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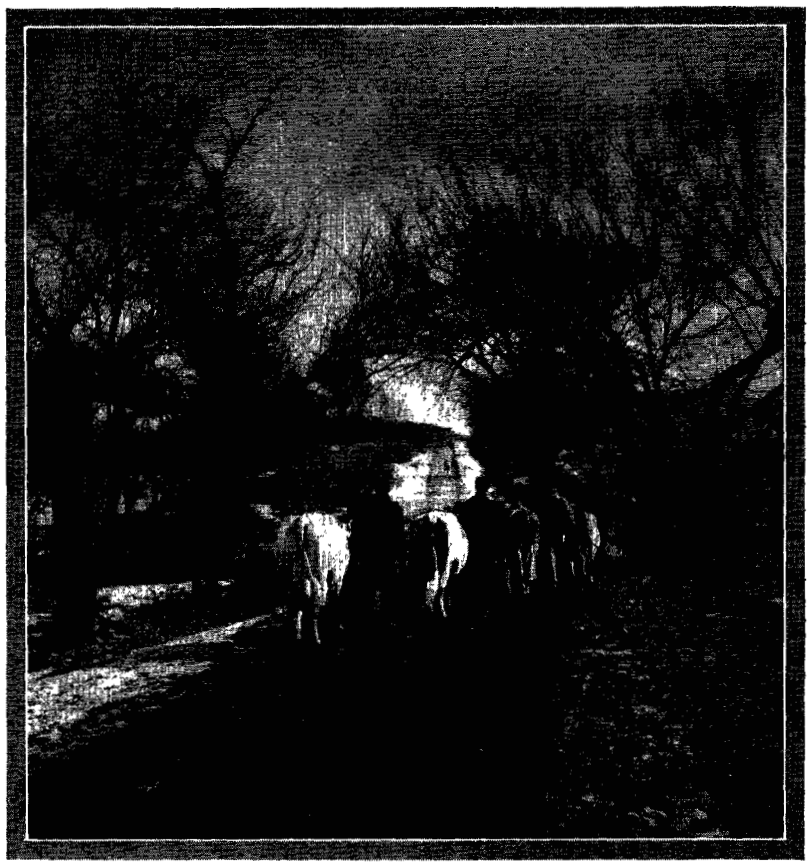
KANSAS STATE AGRICULTURAL COLLEGE
MANHATTAN, KANSAS

DEPARTMENT OF DAIRY HUSBANDRY



FARM DAIRYING[1]

J. B. FITCH

DAIRYING IN KANSAS

The dairy industry has become well established in Kansas as compared with what it was ten years ago. During this period the value of annual dairy production, as given in the reports of the State Board of Agriculture, has increased from $25,587,301 in 1917,

1. Contribution No. 65 from the Department of Dairy Husbandry.

to $38,190,703 in 1928. The number of breeders of dairy cattle holding memberships in national breed associations has gradually increased and the number of cows in dairy herd improvement associations increased from 154 in 1917, to 3,322 in 1927.

The number of dairy cattle in Kansas, as given in the 1927 Yearbook of the United States Department of Agriculture, is 715,000. With this number Kansas ranks eleventh among the states. The State Board of Agriculture report gives the number of dairy cattle in Kansas for 1927 as 614,634. The statistics compiled by the State Board of Agriculture are taken from the assessors' reports, and this fact may account for the difference in numbers from the two sources. The number of dairy cattle in Kansas has been nearly constant for the last five years, as indicated from estimates from both the sources mentioned above.

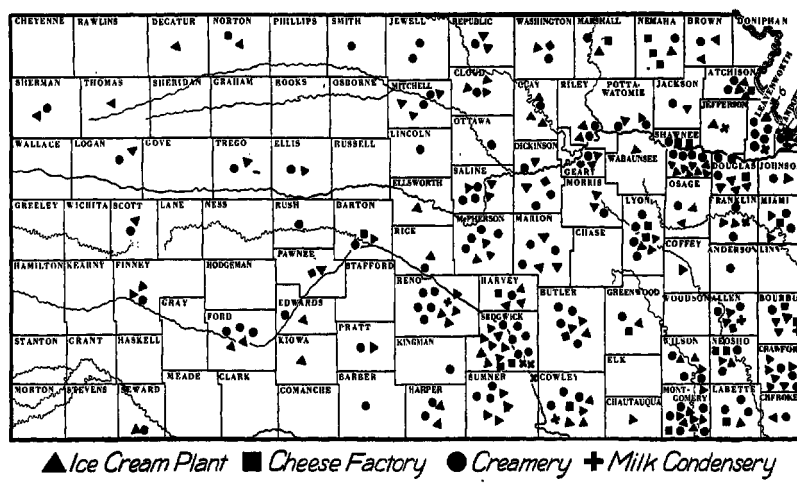


FIG. 1.—Map of Kansas showing the approximate location of its 123 creameries, 11 milk condenseries, 29 cheese factories, and approximately 150 ice-cream plants.

The interest in dairying in Kansas is not confined to any one part of the state. (Fig. 1.) It is true that the eastern half of the state is perhaps better adapted to dairying on account of feed and market conditions, but there is not a county in the state but what has shown increased interest in milk cows during recent years. The eastern half of the state may be better suited to dairying but a good system of agriculture in the western half makes dairying more necessary.

Kansas has advantages in the raising of feed for dairy cows that many dairy states do not have. Alfalfa hay and corn, cane, or

kafir silage will make the cheapest and best balanced ration obtainable. The growing use of sorghums for silage will put the Kansas feed supply on a more certain basis. This fact, coupled with the greater use of silos in all parts of the state is making dairying and live-stock farming more profitable and more popular.

MARKETING DAIRY PROCUCTS

The common market for the produce of the dairy cow in Kansas is the cream station. There are 2,835 cream stations in the state, which represent about 70 creameries. There are 123 creameries in the state, a few of which do not have cream stations but receive cream shipments direct. The cream stations receive cream, pay for it on the butter-fat basis, and ship it to the creameries. These stations provide a good market for cream in nearly all of the small towns of the state.[2]

In addition to the cream stations and creameries, there are 11 milk condenseries, 1 powdered-milk plant, 29 cheese factories, and approximately 150 ice-cream plants in the state. The location of these plants is shown in figure 1.

The sale of whole milk from the farm brings in the largest amount of money, but in many cases where whole milk is sold the calves and perhaps other live stock on the farm are underfed. The marketing of sweet cream to ice-cream plants or to other markets brings 5 to 10 cents more per pound for butter fat than the sale of sour cream. Sweet cream or whole milk should be marketed daily. Sour cream should be marketed three times a week in the summer and twice a week in the winter. If distance from market makes it impossible to deliver sour cream, butter can be made on the farm and marketed once a week.

Kansas dairymen may benefit by a change that is now taking place in the dairy industry of the United States. For some time the Middle West has furnished the butter used in the densely populated East. The cheese interests have been crowded out of the East and the whole eastern part of the United States has become a whole-milk market. The cheese interests in Wisconsin are now moving south and west to get away from the competition of the Chicago fluid-milk demand. This accounts for the fact that many cheese factories are now found in Nebraska, Kansas, Oklahoma, Missouri, Kentucky, and other southern and western states.

At the present time a few Kansas and Missouri creameries are

2. For further information regarding the handling of cream and the Kansas cream-station system, write to the state dairy commissioner, Topeka, Kan.

shipping sweet cream to eastern markets. One Kansas creamery in 1927 shipped 200 cars of sweet cream to the Boston market. The development of artificial refrigeration has brought us closer to the consuming public, and it looks reasonable to believe that the production of the bulk of dairy products eventually will be in the sections of the country where feed for dairy cows is most available.

The demand for dairy cattle by the eastern milk producers may also be an outlet for surplus dairy cattle if the Middle West should develop a surplus. At the present time eastern buyers are taking large numbers of cows from the dairy states north of Kansas, and last year more than fifty carloads of cattle were shipped from the Kansas City territory to eastern dairy states. In addition to producing some of the dairy products used in the East, Kansas may also furnish some of the cows for their fluid-milk supply.

ADVANTAGES OF DAIRYING

A farm used for dairy purposes does not need to lose in fertility, but can gain, and may be used for dairying almost indefinitely. On a well-managed dairy farm practically all the feed grown is marketed through the cow. Concentrated protein feedingstuffs, such as bran and oilmeal, are usually purchased to balance the ration. These feeds contain a high per cent of fertilizing ingredients, and the manure from the cows consuming such feeds is very rich in plant food.

The first method of farming practiced in a newly settled country is grain farming. This is continued until the land becomes high-priced and the fertility of the soil is decreased, when live-stock farming usually comes into practice. In grain farming the land is cropped year after year and these crops are sold off the land. In live-stock or dairy farming the crops are harvested and fed to the animals and the income is obtained by selling the animals or their products.

Selling grain and other crops from the farm means selling soil fertility or plant food. No soil can grow crops year after year without sooner or later reaching the point where this depletion is felt. When animals and milk products are sold from the farm only a small portion of the plant food of the entire crop is sold. The greatest part of the plant food is left behind in the form of barnyard manure, and this may be returned to the soil. This is very clear when we compare the amount of plant food that is sold in milk and dairy products with that contained in the ordinary farm crops.

The amount of fertilizing constituents in a ton of each of the com-

mon dairy products and farm crops and their value at the average price at which commercial fertilizing constituents were sold in Kansas in the spring of 1929, are shown in Table I.

TABLE I.—FERTILIZING CONSTITUENTS IN A TON OF EACH OF THE COMMON DAIRY PRODUCTS AND FARM CROPS, AND THEIR VALUE AT CURRENT PRICES.

SUBSTANCE.	Pounds of fertilizing constituents in a ton (a).			Value at average price of commercial fertilizer, spring 1929 (b).
	Nitrogen.	Phosphoric acid.	Potash (potassium oxide).	
Butter	3.2	0.0	0.0	$0.64
Milk	10.6	3.8	3.6	2.93
Wheat	47.2	15.8	10.0	12.13
Oats	41.2	16.4	12 4	11.30
Corn	36.4	14.0	8.0	9.55
Alfalfa	43.8	10.2	33.6	14.17

(a) Adapted from Eckles, "Dairy cattle and milk production," p. 3, The Macmillan Co. 1919.

(b) Nitrogen is figured at 20 cents per pound. Phosphoric acid is figured at 8½ cents per pound. Potash is figured at 13½ cents per pound.

In some of the eastern states of the United States land became so unproductive, largely as a result of grain farming, that some owners abandoned their farms. During the more recent years attention has been directed to these farms, and some of them are now yielding large crops. This change from an unproductive to a productive state has been brought about largely through the use of the dairy cow. On these farms hay and concentrated feeds have been purchased and fed, and in this way the fertility of the soil has been and is now being increased. The same conditions exist in other countries. Much of Europe has gone through this period of soil depletion, and has taken up dairying, until now in Germany, Denmark, and Holland, where cows are handled extensively, the land is producing larger crops than it did fifty years ago.

In many parts of Kansas the soil contains a sufficient quantity of plant food, but it is so devoid of humus, or vegetable matter, that the plant food is not available. Soil lacking in vegetable matter will not retain water, and packs and bakes after rains. Such a soil is called a poor soil. By rotation of crops, by marketing the crops grown through dairy cows or other live stock, and by using the manure, it is possible to add humus to the soil and thus to render it more productive.

The dairy cow is an economical producer of human food. No

other animal can produce the same quantity of digestible food so economically as can the dairy cow. Because of this economy of production, she is adapted to high-priced lands and can utilize high-priced feed to advantage. That dairying is adapted to high-priced land is shown by illustrations from European countries. Land on the Island of Jersey, which is the home of the Jersey cow, rents for from $50 to $80 per acre. Land in Holland is valued at $1,000 per acre, and the chief agricuitural pursuit is caring for and handling the Holstein cow and her products.

The high price of food products during the last few years has caused a great demand for dairy products. When the cost of food nutrients is taken into account, milk is the cheapest food obtainable. Recent investigations have shown that milk, in addition to being an important source of ordinary food nutrients, contains certain substances which are essential to the growth of the animal body. These substances are called vitamins, and their presence in milk makes milk desirable as a food if normal growth is to occur.

In all the schools in the state where the children have been weighed a high per cent of undernourished children have been found, as indicated by their body weight. When the children have been encouraged to drink more milk at home, or when they have been given a half pint of milk at recess time, they have shown good increases in weight. This does not mean that the children had been deprived of things to eat, but it does show that they were not getting the proper food. A survey among the school children of Kansas City, Mo., indicated that a big proportion of the undernourished children came from families that were well-to-do, but good judgment had not been used in selecting food.

Too often, however, milk is considered a luxury. As the price of milk advances the amount consumed by many people is reduced. The public should be educated to the point of knowing the food value of milk and other dairy products, and when this time comes milk will occupy the place in the human diet that its value warrants.

Dairying furnishes immediate and constant returns. A man with small capital can invest his money in a dairy cow and soon begin to realize on his investment. The prices of milk and butter fat are never subject to any great fluctuations, but are more steady and uniform than the price of many other commodities.

As practiced on a large per cent of Kansas farms, dairying leaves a valuable by-product in the form of skim milk. As a feed for live stock it contains the most valuable part of the milk and when

used judiciously may be a source of profit when fed to calves, hogs, and chickens, or made into human food.

Keeping dairy cows on the farm furnishes employment the year round and in many sections this enables one to get the better class of farm labor. The best farm hands prefer to work during the entire year, and they can usually find work around the dairy. In the sections of Kansas where wheat, farming is followed, winter dairying is becoming more generally adopted and will result in a more profitable and permanent system of agriculture.

BREEDS OF DAIRY CATTLE

The first essential of profitable dairying is good cows. The profitable dairy cow is one that will make the maximum production on the minimum quantity of food. The most profit can be made from special-purpose dairy cattle. A number of special dairy breeds have been developed by careful breeding and selection, covering periods of from 100 to 2,000 years. Very often good milk cows are found among ordinary herds of scrub cattle, or among the beef breeds, but the great objection to such cows is that they do not usually transmit their milking qualities to their offspring.

The following named breeds are now classified as dairy cattle: Jersey, Guernsey, Ayrshire, Holstein, and Brown Swiss.

Jersey.—The native home of this breed is Jersey Island, the largest in the group of the Channel Islands, lying between England and France. The Jersey (fig. 2) is small in size, the cows weighing from 800 to 1,000 pounds when mature. The majority of the animals are of yellow or gray-fawn color with a black nose, black tongue, and switch of solid black. There are a great many broken colored Jerseys, the bodies of which are some color of fawn with white spots.

The milk of the Jersey is very rich in butter fat, the average test for the breed being about 5.3 per cent. It has a high color and is easily churned. The color and richness of her milk makes the Jersey a great favorite as a family cow. The cows of this breed are very economical producers of butter fat.

The office of the secretary of the American Jersey Cattle Club is located at 324 West 23d street, New York City.

Guernsey.—The Guernsey breed (fig. 3) had its origin on the Island of Guernsey, the second largest island in the Channel Island group. Cows of this breed are somewhat larger than the Jerseys, averaging about 1,000 pounds in live weight. The characteristics of the Guernsey are somewhat similar to those of the Jersey. In color

the Guernsey may be either orange fawn or fawn with white markings. The nose is buff color and the tongue and switch are generally white.

The milk of this breed is not quite so rich as that of the Jersey, but the cows produce more of it. The milk is especially noted for its extreme yellow color, and the butter made from it at any time of the year has a good yellow color. The average milk contains about 4.9 per cent butter fat.

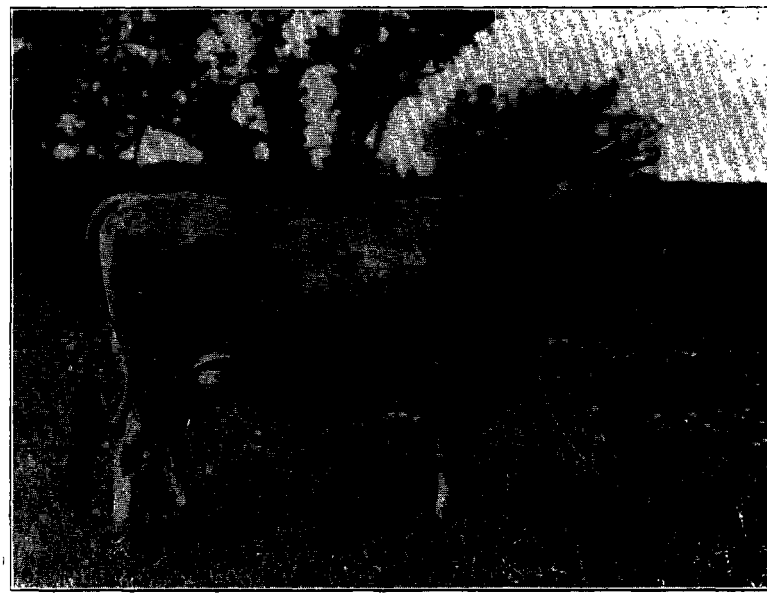


FIG. 2.—Owl's Design, pure-bred Jersey cow owned by the Kansas State Agricultural College. Record for one year: 14,606 pounds of milk, 650 pounds of butter fat.

The office of the secretary of the American Guernsey Cattle Club is located at Peterboro, N. H.

Ayrshire.— The native home of the Ayrshire (fig. 4) is the County of Ayr, Scotland. The cattle of this breed are very strong and thrifty. The cows average about 1,000 pounds in live weight. In color they may be either a dark red and white or light red and white. The red color in the bulls often deepens into mahogany. The color of the Ayrshire gives her an advantage over the other breeds when fattened and sold for beef, as there is still a general prejudice among stock buyers against the dairy breeds for beef, especially against the

Jerseys and Guernseys. In form the Ayrshire does not show the extreme angular dairy type exhibited by high-class Jerseys or Holsteins. They are somewhat smoother over the shoulders, back, and hips. The Ayrshire cows are especially noted for their symmetrical udders. Ayrshires are excellent rustlers, good breeders, and the calves are very strong and vigorous.

The milk has an average composition of 4 per cent butter fat, which adapts this breed to the production of market milk.

FIG. 3.—Imported Pallas 65709, pure-bred Guernsey cow owned by the Kansas State Agricultural College. Record for one year: 13,240 pounds of milk, 625 pounds of butter fat.

The office of the secretary of the Ayrshire Breeders Association is at Brandon, Vt.

Holstein.—This breed (fig. 5) originated in Holland and has been bred in that region for at least 2,000 years. During this time there has been very little, if any, mixing with outside blood. Since ancient times, Holland has been noted for its butter, cheese, and immense oxen. The Holsteins are the largest of the dairy-bred cattle. The average weight of the mature cow is 1,250 pounds, but individual cows often weigh 1,400 pounds or more. The color markings are black and white. The cows have good dispositions and are not easily frightened at any sudden disturbance. As beef producers

this breed ranks high for a dairy breed. The calves are large at birth, grow rapidly, and make excellent veal.

As milk producers Holstein cows are unexcelled. They produce more milk and at a less cost per 100 pounds than any other breed. The milk averages about 3.5 per cent butter fat. The Holstein is well adapted to supplying milk for cities on account of the high yield and relatively low per cent of butter fat.

FIG. 4.—B M's Bangora Melrose 60018, a pure-bred Ayrshire cow, bred and owned by the Kansas State Agricultural College. Record for one year: 19,400 pounds of milk and 754 pounds of butter fat.

The office of the Holstein-Friesian Association of America is at Brattleboro, Vt.

Brown Swiss.—The Brown Swiss breed (fig. 6) has been developed in Switzerland, and is probably one of the oldest breeds of cattle known. In its native land it is classed as a dual-purpose breed and formerly was exhibited both as a beef and a dairy breed in America, but is now classed as a dairy breed. The cows weigh from 1,200 to 1,400 pounds, and the bulls often weigh more than a ton. The color is brown to silver gray, resembling the color of some

individuals in the Jersey breed. The cows give a good flow of milk, containing about 3.7 per cent of butter fat.

The office of the secretary of the Brown Swiss Cattle Breeders' Association of America is at Beloit, Wis.

FIG. 5.—Inka Hijlaard Walker 360354, a pure-bred Holstein-Friesian cow, owned by the Kansas State Agricultural College. Record for one year: 21,200 pounds of milk and 775 pounds of butter fat. This cow has three records which average 20,036 pounds of milk and 756 pounds of butter fat a year.

THE BREEDS COMPARED

In a comparison and classification of the four principal breeds of dairy cattle, they rank as follows:

1. With reference to amount of milk produced: Holstein, Ayrshire, Guernsey, Jersey.
2. With reference to richness of milk produced: Jersey, Guernsey, Ayrshire, Holstein.
3. With reference to yellow color of milk: Guernsey, Jersey, Ayrshire, Holstein.
4. With reference to size: Holstein, Ayrshire, Guernsey, Jersey.
5. With reference to early-maturing qualities: Jersey, Guernsey, Ayrshire, Holstein.

With reference to the amount of butter fat produced there is very little difference among the breeds. There is more difference

among individual cows of the same breed than among the breeds. High-producing individuals are common among the Jersey, Guernsey, Holstein, Ayrshire, or Brown Swiss breeds. The names and yearly records of the cows holding the highest butter-fat records in each of these breeds in the United States are as follows:

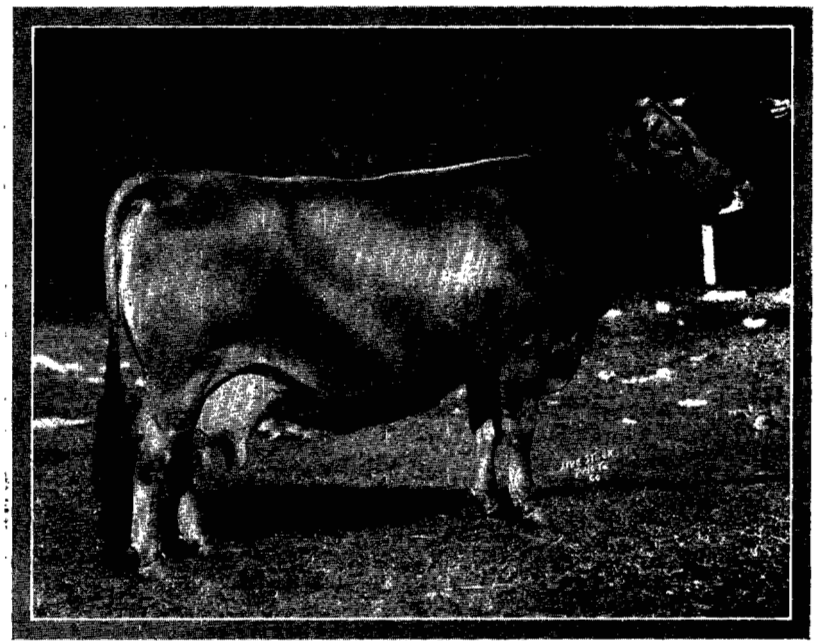


FIG. 6.—Silver Bell 9322, a typical Brown Swiss cow. This cow has an Advanced Registry record of 17,692 pounds of milk and 773 pounds of butter fat in ten months.

Breed and name of cow.	Pounds milk.	Per cent fat.	Pounds fat.
Holstein: De Kol Plus Segis Dixie	33,464	4.03	1,349
Jersey: Abigail of Hillside	23,677	5.05	1,197
Ayrshire: Nellie Osbourne of Elmshade 16th	27,192	4.62	1,257
Guernsey: Anesthesia's Faith of Hillstead	19,741	5.63	1,112
Brown Swiss: June's College Girl	24,571	4.32	1,062

The following table gives the average production of all Advanced Registry cows tested for 305 days and 365 days in the respective breeds and in dairy herd improvement associations:

Breed.	Number of records.	Pounds milk.	Per cent fat.	Pounds fat.
Holstein-Friesian	30,297	15,796	3.39	535
Jersey	34,313	8,439	5.36	452
Guernsey	26,717	9,770	4.98	487
Ayrshire	6,831	10,359	3.97	411
Brown Swiss	741	12,070	4.01	484
Cows in D. H. I. A. (all breeds)	140,084	7,410	3.98	295

In selecting a breed of dairy cattle it is well to choose the breed in which animals are most plentiful and can be purchased most easily in the locality. Another factor that may enter into the selection of a breed is the access to markets. For a whole-milk market the Holsteins or Ayrshires are best adapted, while those who are farther away from markets or those who have a special market will perhaps choose Jerseys or Guernseys for the production of butter fat and butter.

In addition to being registered in the herd books of the different breeds, pure-bred cows are eligible to the Advanced Registry of their respective breeds when they meet the production requirements specified by the breed association.

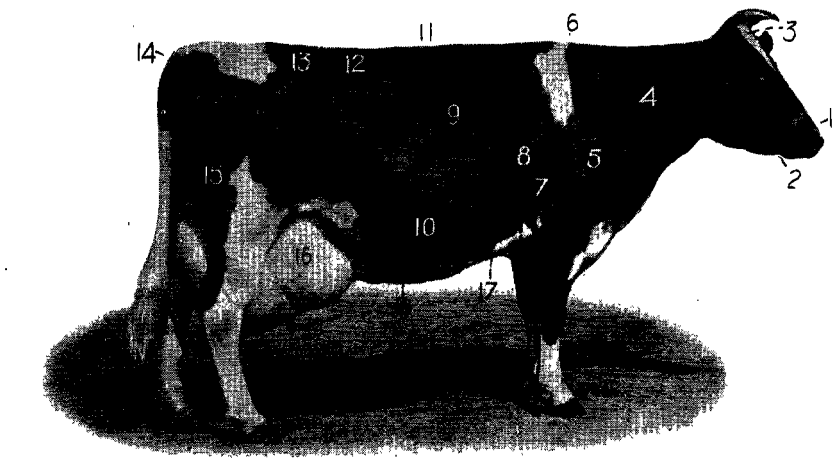


FIG. 7.—Location of points on cow:

1. Face.
2. Muzzle.
3. Forehead.
4. Neck.
5. Shoulder.
6. Withers.
7. Chest.
8. Heart girth.
9. Ribs.
10. Barrel.
11. Back.
12. Loin.
13 Hips.
14. Pin bones.
15. Thigh.
16. Udder.
17. Milk wells.
18. Milk veins.
19. Teats.

SELECTION OF THE DAIRY COW

The points commonly referred to in describing a dairy cow are shown in figure 7.

In starting a dairy herd the first thing to consider is the selection of the cows. There are two methods which can be used. The first is selection by conformation or type of the cow; the second is the selertion of cows according to records of milk production. The first method is the one most generally used. The second method, although more reliable, cannot be followed so extensively, because only a small per cent of the cows have records.

There is no doubt that there is a certain type or form that is associated with large milk production, and in conformation the dairy cow is quite the opposite of the beef animal. The dairy cow is angular, spare in flesh, and is usually referred to as being wedge-shaped, while the beef animal has a square, blocky form. The score card given below may be used somewhat as a guide in selecting dairy cows according to type or conformation. It shows the relative importance of the different parts of the body.

Score Card—Dairy Cow

SCALE OF POINTS

	Possible score.
General Appearance—18 Points	
Form, inclined to be wedge-shaped	6
Quality, hair fine, soft; skin mellow, loose, medium thickness; secretion yellow; bone clean, fine	6
Temperament, nervous, indicated by lean appearance when in milk	6
Head and Neck—7 Points	
Muzzle, clean cut; mouth large; nostrils large	1
Eyes, large, bright, full, mild	1
Face, lean, long; quiet expression	1
Forehead, broad	1
Ears, medium size, yellow inside, fine texture	1
Horns, fine texture, waxy	1
Neck, fine, medium length, throat clean; light dewlap	1
Fore Quarters—5 Points	
Withers, lean, thin	1
Shoulders, light, oblique	2
Legs, straight, short; shank fine	2
Body—26 Points	
Chest, deep, low; girth large, with full foreflank	10
Barrel, ribs broad, long, wide apart; large stomach	10
Back, lean, straight, open-jointed	2
Loin, broad	2
Navel, large	2
Hind Quarters—44 Points	
Hips, far apart, level	2
Rump, long, wide	2
Pin Bones, high, wide apart	1
Tail, long, slim; fine hair in switch	1
Thighs, thin, long	4
Udder, long, attached high and full behind, extending far in front and full, flexible; quarters even and free from fleshiness	22
Teats, large, evenly placed	5
Mammary Veins, large, long, tortuous, branched, with double extensions; large and numerous milk wells	5
Legs, straight; shank fine	2
Total	100

General Appearance of the Cow.—The first impression one gets when viewing a high-producing cow, or a photograph of a high producer, is the marked angularity and thin, loose-jointed appearance. The thin appearance is not a condition caused by lack of feed, but the animal is well-muscled and neat, with the hair and skin in good healthy condition. The angular conformation is best described by the term wedge shaped. The dairy cow has three wedges. A wedge is noticed when the cow is viewed from the front,

from the side, and also from above. The first wedge mentioned is formed by the withers being sharp at the top and the chest being wide at the base. The depth through the rear part of the barrel and udder tapering to the neck and head forms the wedge as viewed from the side. The wedge, as seen from above, is formed by the extreme width through the hips gradually tapering to the sharp withers. The wedge shape is not extremely pronounced in all dairy cows but is usually found in the best animals.

Quality.—The dairy cow should have quality. High production of milk and butter fat is associated with this characteristic. Quality is indicated by fine hair, soft, loose, mellow skin of medium thickness, and a fine, clean bone. Dairy temperament is another essential. By this is meant the ability to convert the feed into milk. Dairy temperament is indicated by a neat, refined appearance, spareness in flesh when in milk, and a large, full, mild eye. The dairy cow should be healthy and in good condition; should be spare in flesh while in milk; but may be allowed to carry considerable flesh when not giving milk.

The Head.—The head should be clean cut, of medium length, quiet expression, and of feminine appearance. The eye should be large, bright, and full. A mild expression in the eyes indicates a good disposition. The forehead should be slightly dished and broad. The jaw should be strong and wide, tapering somewhat to a strong, broad muzzle. A good-sized muzzle and strong jaw are indications of a good feeder. The ears should be of medium length, good texture, and fine quality, with an abundance of orange or yellow secretion inside. The neck of the cow should be moderately long, thin, and muscular, with clean throat and light dewlap. The neck of the typical dairy cow does not join the body so neatly as does the neck of the beef animal, but is long, lean, and free from fleshiness.

Body.—The heart girth should be large, indicating lung and heart capacity. The back should be long, straight, and open-jointed. The ribs should be long, wide, well sprung, and far apart. The abdomen or barrel should be long, wide, and deep, especially just in front of the udder. A cow must have capacity of barrel to be able to handle large amounts of food. Often a cow will not show a great depth of barrel, but may have a large capacity for food by having a greater width of barrel and wide spring of ribs. A strong jaw, keen eye, large muzzle, and capacious barrel are the indications of ability to consume and digest large quantities of food, which is

necessary for high production. The loin should be broad and strong, with roomy coupling.

Hind Quarters.—The hind quarters should show the leanness characteristic of other parts of the body. The hip points should be far apart, prominent, and level with the back. The rump should be long and wide with a roomy pelvis; the pin bones high and wide apart. Such a conformation of this region affords plenty of room for the generative organs and reproduction. The thighs should be long, thin, and wide apart, with plenty of room for the udder. The legs should be fine, straight, and far apart.

Udder.—The udder and mammary veins of the cow constitute one of the most essential organs, and are largely used as a determining factor of the ability of the cow as a producer. The udder should be capacious, free from flesh, and when empty should be soft and flexible. Capacity of the udder should be gained by length and width rather than depth. It should be attached to the body high behind and far forward toward the navel and show plenty of width throughout. This conformation permits of more contact for the blood vessels and milk-secreting cells. The quarters should be even in size and not cut up, and the base or sole of the udder should be flat. The teats should be even, of good size for milking conveniently, and set squarely on each quarter of the udder. The hair on the udder should be fine and soft, indicating quality.

The udder is the milk factory, where the nutrients are taken from the blood and made over into milk. By some unknown process in the udder the food materials taken from the blood are changed to the substances found in the milk. The milk veins serve as an index to the amount of blood that flows through the udder. These veins carry the blood from the udder back to the heart. They can be noticed leading from the fore quarters of the udder and running forward just underneath the skin and entering the abdomen near the center of the body. The milk wells, through which the milk veins enter the body, should be large. There may be more than one milk well on each side of the body. In some cases the milk veins branch after leaving the udder and enter the body through several milk wells. Cows have been known to have as many as five milk wells on each side, and it is not uncommon to find cows with two or three milk wells on each side of the body.

The general score card described above applies to all breeds of dairy cattle. When, however, a certain breed of dairy cattle is to be considered the breed score card giving the requirements as

adopted by the association representing this breed must be referred to. The breed score cards differ from the general score card in that they bring out the characteristics of the respective breeds. In addition to dairy type, breed type is a union of all the points desirable on the dairy score card with the accepted breed characteristics. Breed score cards are also available for bulls. Score cards for the different breeds may be obtained from the breed secretaries whose addresses were given in the discussion of the respective breeds.

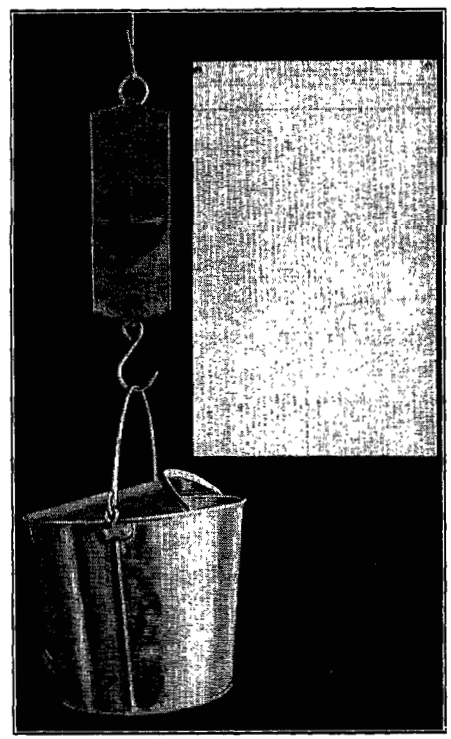


FIG. 8.—Outfit for keeping complete milk records.

KEEPING RECORDS OF THE COWS

After one has a herd there is no excuse for not knowing the production of each animal in it, for this is the only sure way of selecting profitable cows. A cow may score very high according to the score card and still not be a very profitable producer. By selecting cows on their records, discarding the unprofitable ones, using good sires, and raising heifer calves from the best cows, one is sure to increase the productiveness of the herd.

The milk of each cow should be weighed at each milking and the records kept. An outfit for keeping complete milk records is shown in figure 8. The essentials of the monthly milk-record sheet, shown fastened to the board by thumb tacks in figure 8, are shown in detail in figure 9.

To obtain the butter-fat production weigh the milk of each cow at each milking, as previously provided, and test each cow's milk at regular intervals with the Babcock tester. In this way the actual record of each cow's production can be ascertained. This information will also be of value in the feeding of the herd.

Milk-record sheets may be obtained by writing the Department of Dairy Husbandry, Kansas State Agricultural College. A Babcock testing outfit (fig. 12) may be obtained from any firm handling dairy supplies.

It is not practical to make a butter-fat test of each milking; testing the milk for several milkings once a month will be sufficient. It is more essential to know the amount of milk produced by an animal than to know the per cent of butter fat in the milk. The per cent of butter fat is fairly constant for an animal, while the amount of milk varies widely owing to many causes. A composite sample, representing the milk given during two days, will give very accurate results. The per cent of fat obtained from this sample multiplied by the pounds of milk given during the month will give the estimated butter fat record for the month. The method of testing milk for butter fat given on page 30.

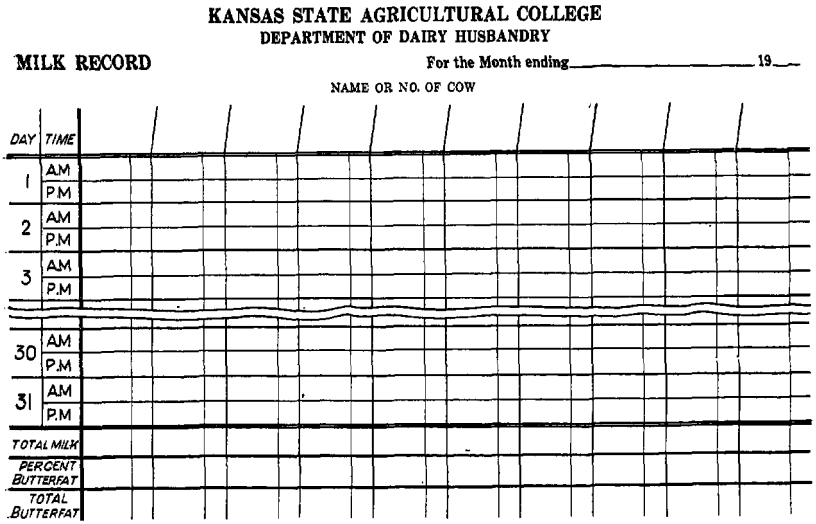


FIG. 9.—Essentials of a monthly milk-record sheet.

In giving the records of cows breeders often use the term BUTTER, while others speak of BUTTER FAT. Butter fat is the basis on which cream is sold to the cream stations or creameries, and butter is the finished product. The amount of butter fat in butter varies with the method of churning, the amount of moisture, and many other causes. In general, 80 pounds of butter fat will make 100 pounds of commercial butter. To change butter fat to 80 per cent butter, divide the number of pounds of butter fat by 8, or increase the number of pounds of butter fat by one-fourth.

The keeping of milk records on a dairy herd is comparable to keeping a set of books in any business. In addition to determining the difference in producing ability of cows it serves as a guide to profitable feeding of the herd, as will be explained later. It also gives a basis of comparing the sires used in a herd. It takes about six minutes per day to weigh and record the milk from a herd of ten cows, and no other operation on the dairy farm will pay so high returns as keeping milk records on the dairy herd.

In communities where several dairy herds are in close proximity the farmers cooperate in keeping the records of their herds by forming a dairy herd improvement association, formerly called a cow-testing association. Such an association is generally made up of twenty-six dairy herds and the owners hire a man to spend one day each month with every herd. This man, on his monthly visit, weighs the milk and tests for butter fat a daily composite sample of the milk from each cow in the herd. He also records the amount of feed eaten by each cow during his visit. Using the results thus obtained he is able at the end of the month to give the production and the feed consumed by each cow. At the end of the year each herd owner has a summary of the work of every cow in his herd.

In addition to keeping records the supervisor should be able to give help to the individual farmer in feeding and management of the herd.

Table II is a summary of the production records of the twelve Kansas dairy herd improvement associations, representing 3,326 cows, for the year ending December 31, 1927.

On December 1, 1928, twenty dairy herd improvement associations were in operation in the state of Kansas. Dairy herd improvement associations are demonstrating to dairy farmers that it pays in many ways to keep records of the production of their cows. Dairy farmers who are not able to join a dairy herd improvement association should keep private records as outlined above.

TABLE II.—SUMMARY OF KANSAS DAIRY HERD IMPROVEMENT ASSOCIATION PRODUCTION RECORDS FOR 1927.

Number of cows (3,326).	Pounds of milk.	Average per cent butter fat.	Pounds of fat.	Value of product.	Feed cost.			Value of product above feed cost.
					Roughage.	Grain.	Total.	
8	1,370	4.2	58	$43.38	$25.25	$10.62	$35.87	$7.51
51	2,594	4.1	106	78.14	30.24	14.96	45.20	32.94
181	4,074	3.8	155	95.09	31.80	15.82	47.62	47.47
475	5,314	3.8	202	129.40	32.39	21.21	53.60	75.80
720	6,504	3.9	251	162.61	34.68	27.97	62.65	99.96
753	7,869	3.8	299	196.48	36.85	33.90	70.75	125.73
561	9,107	3.8	347	229.65	38.15	39.02	77.17	152.48
343	10,571	3.7	396	273.82	40.44	44.62	85.06	188.76
161	11,953	3.7	445	300.94	41.19	50.93	92.12	208.82
52	12,965	3.8	495	346.79	40.44	57.31	97.75	249.04
11	15,106	3.6	546	363.55	41.73	64.18	105.91	257.64
8	16,648	3.6	599	397.25	38.25	67.50	105.75	291.50
Average.	7,721	3.8	293	$194.00	$36.21	$32.84	$69.05	$124.95

Note.—For this tabulation the records were sorted in such a way as to have the group centers 50 pounds of butter fat apart.

A summary of the production records of the dairy herd improvement associations of Kansas for the last five years is given in Table III.

TABLE III.—SUMMARY OF THE PRODUCTION RECORDS OF THE DAIRY HERD IMPROVEMENT ASSOCIATIONS IN KANSAS, 1923 TO 1928.

YEAR.	Number of associations.	Number of cows.	Pounds of milk.	Average per cent butter fat.	Pounds of fat.	Value of product.	Feed cost.			Value of product above feed cost.
							Roughage.	Grain.	Total.	
1923-'24.....	9	1,174	7,085	3.7	263	$172.27	$33.71	$28.46	$62.17	$110.10
1924-'25.....	7	1,736	7,500	3.6	272	163.15	39.24	30.11	69.35	93.80
1925-'26.....	12	4,200	7,469	3.8	287	198.69	38.16	31.57	69.73	128.96
1926-'27.....	14	4,353	7,692	3.8	292	192.39	36.00	32.70	68.70	123.69
1927-'28.....	12	3,326	7,721	3.8	293	194.00	36.21	32.84	69.05	124.95

THE SELECTION OF THE HERD SIRE

The future development of the herd depends to a great extent upon the kind of sire used with the herd. It has been said that the sire is half the herd. The herd sire should be a purebred of the breed he represents and be backed by good ancestry. If possible he should be a sire whose close ancestors have shown high records of

production or the ability to sire high-producing cows. Yearly records are to be preferred to those of shorter duration.

If it is not possible to know the record of production one should by all means see the mother of the animal in question and note how closely she conforms to the dairy type. If the sire's father has daughters that have proved to be good producers he is more certain to transmit the dairy qualities desired. Very often it is possible to buy an old sire who has proved to be a good breeder. Good results from the use of such an animal are almost certain. The objection to buying an old bull is that he is high priced, if his value is known, and one runs a chance of getting an unruly animal. A bull calf is usually selected. A calf can be purchased for less money and the owner can train him as he chooses.

Too much attention cannot be given to the selection of a sire, for future successes depend largely upon the head of the herd. In addition to having good records back of him, a bull should be a good individual. (Fig. 10.) If good cows are wanted the sire must have the desirable characteristics that are to be transmitted to them. In addition to showing a strong, resolute, masculine character, he should also have good quality, large barrel capacity, a strong constitution, a straight top line, a level rump, and good breed type.

FIG. 10.—Jolly Tipsy's King 187286, the senior herd sire of the Jersey herd at the Kansas State Agricultural College.

It is more desirable to use a proved sire than to take a young calf with a good pedigree and trust to his being a sire of high-producing daughters. Too many breeders are discarding bulls when their heifers are ready to breed. A man with a small herd cannot be expected to keep two bulls, but an effort should be made to trade bulls for a few years and in this way save the expense of a second bull and give the daughters of the first bull a chance to develop before the bull is slaughtered. The value of a bull is measured by his ability to sire animals that are higher producers than their dams, and it is a well-known fact that the higher the production is the greater the difficulty in obtaining a bull that will increase it.

A pedigree showing good records of the ancestors of a bull constitutes a promise of a bull's being a sire of good individuals and high-producing daughters. This promise is fulfilled only when a bull has proved his ability through his offspring. The only sure way to make progress in building a dairy herd is by continued record keeping and the successive use of proved sires,

FEEDING AND MANAGEMENT

In order to reap the highest and most, economical returns from a properly bred and selected herd, the animals must be fed intelligently. One of the principal reasons for the low average production of the Kansas cow is that she is not properly fed. By weeding out the poor cows and feeding the best ones more intelligently it would easily be possible to double the production of the cows of the state.

A factor that is important in obtaining the best returns from dairy cows is the time of the year at which they freshen. A cow calving in the fall of the year will produce from 30 to 40 pounds more butter fat than the same cow calving in the spring of the year. A cow calving in the fall gives the maximum production on dry feed, and as the production declines in the spring she is turned on grass and this causes her to produce more milk. As a result she keeps up her production longer and is ready to be turned dry during the hot summer months when pastures are short and the flies bad.

Even if the cow calving in the fall did not produce a pound more fat than the cow calving in the spring, she would be more profitable because dairy products are highest in price in the fall and winter months, while in the spring during the flush season they are generally lowest. It is not only more profitable to have the cows calve in the fall, but it is also better for the calves. A fall calf can be handfed

during the winter, and when spring comes will be ready to be turned on pasture and will give little trouble beyond that time. A calf dropped in the spring has hot weather and flies to contend with, and is frequently turned on grass too early for the best development. A farmer has more time to spend with the cow and calf when the cow freshens in the fall, and the cow and calf will also give him the least trouble during his busy season.

If the cows are to make their maximum production it is essential that they be properly fed and cared for before they freshen. Each cow should be given six to eight weeks rest each year. During the time the cow is dry she must be well cared for, and not turned out on a poor pasture or stalk field to care for herself. The cow needs this rest to build up a reserve in her body. She should also be fed so she will gain in weight. The cow that freshens poor in flesh cannot be expected to milk well during the following milking period. But the cow that is in good flesh when she freshens will start off giving a large flow of milk and will keep it up for a long time.

For four or five days before the cow is due to freshen her grain should consist of bran. The bran will act as a laxative and thus the digestive system of the cow will be brought into good condition before calving. Immediately after she freshens the cow does not need, and should not be fed, a heavy grain ration. A ration of bran, fed dry or as a wet mash in addition to hay and silage, is sufficient for three or four days, after which grain feeding should begin. If the cow has surplus flesh at this time she will draw on this reserve :and produce a large amount of milk from the start. The cow should be given but four or five pounds of grain at first, this being gradually increased as the milk flow increases. After all swelling and inflammation is gone from her udder she may be given a heavier grain ration. At the end of three or four weeks she will reach her maximum milk production and should then be on full feed. From this time on the ration should be regulated according to the quantity of milk given. The ration given the cow will depend upon the kinds of feed available. This will vary according to location. Thus a general discussion of the feeding question is necessary.

MAINTAINING SUMMER CONDITIONS

Economic feeding resolves itself into a study and execution of the lessons which nature teaches. Under natural conditions the average cow makes her greatest production in milk during May and June or early summer. When she is turned to pasture in the spring,

after having received a dry ration, she will invariably increase in milk flow. The ration the cow receives at this time is nature's ration, grass in its choicest form. There is plenty of food at hand, it is palatable, succulent, easily digested and contains plenty of food nutrients, and the cow is comfortable. The intelligent feeder, therefore, will strive to maintain these conditions as nearly as possible throughout the year.

While the average cow does her best on pasture and receives sufficient nutrients at that time, the high producer will require additional feed while on pasture and should be given all the grain for which she will make returns. A high-producing cow on pasture will for a time make up the deficiency by drawing on her body for the necessary nutrients required, but she will soon exhaust this supply and will then decline in milk production. As the season advances the pastures dry up or get short, and they should then be supplemented with other feeds. Silage or green crops such as corn, alfalfa, oats and peas may be fed at that time. Perhaps that is the most critical time in the milking period of the average cow. The majority of cows in the state freshen in the spring, and when the pastures are not supplemented they decline very rapidly in milk production or "go dry" entirely.

Many dairymen are successfully using Sudan grass or sweet clover pastures to supplement native pasture or as their only pasture crop. It is possible by using these crops and by practicing deferred grazing to have some pasture during the entire summer.

A BALANCED RATION

As winter approaches the conditions prevailing in early summer must be provided for by the feeder. The feed supply should be plentiful and be so combined as to make the ration a balanced one. It is highly essential that the cow owner know something of the composition of the various feeds and know how to combine these feeds in a ration to get the best results.

There are three substances which must be considered in making up the ration of the dairy cow. These substances are contained in almost all feedingstuffs to a greater or less extent. They are protein, carbohydrates, and fat. Some feeds contain a high per cent of one of these substances and other feeds contain a high per cent of another substance. The protein or nitrogenous substance is the most expensive of the three. It is used by the animal in the production of hair, hoof, hide, horn, blood, and muscle. Such feeds as alfalfa, cowpea and clover hay, cottonseed and linseed meal, bran,

oats and gluten feeds contain a high per cent of this substance. The carbohydrates (sugar and starches) and fat are used for the same purpose and may be classed together. These substances are used by the animal to produce heat to keep the body warm, to furnish energy, and to make the fat that is stored up in the body and in the milk. Such feeds as corn, cane, kafir, and the silage and stover from these plants; prairie hay, Sudan hay, and oat and wheat straw all contain a high per cent of carbohydrates. All of the feeds mentioned in the above groups contain some fat.

A balanced ration must contain both protein and carbohydrate foods. In sections of the state where alfalfa, clover, peas, or other legumes can be successfully grown for hay they should be depended upon to furnish the protein in the ration, and since the protein is furnished in the roughage it is best to feed a grain ration that is rich in carbohydrates in order to balance the ration. Thus if alfalfa hay is available for roughage, corn is the logical grain ration. Where legumes cannot be grown the roughages usually are depended upon to furnish the carbohydrates, and under this condition the grain ration should be made up of some food rich in protein. If the roughage consists of cane or kafir hay or stover, or prairie hay, the grain ration should be made up of such feeds as bran, oil meal, oats, etc. The protein feeds are the most expensive feeds on the market; hence a cheaper dairy ration can be obtained in localities where the protein is produced in such home-grown feeds as alfalfa, pea, and clover hay.

COWS MUST BE FED AS INDIVIDUALS

To feed cows economically they must be fed as individuals and not as a herd. It is often the case that cows in a herd are all fed the same quantity, regardless of the quantity of milk produced. By such a practice some cows are overfed, while others are underfed. The amount of milk a cow will produce can be influenced by feeding, and in this way the amount of butter fat produced can also be affected. The per cent of fat in milk, however, cannot be directly increased by feeding. It is to a certain extent a breed characteristic, but also varies with the individual.

In feeding animals it should be understood that the animal uses a certain amount of the food it receives to maintain the body. This is called food of maintenance and it is the first use to which the animal puts its food, whether producing milk or not. The feed given in excess of this amount is used for producing milk, storing fat on the body, or for growth in the case of the young animal.

It is in feeding the individual cow that the keeping of milk records serves one of the greatest needs. By feeding the cow in proportion to her production, as explained later, the cow is given an opportunity to demonstrate her ability to produce economically.

Of the two common mistakes in feeding, perhaps underfeeding is the more common. It is a poor practice and a serious mistake to feed a cow only the amount required to maintain her body and to deprive her of sufficient additional feed to produce all the milk she is capable of producing. The effect of underfeeding may not be noticed at once, as a cow will produce milk for a time at the expense of her body. That is, she will take the surplus flesh off her body and convert it into milk. Hence, if a cow declines in weight while producing milk it shows that she is not receiving enough feed. Overfeeding may be detected in a short time because the cow will put fat on her body, or go off feed.

THE VALUE OF SILAGE

Another condition of the early summer ration that should be maintained or imitated during the winter, is that of feeding a succulent ration. By the term succulent feed is meant feed having the property possessed by green grass. Such a feed has a value in addition to the nutrients it furnishes. It serves to keep the digestive organs in good condition. This succulent may be secured in the winter ration by feeding silage or roots. Where roots can be grown successfully they serve the purpose well. In this state silage is the cheapest succulent feed, because it is possible to obtain large yields of corn, cane, or kafir, and such feeds make excellent silage. Aside from supplying an excellent feed, the silo furnishes a means of handling the whole forage plant in the most convenient and best way possible.

A FEW RATIONS

The main object in formulating a ration, after selecting the feeds to be used, is to provide a sufficient bulk at all times to satisfy the appetite and feeding capacity of the animal and to furnish the amount of nutrients needed for the work the cow is doing. If the ration lacks bulk the cow will be discontented. An animal may be fed enough nutrients in the form of grain to perform her work, but may receive too little of bulk to be satisfied. The roughage should form the foundation of the dairy ration. A cow should have all the roughage she will clean up at all times and the grain ration should be regulated by the amount of milk produced. A cow will generally

eat one pound of alfalfa hay and three pounds of silage per 100 pounds of live weight.

In the absence of silage the amount of hay consumed will increase. With plenty of silage and legume hay a cow will produce milk up to a gallon and a half to two gallons daily. Above this production grain should be fed in proportion to production.

As the winter-feeding period comes on the animal's comfort should be considered. Shelter and clean quarters should be provided. A cow will respond readily to warm and comfortable stables, well lighted and properly ventilated. If exposed to cold, a large portion of the feed ration which otherwise would be turned into milk goes to supply the necessary warmth. This makes economic feeding impossible, since the feed of the dairy cow is expensive fuel.

In recent years evidence has been presented from several parts of the country indicating a deficiency in certain mineral elements in the feeds raised in those localities. This deficiency eventually showed in the poor development of the live stock. As yet there is but little evidence of any such conditions in the state of Kansas. It is well known that high-producing cows use large amounts of calcium, but a ration making use of liberal amounts of alfalfa hay or other legume hay with a mixed-grain ration generally will furnish sufficient calcium and other minerals for the cow's need. In the event that an additional safeguard of minerals is desired, a good mixture may be made by using equal parts of special steamed bone meal, finely ground limestone, and common salt. As the result of experimental work at the Wisconsin[3] and Michigan[4] agricultural experiment stations, this mixture is recommended over the more complex and more expensive mineral mixtures on the market. This mixture can be fed by adding three pounds to each 100 pounds of the grain mixture. The special steamed bone meal may be obtained at most feed dealers or from any of the packing houses. Finely powdered limestone may be obtained at almost any rock crusher.

Additional salt can be fed to the cows by allowing them free access to salt outside of the barn.

SUGGESTED RATIONS FOR DAIRY COWS

In the rations suggested below, alfalfa hay is preferred, but any legume hay may be used. In the grain mixtures, corn, oats, barley, corn and cob meal, kafir, and Kansas Orange cane may, when ground, be interchanged as price and availability dictate. When alfalfa hay or silage is fed either

3. Hart, E. B., Steenbock, H., and Morrison, F. B. The mineral feed problem in Wisconsin. Wis. Agr. Expt. Sta. Bul. 390:1-28. Figs. 14. 1927.

4. Reed, O. E., and Huffman, C. F. Feeding minerals to dairy cattle. Mich. Agr. Expt. Sta. Circ. Bul. 95:1-14. Figs. 6. 1926.

cottonseed meal or linseed oil meal may be used. In the absence of a legume hay and silage, linseed meal is to be preferred. Ground soy beans, soy-bean meal, and gluten meal may be used as protein supplements along with or in place of cottonseed meal and linseed oil meal. When bran is high in price ground oats or ground alfalfa may be substituted.

Suggested Ration No. 1.—If alfalfa hay is the only roughage the ration can be balanced by giving the cow what hay she will eat and 1 pound of corn chop, ground barley, ground kafir, or ground oats for each 4 pounds of milk she produces per day. A mixture of equal parts of any of these grains may be used, also. For cows producing less than 15 pounds of milk daily a liberal feeding of alfalfa hay is sufficient. For cows producing more than 1.5 pounds of butter fat daily 1 pound of cottonseed meal or linseed oil meal should be added for each additional ½ pound of butter fat produced.

Suggested Ration No. 2.—The following ration, containing 13 per cent digestible protein, can be fed when alfalfa hay is used with silage or other carbohydrate roughage:

400 pounds corn chop.
200 pounds bran,
100 pounds cottonseed meal.

For cows producing more than 12 pounds of milk daily feed 1 pound of the grain mixture to each 4 pounds of milk testing up to 4 per cent in butter fat. For higher-testing milk feed 1 pound of grain to each 3 pounds of milk.

Suggested Ration No. 3.—The ration below, containing 18 per cent of digestible protein, is suitable for feeding with cane hay or any carbohydrate roughage:

200 pounds ground kafir.
200 pounds bran.
100 pounds cottonseed meal.
100 pounds linseed oil meal.

Feed 1 pound of the mixture to each 3 pounds of milk testing up to 4 per cent. For higher-testing milk feed 1 pound of grain for each 2.5 pounds of milk produced.

Suggested Ration No. 4.—This is another ration to use in the absence of a legume hay. The mixture contains 20 per cent of digestible protein and is to be fed in the proportion of 1 pound of the mixture to 3 pounds of milk testing under 4 per cent, and 1 pound to each 2.5 pounds of milk testing above 4 per cent.

200 pounds corn chop.
200 pounds ground oats.
200 pounds bran.
300 pounds cottonseed meal.
150 pounds linseed oil meal.

Suggested Ration No. 5.—When on good pasture a cow producing more than 20 pounds of milk daily should be fed some grain. A mixture of equal parts of ground corn, ground oats, and bran, fed in the proportion of 1 pound of the mixture to each 5 pounds of milk above the minimum specified should prove satisfactory. As the Reason advances and the pasture becomes dry, ration No. 2 should be used.

THE DAIRY BARN [3]

A cow will not produce the maximum flow of milk unless she is comfortable. The barn does not need to be expensive but must provide a comfortable tie, a substantial floor that can be kept clean, and plenty of fresh air and sunlight, and it should be warm enough for comfort in severe weather.

There must be plenty of windows to admit fresh air and sunlight. A dark barn affords an ideal place for the growth of bacteria. Sunlight is the greatest enemy of bacteria and it does not cost much. A barn must be ventilated by dropping the windows in from the top,

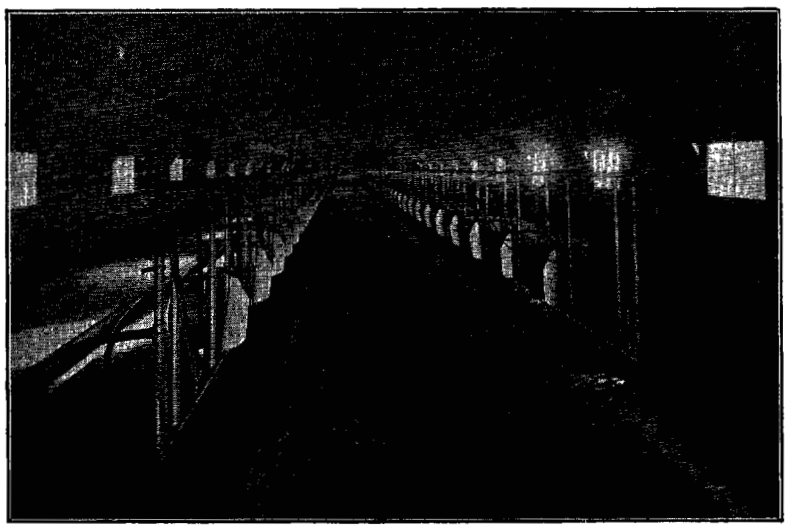


FIG. 11.—Interior view of dairy barn, Kansas State Agricultural College.

or a system of ventilation, such as the King system, can be installed for this purpose.

The stalls should be adjusted to the size of the cows. For Holsteins, or other large cows, the stalls should be at least 3½ feet wide, and 5 feet long, measured from the stanchion to the manure gutter. For cows of the size of the Jersey the stall should be 3 feet wide and 4½ feet long. It is advisable to make the platform wider at one end of the barn than at the other, so that the largest cows may be accommodated at the wider end and the smaller cows at the

3. For further information on dairy buildings the reader is referred to Bulletin 236, "Dairy Buildings for Kansas," copies of which may be secured as long as available by addressing a request to AGRICULTURAL EXPERIMENT STATION, MANHATTAN, KAN.

other. When the platform is accurately adjusted to the size of the cow it is much easier to keep the cows clean. The manger should be at least 2½ feet wide and the manure gutter at least 16 inches wide and from 6 to 10 inches deep.

The floor of a barn may be made from almost any building material, but a cement floor (fig. 11) will give more general satisfaction than will any other, because it is more durable and easier to keep clean. Objection is raised to a cement floor because of its coldness, and some claim that the cow's knees are injured because of the hardness of the cement. If plenty of bedding is used these objections are easily overcome, In cold climates, or where bedding is scarce and expensive, a wooden platform can be built over the cement floor to protect the cows, The cement floors on which the cows are expected to walk should be made rough to prevent the animals from slipping and falling. Too often the floors are made smooth for the reason that they are easier to keep clean, but the cows' comfort and safety should have first consideration,

DIRECTIONS FOR MAKING THE BABCOCK TEST

Apparatus: 17.6 c.c. pipette, 17.5 c.c. acid measure, test bottles, dividers, water bath, centrifuge, and sulphuric acid, specific gravity 1.83 to 1.84. (Fig. 12) The milk to be tested and the acid used should be brought to a temperature of about 70 degrees; this can best be done by the use of the hot-water bath.

1. Pour sample of milk to be tested from one vessel to another at least five times.

2. Take pipette between thumb and second and third fingers, leaving the index finger free. Draw milk into pipette immediately after stirring, and place the index finger over the top of the pipette; now release the finger very slightly until top of the milk column is even with the mark on the pipette.

3. Insert pipette into the opening of the milk-test bottle. The stem of the pipette should be long enough to extend down to the enlarged portion of the bottle to facilitate emptying the pipette. The last drop of milk should be blown from the pipette.

4. Fill acid measure to mark *(never draw acid into pipette),* take milk bottle by the neck between thumb and fingers of the left hand, so that the bottle can be turned; now bring the lip of acid measure to mouth of bottle, and pour acid into the bottle, rotating the bottle so that all the milk will be washed from the neck into the bottle. Hold the bottle at a slant so that the acid will not fall directly on the milk and form pieces of charred curd.

5. Give bottle a rotary motion in order to cause a gradual mixing of milk and acid; sudden mixing will cause large amounts of heat and gas and will throw the material out of the bottle.

6. After the bottle has been stirred thoroughly and the curd is dissolved, place the bottle in centrifuge and whirl five minutes.

7. Place bottles in water bath of 180° F. for five minutes and fill with hot water to neck.

8. Whirl for two minutes.

9. Place in water bath for five minutes and fill with hot water to within one-half inch of the top of bottle.

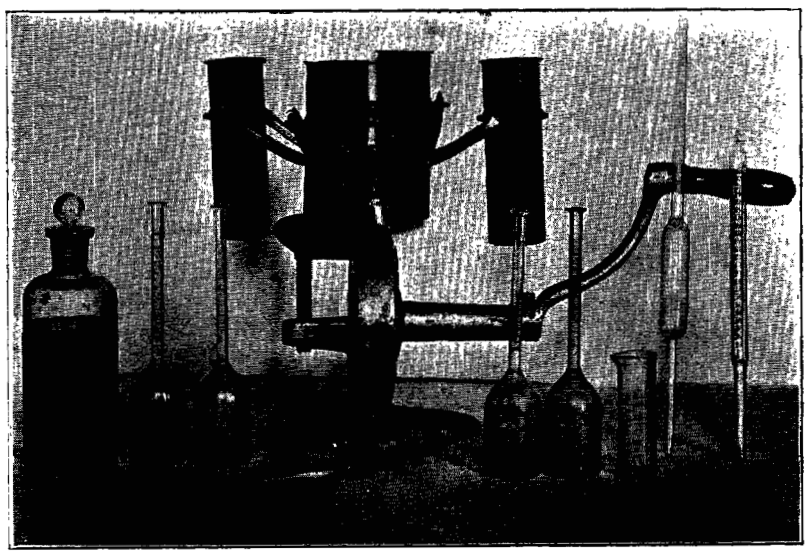


FIG. 12.—Babcock testing outfit.

10. Whirl for two minutes.

11. Place in water bath, 130° F., for five minutes.

12. Measure fat column by placing one point of dividers at bottom and the other at the top; then, keeping dividers at that spread, place one point on the zero mark and note where the other point falls on the scale. That number will correspond to the per cent of fat in the milk.

In testing cream, regular cream-test bottles must be used, and the samples of cream for testing should be weighed insteadof being measured. Only sufficient acid is used to dissolve the milk solids. In reading the cream test read from lower edge of fat, column to a point that includes one-half of meniscus.

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