incubator can be employed if desired. All glassware and rubber stoppers used are sterilized in boiling water or in steam immediately before use. The test is made by adding 1 cc. of methylene blue solution to a test tube containing 10 cc. of the producers milk; a rubber stopper is inserted in the tube and the tube then placed in a water bath maintained at a temperature of 98°F.; after 5 minutes the tube is inverted and then returned to the water bath or placed in an air incubator at 98°F.; the tubes of milk from the different producers are observed at hourly intervals for eight hours and the time at which the blue color disappears is recorded.

The length of time required for the color to be reduced is closely related to the number of bacteria in the milk, the reduction time decreasing as the bacterial content increases. Very good milk will retain the blue color for eight hours or longer, while poor milk will decolorize in less than 3.5 hours.

The test tubes containing the milk samples must be protected from strong light, including electric lamps, because light shortens the reduction time.

**Lactometer and Other Tests**

A lactometer reading is frequently made on the producer’s milk at the plant intake to determine which samples are low in specific gravity. Herd milk normally varies in specific gravity between 1.029 and 1.034 while the average is considered to be 1.032 at 60°F. Milk may be low in specific gravity because of low solids-not-fat content when obtained from the cows or because of the addition of water to the milk.

If the specific gravity of the milk is low, a freezing point determination can be made on the milk by means of a cryoscope to ascertain if water has been added. Milk normally freezes at 31.01°F. and the addition of a relatively small amount of water would raise the freezing point enough to be detected.

If for any reason the addition of a particular preservative to the milk is suspected, special tests can usually be made for its detection.
MINIMUM STANDARDS FOR CREAM STATIONS

W. H. E. Reid

The butter industry has during the past twenty-five years adopted and applied numerous constructive procedures for the express purpose of improving the quality of milk and cream produced on our dairy farms, improving methods of transporting cream to the cream stations or creamery and improvement in methods of manufacturing butter so as to assure the consuming public of receiving butter of a high quality.

To further safeguard the quality of cream to be used for butter manufacture the Butter Industry is sponsoring a new project "Minimum Requirements for A Cream Buying Station". This project applies principally to the sanitary condition of the physical assets of the cream station, however, attention will also be directed to the methods applied in receiving and caring for the cream in the cream station. This project is of vital importance to the entire dairy industry of Missouri.

"Minimum Requirements for a Standard Cream Buying Station"

Recommended by National Cream Quality Program and Adopted by the Butter Industry of Missouri in so far as They are Compatible with the Missouri Dairy Laws are as follows:

1. All rooms in which cream is purchased shall be of such size as to permit the handling of the volume of cream purchased in an efficient and sanitary manner, in no case less than a minimum floor space of 120 square feet.

2. The floors shall be of non-absorbant material that can be kept washed and clean. Cement floors provided with adequate drains are considered ideal. It is recommended that new stations be required to have floors of cement, tile or like impervious material with suitable floor drains.

3. The walls and ceiling shall be of tight construction and be kept clean. Walls and ceiling that can be painted a light color above the wainscotting and kept washed are ideal and should be standard in new stations.

4. The room should be well lighted and have outside ventilation, and have all openings effectively screened against flies. Window glass shall be kept clean.

5. When the cream room adjoins a room in which poultry or other contaminating factors are handled, the cream room must be separated from such other room by a tight partition so as to exclude dust or undesirable odors from the cream room. When a door connects a cream room with a poultry room or other rooms with contaminating factors a vestibule with a tight-fitting, solid, self-closing door shall be provided at each end to safeguard the cream room.

6. No poultry or other contaminating commodities shall be weighed or handled in the cream room at any time.
7. There shall be no articles in the cream room either on floors or walls except those necessary to the proper handling and testing of the cream. Acid containers must be plainly labeled and protected.

8. Each station shall be equipped to run sediment tests on each producer's cream. (It is recommended that these tests be run in compliance with state legal requirements. In states in which there are no such requirements, sediment tests should be run on each producer's cream at least once each month, except when any seller's cream shows an undue amount of sediment present, tests should be run on each subsequent delivery by such sellers, until this condition is remedied.)

9. Some satisfactory method of cooling cream at the station is required. Cans containing cooled cream should be tightly covered.

10. Every cream station must be equipped with a satisfactory method of cleaning the patrons' cans. Brushes and suitable cleansing agents must be available and in use. Rags or cloths of any kind are prohibited. Provision should be made for a sufficient amount of steam or hot water to clean cans effectively and for a can rack on which to drain, dry and air them.

11. Surplus shipping cans should be sheltered in a clean store room and inverted on the can rack for airing and must be rinsed before using for cream. Cream must not be placed in rusty or unclean cans.

12. No station shall be considered Standard unless the buyer is clean in person, clothing and in the operation of his station.

Classifications of Stations

Stations shall be classified according to the sanitary condition and operation of the station and personnel; with especial attention to the methods and equipment used in cleaning patrons' cans and in the holding and cooling of cream.

A STANDARD STATION shall be one that meets all the minimum requirements listed above.

AN IDEAL STATION shall be one that meets all requirements for a standard cream buying station and in addition, shall have:

(a) A smooth concrete or other impervious floor with suitable drains.
(b) Walls and ceiling which are either painted or of such material that they can be washed and kept clean.
(c) A supply of running water in the station.
(d) Can washing equipment that returns a clean dry can to the patron.
(e) Sufficient room on the can rack to hold a day's supply of shipping cans in addition to enough room to drain and air all patrons' cans.
(f) Daily shipment of cream on cream buying days so that cream
shall reach the plant for churning not later than the day following date of purchase.

Any station that lacks one or more of the minimum requirements for a Standard cream buying station shall be designated as a Sub-Standard station. After April 1, 1944, any station so designated shall have the minimum requirements which are lacking, supplied within sixty (60) days of the date so designated or the station should be discontinued as a cream buying station.

This is an action program of the Butter Industry of Missouri in cooperation with the State Department of Agriculture. In due time every cream station in Missouri will comply with these practical requirements or will cease to operate. The quality of cream received by creameries purchasing cream in Missouri will show definite improvement as a result of this constructive project. The quality of butter manufactured from cream produced in Missouri will likewise show improvement and thereby maintain the good will of the consuming public. The entire butter industry will be on a sounder foundation as a result of this project.

CLEANING THE MILKING MACHINE

E. R. GARRISON

The milking machine must be maintained in a clean and sterile condition at all times if good quality milk is to be produced. A machine that is improperly cleaned and sterilized will be a serious source of milk contamination. When a milking machine is the cause of high bacterial counts in the milk it is usually due to an unsatisfactory procedure followed in washing and sterilizing the machine or to negligence on the part of the person performing these operations. Several methods have been used extensively that give good results. Each dairyman should adopt an approved method and always follow it carefully.

Method No. 1

1. Immediately after the last cow is milked, suck 3 gallons of clean, cold water through the teat cups and tubes into the pail, raising the teat cups out of the water every few seconds to break the suction and draw air into the tubes. Discard the water after it is all drawn into the pail. Use fresh water for each machine unit.

2. Wash and brush the inside and outside of the pail, head, teat cups and rubber parts in hot water containing a good dairy washing powder using the special brushes provided by the manufacturer.

3. Reassemble the unit and suck 3 gallons of scalding hot water through it without raising the teat cups out of the water. Discard the water from the pail and place the pail and head on a rack to dry.

4. Place the teat cups and milk tube on a solution rack and fill with a 0.5 per cent lye solution. Prepare the lye solution as follows: Place the contents of a 13 ounce can of lye in a 1 gallon jug, then
fill with water. Shake well to dissolve the lye, then permit the undissolved material to settle. Measure out 8 ounces (½ pint) of this stock solution, place in a 1 gallon jug and fill with water. Use this 0.5 per cent lye solution for filling the rubber tubes on the solution rack.

5. Just before milking:
   (a) Drain the lye solution from the teat cups and milk tubes.
   (b) Assemble the milking machine and draw 2 gallons of chlorine water containing 100 ppm. of chlorine through each unit. Drain chlorine solution from the pail before milking.

6. At weekly intervals dismantle the rubber parts and brush the inside and outside of each part in a hot solution of washing powder. Replace any defective parts with new material.

**Method No. 2**

The Dairy Department, Missouri College of Agriculture, has successfully used a slight modification of Method No. 1 as outlined above. The procedure has been:

1. See No. 1, Method 1.
2. Dissolve 2 tablespoons of a good dairy washing powder in 3 gallons of hot water and suck this solution through each unit. Discard the solution.
3. Suck 3 gallons of scalding hot water through each unit.
4. See No. 4, Method 1.
5. Brush the pail and head in a vat of hot water containing washing powder, then rinse with hot water and place on a rack to drain and dry.
6. See No. 5, Method 1.
7. See No. 6, Method 1.

**WASHING THE CREAM SEPARATOR IN TWO MINUTES**

**E. R. Garrison**

A new and rapid method of washing the cream separator that has proved effective under practical farm conditions was recently developed by the Dairy Extension Department of Iowa State College. A few of the wetting agents on the market that have been found effective for washing the cream separator (and other dairy equipment) are as follows: Dreft—Proctor and Gamble; Swerl—Swerl Products Co.; Naccanol—National Soap Co.; M. P. 189—Dupont Co.; Neosuds—G. B. Ford Co.; Arctic Syntex M Beads—Colgate-Palmolive-Peat Co.

The separator is washed by the following method:

1. After all milk has left the supply can, shut off power or stop turning the separator crank.
2. Rinse the supply can with a cup of warm water and shut off faucet.
3. Add directly over the float one pint of warm water or skim-milk, or enough to clear the cream from the machine.

4. Place about one tablespoon of a wetting agent in the supply tank. Then pour in a pail of warm water. Be sure it is a full pail about 120° F. See that the wetting agent is dissolved and let this go through the separator while the bowl is running down. While the solution is running from the machine brush the supply tank inside and out with a soft brush; also brush the inside and outside of the cream and skimmilk spouts, as well as the frame of the separator.
   (The four steps above must be followed out as rapidly as possible.)

5. Pour the water which has come through the machine into a dishpan.

6. Dismantle the separator. The supply tank, spouts, float and inlet will seldom need further cleaning. Place these parts in the supply tank. There may be some foam on these parts when they are removed but further inspection will disclose that this foam is from the cleaning solution and is not milk or cream.

7. On opening the bowl the discs will be perfectly clean as a rule. There may be a slight smear on an occasional disc. In that case set the discs in the water and run the brush down through the hole, pumping the water between them. The flow caused by the brush will clear the discs. Shake the discs apart for inspection and place them in the supply can.

8. The slime on the rest of the bowl parts will be soft and easily washed off with a brush. It requires no scouring and a soft brush will do the work nicely.

9. After all the parts are in the supply can pour a kettle of boiling water over them, drain and allow to dry.

FARM-TO-MARKET TRANSPORTATION OF MILK
HERMAN M. HAAG

Beginning in May, 1942, the Missouri College of Agriculture began to work on programs to conserve transportation facilities. The first impetus to transportation studies was the necessity for conserving rubber, but, as expected, the programs also were needed to save trucks and manpower.

The first research work set up to provide background materials for conservation plans was started in the St. Louis Milkshed in July, 1942, with the financial assistance of the Sanitary Milk Producers Association and the Cooperative Milk Producers of Missouri. This was intended to serve as a model for other large milksheds throughout the United States. Other studies have been made in South Central Missouri.
The fact that considerable savings in milk truck mileage for assembly and mainline hauling could be made was well-known but the extent to which it was practicable to reorganize milk routes was a debatable question. Each truck route was organized around a nucleus of producers shipping to a certain dairy. Existing routes were the most efficient routing if these producers alone were considered but several different routes covered the same territory. To permit each distributor to retain his shippers and still reduce truck mileage, the solution was assembly routes to bring milk to local concentration points which would be served by mainline routes. A mainline truck might also serve as the truck for an assembly route. Precedence for this type of arrangement was found in Jefferson County.

The job of preparing a rearrangement of milk routes includes the following steps:

1. Obtain supplies for collecting information about present routes. These include maps, survey schedules, color pencils. Maps may be obtained from the State Highway Department and suggested schedule forms from the Department of Agricultural Economics, University of Missouri.

2. Make a list of truckers serving present routes within the area to be studied. From each trucker obtain:
   a. A list of milk producers on his route by order of pickup and the volume of milk shipped by each.
   b. Pertinent information about the truck used.
   c. The location of each producer on a field map.

3. Transfer locations of shippers to master maps, retaining proper identity of shippers and routes.

4. Study master maps to determine assembly routings which would reduce mileage. Assembly and mainline hauling in large milksheds should be regarded as separate services. In small sheds this may not be possible. Plan routes to resemble circles originating and ending at concentration points.

5. Determine the number of mainline routes necessary to serve the concentration points proposed above. These should be arranged so that all milk going to Dairy A from concentration points along a route will be hauled by trucks serving Dairy A alone when the volume of milk is sufficient to justify this procedure.

6. Determine the mileages saved by the rearrangement of routes.

7. Submit the rearrangement of routes to local groups of producers, truckers, and other interested persons for their consideration and suggestions.
THE DAIRY INDUSTRY TRANSPORTATION PROGRAM
OF MISSOURI
W. H. E. REID

The Statewide Missouri Dairy Industry Transportation Program was inaugurated at a meeting of representatives of the entire dairy industry of this state.

The principal objective of the program is to conserve those materials essential to the efficient and daily transportation of milk and cream from Missouri dairy farms to our several hundred milk and milk products processing plants. The essential materials involved are trucks, tires, gasoline, oil and truck parts. The milk and cream involved totaled many millions of pounds each day.

To afford efficient conduct of this program seven major areas and fifteen sub-areas were established by allocating counties to each area or sub-area depending upon the market for the milk and cream involved. The areas established are St. Louis; Kansas City; Southwest area, with four sub-areas; Northwest area, with two sub-areas; Northeast area, with two sub-areas; Central area, with three sub-areas and Southeast area, with four sub-areas.

Eight steps are involved in organizing the program in each area:—

Committees have been appointed in every area in Missouri, in fact, Missouri was the first of all states to complete the organization of its program. Plans of nine areas have been approved by the Office of Defense Transportation and the remainder of the plans are in the process of completion. Administrators of the program have been appointed in several areas with the result that large conservations of materials have been made during the past twelve months.

To illustrate the practical application of these transportation plans and the saving that may be realized, I wish to refer to two areas:—
1. The Kansas City Milk Industry Transportation Plan.—The total mileage for each delivery of milk from the farms to the receiving stations or plants of dealers was, prior to the consolidations, transfers and joint action set forth above, 5228 miles. Under the proposal and under the plan now in effect, with the consolidations and transfers, the total mileage is 4579 miles. The mileage savings is 649 miles.

There is once-a-day pick-up and delivery from the farm to the bottling plants during the cool months of the year, approximately from November 1st to April 1st. During the warm months of the
year, approximately from April 1st, to November 1st, there is twice-
a-day pick-up and delivery, that is after each morning and evening
milking. On an annual basis the mileage savings involved in the
Plan is computed as follows:
Mileage saved during period of
once-a-day pick-up and delivery (151 hauls x 849 miles) .. 97,999
Mileage saved during period of
twice-a-day pick-up and delivery (428 hauls x 649 miles) . . . 277,772

Total miles saved for year .. 375,771

2. The Southwest area of Missouri.—This area is now recognized
as one of the heaviest milk producing areas in the United States and
exceeds by several times the volume of milk and produced daily
in the St. Louis and Kansas City areas. The volume of milk pro-
duced daily in the Springfield area varies from 3,500,000 to 5,000,000
pounds during the “flush” season. The transportation of this large
volume of milk each day presents a difficult transportation problem
since it involves thousands of producers and approximately 1000
trucks each day.

I am sure you will be interested to know that in developing these
programs in the Southwest Missouri area it has been necessary to
analyze the operation of more than 900 milk routes serving approxi-
mately 30,000 producers and involving a tire mileage of 118,000,000
tire miles. The proposals now in operation and in the course of
approval affected the operation of 486 of these routes and affected
more than 3,000 of the producers. The results in transportation
conservation measured in terms of mileage indicate a saving of more
than 3,000,000 truck miles per year and some 18,000,000 tire miles
annually.

These transportation programs are making an immeasurable con-
tribution to our war program. As a result of these programs the
producers, processors, truckers and consumers will be greatly bene-
fitied during post-war years by having been made familiar with
methods that promote conservation of essential transportation ma-
terials.
REFERENCES

Missouri College of Agriculture publications:
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B365—Factors Affecting the Composition of Milk.
B377—Raising the Dairy Calf.
B407—Artificial Insemination of Dairy Cows.
B451—Korean Lespedeza Seed as a Protein Supplement for Milk Production.
B453—Vitamins for Livestock.
C175—Management of Bluegrass Pastures.
C189—Testing Milk and Cream.
C193—An All-year Pasture System for Missouri.
C209—Legumes, Grasses and Cereal Crops for Silage.
C210—Management of Korean Lespedeza.
C215—Management of Sweet Clover in a Pasture System.
C218—Liming Missouri Soils.
C234—Grass Silage in Wartime.
C242—Wartime Recommendations on Use of Commercial Fertilizers.
C244—Seeding Permanent Pastures in Missouri.
C245—How to Choose Commercial Feeds.
C249—Rations for Livestock and Poultry.
E276—Sudan Grass.
E358—The Restoration of Bluegrass Pastures in Missouri.
E385—Mastitis, Its Diagnosis and Control.
E399—Conserving Soil by Contour Farming.
E405—Rations for Dairy Cows.
E418—Farm Water Systems.
E433—Water Management for the Farm.
E456—Milk and Milk Products for the Family.
E470—Dairy Farm Building Plans.
L49—Soybeans and Winter Barley in One-year Rotation.