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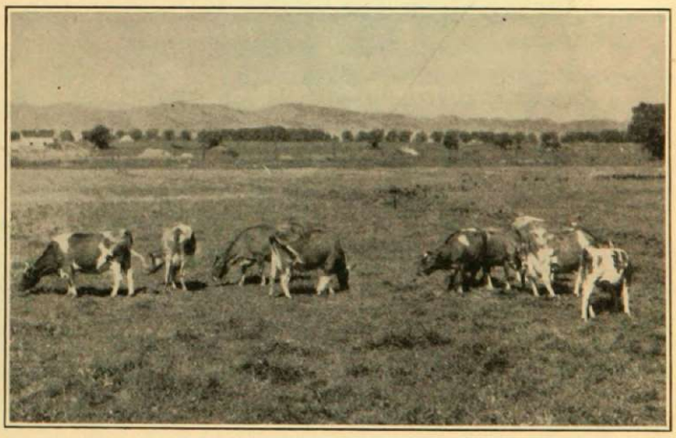
FEEDING AND CARE OF DAIRY CATTLE



Guernsey cows on Morton's permanent pasture mixture

COLORADO AGRICULTURAL COLLEGE
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FEEDING AND CARE OF DAIRY CATTLE

By B. W. FAIRBANKS and C. A. SMITH

Profitable dairying is dependent upon the type of the dairy cows in the herd. The correlation of form and function is recognized by all observers of farm animals. The breeding and selection, for many generations, of dairy cows that will produce profitably, has resulted in a true dairy type.

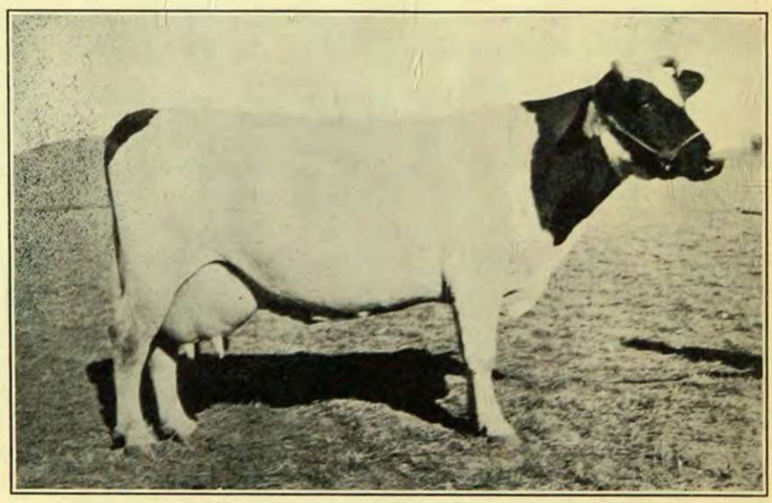
True dairy type is shown by an angular body, something of a wedged-shaped form, a large capacious barrel, width and depth of chest, spacious hind-quarters and a well-developed udder. A large capacious barrel enables the cow to consume large quantities of feed which are required in profitable milk production. A deep and wide chest indicates constitution and vigor which enable the cow to accomplish the great amount of work demanded of her.

The judging and selection of dairy cows is a separate subject by itself. Bulletins and circulars upon this subject are available for distribution by state agricultural colleges and the United States Department of Agriculture.

High Producers are Economical Producers.—The records of the various state experiment stations, and especially records of cow-testing associations bear testimony to the fact that cows of highest production are the most profitable. Such cows are heavy consumers of grain, silage and hay because milk is produced from that feed which is fed in excess of the labor of the other requirements of the dairy cows. If the cow is of the right type and has been bred for milk production, she will more than pay in milk for the heavy consumption of feed. Occasionally a man is heard to criticize a cow because she is a big eater. Suspicion should be aroused when a dairy cow is a small eater, for generally such a cow is a small and unprofitable producer.

Establishing a Dairy Herd.—The milk and butterfat of the United States are produced in the main by small, grade-cow dairies upon thousands of scattered farms. The dairy business is a profitable sideline and makes for a well-balanced and diversified farm business. So to be a dairyman, one does not need a large herd, nor does it necessarily need to be a herd of purebreds.

In establishing the herd, grade cows should be purchased of such quality and in such numbers as desired and finances permit. These foundation cows may not be the most desirable cows obtainable and the herd may be lacking in uniformity of type and production. The



Purebred Holstein-Friesian cow showing good dairy type. Yearly production 17,301 pounds of milk and 657.8 pounds of fat.

sign of a true dairyman is not what his foundation cows looked like or what they produced, but what improvement was made during the succeeding years. The best purebred bull that finances will permit should be purchased to mate with these foundation cows. This bull should have proved production in his ancestry and should possess the marks of prepotency, so that he will transmit dairy qualities and milk production to his offspring. The use of a good purebred sire and the constant culling of females will result in a uniform herd of high-producing and profitable cows.

Each Cow Must Pay Her Way.—The percentage of dairy cows that do not pay for their feed and care, if known, would astound the most practical of dairymen. Careful selections, proper feeding and conscientious care of dairy cattle are important, but to know whether each cow in the herd is paying for her feed and care is imperative. It is net profits and not gross returns that pay the bills.

Purebred cattle that have been bred for centuries for milk production have low producers among them. It is necessary to cull and select purebred cattle. If this is necessary for purebred cattle, it is even more necessary for grade cattle, that have in their ancestry some individuals of uncertain dairy qualities.

A dairy cow will prove her worth or show whether she should be relegated to the block. If the dairyman will weigh her milk carefully,

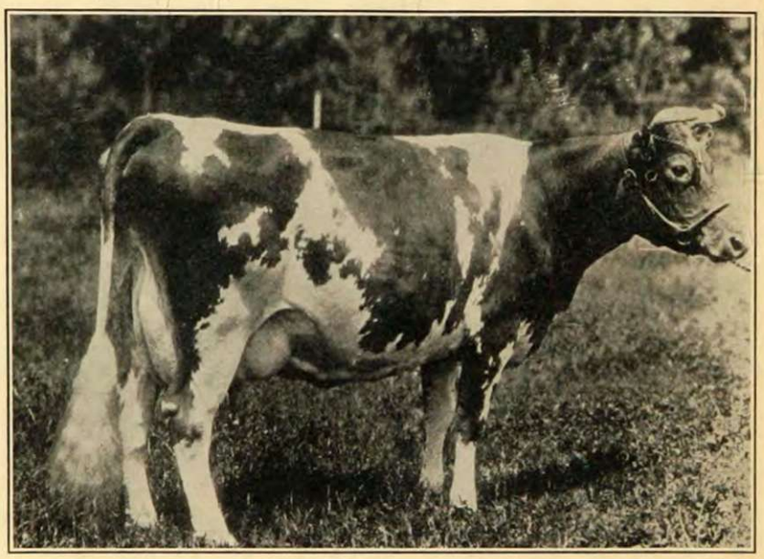
estimate the feed she consumes and apply the Babcock test periodically to her milk, the information thus obtained quickly shows the cows that do not pay their way. A herd of profitable cows is the result of keeping a purebred sire of high-producing ancestry, culling out the unprofitable cows and keeping for replacement, heifers that have been dropped by the highest-producing cows in the herd.

Keeping Records.—The keeping of records takes time and it is admitted that it is a bother. Yet it is questionable whether time spent upon any other one thing will pay greater dividends than the time spent on keeping records of milk production. It will be found, however, that the time required is exceedingly little, if a milk sheet is tacked upon the wall and a pair of spring-balanced milk scales are hung nearby. Each milking of each cow can be quickly weighed and the amount recorded. Once a month a composite sample of each cow is taken for one day and is tested for butterfat. There are simpler methods of record keeping than the one described, but they are not accurate. The time required for such a record is so little and the values received are so great with this method that other methods have not been discussed in this bulletin.

Herd-Improvement Associations.—One of the most effective aids to profitable dairy production has been the herd-improvement or cow-testing association. In brief, it is an organization of approximately 25 farmers who employ a cow tester to assist in record keeping and figuring of results. The cow tester spends one day each month on the farm of each dairyman, who is a member of the association. He weighs the milk, weighs the grain and estimates the weight of the roughage consumed by each cow. A sample of each milking is taken and the composite tested for its butterfat content. From these figures the cow tester computes the milk and butterfat produced by each cow in the herd, and figures the cost of the feed and the return above feed cost for each cow for the current month. Great improvements have been made at small cost by herd-improvement associations.

The average cow in Colorado produces about 141 pounds of butterfat in a year. The cows in herd-improvement associations in Colorado produce an average of 313 pounds of butterfat in a year. Forty-eight herds in herd-improvement associations in Colorado produced 350 pounds of butterfat or better in the year 1928. These results have been accomplished by culling, feeding and breeding.

For further information on herd-improvement associations see your county extension agent or write the Dairy Extension Specialist, Extension Service, Colorado Agricultural College, Fort Collins, Colorado.



Purebred Guernsey cow showing good dairy type

Semi-Official and Official Testing of Dairy Cows.—The semi-official and official testings of dairy cows are important aids to dairy development and are available to those who have purebred registered dairy cows. The rules and regulations for such testing are formulated by the various breed associations. The testing of the cows is done by supervisors of official testing, working under the state experiment stations. If a cow upon test produces above a certain amount of butterfat in a given length of time, age considered, she is admitted into the Advanced Registry, and receives a certificate of Advanced Registry. Such tests are valuable in the sale of purebred cattle and those related to them. A dairyman purchasing a bull to head a herd of grade cows can secure one from many breeders whose ancestry have Advanced Registry records.

For further information concerning Advanced Registry, write the Superintendent of Official Testing, Colorado Agricultural College, Fort Collins, Colorado.

Principles of Dairy-Cow Nutrition

General Requirements.—A ration to meet the requirements of a dairy cow must contain protein, carbohydrates, fats, mineral matter and vitamins. Milk is high in protein and mineral matter, and con-

tains milk sugar and butterfat. A satisfactory dairy ration is high in protein and mineral matter and supplies sufficient calcium and phosphorous to meet all mineral requirements. Grains which furnish energy, carbohydrates and fat are required in fairly liberal amounts to meet the demands for energizing nutrients. The grain mixture is supplemented with roughages of high quality and succulence.

Maintenance Requirements.—At least one-half of the feed consumed by a dairy cow is utilized for maintenance. The importance as well as the expense of this part of the ration is at once apparent. Nature's provision is that the cow will satisfy her maintenance requirements first. If any feed remains for growth, development of fetus or milk production, the amounts fed must be in excess of the maintenance requirements. The maintenance requirements of the dairy cow are usually based upon the individual weight of the cow.

Growth Requirements.—Immature animals require above their maintenance requirements, feed for building of body tissues. Feed nutrients required for growth are protein and mineral matter. As mentioned below, two vitamins play an important part in normal growth.

Pregnancy Requirements.—During the time of pregnancy additional food nutrients are required for the normal development of the fetus. The requirements of pregnancy are largely for protein and some mineral matter. Extensive investigations at the Vermont Experiment Station indicate that the greatest need of additional protein is during the last one-third of the gestation period. At this time the growth of the fetus is most rapid. In other words, during the first two-thirds of a gestation period, the ration need only supply the requirements for maintenance and for the amount of milk which is being produced.

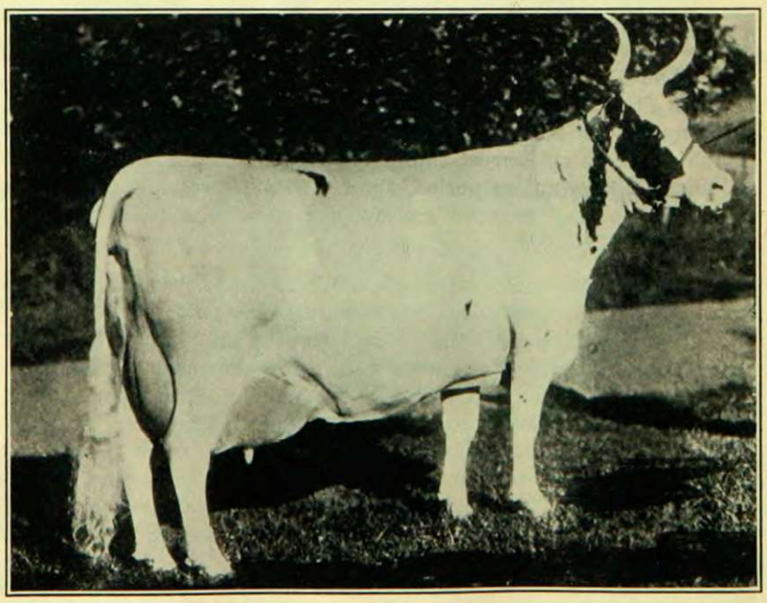
Milk-Production Requirements.—When the needs of maintenance, growth and pregnancy have been satisfied, any nutrients that remain may be utilized for the production of milk. This immediately suggests the importance of liberal feeding in economical and profitable milk production. As milk is high in protein and mineral matter, these two nutrients must be supplied in generous amounts. The feed requirements for milk production are usually based upon the amount of milk or the amount of butterfat produced. In discussing the requirements of milk production, protein and mineral matter are usually emphasized, and rightly so, but the feeder should not overlook the fact that carbohydrates and fats are needed for energy, milk sugars and butterfat. This latter class of nutrients is adequately supplied by generous amounts of the carbonaceous concentrates.

Protein.—The protein of the feed is used by the body to build muscle, hair, hide, etc., and to make milk proteins found in milk. Further, the protein of the feed stimulates metabolism, supports physical well-being and promotes longevity.

In 100 pounds of average milk there are found 3.3 pounds of protein. It is one of the prime essentials of economical milk production. Protein requirements must always be met and there are certain times and conditions when an amount of protein in excess of actual requirements is advantageous.

All proteins are not of the same chemical composition and therefore, individual proteins vary widely in their feeding value. In consequence of this variation, the quality of proteins is as important as the quantity of proteins. Present information upon the quality of proteins is very fragmentary, but enough is known to warrant the recommendation that dairymen feed a variety of feeds. The better results which are obtained are attributed to the fact that proteins from various sources tend to balance one another. This is what is meant by quality of protein.

Carbohydrates and Fats.—The carbohydrates and fats of feeds are used by the body to form heat to maintain body temperature,



Purebred Ayrshire cow showing good dairy type

fat to be stored upon the body, butterfat to be yielded in the milk, and energy to carry on the work of the life process. One hundred pounds of average milk contain 5 pounds of carbohydrates and 4 pounds of butterfat.

Minerals.—Generous amounts of calcium and phosporous are required in high milk production. In fact high producers will yield more of these minerals in their milk than they are able to obtain from a well-balanced dairy ration consisting of a good grain mixture and legume hay. This loss in mineral matter is built up in the body during the latter part of the lactation and during the dry period between lactation periods.

Dairy cows upon pasture are capable of assimilating more calcium than when they are upon dry food. This is due to the calcium-depositing vitamin (vitamin D) which is present abundantly in fresh green forage. When upon pasture cows are under the direct rays of the sun and the undissipated ultra-violet rays of the sun assist in depositing calcium.

In some sections of the United States goitre or "big neck" is experienced. This is due to a lack of iodine.

Sources of Minerals and Mineral Mixtures.—Steamed bonemeal and ground rock phosphate are sources of both calcium and phosphorous; calcium alone is supplied by ground limestone, air-slaked lime, reprecipitated lime cake from sugar factories and sifted wood ashes.

Minerals are supplied by mixing them with the grain mixture or placing them in a box from which the cattle may help themselves.

The following are recommended mineral mixtures:

1. Mix 2 to 4 pounds of ground rock phosphate with each 100 pounds of grain mixture.
2. Mix and place in mineral feed box:

Steamed bonemeal	40 pounds
Air-slaked lime	30 pounds
Salt	30 pounds

3.

Steamed bonemeal	40 pounds
Ground limestone	30 pounds
Salt	30 pounds

Supplying Iodine.—In supplying iodine the following suggestions are made by Kalkus of the Washington Experiment Station:

1. Mix 2 grains of potassium iodine with the feed given each cow daily.
2. Pour 1 teaspoonful of tincture of iodine over the back of the animal every 2 weeks during pregnancy.

3. Inject 10 cubic centimeters of 10 percent solution of tincture of iodine under the skin every 2 weeks during pregnancy.

Need of Salt.—Salt is a requirement of dairy cows. About ¾ of an ounce is required daily per 1000 pounds liveweight and about ¾ of an ounce is required for each 20 pounds of milk produced. The daily requirements will therefore vary from 1 to 3 ounces depending upon weight and production. The methods of feeding salt vary. Some dairymen mix 1 pound of salt into each 100 pounds of feed; others feed it in a salt box to which the cows have constant access, while others put a small handful of salt each day into the manger. Rock salt may be placed before the cows where they can lick it at will.

Need of Vitamins.—The following is taken from Henry and Morrison's "Feeds and Feeding" page 357:

"Dairy cows which are fed well-balanced rations, including plenty of good-quality legume hay, and are supplied with good pasturage or other green feed during the summer, will secure an ample amount of the fat-soluble vitamin for health, for green-leaved plants are rich in this vitamin and it is not destroyed by drying. Furthermore, such rations will furnish plenty of the water-soluble vitamin.**** Also there will be no deficiency of the anti-scorbutic vitamin.**** Therefore, except for the possible relationship of a vitamin to the assimilation of calcium, the rations ordinarily recommended for dairy cows apparently furnish an ample supply of vitamin."

Purebred Jersey cow showing good dairy type

Feeds For Dairy Cows

Classification of Dairy Feeds.—1. Carbonaceous concentrates furnish a large amount of digestible matter in proportion to their bulk. The digestible matter furnished is high in carbohydrates.

2. Nitrogenous concentrates furnish a large amount of digestible matter in proportion to their bulk and this digestible matter is relatively high in protein.

3. Carbonaceous roughages are those feeds which are relatively high in fiber, and the digestible matter is high in carbohydrates.

4. Nitrogenous roughages are those feeds which are relatively high in fiber and the digestible matter is fairly high in protein.

5. Succulent feeds are carbonaceous roughages which contain a large amount of plant juices and the digestible matter which it contains is high in carbohydrates.

Carbonaceous Concentrates

Corn.—Corn is a very popular feed with dairymen because of its palatability and its availability. In feeding value it may be considered as equal to barley. As corn is high in carbohydrates and fats, it furnishes one of the cheap sources of energizing nutrients. It is low in protein and the protein is of poor quality. Mineral matter, especially calcium, is deficient in this grain. In feeding corn, it is necessary to supplement it with feeds which are high in protein and mineral matter. Bran, ground oats, linseed oilmeal, and cottonseed meal are extensively utilized as supplements to corn. As corn is a heavy feed, ground oats or wheat bran are fed to some extent for bulk.

Corn and Cobmeal.—The value of corn and cobmeal in the dairy ration depends upon the presence or absence of other bulky feeds. If the ration contains some bulky feed, such as wheat bran, 100 pounds of corn grain in the form of corn and cobmeal is worth no more than 100 pounds of corn grain in the form of ground corn. If no other bulky concentrates are used in the grain mixture, it may pay to feed corn and cobmeal. Corn and cobmeal and cottonseed meal would be superior to ground corn and cottonseed meal. The latter ration lacks bulk.

Wheat.—Wheat is not commonly fed to dairy cattle because of its price. Salvage wheat, frozen and low-quality wheat, can be fed when available. There are times, tho rare, when wheat is low enough in price that dairymen may include it in the grain mixture. Wheat is a heavy feed and should be mixed with other bulky concentrates. In feeding value ground wheat is equal to ground corn and is also equal to mixed barley and oats. Smutty wheat should not be fed to dairy cows.

Oats.—This grain is more valuable as a dairy-cow feed than its amount of digestible nutrients indicates. This has been demonstrated by many practical feeding tests. Some authorities rank it at 90 percent the value of corn while Lindsey of the Massachusetts Experiment Station found it equal to corn, if fed with bran and mixed hay. Oats are a bulky feed, higher in protein, but considerably lower in carbohydrates and fat than corn. In feeding oats, they should be ground or crushed.

Barley.—In many sections of Colorado, barley is the home-grown carbonaceous concentrate. A better understanding of its feeding value and a more general use of this grain should prove valuable. The Danish dairymen consider a mixture of ground barley and ground oats one of the best mixtures for a dairy cow. Barley is equal to corn in feeding value, in spite of the fact that its chemical composition suggests a slightly lower value. Morrison, Humphrey and Hulce of the Wisconsin Experiment Station fed barley as high as 60 percent of the grain mixture and the results obtained equalled those of corn. Barley should be rolled, ground or crushed.

Rye.—The daily allowance of rye for each dairy cow should not exceed 2 to 3 pounds. Where fed in larger amounts it produces a hard and dry butter. Rye fed in limited amounts and properly mixed with concentrates has a feeding value approximately 95 percent that of corn. Like wheat it should not be fed, if it contains any smut.

Grain Sorghums.—The grain sorghums principally kafir corn, milo and feteria, are the carbonaceous grains of the non-irrigated sections of Colorado. They are extensively grown upon the eastern plains of Colorado. They are valuable grains for milk production and have a feeding value equal to 90 to 95 percent that of corn. Like corn they are low in protein and mineral matter and must be supplemented with feeds which will furnish these two components of a satisfactory ration. As the roughages produced upon the non-irrigated lands are carbonaceous, protein concentrates such as wheat bran, cottonseed meal, or linseed oilmeal must be purchased to balance the rations.

Dried Beet Pulp.—Dried beet pulp is an excellent carbonaceous concentrate and its value as a dairy feed is due to its bulk and laxative and cooling effect. Its feed value varies from 90 percent to equal that of corn, depending upon the feeds with which it is being fed. If a dairyman is purchasing dried beet pulp as an additional source of food nutrients, the price paid should be equal to, or less than that paid for corn. If a dairyman is doing Advanced Registry work or is

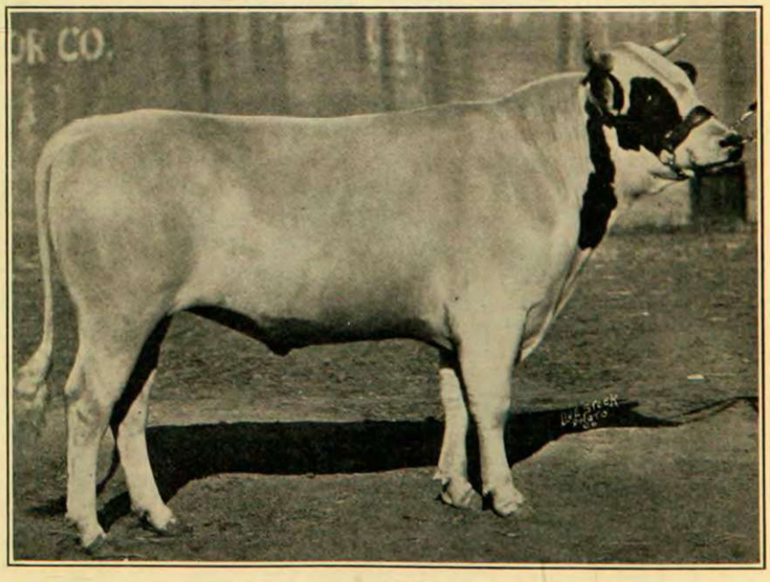
feeding a very heavy ration, dried beet pulp could be purchased at a price exceeding that of corn, because of its bulkiness, laxative and cooling effect. Dried beet pulp may be used as a source of succulence where silage is not available. It is soaked with water from one feeding to the next.

Dried Molasses Beet Pulp.—Dried molasses beet pulp is a bulky carbonaceous concentrate. In feeding tests it has been found practically equal to dried beet pulp. Both dried beet pulp and dried molasses beet pulp are low in protein, and should always be fed with protein-rich supplements.

Beet Molasses.—Beet molasses in Colorado may be considered a cheap source of carbohydrates. When fed in limited quantities in well-balanced rations, its feeding value is equal to corn pound per pound. In feeding molasses not more than 2.5 to 3 pounds of beet molasses should be fed daily per 1000 pounds of liveweight.

Black Strap Molasses.—Practical experience indicates that beet molasses is equal in feeding value to black strap molasses. If the latter is fed, it should be handled in the same manner as beet molasses, discussed above.

Whey.—Whey is a by-product of the cheese industry and may



Holstein bull calf of good type

be fed to dairy cows. It probably gives larger returns when fed to swine or to calves. Twelve pounds of whey have a feeding value equal to 1 pound of corn or barley. As much as 22 pounds of whey have been fed to dairy cows in one day with good results. Dairy cows refuse sour whey.

Nitrogenous Concentrates

Wheat Bran.—Wheat bran is the most popular nitrogenous concentrate fed to dairy cows. Many dairy authorities never recommend a dairy ration without including wheat bran. Due to its popularity, wheat bran is often high in price, making it necessary for the dairyman to understand thoroly its feeding value. Wheat bran is bulky, high in protein, rich in phosphorous, and has a beneficial laxative effect upon the digestive tract. Due to the fact that protein may be purchased cheaper in cottonseed meal or linseed oilmeal as a rule, the value of wheat bran is in its bulk and its laxative effect, rather than in its protein content. Under such conditions the amount of wheat bran could be materially decreased in dairy rations.

Wheat Middlings.—Wheat middlings, while higher in protein than wheat bran, are considerably heavier and not as palatable. They are not generally considered as an ideal dairy feed but can be fed in limited amounts. For best results, the grain mixture should not consist of more than one-third of wheat middlings.

Cottonseed Meal.—Cottonseed meal is a highly nitrogeneous feed and under Colorado conditions is generally one of the cheapest sources of protein. As it is constipating it should be fed with laxative feeds such as wheat bran or linseed oilmeal or with some succulent feed such as silage or roots. Cottonseed meal when fed in limited amounts is not injurious to the cattle and will have no ill effects upon the milk and butterfat produced. This feed is very concentrated and heavy, and should be fed with feeds which are bulky in nature. It should only be fed in moderate amounts, not in excess of 3 pounds daily for mature cows.

Linseed Oilmeal.—Linseed oilmeal is a very valuable and palatable nitrogenous supplement. It may be considered one of the best protein feeds available to dairymen. It would be used more extensively were it not for its cost. Cottonseed meal will furnish protein cheaper than linseed meal, yet the linseed oilmeal is a cheaper source of protein than is wheat bran. Linseed oilmeal is high in protein, laxative, and has a conditioning effect upon the animal. In spite of its high cost, many dairymen feed 1 or 2 pounds of linseed oilmeal with

cottonseed meal to offset the constipating effect of the cottonseed meal. When silage is not fed or when hay from the grasses or fodder and stovers from corn or sorghums are used, it may be necessary to include oilmeal in the grain mixture for its laxative effect.

Corn Gluten Feed.—This nitrogenous concentrate contains twice as much digestible crude protein as wheat bran and it furnishes considerable more total digestible nutrients. When compared with linseed meal or cottonseed meal, it is found that it furnishes only about two-thirds as much digestible crude protein. However, in feeding trials corn gluten feed has been found superior to linseed oilmeal when results were measured by the amount of milk and butterfat produced. This is probably true when it is added to a ration fairly high in protein.

Nitrogenous Roughages

Alfalfa Hay.—Alfalfa is generally ranked first among the hays fed to dairy cows. This valuable legume hay holds its rank because of its high protein content. The proteins are of good quality, the mineral content is high, the palatability is good, and it has a beneficial physiological effect due to its laxativeness.

The high feeding value of this hay makes it possible for it to replace a part of the concentrates. There is a temptation at times to feed hay in such quantities as to replace a large part or all of the concentrates. Alfalfa hay is a roughage and as a roughage it cannot be expected to do the work of a concentrate. Greater and more profitable milk production will follow the addition of sufficient grain to the ration.

Alfalfa Meal.—Alfalfa meal contains 3 times as much fiber and only 85 percent as much digestible crude protein as wheat bran. While this feed is frequently recommended as an addition to the grain mixture, it is still a roughage. The grinding of a roughage will never make a concentrate out of it. Alfalfa meal will add bulk to a grain mixture but further than that there is no experimental evidence which indicates that alfalfa meal is really needed when good alfalfa hay is available.

Sweet-Clover Hays.—The dairymen of Colorado grow both varieties of sweet-clover hay, namely, the white blossom and the yellow blossom. There is considerable controversy as to which is superior. The yellow blossom has a little finer stem than the white blossom and for that reason the feeder usually prefers the hay from the yellow blossom sweet clover. Both hays when well cured may be fed to dairy cattle. The hay from the sweet clover contains as much digestible protein as is found in alfalfa hay.

Soybean Hay.—Soybean hay is equal in feeding value to alfalfa hay for milk production. When cut early it makes a palatable hay. While it can be grown in most dryland sections of Colorado, the rabbits which apparently crave it, make it an unprofitable crop. Were it not for this pest the dryland farmer would have a valuable legume hay, which would greatly simplify feeding problems.

Canada Field Peas.—Hay from Canada field peas is very satisfactory for dairy cows. The amount of protein in this hay is even higher than in alfalfa hay.

Field Pea and Oat Hay.—This is a very popular and satisfactory combination for a hay crop at high altitudes in Colorado. It may be criticized slightly for a lack of palatability but this objection does not become serious when one realizes that for some sections it is the best combination that can be grown for a hay crop.

Carbonaceous Roughages

Corn Fodder.—Corn fodder is low in protein and may be used as a roughage for dairy cows when the protein is built up by some other feed. Alfalfa hay or an addition to the amount of nitrogenous concentrates in the grain mixture are two methods of balancing this ration. Corn fodder is inferior to corn silage and has about the same feeding value as timothy hay pound per pound. When a small amount of corn fodder is fed with alfalfa hay and a well-balanced grain mixture, 1 pound of corn fodder is equal in feeding value to 1 pound of alfalfa hay.

Corn Stover.—Corn stover is too low in food nutrients to be used extensively as a roughage for dairy cows. While it is palatable, it can be fed only in limited quantities. One ton of clover hay has been found to be more valuable than 3 tons of corn stover. In feeding coarse, uncut stover, as much as 34 percent has been wasted. If corn stover is fed, it should be shredded. Allow the cows to pick out what they will and that which remains may be worked into the manure and bedding.

Sorghum Hay.—Sorghum hay is one of the main roughages for dairy cows in the non-irrigated sections. It is highly carbonaceous and low in mineral content. When fed to dairy cows it should be supplemented with a grain ration high in protein and mineral.

Millet Hay or Hershey.—Millet hay is relished by dairy cattle and its feeding value is higher than the hays made from the various grasses. The protein content of this hay is low, being about one-half that of alfalfa hay. Valuable use may be made of this hay, if it is fed with rations properly balanced with protein supplements.

The silo provides a way for economically storing a succulent feed

Succulent Feeds

Corn Silage.—Corn silage is the best and most popular source of succulence in most sections of Colorado. It is palatable, bulky and an economic source of carbohydrates. Corn silage stimulates appetite and prevents animals from going off feed. Where it can be produced it is a great aid to economical milk production. When silage and hay are fed, 1 pound of hay and 3 pounds of silage are fed for each 100 pounds of liveweight. Corn for silage should be cut when the kernel is in the dent stage.

Corn Silage vs. Corn Fodder.—Henry and Morrison average nine trials in which corn silage and corn fodder have been compared. The results show that 7.4 pounds more of milk is produced from 100 pounds of dry matter in corn silage than from the same amount of dry matter in corn fodder. Corn silage is consumed with less waste, there is no loss of food nutrients due to exposure to the weather, and corn silage adds a succulence to the ration which is needed for maximum milk production.

Corn Silage vs. Hay.—Several experiments have been conducted in which one lot of dairy cows was fed hay alone and another fed a combination of hay and silage. In every instance the corn silage has increased the milk flow. It is concluded that 250 to 300 pounds of good corn silage is worth as much as 100 pounds of hay for feeding dairy cows.

Corn-Stover Silage.—The feeding value of corn-stover silage is not high as might be expected when it is remembered that the ears have been removed. Yet, corn-stover silage is a superior dairy feed to corn stover. The corn-stover silage is more palatable and consumed with less waste than corn stover. Trials at the Wisconsin Experiment Station show the value of corn-stover silage to be only 61 percent of the value of corn silage. The practice of removing the ears and then making corn-stover silage is not as economical as ensiling the entire corn plant, thereby making a good corn silage.

Sorghum Silage.—The dairymen in the non-irrigated sections of Colorado should realize that they have in the silages made from the grain sorghums a valuable succulent feed which is practically equal to corn silage. This has been demonstrated by the Kansas Station where a direct comparison of the two silages was made. Sorghum silages under plains conditions were more valuable than corn silage, because of the greater yields to be obtained from the sorghums. The various sorghums should be fairly mature before one cuts them for silage.

Sunflower Silage.—Sunflowers for silage are to be recommended in those sections of Colorado where corn and sorghums cannot be grown because of shortness of season. There is no thought that this

Sunflowers are a good crop for silage in the high-altitude sections

mammoth crop will replace corn or sorghums for silage where these two crops can be grown. It is admitted that sunflowers yield more per acre than does corn but they furnish a silage lower in the food nutrients and not quite as palatable as corn silage. However, the authors recommend sunflower silage for the higher altitudes such as the San Luis Valley and Northwestern Colorado.

Roots.—Roots commonly grown and fed to dairy cows are sugar beets, stock beets, mangels, stock carrots and turnips. They add succulence to the ration and stimulate appetite. Roots are conveniently stored in pits or cellars for winter feeding. They are not extensively employed in feeding in Colorado as corn silage is a more practical and economical source of succulence. The labor required in their production is very high. Many experiments prove that 1 pound of dry matter in corn silage is equal in feeding value to 1 pound of dry matter in roots. Even in sections where corn silage cannot be produced, it is believed that sunflower silage will be better than roots. Roots may be used with dairy herds so small that it would not pay to build a silo. Cows upon semi-official or official test are frequently fed some roots. In such feeding the amount of production and not the cost is the chief consideration.

Potatoes.—Potatoes may be fed to dairy cows if they are not fed

Cutting sunflowers for silage

in too large amounts. A maximum feed of cooked potatoes will be about 30 pounds per head per day and slightly less if the potatoes are raw. If fed in greater amounts, milk of poor flavor and salvy butter may result.

Wet Beet Pulp.—Wet beet pulp is a satisfactory feed but should always be fed in limited amounts such as 25 to 35 pounds per head per day. It is low in both protein and mineral matter but is palatable. One ton of wet beet pulp is usually considered as having a feeding value equal to one-third of a ton of corn silage. If it is fed as the only source of succulence, its feeding value may be somewhat higher. Poor-quality milk is sometimes attributed to wet beet pulp This may be avoided by feeding wet beet pulp in smaller amounts, or feeding after milking. Due to its low protein and mineral content, weak calves may result from feeding too much wet beet pulp to pregnant cows. Reducing the amount of wet beet pulp and increasing the amount of alfalfa hay will reduce this danger.

Pastures

Advantage of Pastures.—Ideal feeding conditions for dairy cows are furnished by luxuriant pastures. This fact is so well recognized that the dairyman attempts to imitate summer conditions in winter feeding. Pastures are rich in mineral matter and mediumly high in protein, and furnish protein of high quality. The amounts of energizing nutrients supplied by pastures are relatively low. Due to their mineral-matter content, fairly high protein, generous supply of vitamins, succulence and palatability, pastures are generally found on well-managed dairy farms, and are an important factor in cheapening the cost of milk production.

Morton's Pasture-Grass Mixture.—A mixture of pasture grasses is much superior to any one grass. The mixture that has been demonstrated to be so valuable under irrigated conditions is known as the Morton's pasture-grass mixture. This mixture was developed by Professor G. E. Morton, head of the department of Animal Husbandry, Colorado Agricultural College, after many years of careful investigation and research. There is hardly a community of the irrigated sections of Colorado where this pasture has not been tried and cannot be seen today by the interested dairyman. In every instance where directions have been followed and care given to the pasture it has proved to be a success. The mixture of the Morton's pasture-grass mixture is as follows:

Brome grass	15 pounds
Orchard grass	15 pounds

Meadow fescue .....10 pounds
Timothy ..... 6 pounds
Yellow-blossom sweet clover..... 4 pounds

A special pamphlet has been prepared upon the pasture-grass mixture, and may be obtained by addressing the Animal Husbandry Department, Colorado Agricultural College, Fort Collins, Colorado.

Morton's mixture has a carrying capacity of one and a half to four mature animals per acre during the pasture season

Other Pasture Grasses.—Other pasture grasses which are giving good results on irrigated land are Ladino clover, yellow-blossom sweet clover, rye and alsike. In the non-irrigated sections sudan grass, yellow-blossom sweet clover, slender wheat grass, brome grass and rye have given excellent results for dairy cattle pastures.

Ready-Mixed Commercial Feeds

There are available a large number of ready-mixed commercial feeds on the market. Many of these are the results of honest and intelligent efforts. When such feeds are considered the ingredients and analysis should be carefully studied. A guide to the purchasing of ready-mixed commercial feeds includes quality, results from feeding, the cost of 1 pound of protein, and the cost of 1 pound of total nutrients.

Feeding for Milk Production

It Pays to Feed a Well-Balanced Ration.—The following definition of a well-balanced ration is given by Henry and Morrison. "A balanced ration is the feed or combination of feeds furnishing the

several food nutrients—crude protein, carbohydrates and fats—in such proportion and in such amounts as will properly nourish a given animal for 24 hours." A balanced ration for a dairy cow is one that furnishes a large amount of protein, mineral matter, especially lime, and net energy. The protein should come from several feeds in order that it will be correct in quality. As explained before, proteins vary widely in composition, and proteins from various sources have the tendency of supplementing each other. A ration composed of corn and carbonaceous roughages is clearly out of balance. Such a ration furnishes enough net energy, but is lacking in quantity and quality of protein and in mineral matter.

It Pays to Feed a Good Cow Liberally.—As pointed out under the discussion, "Principles of Dairy Cow Nutrition" page 6, the amount of nutrients which should be available for milk production is that fed in excess of requirements for maintenance, growth and pregnancy. These facts coupled with the all-important one, that the dairy cow is one of the hardest-worked animals on the farm, suggest the importance of liberal feeding. The amount of concentrates which should be fed is a very important one. The factors which influence the amount needed are the kind and amount of roughage, the quality and quantity of the milk produced, and the relative price of concentrates and roughages. Cows of good average dairy production will consume from 6 to 9 pounds per head daily. Many cows of good breeding and high production will economically handle more grain than mentioned. If a dairyman is feeding carbonaceous roughages even to cows of medium production, 10 to 12 pounds of concentrates will be required to balance the ration.

It Pays to Feed Cows Individually.—In the most uniform and best-selected dairy herds there will be considerable variation in the productive abilities of various cows. Maximum profits will not be obtained if all the cows in the herd are fed exactly alike. Feeding the cows individually does not mean that a ration must be balanced for each and every cow in the herd. In feeding the herd a grain mixture is compounded which is the best supplement to roughage or roughages available. This grain mixture is then fed in various amounts to the various cows in the herd.

It Pays to Make Good Use of Roughages.—The roughages fed determine to a large extent the cost of milk production. The nitrogenous roughages such as alfalfa, clover and soybean hay are much superior to the carbonaceous roughages such as the fodders and stovers. When legume hays are fed as the only roughage, less high protein concentrates are needed to balance the ration. While the cow has a capacity to handle large amounts of roughage, there is a limit

beyond which a feeder should go. Too much dependence upon roughage is not advised. If the feeder is forced by circumstances to feed the corbonaceous roughages, it should be remembered that the cow must expend large quantities of energy in digesting these feeds from which she does not get the greatest amount of nutritive returns. It is necessary then to build up the quantity and quality of the deficient nutrients by generous feeding of nitrogenous concentrates.

Sweet clover and brome grass pasture is relished by the dairy cow

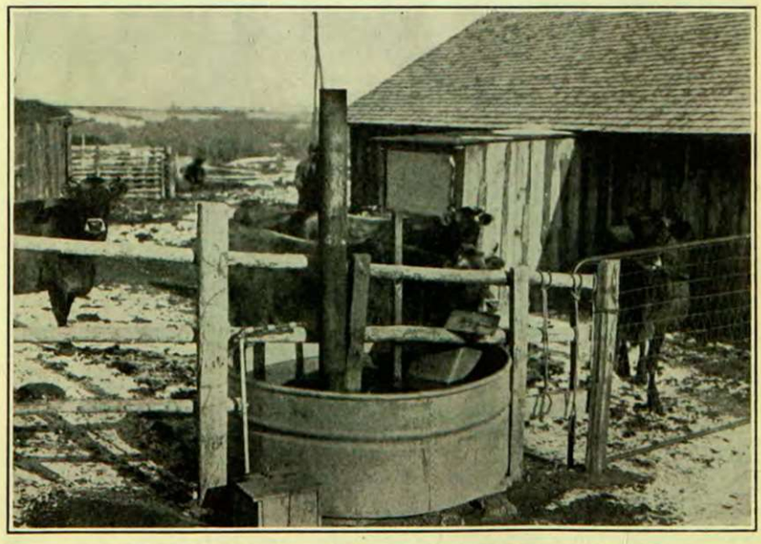
It Pays to Feed Succulent Feeds.—Succulence is an essential of economical milk production. The introduction of succulent feeds into winter feeding is an attempt to imitate summer pasture conditions, which are considered as ideal. Succulent feeds are palatable, laxative and aid digestion. They "whet" the appetite and the dairy cows consume larger quantities of roughage. When succulent feeds are included in the ration there is less trouble from animals going off feed. A succulent feed with a legume hay furnishes protein, mineral matter, and succulence which approaches summer pasture conditions. Dr. C. I. Bray stated, "It is better for a man to start dairying without dairy cows than to start without a silo." Silage is the standard succulent feed in Colorado.

It Pays to Feed Feeds Which Are Palatable.—A good flow of milk is due in part to a heavy consumption of feed which is possible only when the feeds offered are palatable. When any feed is known

to lack in palatability it should always be mixed with feeds of high palatability. The concentrated mixture should always contain a variety of feeds and much better results are obtained when more than one roughage is fed.

It Pays to Feed a Variety of Feeds.—Variety of feeds increases the palatability of the ration. Palatability increases consumption and increased consumption results in a larger milk yield. Thruout this bulletin the importance of protein in the ration has been emphasized. As has been stated the quantity of protein must be sufficient to meet requirements and the protein must be of the right quality. By quality of protein is meant that all essential amino acids which are the component parts of proteins are present and in sufficient amounts. If the sources of protein are many, there is more likelihood that all of the amino acids will be present and in the required amounts. The problem of quality of proteins further emphasizes the importance of furnishing a ration which has variety.

It Pays to Supply Plenty of Fresh Pure Water.—Water is cheap and inexpensive yet an abundant supply of fresh, pure water is often neglected. Milk is approximately 87 percent water, which makes the need of an abundance of water very apparent. A large dairy cow in milk will drink from 150 to 300 pounds of water in a day, while



A water heater is a good investment during freezing weather. Cows will drink more water if the chill has been taken off.

the same cow when dry will not consume over 50 to 70 pounds of water. Plenty of water easily accessible will increase milk production. So to insure best results, have water before the cows at all times so that they may drink at will. In the winter time a water heater will take the chill off and the cows will drink more.

Rules for Feeding.—The following rule is taken from Henry and Morrison's "Feeds and Feeding" page 118.

"Dairy cows in milk will eat 2 pounds of good quality dry roughage daily per 100 pounds liveweight. Silage may be substituted for dry roughage at the rate of 3 pounds of silage for 1 pound of dry roughage. A common rule is to feed 1 pound of hay and 3 pounds of silage daily per 100 pounds of liveweight. Sufficient concentrates should be fed in addition to bringing the nutrients up to the standard."

The following is copied from Henry and Morrison's "Feeds and Feeding" page 396.

"Then the amount of concentrates for each cow may be determined from one of the following rules:

"1. Feed 1 pound of concentrates per day for each pound of butterfat the cow produces a week, or

"2. Feed 1 pound of concentrates per day for each 3 or 4 pounds of milk, depending on its richness, or

"3. Feed as much as the cow will pay for at the ruling prices for feeds and product, increasing the allowance gradually until she fails to respond by an increase in production which will cover the increase in cost."

The amount of grain fed is dependent upon breed, amount of milk produced, and the kind of roughage (See Appendix page 39). Grain is fed to a Guernsey and Jersey at the rate of 1 pound of grain to 3 and one-half pounds of milk produced. Grain is fed to a Holstein, Ayrshire or Milking Shorthorn at the rate of 1 pound of grain to 3 and one-half to 4 pounds of milk produced.

The amount of silage fed should be in accordance with the cow's capacity to consume feed. If silage is plentiful and the cow will clean up the feed readily, the amount of silage recommended above may be increased. If the amount of silage is scarce, the amount fed may be reduced. It is better to feed silage after milking.

The most satisfactory method of feeding hay is at will. It is generally a cheap source of nutrients and dairy cows are capable of handling large quantities.

Dairy cows are generally fed twice a day, one-half of daily grain ration being given at each feed. If cows are on three or four-time milking, feed grain at each milking time.

Jerseys on timothy and clover pasture

Summer Feeding of Dairy Cows

Feeding Cows On Pasture.—When the pasture season starts, the dairyman realizes that the worries and work of winter feeding are over, and that the simplest and easiest feeding of his cows is now at hand. Perhaps dairymen put too much faith in pasture as the simplest and easiest method of feeding for frequently dairy cows are neglected while upon pasture. The period of greatest danger is when pasture starts to dry up and when the forage becomes scarce.

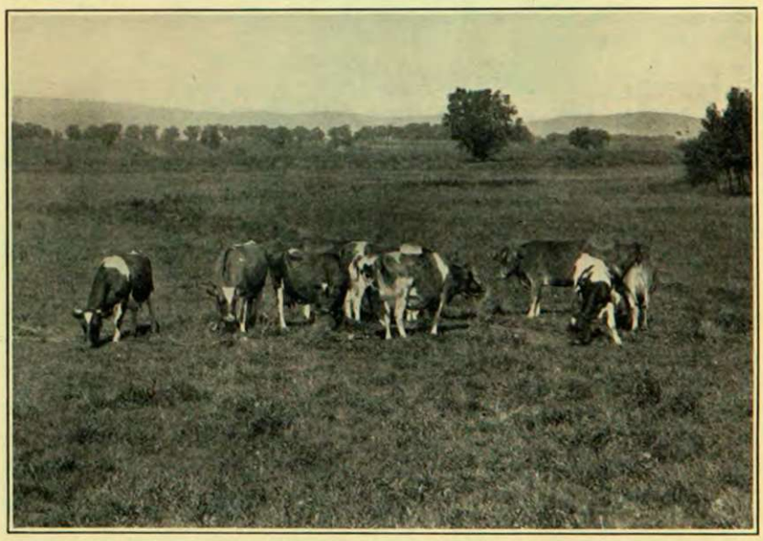
The first mistake made in summer feeding on pasture is that cattle are turned upon pasture too early. This is very injurious to the pasture, has a tendency to reduce the length of usefulness of the pasture, and young tender grasses are too washy to make a satisfactory dairy-cow feed. It is important that dairy cattle be left off pasture until the grasses have been growing for at least a week or 10 days. Due to the washiness of young grasses the feeding of hay and possibly silage should be continued for a few days after cows have been turned on pasture.

Supplementing Pastures With Grain.—The coming of the pasture season is welcomed by some dairymen for they have the mistaken idea that dairy cows on pasture do not require grain. It must be remembered that pastures furnish a feed which is bulky and watery. The water content of pasture grasses will vary from 75 to 90 percent water depending upon the state of maturity. A heavy-producing cow receiving no grain, will lose flesh and drop off in milk

production. A little grain fed during pasture season frequently returns big dividends the following winter. Grain fed at this time keeps up the milk flow, and all know that if the milk flow once drops it is next to impossible to build it up again.

Grain should always be added if the pasture becomes depleted or starts to dry up.

As guides to when grain should be added, the following suggestions are given: All cows that produce more than 1 pound of butterfat a day should receive grain. If cows of the Jersey and Guernsey breed produce more than 20 pounds of milk a day, grain should be fed. With the Holstein or Milking Shorthorn breeds grain is added when the daily production exceeds 25 pounds.



A permanent pasture cuts production costs

Amount of Grain to Feed on Pastures.—Two factors which determine the amount of grain to feed on pastures are the condition of the pasture and the production of the dairy cows.

When the cows are first turned to pasture the amount of grain fed should not be changed due to the washy condition of young grasses. If the cattle are Jerseys or Guernseys producing more than 20 pounds of milk daily, feed 1 pound of grain to each 5 or 6 pounds of milk produced. If the cows are Holsteins, Ayrshires or Milking Shorthorns producing more than 25 pounds of milk daily, feed 1 pound of grain to each 6 to 7 pounds of milk produced.

Supplementing Pastures with Silage.—There are times when the forage of summer pasture becomes inadequate, or the use of pasture must be discontinued entirely. Silage makes the most economical and most convenient substitute for pasture.

It Pays to Give the Cows a Rest.—Dairy cattle require a rest period between lactation periods. This rest period should be at least 6 weeks in length and if the cow is in thin condition a rest of 8 weeks will prove beneficial. The object of the rest period is to put the cow in good condition before she freshens. Due to the reserve supply of nutrients and minerals which the cow stores in the body during the rest period, she is able to start the lactation period at a higher level of production, and produce a higher milk yield during the lactation period. This greater production will more than offset expense of the rest period.

Drying Off a Dairy Cow.—In drying off a dairy cow considerable time should be taken. At first milk her only once a day for a few days, never stripping her completely dry. During the next 4 or 6 days she is only milked every 2 days, and then this increased to a week. When she is giving 10 pounds of milk or less a day, she need not be milked any more. With some cows it may be necessary to remove the grain and put her upon a poor roughage until she is dry. A little patience at this time will avoid injury to the udder.

Feeding During the Rest Period.—The object of feeding during the rest period is to have the cows thrifty and in good condition of flesh when they freshen. If cows are upon good pasture and in good condition, no additional grain will be required and the additional laxative feeds will not be necessary just before calving. If the pasture is poor, additional grain will be needed.

In the winter time, cows during the rest period are fed from 2 to 4 pounds of a well-balanced grain mixture, from 20 to 30 pounds of silage, and legume hay. The grain mixture should be composed of feeds which are cooling and restful. The following grain mixture is somewhat expensive but is included here as illustration of an ideal ration during the rest period:

Ground corn	100 pounds
Ground oats	100 pounds
Wheat bran	100 pounds
Linseed oilmeal	75 pounds

Feed and Care Before Calving Time.—The corn is generally removed from 10 days to 2 weeks before freshening, as this helps to

prevent udder troubles with high-producing cows. The grain and silage are reduced in amounts from 4 to 5 days before calving. On the day before calving, omit grain entirely and feed warm bran mashes.

Another excellent feed at this time is composed of 2 parts wheat bran and 1 part linseed oilmeal. It is very necessary that laxative feeds be offered at this time and if the laxative feeds suggested do not loosen the bowels, 1 quart of linseed oil or 1 pound of Epsom Salts should be given.

Feed and Care at and After Calving.—If the cow is not to freshen on pasture, a clean well-bedded box stall should be provided. At calving time do not molest her, unless assistance is absolutely necessary.

For 2 or 3 days after calving, the water which is offered should be luke warm. The first feed after calving should consist of warm bran mashes; in fact, bran is an excellent feed for the major part of the ration for 2 or 3 days. Silage and legume hay are valuable roughages to feed at this time. In 4 or 5 days, the cow can consume 4 or 5 pounds of concentrates made up of a mixture of ground oats, wheat bran and linseed oilmeal. From this mixture the cows are gradually changed over to the regular herd mixture, and gradually increased to a full ration by increasing the daily feed to about one-half pound per day every other day. In 3 to 5 weeks the cow will be upon a full feed.

Milk Fever.—The dairy cows with greatest milking capacities are those which are more liable to have milk fever. This trouble is in no way associated with the feeding or fitting before the cow freshens. A milk fever outfit may be purchased from most any stockman's supply house. Such an outfit and the knowledge of its use will be of great assistance until the veterinarian arrives. As precautions against milk fever, do not milk the cow for a period of 36 to 48 hours, except that which is required by the calf. After this period, milk the cow several times during the day, but do not milk her dry.

Feeding and Management of Cows on Official Test

Feeding Cows During Dry Period for Official Test.—The dry period for cows that are to be put upon official or semi-official tests is much longer than that for the ordinary dairy cows. The dry period will be from 6 to 12 weeks and the special fitting will start at the end of the third or fourth week. This special fitting is actually

fattening the animal, on the theory that during the fore part of the lactation period the cow will milk this fat off her body. Two kinds of fitting will be discussed under the terms of "soft-fitting" and "hard-fitting."

"Sqft" Fitting.—"Soft" fitting, as the term implies, is putting soft fat on the body of the dairy cow which will milk off rapidly. This type of fitting is for cows that are going on a short-time official test, such as a 7-day test. A ration for a "soft fitting" is relatively low in protein. Equal parts of ground corn, ground oats, wheat bran and linseed oilmeal will serve as an illustration of this type of feeding. Barley can be used to replace the corn and part of the oats if desired. With this ration silage and legume hay should be fed.

"Hard" Fitting.—In "hard" fitting a harder fat is put on the body and this form of fitting is used when the cow is to be put on a long-time semi-official test such as a yearly test. More protein is fed in the "hard" fitting than in the "soft" fitting. A ration which will illustrate a desirable one for this type of fitting is as follows:

Ground corn	100 pounds
Ground oats	100 pounds
Wheat bran	200 pounds
Linseed oilmeal	100 pounds
Cottonseed meal	50 pounds

Feed Before Calving.—About 10 days or 2 weeks before the cow is due to freshen, her fitting ration is changed to a "cooling" ration. This consists of all the roughage that she will eat, with a grain mixture as follows:

Wheat bran	2 parts
Ground oats	2 parts
Linseed oilmeal	1 part

It is very difficult to say how much to feed, for many factors must be taken into consideration. The only advice that can be given is that from 2 to 10 pounds or more will be required.

From 1 to 2 days before calving, the ration is changed again to 2 to 3 pounds of wheat bran or the same amount of a mixture of equal parts of wheat bran and whole oats.

If the bowels are not open, 1 quart of linseed oil or 1 pound of Epsom Salts should be given.

Care Before and During Calving.—A box stall which is well ventilated, and which has been disinfected and well bedded is pre-

pared for the dairy cow about 1 week before she is due to freshen. It is not desirable that the cow be disturbed during calving unless assistance is absolutely necessary. During the time that she is in the box stall it may be well to keep her blanketed.

Feed and Care After Calving.—During the first day after calving, all the feed required is a bran mash. For 3 or 4 days it will be well to offer her luke warm water. If the cow has been blanketed before calving, the blanket should be left upon her. During this time the herdsman should be on the alert for milk fever and be ready to treat it if it should appear. To reduce the possibility of milk fever the udder should not be milked out completely for 3 or 4 days.

Feeding During an Official or Semi-Official Test.—On the second or third day after calving, the cow is put back on the cooling ration discussed above under "Feed Before Calving," page 28. About 3 or 4 pounds of this ration is fed, and never increased until after the cow has passed the afterbirth. With normal conditions, the ration is gradually changed from the "cooling" ration to the regular test feeding rations beginning on the fourth or fifth day after calving. This change is made by a substitution of from 0.5 pound to 1.0 pound of the test feeding ration for the cooling ration until the change is complete. The amount is then gradually increased until the cow is on full feed. In 3 weeks the cow will be receiving from 15 to 20 pounds of grain which will be considered a full feed. Some increases may be made provided that it is followed by an increase in milk flow. All increases should be very small and consisting of 0.25 pounds to 0.5 pounds per day.

Ration During the Test Period.—The regular test feeding ration will vary practically with every test cow feeder. All of the rations used have some points of similarity. In the first place all feeders use a variety of the most palatable feeds. Light and bulky feeds such as wheat bran, ground oats and dried beet pulp are always included. In all test rations will be found an abundance of the protein rich concentrates such as linseed oilmeal, cottonseed meal and gluten feed. The following ration is one of the simple ones and may serve as an illustration:

Ground corn	1 part
Ground oats	1 part
Wheat bran	1 part
Linseed oilmeal	1 part

While on test the dairy cow is given all the alfalfa hay she will

eat, while the corn silage may be limited in some instances. The amount of silage fed a large cow will be from 20 to 25 pounds per head daily. In addition sliced roots or 6 to 10 pounds of dried beet pulp which has been soaked before feeding, is given.

Raising the Dairy Calf on Skimmilk

Nutrient Requirements.—The dairy calf requires plenty of protein and protein of the right quality. The mineral content of the feed should be high and furnish the 2 minerals, calcium and phosphorous. The dairy calf further requires the vitamin A and vitamin B for normal growth.

The milk of the dairy cow is the ideal feed for the young calf, but as butterfat is so valuable on the market, little whole milk is used in calf feeding. Experience has demonstrated that excellent calves can be raised upon skimmilk when they are changed to it after being fed for about 2 weeks upon whole milk.

Both skimmilk and whey have had the butterfat removed, and with it the fat soluble or vitamin A. When the calf receives roughages the vitamin A is supplied as most green-leaved forage is high in this vitamin. There is no danger of a lack of vitamin B in the calf's ration as this vitamin is quite generally distributed in feeds.

Protein Requirements.—The amount of protein which is required by a growing dairy calf is one of great economic importance, due to the expense of the nutrient protein. At present there is a controversy among nutrition men, as to the exact minimum requirements of protein. Elaborate experiments are now being conducted, but it will be some time before definite conclusions can be drawn. In the meantime, the authors of this bulletin are going to recommend a liberal allowance of protein. They are of the opinion that physical well-being, longevity, and possibly normal and regular reproduction are associated with a generous supply of protein.

Skimmilk Calves vs. Whole-Milk Calves.—During the first few months of growth the skimmilk calf will not be as fat or look as good as the whole-milk calf. When the age of 18 months or 2 years has been reached the calf fed skimmilk until it was weaned will be just as growthy, have as large a frame, and be just as heavy as the calf which received whole-milk until it was weaned.

Skimmilk Supplements.—Skimmilk is the result of separating butterfat out of whole milk. Therefore skimmilk is more of a protein feed than whole milk from which it came. Consequently a proper supplement of skimmilk is not one of the nitrogenous supplements, but rather one of the carbonaceous concentrates. Admirable supplements to skimmilk are the farm grains.

Farm Grains as Supplements to Skimmilk.—Corn, oats, barley or any of the grain sorghums may be used as supplements to skimmilk. Any of these will give better results than nitrogenous supplements. Many dairymen, however, add a little wheat bran or linseed oilmeal to farm grains, but this is done only for an increase in palatability. If the supply of skimmilk is limited, the amounts of wheat bran and linseed oilmeal will be increased to properly balance the ration.

Grinding Farm Grains for Dairy Calves.—When the dairy calf is being taught to eat grains they are usually ground. After this period they are fed whole until the calf is 6 or 8 months old, at which time it will pay to grind the grains again, as the calf will not chew its feed as well as it did before. Hard and small grains such as wheat, barley or grain sorghums should always be ground.

Salt for Dairy Calves.—Salt should be supplied to dairy calves as soon as they are given grain, for they require salt the same as older cattle. Free access to salt has been found to be the best method of feeding it.

Mineral Matter for Dairy Calves.—Dairy calves receiving good legume hay and skimmilk or some other protein-rich supplement generally receive enough calcium and phosphorous for normal growth. In some sections where the phosphorous and calcium content of the soil is known to be low, or if part of the roughage is composed of carbonaceous roughages, calcium and phosphorous may be deficient. They can both be supplied to the ration by adding one-half ounce of bonemeal or ground rock phosphate daily. If only calcium is required, this may be supplied by adding one-half ounce of finely ground limestone. The prevention of goitre or big neck has been discussed under "The Need of Minerals" (page 9).

Starting the Dairy Calf on Whole Milk.—During the first 2 to 4 days of a dairy calf's life it should receive its own mother's milk. The first milk produced by the cow is known as colostrum milk and is valuable because of the laxative effect, and its ability to properly start the functions of digestion.

In starting the dairy calf upon whole milk it should be remembered the calf has a small stomach and it instinctively prefers the frequent ingestion of small quantities of milk. The first day of whole-milk feeding, not over 5 or 6 pounds should be fed. It is necessary that milk be given fresh and at a temperature of 100 degrees Fahrenheit. From this small beginning the milk is increased gradually. The best of rules are frequently found wanting, but one

which may be used as a guide at this time is: Feed 1 pound of whole milk to 8 to 10 pounds of liveweight. Even less should be offered the calf which is weak and not doing well. At no time even with strongest and most vigorous calves, should 12 pounds of milk be exceeded.

Starting Dairy Calves on Skimmilk.—At the age of 2 to 4 weeks depending upon the strength and vigor of the calf, the change from whole to skimmilk may commence. To make the complete change, 7 to 10 days are usually required. After this change is completely made the amount of skimmilk is gradually increased. How high should one go is always a problem. At the end of 6 weeks the calf will take 15 to 16 pounds and in very rare instances as much as 18 pounds. After the first 6 weeks have passed the amount may be increased somewhat but at no time should more than 20 pounds be given. During the first 3 or 4 months skimmilk should be fed at a temperature of 100 degrees Fahrenheit. After this time the calf may be gradually accustomed to cooler milk.

Calves are generally weaned when they are 7 or 8 months old. If the supply of skimmilk is limited, they may be weaned from 2 to 3 months. If weaned at such an early age, good milk substitutions must be fed as discussed on page 35.

Starting the Skimmilk Calf on Grain.—Grain feeding may be started when the dairy calf is from 1 to 2 weeks old. The first grains offered are such feeds as cornmeal, ground oats with the hulls sifted out, barley meal, kafir meal, wheat bran, and linseed oilmeal alone or in combination. At 6 weeks of age the calf will eat 0.5 pounds daily, and at 2 months, 1.0 pound daily, at 3 months, 2 pounds daily. Up to 6 months of age the calves need no more than 2 or 3 pounds of concentrates daily.

Rations for Skimmilk Calves.—Skimmilk calves are fed largely upon the farm-grown grains. A very popular grain mixture is equal parts of corn and oats. Such a mixture is made more palatable and will give better results if a very small amount of protein-rich concentrate is added.

The following suggested rations are taken from Henry and Morrison, "Feeds and Feeding," (page 431.)

1. Corn 3 parts, oats 3 parts, wheat bran 1 part, linseed oilmeal 1 part.
2. Equal parts oats, bran and corn or barley.
3. Oats 5 parts, corn 1 part, bran 3 parts, linseed oilmeal 1 part.

Hay for the Skimmilk Calf.—The skimmilk calf will start eating hay almost as soon as it will grain. At first as much grain will be consumed as hay, but at the age of 6 months they will consume 3 times as much hay as grain. The skimmilk calf should be encouraged to eat large quantities of hay as it develops a large roomy barrel which is so much desired in the dairy cow. During the first 2 or 3 months, however, large quantities of legume hay may cause scours.

Silage for Skimmilk Calves.—A small amount of silage may be fed when calves are 2 months old. Before this time they will consume so little that it will be of no value, and as silage is laxative, there is the danger of scours. White and Kuelling of the Connecticut (Storrs) Experiment Station give the following as the amounts of silage consumed by calves of various ages:

2 to 3 months	2 pounds daily
3 to 4 months	5 pounds daily
4 to 5 months	7 pounds daily
6 to 7 months	10 pounds daily

Pasture for Skimmilk Calves.—Pasture is ideal for calves old enough to make use of it. They should be from 2 to 4 months old before being turned out on pasture. Before this age they are likely to scour and suffer from heat and flies. When calves are first turned on pasture they should not be left more than 1 hour the first day. After the first day they may be left on longer.

Raising the Dairy Calf on Skimmilk Substitutes

Buttermilk as a Skimmilk Substitute.—The most satisfactory substitute for skimmilk is buttermilk. In tests that have been made, buttermilk gave slightly poorer results than did skimmilk. In the feeding of buttermilk, great care must be exercised in the handling. A little carelessness may be the source of scours.

Whey as a Skimmilk Substitute.—In feeding whey it should be remembered that the protein has been removed in making the cheese. In supplementing whey, protein-rich feeds are required which is not the case when feeding skimmilk or buttermilk. While it can be fed with success to dairy calves the gains will not be as large as when skimmilk is fed. In feeding whey the temperature should be 100 degrees Fahrenheit. Either sweet or sour whey may be fed, but do not feed sweet whey one day and sour the next. The changing from one to the other will cause scours.

Using a Minimum Amount of Skimmilk.—If the amount of skimmilk is limited, fairly satisfactory results may be obtained by dis-

continuing the skimmilk when the calves are 2 to 3 months of age. In trials which have been conducted, 10 days were utilized in weaning the calves. It will be necessary to feed liberally of concentrates containing plenty of protein and good legume hay. The Missouri Experiment Station obtained good results with a grain mixture composed of:

4 parts corn
1 part wheat bran
1 part linseed oilmeal

Using a Minimum Amount of Whole Milk.—The conservation of whole milk is a problem where there is no skimmilk, buttermilk or whey available. The calves may be given a good start upon whole milk for about a month. Then the whole milk is discontinued and the calf put upon a grain mixture as described and discussed above under "Using a Minimum Amount of Skimmilk."

Growing Out the Dairy Heifer

Feed and Care of the Growing Heifer.—The ideal feed for a growing heifer is obtained from a luxuriant pasture. No additional feed is required if the pasture furnishes ample forage.

The following is taken from Henry and Morrison, Feeds and Feeding, page 439:

A Holstein heifer of good type. It pays to grow the heifer out well.

"In the winter there is no better ration than legume hay, silage and sufficient grain to keep them thrifty and growing vigorously, without becoming too fat. The ration should supply plenty of protein and hence unless a liberal amount of good legume hay is fed, the concentrate allowance should be richer in protein than is advised for skimmilk calves.

"When legume hay and silage are available, feed all of each of these feeds the heifer will clean up. For animals less than 10 months old feed 2 to 3 pounds of concentrates a head daily in addition.

"When legume hay is not available but corn silage is on hand, silage may form the chief roughage. Heifers make good gains on silage and concentrates, with no dry roughage but often they show a great desire for some dry forage. Hence it is best to feed also some hay, or corn or sorghum fodder or stover. In addition 2 or 3 pounds of concentrates should be fed daily at least one-half of which should be high-protein feed, like linseed oilmeal, cottonseed meal or gluten feed. The rest may be corn or else barley, oats or bran, if these feeds are cheaper per pound than corn."

Age to Breed.—Jerseys and Guernseys are bred to have their first calf at twenty-four to twenty-eight months of age. The Holsteins and Ayrshires are bred so that they will not calve the first time until they are twenty-eight to thirty-six months.

Care and Management of the Dairy Bull

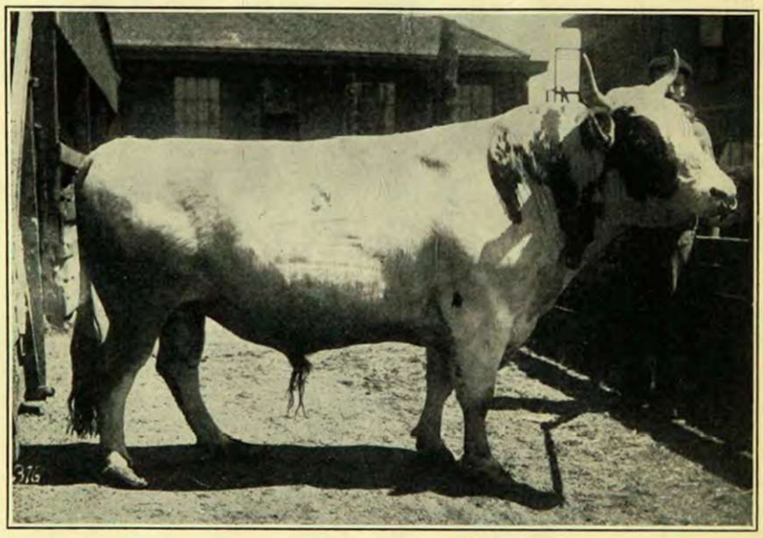
Care and Management of the Dairy Bull.—The bull calf may be raised with heifers until he is 4 or 5 months of age, at which time he should be separated from them.

He should be well grown out as this will increase his value when it is time to dispose of him. This can be accomplished by feeding milk until he is 7 or 8 months of age. A rather liberal grain ration of equal parts of corn, oats and bran should be fed with the milk.

The best roughage for the young bull is alfalfa hay. When this legume hay is not available, hay of sorghum or millets gives good results if some protein concentrate and mineral are added to the grain ration.

The young bull should not be used for service until he reaches the age of 12 months and then only for light service.

Feed and Care of the Mature Bull.—The mature bull should be kept in a very substantial bull pen, which is large enough to afford him plenty of exercise.



Purebred Ayrshire bull of good type

The practice of allowing the dairy sire to run with the herd is not to be recommended. Many heifers are bred too young, the bull is over worked, and there is a possibility of the bull attacking humans. The most gentle bull should never be trusted. He should be dehorned at an early age and a strong ring placed in his nose.

When handling the bull a staff should always be used. A rope or strap tied to the ring will not stop the bull, should he decide to attack.

After reaching maturity the bull should be kept in good condition but not fattened. Over feeding and lack of exercise reduce the breeding powers of an animal.

From 4 to 8 pounds of grain are usually fed to the mature bull. The grain mixture fed is frequently the same as is fed to the milking herd. If the hay fed is alfalfa or clover, a cheaper grain mixture for the bull would be ground corn and ground oats, with a little bran and cottonseed meal. If the roughage is a carbonaceous hay, a grain mixture of 200 pounds of ground corn, 300 pounds of oats, 100 pounds of bran and 100 pounds of cottonseed meal may be used.

From 15 to 20 pounds of hay should be the daily feed of the bull. Different bulls react differently to the feeding of silage.

Some bulls do not breed well on a silage ration. Not over 15 pounds of silage should be fed until one learns how the bull reacts to silage. If any bull should become a slow breeder, remove the silage at once.

Selecting the Grain Ration for the Dairy Cow

In selecting the grain ration for the dairy cow, one should always select a ration which utilizes all home-grown grains possible and buy only those feeds which are needed to bring the ration into balance. Usually the only feed which must be purchased is a protein supplement.

The following are groups of farm grains and commercial protein supplements which may be used interchangeably. That is, any one feed within a particular group can be substituted for another feed within the same group without materially affecting the nutritive ratio.

Group 1	Group 2	Group 3	Group 4	Group 5
Corn Chop Dried beet pulp	Crushed oats Crushed barley Crushed wheat Crushed rye Crushed millet	Alfalfa meal Wheat bran	Linseed oilmeal	Cottonseed meal Corn gluten meal

Suggested Grain Rations

Grain Rations Suggested for Use With Legume Hays.—As previously pointed out in this bulletin, legume hays are a very good source of protein and mineral matter. Therefore very little protein supplement need be added to the grain ration to balance the feed consumed by the cow.

The following rations are suggested when legume hays are the only roughage fed. Ration No. 1 and 2 are suggested when a large amount of high-quality hay is fed. No. 3 is suggested when the amount of roughage is limited or of poor quality.

To Feed With Legume Hays and No Succulence

No. 1
300 pounds ground oats
300 pounds ground barley
300 pounds corn chop
100 pounds cottonseed meal

No. 2
300 pounds kafir corn
300 pounds corn-and-cob meal
300 pounds ground barley
100 pounds linseed meal

No. 3
400 pounds ground oats
400 pounds ground barley
100 pounds cottonseed meal

Grain Rations Suggested for Use with Legume Hays and Succulence.—When succulent feeds such as silage, wet beet pulp or roots are added to the roughage ration, they replace a part of the legume roughage, thereby lowering the amount of protein consumed by the animal. Therefore, more protein should be added to the grain ration than when legume hay is the only roughage used.

The following rations are suggested:

To Feed with Legume Hays and Succulence

No. 1
250 pounds ground oats
100 pounds ground barley
100 pounds corn chop
100 pounds linseed oilmeal

No. 2
225 pounds corn chop
200 pounds ground oats
150 pounds dried beet pulp
150 pounds cottonseed meal

No. 3
100 pounds corn chop
200 pounds crushed rye
300 pounds ground barley
150 pounds linseed meal

No. 4
300 pounds ground oats
200 pounds ground barley
100 pounds cottonseed meal

No. 5
400 pounds bran
100 pounds corn chop
100 pounds ground oats

No. 6
275 pounds ground barley
100 pounds bran
100 pounds crushed rye
125 pounds linseed oilmeal

Grain Rations Suggested for Use with Carbonaceous Roughages.—The carbonaceous roughages such as corn fodder or stover, millet and cane hay and timothy need a large amount of protein in the grain ration to supply the needs of the cow.

The following rations are suggested:

No. 1
225 pounds corn chop
175 pounds oats
150 pounds cottonseed meal

No. 2
200 pounds corn chop
200 pounds ground barley
125 pounds cottonseed meal

No. 3
200 pounds millet (ground)
200 pounds oats
200 pounds cottonseed meal

No. 4
200 pounds sorghum grain
200 pounds millet
200 pounds corn-and-cob meal
250 pounds cottonseed meal

No. 5
200 pounds corn-and-cob meal
100 pounds barley
100 pounds oats
225 pounds linseed oilmeal

No. 6
200 pounds barley
200 pounds oats
100 pounds cottonseed meal
50 pounds corn gluten feed

Vitamin Content of Feeding Stuffs

(Adapted from Henry and Morrison. Feeds and Feeding)

– Indicates that the feed contains none of the vitamin or a very small amount.
* Indicates that the feed contains a small amount of vitamin.
** Indicates that the feed is a good source of the vitamin.
*** Indicates that the feed is an excellent source of the vitamin.
**** Indicates that the feed is exceptionally rich in the vitamin.
? Indicates that there is no information on the vitamin content of the feed, or that the data are not conclusive.

	Fat Soluble Vitamin A	Water Soluble Vitamin B	Anti-Scorbutic Vitamin C
Barley	–	**	–
Corn (white)	–	**	–
Corn (yellow)	**	**	–
Millet	– to **	**	?
Oats	–	**	–
Oats (green sprouted)	*	**	*
Rye	–	**	–
Wheat	–	**	–
Wheat Bran	–	**	–
Wheat Middlings	–	***	–
Alfalfa (well cured)	***	**	–
Alfalfa (bleached)	–	?	–
Alfalfa (green)	***	**	****
Corn silage	**	?	–
Mangel	–	– to *	– to *
Potato	– to *	**	**
Beets (sugar)	–	– to *	– to *

COST OF 100 POUNDS OF DIGESTIBLE PROTEIN

Price per ton	Price per 100 lbs.	Alfalfa	Barley (gr.)	Beet pulp (dried)	Wheat bran	Corn chop	Cotton-seed meal (choice)	Lin-seed meal	Mid-dlings wheat	Oats (gr.)	Rye (gr.)	Sor-ghum grain	Corn gluten meal
10.00		4.71											
12.00		5.66											
14.00		6.60											
16.00		7.54											
18.00		8.96											
20.00	1.00	9.43	11.11	21.74	8.00	14.49			7.46	10.64	10.87	13.33	
21.00	1.05	9.91	11.67	22.83	8.40	15.22			7.84	11.17	11.41	14.00	
22.00	1.10	10.37	12.22	23.91	8.80	15.94			8.21	11.70	11.96	14.67	
23.00	1.15	10.85	12.78	25.00	9.20	16.67			8.58	12.23	12.50	15.33	
24.00	1.20	11.32	13.33	26.09	9.60	17.39			8.96	12.77	13.04	16.00	
25.00	1.25	11.79	13.89	27.17	10.00	18.12			9.33	13.30	13.59	16.67	
26.00	1.30	12.21	14.44	28.26	10.40	18.84			9.70	13.83	14.13	17.33	
27.00	1.35	12.73	15.00	29.35	10.80	19.57			10.07	14.36	14.67	18.00	
28.00	1.40	13.20	15.56	30.43	11.20	20.29			10.45	14.89	15.22	18.67	
29.00	1.45	13.68	16.11	31.52	11.60	21.01			10.82	15.43	15.76	19.33	
30.00	1.50	14.15	16.67	32.61	12.00	21.74			11.19	15.96	16.30	20.00	
31.00	1.55		17.22	33.70	12.40	22.46			11.57	16.49	16.85	20.67	
32.00	1.60		17.78	34.78	12.80	23.19			11.94	17.02	17.39	21.33	
33.00	1.65		18.33	35.87	13.20	23.91			12.31	17.55	17.93	22.00	
34.00	1.70		18.89	36.96	13.60	24.64			12.69	18.09	18.48	22.67	
35.00	1.75		19.44	38.04	14.00	25.36			13.06	18.62	19.02	23.33	
36.00	1.80		20.00	39.13	14.40	26.09			13.43	19.15	19.57	24.00	
37.00	1.85		20.56	40.22	14.80	26.81			13.81	19.68	20.11	24.67	
38.00	1.90		21.11	41.30	15.20	27.54			14.18	20.21	20.65	25.33	
39.00	1.95		21.67	42.39	15.60	28.26			14.55	20.74	21.20	26.00	
40.00	2.00		22.22	43.48	16.00	28.99	5.41	6.62	14.93	21.28	21.74	26.67	5.30
41.00	2.05		22.78	44.57	16.40	29.71	5.54	6.79	15.30	21.81	22.28	27.33	5.43
42.00	2.10		23.33	45.65	16.80	30.43	5.68	6.95	15.67	22.34	22.83	28.00	5.56
43.00	2.15		23.89	46.74	17.20	31.16	5.81	7.12	16.05	22.87	23.37	28.67	5.70
44.00	2.20		24.44	47.83	17.60	31.88	5.95	7.28	16.42	23.40	23.91	29.33	5.83
45.00	2.25		25.00	48.91	18.00	32.61	6.08	7.45	17.16	23.94	24.46	30.00	5.97
46.00	2.30		25.56	50.00	18.40	33.33	6.22	7.62	17.54	24.47	25.00	30.67	6.10
47.00	2.35		26.11	51.09	18.80	34.06	6.35	7.78	17.91	25.00	25.54	31.33	6.24
48.00	2.40		26.67	52.17	19.20	34.78	6.49	7.95	18.28	25.53	26.09	32.00	6.38
49.00	2.45		27.22	53.26	19.60	35.51	6.62	8.11	18.66	26.06	26.63	32.67	6.51
50.00	2.50		27.78	54.35	20.00	36.24	6.76	8.28	19.40	26.60	27.17	33.33	6.55
56.00	2.80						7.57	9.27					7.40
60.00	3.00						8.12	9.93					7.95
70.00	3.50						9.47	11.50					9.28