UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION
COLUMBIA, MISSOURI

CIRCULAR 115 NOVEMBER, 1923

Feeding Dairy Cows

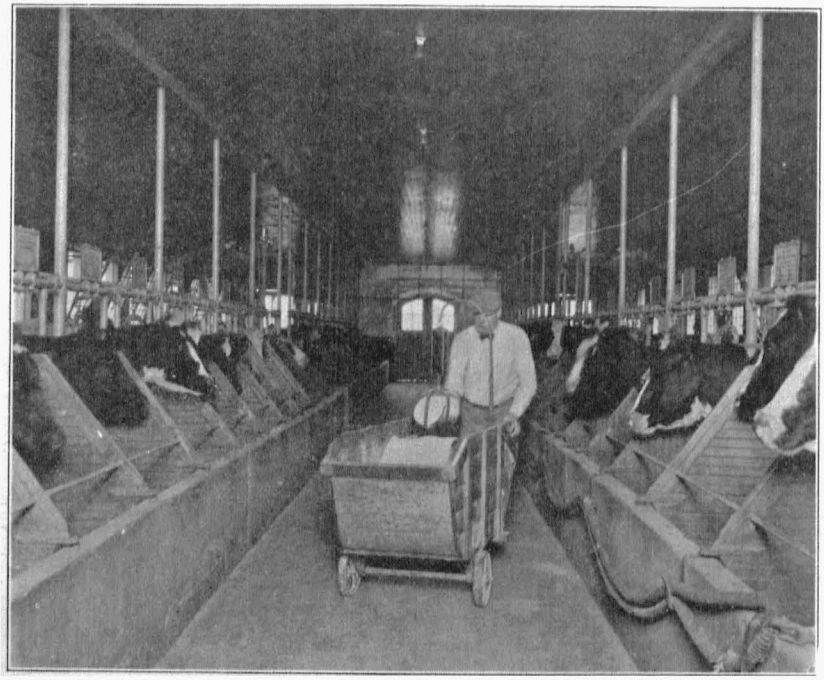
A. C. RAGSDALE

Profitable milk production depends much upon selecting and buying feeds. Improper feeding is thought by those familiar with prevailing conditions to be the chief factor limiting profits with the majority of milk cows. A good cow may do well for a considerable period of time on poor feeds but this is done at the expense of her body and if proper feed is not supplied even the best cows cannot continue to give a large yield of milk.

REQUIREMENTS OF A DAIRY RATION

In formulating a ration which will approach the ideal there are at least six factors which may be regarded as requirements:

Balance of nutrients is essential; because, if the dairyman is to get maximum profit from his cows, he must supply nutrients in such quantities and of such quality



as to keep them at their maximum production. This usually means a ration having a nutritive ratio between 1 to 4½ and 1 to 7, the ration with the narrower ratio going to the higher producing cows.

A succulent feed when given with other roughages and grains renders them more palatable and aids in their digestion. For instance; June grass pasture is Nature's best feed for the dairy cow, although it contains 80 per cent water. Corn silage is perhaps our best and most economical succulent feed, since roots and soiling crops, though capable of serving the same purpose, are usually more expensive. Beet pulp and molasses are not succulent feeds, but where there is no succulence either makes a desirable addition to the ration since both exert a beneficial effect on the bowels.

Palatability is important, for it is essential that a cow's feed appeal to her appetite. Make the feed palatable by keeping the mangers clean and by feeding three or more different grains. Greatest returns may be expected only when the cow enjoys her feed.

Variety in the ration means palatability and gives greater assurance of sufficient mineral matter in the ration. While variety is not so essential for low producing cows, it is desirable to have at least four plants represented in the entire ration including both roughages and grain feeds.

Bulk is necessary because a cow's stomach is especially adapted to handle bulky feeds. A ration deficient in roughage does not seem to satisfy the cow regardless of the amount of grain she receives. Bulk is closely associated with palatability. Therefore, in choosing bulky feeds dry roughages such as hay are usually not sufficient but some succulence such as silage or roots seems necessary to bring about an ideal condition.

Economy in feed selection often means the difference between profit and loss. Home-grown feeds usually furnish nutrients more cheaply than they can be purchased. Usually, therefore, every dairyman should grow all the feed possible and when necessary to purchase feeding stuffs select those which furnish the nutrients desired most economically.

Low costs of nutrients rather than low price per hundredweight is the proper measure of the relative economy of feeding stuff. Dividing the cost of 100 pounds of a feeding stuff by the pounds of digestible protein which it contains gives the cost of a pound of protein in that particular feed. In like manner dividing the cost of 100 pounds of a feed by the total digestible nutrients gives the cost per pound of total nutrients.

For example if it is desired to determine whether cottonseed meal or linseed oil meal is the more economical when either can be bought for $50 per ton, or $2.50 per hundredweight; Table II giving the percentage of digestible nutrients in feeding stuffs shows that cottonseed meal contains 37 pounds digestible crude protein. Dividing $2.50 by 37 we get 6¾ cents as the cost of 1 pound of digestible crude protein. In like manner the cost of 1 pound of digestible crude protein, when supplied by linseed oil meal is found to be 8¼ cents per pound. Thus at the prices given cottonseed meal is the more economical feed as a source of protein. The relative cost of total digestible nutrients is determined in a similar manner. The figures thus obtained are worthy of consideration by every feeder as they denote the relative cost of the really useful, growth-promoting, milk-stimulating, food nutrients.

It must be remembered, however, that the best rations cannot be computed on the basis of costs alone, but consideration must be given to balance of nutrients, succulence, palatability, variety, and bulk. As a fundamental principle, however, it is well to determine the cost per pound of nutrients in available feeding stuffs.

The feeder is then in a position to select those feeds which mixed together will furnish all the requirements of a good ration. It must also be borne in mind that this method of studying the comparative economy of feeding stuffs, while fairly accurate when feeds of similar composition and general characteristics are compared, is not altogether applicable when feeding stuffs of widely varying composition and characteristics are considered.

SELECTING RATIONS OF MILK COWS

The first thing to consider in selecting a ration is the feeds available, especially the kinds of roughage, and with particular reference to whether a leguminous hay and a succulent feed are available. The second step is to select a grain mixture that, with the roughages available, is best suited for general use and then to feed it to the whole milking herd according to the individual requirements of the cows. The experienced feeder will know and the novice must learn by experience how to vary the ration to secure the maximum production from individual cows when it is desired to push certain animals for large production.

Every dairy farmer welcomes the time when he can turn his cattle out to pasture, for experience has taught him that it is late spring or early summer when the cows are on luxuriant pasture that the dairy herd normally reaches the maximum production of the year. Pasture grass furnishes the choicest feed for dairy cattle; for not only is the supply of nutrients liberal but also the feed is palatable, and succulent and good pasture is rich in protein, mineral matter, and vitamins.

Combinations of hay, silage or roots, and suitable grains make desirable and profitable rations for dairy cows when all other conditions relating to care and management are satisfactory. Good alfalfa, clover, soybean, or cowpea hay, together with good corn silage, and a well selected concentrate mixture, provides a ration that is approximately equal to good pasture. The better the hay and silage which constitute the roughage, the simpler the grain mixture can be. When silage or roots and legume hays are not available, more expensive grain mixtures and more liberal feeding of them are necessary.

Roughages naturally divide themselves into three groups. These groups together with grain mixtures suited to be fed with each are as follows:

Medium Protein Roughages.—Silage, roots or other non-legumes when fed in approximately equivalent portions with alfalfa, clover, cowpea, soybean, or other leguminous roughages, give the best possible results. The following types of grain mixtures are well suited to this type of roughage. (Mixtures number 3 and 4 are especially desirable for test cows.)

1

400 lbs. ground corn
200 lbs. wheat bran
100 lbs. cottonseed meal

2

400 lbs. ground corn
200 lbs. wheat bran
200 lbs. ground oats
100 lbs. cottonseed meal
100 lbs. linseed oil meal

3

300 lbs. corn and cob meal
100 lbs. wheat middlings
100 lbs. wheat bran
100 lbs. ground oats
100 lbs. gluten feed
100 lbs. linseed oil meal

4

200 lbs. hominy feed
200 lbs. ground corn
200 lbs. wheat bran
200 lbs. ground oats
100 lbs. linseed oil meal
100 lbs. cottonseed meal
100 lbs. gluten feed

Low Protein Roughages.—Silage, roots, timothy hay, corn stover, mixed hay and other non-legumes or any combination of these roughages, in order to give satisfactory results should be fed with grain mixtures such as are listed below.

1	2
100 lbs. ground corn	200 lbs. ground corn
100 lbs. wheat bran	100 lbs. wheat bran
100 lbs. cottonseed meal	100 lbs. ground oats
	100 lbs. cottonseed meal
	100 lbs. linseed oil meal

3	4
100 lbs. corn and cob meal	100 lbs. hominy feed
100 lbs. wheat bran	100 lbs. wheat bran
100 lbs. gluten feed	100 lbs. ground oats
100 lbs. linseed oil meal	100 lbs. gluten feed
	50 lbs. cottonseed meal
	50 lbs. linseed oil meal

High Protein Roughages.—Alfalfa, clover, cowpea, soybean, or other legumes, singly or in any combination give good results with such grain mixtures as are here suggested. (Mixtures number 3 and 4 are recommended for cows on test.)

1	2
300 lbs. ground corn	400 lbs. ground corn
100 lbs. wheat bran	200 lbs. ground oats
50 lbs. cottonseed meal	100 lbs. wheat bran
	50 lbs. cottonseed meal
	50 lbs. linseed oil meal

3	4
500 lbs. corn and cob meal	200 lbs. ground corn
100 lbs. wheat middlings	200 lbs. hominy feed
100 lbs. wheat bran	100 lbs. wheat bran
50 lbs. gluten feed	100 lbs. ground oats
50 lbs. linseed oil meal	50 lbs. linseed oil meal
	50 lbs. cottonseed meal
	50 lbs. gluten feed

Under usual herd practice, ground corn, hominy feed, corn and cob meal, ground barley, ground wheat, and similar feeds may be regarded as of practically equal feeding value and any one or any combination of two or more may be substituted for any other pound for pound. In like manner wheat bran, and ground oats may be substituted one for the other and in a similar manner cottonseed meal, linseed oil meal, gluten feed and similar high protein concentrates may be substituted pound for pound for each other. While such substitutions do somewhat disturb the balance of nutrients and may affect the physical character of the ration the results are usually satisfactory where reasonable judgment is used.

FEEDING RECOMMENDATIONS

For the Winter Ration.—1. Feed all the roughage the cow will clean up. This will be approximately 3 pounds corn silage and 1 pound of hay, or 5 to 6 pounds of roots and 1 pound of hay, or 1 pound of dried beet pulp soaked twelve to twenty-four hours before feeding and 1 pound of hay, or 2 pounds of legume hay or other dried roughage, for each 100 pounds of live weight. Where at all possible it is

desirable that both a succulent and a leguminous hay be used in the roughage portion of the ration. The most economical production of milk is not ordinarily otherwise possible.

2. Feed the grain mixture according to the amount of milk produced. This means about 1 pound of concentrates for each 3 to 3½ pounds of milk produced in the case of a Jersey or Guernsey, or for each 3½ to 4 pounds of milk produced when feeding an Ayrshire, Brown Swiss, or Holstein.

For the Cow on Pasture.—Many farmers make the mistake of turning their cattle on pasture too early in the spring. This not only reduces the amount of grass for the rest of the season but is apt to cause a fall in the milk yield of the cow, for this early pasturage is so watery that the cows cannot consume enough of it to maintain their production. It is best to wait until the grass is more mature and also to continue giving the cows some hay and silage and some grain in the barn for a time after they are turned on pasture. Some good rules for summer feeding follow:

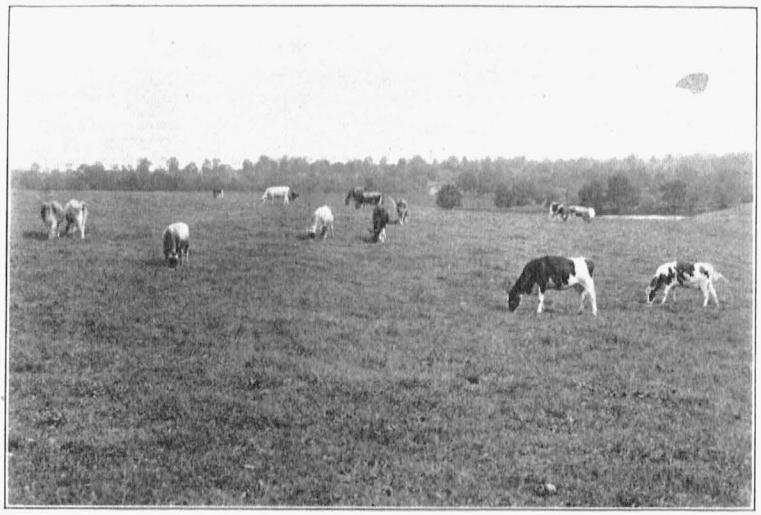


Fig 2.—While on luxuriant pasture in late spring and early summer the dairy herd normally reaches the maximum production of the year. Later, in July and August it is necessary to provide supplementary feed for all cows in milk if a profitable yield is to be maintained.

When on good pasture it is not usually economical to feed grain to cows producing small to average quantities of milk; but heavy producers require more nutrients than they can get from the grass alone. One point of importance that has been observed in connection with the feeding of grain on pasture is that cows receiving grain produce better after the pasture season is over and this should be taken into account in considering the advisability of feeding grain.

The grain mixtures suggested for winter feeding are equally suitable for summer feeding excepting, (a) it is often desirable to reduce the proportions of heating feeds such as corn and of laxative feeds such as oil meal, and (b) the proportion of

high protein feeds such as cottonseed meal, gluten feed, or linseed oil meal may usually be reduced about one-fourth to one-third with economy.

A Jersey or Guernsey cow producing as much as 20 pounds of milk daily should receive while on pasture about 3 pounds of grain and in the case of heavier producers one additional pound fo each 3½ pounds of milk up to 30 pounds. For a production of more than 30 pounds of milk an extra pound of the grain mixture should be given for each additional 2½ to 3 pounds of milk produced. A cow producing 40 pounds of milk daily will thus receive about 10 pounds of the grain mixture and about 14 pounds for a production of 50 pounds.

In the case of a Holstein, Brown Swiss, or Ayrshire, feed 3 pounds of the grain mixture if the daily milk production is as much as 25 pounds. Feed an extra pound for each additional 3½ pounds of milk produced up to 50 pounds. A cow producing 50 pounds of milk daily would thus receive approximately 10 pounds of the grain mixture. For a production above 50 pounds it will usually require an extra pound of grain for each additional 3 pounds of milk produced.

During periods when the pastures are short, supplement them with silage or some green feed in addition to the grain mixture. If this is not done cows will drop in milk flow and run down in flesh so that they cannot be brought back to a satisfactory milk flow during the following winter. If soiling crops are used it is necessary to feed 40 to 50 pounds or more to supply as much dry matter as 30 pounds of silage or 10 pounds of hay. Under Missouri conditions silage is usually more economical than soiling crops for supplementing short pastures.

General Considerations.—The particular order of feeding grain and roughages is not one of importance for when grain and hay are eaten separately they are thoroughly mixed in the paunch of the cow. It may be said, however, that in most instances the cow seems better satisfied when the grain is given first, and with it out of the way, she fills up on the roughages before her. Hay and other dry roughages also fill the air with dust if fed before milking. Silage, turnips, or other feeds with a marked odor should be given only after milking.

The live weight of a cow is a good index to whether she is being fed a proper amount, but good judgment must be used in regulating the ration by observing this condition. It is expected that a cow will lose weight during the first few weeks of her lactation period, and that she will gain in weight toward the end of the milking period.

Heifers in milk will naturally require somewhat more feed than mature cows yielding the same amount of milk because they require some nutrients for growth as well as for maintenance and milk production. Liberal feeding of the heifers results not only in larger immediate production but makes greater profits possible throughout the life of the heifer.

Supply an abundance of fresh water two or more times daily. Often the production is lessened merely because the cows cannot conveniently get plenty of fresh, pure water. The amount of water they will drink depends upon the yield of milk and also the amount of water in their feed. Cows in milk require on the average about 100 pounds or 12½ gallons of water daily and high producing cows much more.

FEEDING DRY COWS

Largest profit during the milking period may be expected only from cows that have been gotten in good condition during the dry period. Cows that are thin at calving time never have an opportunity to do their best.

Silage and a legume hay are the best foundation of a ration for the heifer or dry cow. The fitting ration should be fed liberally (from 7 to 12 pounds per day) for a period of four to six weeks before calving excepting that when within a week or ten days of calving it is best to change to a lighter and mildly laxative ration. Equal parts of corn or hominy feed, wheat bran, ground oats, and from 10 to 25 per cent of linseed oil meal approaches the ideal as a grain mixture for the preparation period. A week or ten days before calving materially reduce or eliminate the corn from the grain mixture and reduce the amount given to from 3 to 7 pounds per day. For the first few days after calving a bran mash or the same grain mixture that was used the week before calving is very satisfactory. If everything goes right the change to the milking ration may be begun three or four days after calving. The feed will then be increased to the limit of the cow's appetite. Experience indicates that this increase should not be more than 1 pound per day excepting in rare cases where the feeder knows his individual cow.

MINERAL REQUIREMENTS OF COWS

Salt.—Dairy cows should have access to salt daily. Roughly, a cow should receive about ¾ of an ounce of salt daily per 1000 pounds of live weight with ⅓ of

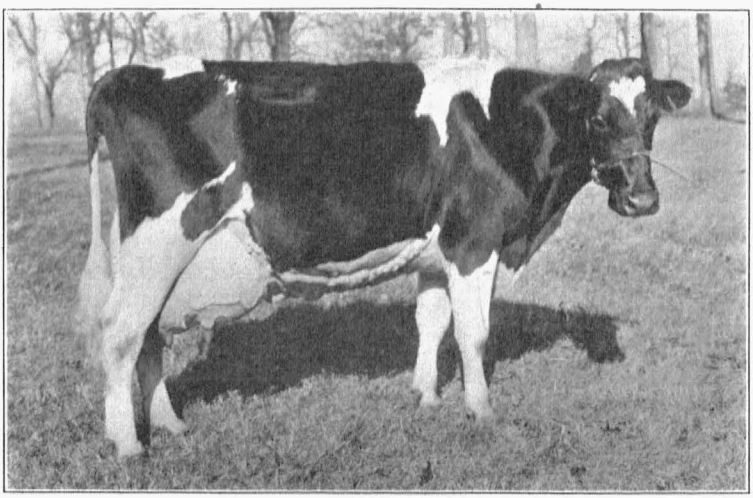


Fig. 3.—Carlotta Pontiac, bred and owned by the Missouri College of Agriculture, in her lifetime produced 157,896 pounds milk containing 4,896 pounds of fat (6,120 pounds butter). At $2.00 per hundred pounds this milk would be worth $3,157.92. A productive dairy cow and a proper system of feeding are two fundamentals in profitable milk production.

an ounce in addition for each 10 pounds of milk she produces. Cows may be allowed free access to salt, they may be fed salt at regular intervals, or it may be mixed with their feed. A plan followed by many dairymen is to mix about 1 pound of salt with each 100 pounds of the grain mixture.

Calcium.—Leguminous roughages like alfalfa and clover hay and good, green pasture ordinarily furnish an abundance of calcium (lime). Cows receiving a poor grade of roughage such as timothy hay or other non-leguminous roughages, or that are getting feed produced on acid soils should ordinarily receive some calcium

in addition. Where legume hay is not available, and for exceptionally heavy producing cows, it is recommended that 3 to 4 pounds of steamed bone meal, pure, finely ground limestone, wood ashes, or thoroughly air-slacked lime, be added to each 100 pounds of concentrates.

Phosphorus.—Wheat bran is especially rich in phosphorus, and other grains and mill feeds contain varying amounts of it. Ordinarily these feeds may be depended upon to furnish all the phosphorus needed. Some authorities have found that the daily addition of ½ pound of sodium phosphate, during the dry period of the cow increased the milk production in the following lactation. At present, however, the value of this practice has not been sufficiently demonstrated. It is, therefore, not recommended.

Iodine.—A lack of iodine in the feed causes goiter in calves. Where this trouble exists add 1-10 of a pound of sodium or potassium iodine to each 1,000 pounds of grain fed to pregnant cows. If more convenient dissolve one ounce of the potassium

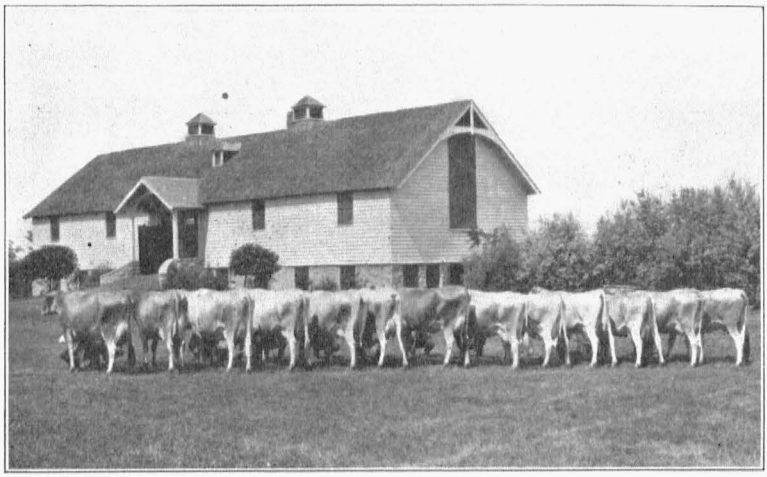


Fig. 4.—Thirteen daughters of Sultana's Virginia Lad, a sire of twenty-five Register of Merit daughters, averaging 579 pounds fat on a mature basis. These cows show the profitable results of good breeding and good feeding.

or sodium iodine in a gallon of water. One tablespoonful (containing about 2 grains of the compound) is a daily dose and may be placed in the drinking water or sprinkled on the feed.

Commercial Mineral Mixtures.—Many commercial mineral mixtures have been placed on the market and are being widely advertised. There is as yet no scientific evidence to show that a farmer will secure any better results from these expensive mixtures than from the simple mineral supplements already mentioned.

Vitamins.—When an abundance of good legume hay is available there will be no lack of vitamins. No prepared vitamin preparation need be purchased.

COMMERCIAL MIXED FEEDS

There are a great many mixed feeds on the market under special trade names. Many of these feeds are the result of honest and intelligent efforts to furnish a ready-mixed, well balanced, grain mixture for dairy cows. A number have won good

reputations among intelligent feeders who are pushing cows for high records, particularly where variety and highly nutritious feed is important rather than cost. In other cases where the supply of unmixed concentrates available on the local market is limited, the farmer has often found a ready-mixed feed economical. There is another class of ready-mixed feeds that consist largely of low-grade materials. Such feeds should be avoided. Any dairyman purchasing feeding stuffs should make a thorough study of the feeds offered before buying, and should compare the cost of nutrients he can secure in any ready-mixed feed with the cost of nutrients in the standard products from which he would otherwise mix his own feed. The matter of buying commercial mixed feeds is one of determining their efficiency and economy.

FIGURING THE DAIRY RATION

It pays to study feeds and to figure rations. Feeds differ in market price, composition, palatability, and in their effect on the cow. It is necessary to consider the market price in order to secure greatest profits, but the market price is no guide of the actual feeding value. In order to figure rations for dairy cows it is necessary first to know the amounts of the various nutrients they require. The following table shows the requirements of dairy cows according to the Morrison Feeding Standard.

TABLE I.—MORRISON FEEDING STANDARD FOR DAIRY COWS.

	Digestible crude protein	Total digestible nutrients
	(*lbs.*)	(*lbs.*)
For maintenance of 1000-lb. cow	0.700	7.925
To allow for maintenance add:		
For each lb. of 3.0 per ct. milk	0.047 – 0.057	0.257 – 0.286
For each lb. of 3.5 per ct. milk	0.049 – 0.061	0.284 – 0.316
For each lb. of 4.0 per ct. milk	0.054 – 0.065	0.311 – 0.346
For each lb. of 4.5 per ct. milk	0.057 – 0.069	0.338 – 0.376
For each lb. of 5.0 per ct. milk	0.060 – 0.073	0.362 – 0.402
For each lb. of 5.5 per ct. milk	0.064 – 0.077	0.385 – 0.428
For each lb. of 6.0 per ct. milk	0.067 – 0.081	0.409 – 0.454
For each lb. of 6.5 per ct. milk	0.072 – 0.085	0.434 – 0.482
For each lb. of 7.0 per ct. milk	0.074 – 0.089	0.454 – 0.505

To find the nutrients required for a cow for both maintenance and production three steps in computation are necessary. (1) Compute the nutrients required for maintaining a cow of the given weight. For example, the nutrients needed for a 960-pound cow may be calculated from Table I by finding the nutrients required for 100 pounds and multiplying this by 9.6. (2) Figure the nutrients required for the amount of milk containing the percentage of butterfat which the cow in question yields. For example, if a cow produces 25 pounds of milk testing 5 per cent fat, the nutrients required for 1 pound of such milk are found in Table I and the amount multiplied by 25. (3) Add together the nutrients required for maintenance and for production, and these give the amount of nutrients that should be supplied by the ration.

THE METHOD OF CALCULATING THE RATION

The method of calculating the dairy ration by the Morrison Feeding Standard is based on the digestible crude protein and total digestible nutrients. Given a

960-pound cow, the first step is to determine the nutrients required for her maintenance. Table I shows that for this purpose a 1000-pound cow requires 0.700 pounds protein and 7.925 pounds of total digestible nutrients. Dividing these figures by 10 gives the nutrients required for the maintenance of 100 pounds and multiplying the result by 9.6 gives results as follows:

	Digestible crude protein (lbs.)	Total digestible nutrients (lbs.)
For maintenance of a 960-lb. cow	0.672	7.608

Assuming that this cow produces 25 pounds of 5 per cent milk we learn from Table I that the amount of nutrients required for each pound of 5 per cent milk is between 0.060 and 0.073 pounds of protein and between 0.362 and 0.402 pounds of total digestible nutrients. Multiplying each of these figures by 25 we get a range of from 1.500 to 1.825 pounds of protein and from 9.050 to 10.050 pounds of total digestible nutrients required for the 25 pounds of milk. The total nutrients required for such a cow for both maintenance and milk production may then be summarized thus:

	Digestible crude protein (lbs.)		Total digestible nutrients (lbs.)	
Maintenance ration of a 960-lb. cow	.672	.672	7.608	7.608
For producing 25 pounds of 5 per cent milk	1.500	1.825	9.050	10.050
Total nutrients required	2.172	2.497	16.658	17.658

The next step is to determine the kinds and amounts of suitable feeds which will supply the protein and total digestible nutrients required. In good dairy practice corn silage and a legume hay are generally fed. From the rules previously stated 30 pounds corn silage and 10 pounds alfalfa hay are about the right amounts of roughage for a cow of this weight. From Table II, showing the composition of some common dairy feeds, we find the nutrients contained in the given amounts of these feeds to be as follows:

	Digestible crude protein (lbs.)	Total digestible nutrients (lbs.)
Corn silage 30 pounds	0.33	5.310
Alfalfa hay 10 pounds	1.06	5.160
Total nutrients supplied by roughage	1.39	10.470

If we subtract from the total nutrients required the amount of nutrients supplied by the roughage we will find the amount of nutrients to be supplied by the grain mixture.

	Digestible crude protein (lbs.)		Total digestible nutrients (lbs.)	
Total nutrients required	2.172	2.497	16.658	17.658
Nutrients supplied by roughage	1.390	1.390	10.470	10.470
Nutrients to be supplied by grain mixture	0.782	1.107	6.188	7.188

TABLE II.—DIGESTIBLE NUTRIENTS IN SOME COMMON FEEDING STUFFS.

	Digestible Crude Protein	Total Digestible Nutrients	Nutritive Ratio
Dried Roughages:	Pounds	Pounds	1;
Alfalfa hay	10.6	51.6	3.9
Red clover hay	7.6	50.9	5.7
Cowpea hay	13.1	49.0	2.7
Soybean hay	11.7	53.6	3.6
Sudan grass	3.7	51.4	12.9
Timothy hay	3.0	48.5	15.2
Orchard grass	4.7	49.4	9.5
Corn stover	2.1	46.1	21.0
Kafir stover	1.7	47.7	27.1
Kafir fodder	4.1	52.9	11.9
Sorghum fodder	2.8	52.1	17.6
Soybean straw	2.8	43.5	14.5
Cowpea straw	3.4	44.1	12.0
Oat straw	1.0	45.6	44.6
Wheat straw	0.7	36.9	51.7
Silage, Roots and Fresh Green Roughages:			
Corn silage	1.1	17.7	15.1
Corn stover silage	0.6	12.2	19.3
Kafir silage	0.8	17.5	20.9
Mangels	0.8	7.4	8.2
Bluegrass (before heading)	3.7	15.9	3.3
Bluegrass (all analyses)	2.3	18.5	7.0
Alfalfa	3.3	14.6	3.4
Red clover	2.7	17.1	5.3
Cowpeas	2.3	11.0	3.8
Soybeans	3.2	14.5	3.5
Peas and oats fodder	2.4	14.4	5.0
Corn fodder	1.0	14.7	13.7
Kafir fodder	1.1	14.4	12.1
Sweet sorghum fodder	0.7	17.1	23.4
Orchard grass	1.7	16.1	8.5
Sudan grass	0.8	13.5	15.9
Concentrates:			
Ground corn (No. 2)	7.1	81.7	10.4
Corn and cob meal	6.1	78.1	11.8
Hominy feed	7.0	84.6	11.1
Ground wheat	9.2	80.0	7.7
Ground barley	9.0	79.4	7.8
Ground oats	9.7	70.4	6.3
Wheat bran	12.5	60.9	3.9
Wheat middlings, standard (shorts)	13.4	69.3	4.2
Cottonseed meal (choice)	37.0	78.2	1.1
Linseed meal (old process)	30.2	77.9	1.6
Gluten feed (from corn)	21.6	80.7	2.7
Gluten meal (from corn)	30.2	84.0	1.8
Corn germ meal	16.5	82.5	4.0
Brewers dried grains	21.5	65.7	2.1
Distilled dried grains (from corn)	22.4	88.9	3.0
Ground soybeans	33.2	94.1	1.8
Soybean oil meal	39.7	84.5	1.1
Molasses cane or blackstrap	1.0	59.5	58.5
Dried beet pulp	4.6	71.6	14.6

A grain mixture that is much used consists of: Ground corn, four parts, wheat bran, 2 parts, cottonseedmeal, one part.

For a trial we will determine the nutrients supplied by 8 pounds of such a mixture since this is the approximate amount of grain we would expect might be required for a cow producing 25 pounds of 5 per cent milk. From Table II, the composition of this grain mixture is found to be as follows:

	Digestible crude protein (lbs.)	Total digestible nutrients (lbs.)
Ground corn, 4 pounds	0.300	3.428
Wheat bran, 2 pounds	0.250	1.218
Cottonseed meal, 1 pound	0.370	0.782
Total nutrients supplied by 7 pounds of grain mixture	0.920	5.428
Total nutrients supplied by 1 pound of grain mixture	0.131	0.775
Total nutrients supplied by 8 pounds of grain mixture	1.048	6.200

By comparing the nutrients required by the standard with that supplied by the roughage and 8 pounds of this grain mixture we can determine whether we are supplying the correct amount of nutrients.

	Digestible crude protein (lbs.)		Total digestible nutrients (lbs.)	
Nutrients supplied by roughage	1.390	1.390	10.470	10.470
Nutrients supplied by grain mixture	1.048	1.048	6.200	6.200
Total nutrients supplied	2.438	2.438	16.670	16.670
Nutrients required by feeding standard	2.172	2.497	16.658	17.658

It will be seen that the nutrients supplied are within the range called for by the feeding standard. This ration will therefore, undoubtedly, supply approximately the correct amount of nutrients for a 960-pound cow producing 25 pounds of 5 per cent milk. A close study of this ration will also show that it has all the essential requirements of a good dairy ration.

FEEDING THE HERD

Once an economical ration has been worked out for the average cow in the herd it is not necessary to attempt to figure rations for each individual cow. All that is necessary is to feed each cow the grain mixture according to her production. It should be remembered, however, that cows vary widely in productive ability and where it is desired to secure the maximum production from any individual cow the feeder must exercise his judgment and make variations in the ration to suit the individual animal.