4-1-1928

Feeding the Dairy Herd for Profit

T.M. Olson

BULLETIN 231 APRIL, 1928

Feeding the Dairy Herd for Profit

T. M. Olson
Professor of Dairy Husbandry

Revised January, 1935

DAIRY DEPARTMENT
EXPERIMENT STATION
SOUTH DAKOTA STATE COLLEGE OF
AGRICULTURE AND MECHANIC ARTS
BROOKINGS, S. D.

BULLETIN 231 APRIL, 1928

Feeding the Dairy Herd for Profit

T. M. Olson
Professor of Dairy Husbandry

Revised January, 1935

DAIRY DEPARTMENT
EXPERIMENT STATION
SOUTH DAKOTA STATE COLLEGE OF
AGRICULTURE AND MECHANIC ARTS
BROOKINGS, S. D.

Feeding the Dairy Herd For Profit

T. M. OLSON, Professor of Dairy Husbandry

PROFITS IN DAIRYING are largely dependent on two factors, the cow and how the cow is fed and handled.

The profitable cow consumes large quantities of feed and converts it into milk. When a dairy cow uses her feed for other purposes, she ceases to be a profitable milk producer. The characteristic of converting feed into milk is inherited and cannot be changed in a cow by any method of feeding or handling. The best one can do is to feed so that this inherited characteristic is utilized to its maximum.

The production records of 18,000 cows in Cow Testing Associations in the United States, indicate very clearly that high producing cows are most profitable. The following table is a compilation of the milk production, feed cost and income over cost of feed of 18,000 cow testing association cows.

Butterfat	Feed Cost	Income Over Cost of Feed
100 lbs.	$34.00	$ 10.00
150 lbs.	40.00	26.00
200 lbs.	46.00	42.00
250 lbs.	52.00	58.00
300 lbs.	58.00	74.00
350 lbs.	64.00	90.00
400 lbs.	70.00	106.00
450 lbs	76.00	122.00

In studying these data it will be observed that when the production increases 50 pounds, the cost of feed increases $6.00, but the income over cost of feed increases $16. The 150 pound cow, shown in this table, has an income over cost of feed of $26. The 450 pound cow has an income over cost of feed of $122.

Data from 892 cows in cow testing associations in South Dakota prove the same conclusion—that high producing cows are most profitable.

It will be noted that high producing cows require more feed but the value of the additional fat which high producing

cows give increases more rapidly than the cost of the feed. These data also indicate the importance of selecting cows which have inherited the capacity for efficient milk production if an efficient herd of dairy cows is to be maintained.

Butterfat	Feed Cost	Income Over Cost of Feed
125 to 175 lbs.	$30.89	$28.35
225 to 275 lbs.	39.77	58.82
325 to 375 lbs.	54.13	86.92

Increased Profit From Fewer Cows

It is indeed singular that dairymen do not seem to appreciate the importance of high production in relation to profit. The evidence from carefully kept records of herds all over the country, so uniformly indicate this fact that all must be convinced of its truth.

Why anyone should house and feed 63, 175-pound-fat cows when equal profits can be obtained from 20 cows producing 300 lbs. of fat annually is beyond understanding.

When feeds are high in price in relation to the price of dairy products as is the case this year, the margin between low and high producing cows is even greater than indicated by the above figures.

No criticism can be directed at the dairyman who by the use of good purebred sires and the application of the known facts of feeding, has not been successful in developing a herd of cows which have attained a production of 300 pounds of fat annually. There are cases where these conditions apply, and are usually due to the fact that the dairyman has purchased purebred bulls which were purebred in name only and not in performance.

However, there are all too many dairymen who do not take cognizance of the above truth either in the selection of the sire to head the herd, or in the feeds grown to be used in feeding the dairy herd.

Space will not permit a discussion of the importance of the sire in increasing production but no dairyman can afford not to give this matter his very best thought if he expects profit from his dairy herd.

Cull the Low Producers. Purebred dairy cows have been bred for milk production for centuries; yet many low producing cows are still found in all breeds. There is need for a continuous process of culling and selection among purebred dairy

cows. If this is true in purebred herds, it is vastly more important in grade or scrub herds because the chances for low production are greater in cows which have ancestors that have not been bred for milk production.

The average milk cow in South Dakota produces about 135 pounds of fat a year. The cows in cow testing associations in South Dakota produced an average of 250 pounds a year. Many individual herds in cow testing associations in the state produce 400 pounds of butterfat a year. These associations have been in progress for only four years, but they indicate what can be done in improving production by culling out the low producers and feeding the balance of the herd a better ration.

Cost Of Milk Production

An understanding of how the costs of milk production are distributed will no doubt bring attention to the importance of feed. It is for this reason that a table of costs is placed in this bulletin on feeding.

Obviously the monetary costs of milk production will vary not only in different sections of the country but will vary with other costs within these sections. However, it is felt that despite these variations the table is of significance in profitable feeding of dairy cows.

Cost of Producing 100 Pounds of Milk in Different Areas*

Item	Vt.	Del.	La.	Ind.	Neb.	Wash.
Average milk yearly per cow	5252 lbs.	5439 lbs.	3106 lbs.	6937 lbs.	5823 lbs.	7839 lbs.
Average per cent fat in milk	3.9	3.6	4.4	3.8	3.7	3.7
Feed:						
Grain	$ .40	$ .67	$1.06	$ .45	$ .23	$ .23
Hauling and grinding	.01	.01	.07	.02	.01	.01
Hay and dry roughage	.83	.29	.17	.30	.31	.28
Silage and succulent crops	.41	.17	.14	.25	.09	.18
Pasture	.11	.27	.18	.15	.38	.29
Bedding	.01	.03	.0004	.02	.01	.01
Feed cost	$1.77	$1.44	$1.62	$1.19	$1.03	$1.00
Labor:						
Human	$ .41	$ .34	$ .47	$ .30	$ .33	$ .36
Horse	.06	.05	.07	.02	.01	.01
Overhead and other costs	.48	1.01	.98	.39	.88	.46
Total cost	$2.72	$2.84	$3.14	$1.90	$2.25	$1.83
Per cent of total cost due to feed	65%	51%	51%	63%	46%	55%

Feeding for Profit Is Important. The second factor in profitable production, viz., "feeding," is equally as important as breeding. The best machine ever made will not run unless it is furnished power. When the good machine is furnished the

* Year book of U. S. D. A.—1922

material for power, its superiority over the poor machine is soon evident.

The dairy cow is a machine which converts the materials she obtains from her feed into milk and body maintenance. In order that this animal machine may function to its capacity, it is necessary to provide sufficient feed of the proper kind. It is obvious that power can not be obtained from a machine unless the materials for power are provided; yet in feeding the dairy herd this fundamental principle is often ignored. It is a conservative statement to make that if the dairy cows in South Dakota were fed the proper feeds in the right amounts, the average production would be increased from 135 pounds of fat to 175 pounds of fat a year. If, in addition, greater attention were given to culling out the low producers, this average could be raised to well over 200 pounds of fat a year. This increase could be brought about with the cows already in the herds in this state.

Not only would there be an increase in fat production if these simple, yet effective, practices were put into operation, but the profit would also be increased, and increased in a much greater ratio than the increase in production.

The Dairy Cow A Profitable Market For Roughage. In the Northwest farmers are located great distances from the centers of population where the foods the farmers produce are consumed. Profits in farming in this area, therefore, necessitate the production of foods which can be shipped long distances at a relatively small cost. The product which is most valuable on the market in proportion to its weight and bulk has an advantage in long distance shipping.

The dairy cow converts roughages into milk from the cream of which butter is made. Butter is a highly concentrated product and can be shipped long distances at a relatively low percentage of its marketable value.

On the other hand, roughage is a bulky product and has a relatively low marketable value in proportion to its shipping cost. If roughages can not be converted into a more concentrated product they will have little or no market value.

Therefore, we may conclude that the dairy cow is a great benefactor to this state and the Northwest in that she can and does utilize the abundant roughages produced and converts them into a concentrated product which can be shipped to the consuming centers with profit.

One may be convinced of the above statement by comparing the cost of shipping and market price of butter and roughage. The cost of shipping butter to the consuming centers will range between 4 and 6 per cent of its market value while the

cost of shipping roughage will average approximately 33 per cent of its market value. Hence it is plain that it becomes necessary to convert roughages into a more concentrated form. The good dairy cow can do this more economically and profitably than any other farm animal.

Profit Depends on Relative Cost of Feeds.— Feed costs vary not only in different sections of the country but in relation to each other. Some years roughages are relatively cheap; other years high carbohydrate or high protein feeds are out of line. This year (1935) following a severe drought the carbohydrate feeds as well as the roughage feeds are relatively high in price.

If the dairyman is seeking the greatest net profits under varying feed prices, obviously he must feed more liberally of the cheaper feeds. This practice may not coincide with what has been said about providing a balanced ration, and neither will such feeding practice result in maximum production. In other words, to provide the most desirable ration and feeding for maximum production does not under all conditions of varying feed prices give the greatest net profit.

Usually when the prices of concentrates are high in relation to prices of butterfat, greater net profits will result from limited grain feeding. This condition obtains this year (1934-35. The reverse is true when concentrates are low in price compared to the price of butterfat.

The dairyman who is attempting to obtain the greatest net profit from his dairy cows will do well to study carefully the relative prices of the various feeds.

How the Dairy Cow Uses Her Feed. To better understand the whys and wherefores for greater profits in correct feeding, it is necessary to know how the dairy cow uses the feed. The power furnished by a machine can be put to many and varied uses but not so with the animal machine. Feed materials for animals have been restricted and limited by heredity to very definite functions. These are for body maintenance, milk production, building the fetus, growth and the production of body fat. The dairyman is concerned primarily with the feed which is used for milk production, yet the animal machine needs feed to keep its machinery going, and keep up the body temperature. A machine which is idling requires some power merely to keep itself running; similarly a cow requires feed when she is not milking.

The animal machine, in addition to keeping up the repair of body tissue, must also maintain the body at a relatively constant temperature. This function requires considerable feed, particularly during cold weather. The blood in the ani-

mal machine is the carrier of the feed materials to all parts of the body, hence the blood must be forced into all parts of the animal machine every 30 seconds. This pumping of the blood goes on constantly during the life of the animal. When one realizes that a large dairy cow has approximately 10 gallons of blood, it is evident that the heart does considerable work, the energy for which must come from the feed she eats.

The unborn calf receives the materials necessary for its skeleton and body tissues from its mother. Although the total material necessary to build the fetus is not great, it must be supplied through the feed consumed. The heifer requires feed in rather liberal amounts for growth. If she is milking heavily, the requirement is exceedingly great, and she should be provided with feeds of the right kind and of excellent quality. If this is not done, the good heifer will sacrifice her own body to provide materials for the milk. This condition cannot go on very long before the growth and physical well being of the heifer is affected and the final result will be a stunted and sometimes a ruined heifer. Frequently the heifer, which uses nutrients from her own body to produce milk when feed is lacking, is the heavy producing type of heifer, the kind the dairy farmer must have in developing a profitable dairy herd. The heifer, which immediately decreases in milk production when the feed is not adequate, does not possess the inherited characters for high production like the former type.

Adequate Feeding Profitable. With cows of average production, about one-half of the feeds which can be profitably consumed are used to take care of bodily functions other than milk production, leaving one half of the feed for the production of milk. In high producing cows, a larger proportion of the feed is used for milk production. Unless the feed is adequate to take care of the bodily functions and leave sufficient for milk production, the latter function will suffer. Hence, the part of the feeds from which the dairyman realizes profit is curtailed and his profits accordingly decreased. To further illustrate this point, when the cow is receiving a balanced ration, assume that one half of the ration is required for maintenance; the other half for milk production. If the ration is decreased by one-fourth, the average cow still requires the same amount of the ration for body maintenance, leaving only one-fourth of the ration for milk production. The total ration has been decreased by one fourth; yet the part of the ration from which the dairyman expects profit has been decreased by one half. This method of feeding would be analogous to providing a machine with enough power to run its own machinery and no more. Profits can not be expected from power so expended;

yet it is a practice which is all too common among dairymen.

Overfeeding Decreases Profits. Overfeeding may be as unprofitable as underfeeding and should be avoided. A common error in feeding is to overfeed on one or two feeds, thus giving the cow too much of one nutrient. For instance, when corn stover and ground corn are fed in large amounts, the cow is being overfed on carbohydrates. She can only utilize a certain amount of carbohydrates, because of a lack of protein. What she cannot utilize for maintenance and milk production she must throw off; hence, so far as the cow is concerned, this surplus carbohydrate is wasted.

It is also possible to overfeed even when the ration is balanced, by feeding more than the cow can utilize for maintenance and milk production.

Feed According to Production. To avoid overfeeding, feed grain according to milk production. If the cow increases in production, increase the grain allowance. Continue increasing the grain as long as there is an increase in production. When no further increase in milk results from an increase in grain, it might be well to decrease the grain slightly and note if a decrease in milk results. If this occurrs, the right amount of grain is being fed.

The writer strongly urges those who feel that feeding cows according to production takes too much time and is not a practical way of feeding, to try it out. Keep a careful record of the amount fed in a week or month when all cows are fed about the same amount of feed; then feed each cow according to her milk production, keeping a careful record of the amount of feed used. (In both cases use the same kinds of feed, the only difference being the method of feeding). It is safe to predict that a material increase in milk will result from the same feeds, when fed according to production rather than allowing the same or about the same amount of feed to each cow.

A Balanced Ration Most Profitable. The dicusssion thus far has indicated how the feeds are used by the dairy cow. When feeds are provided in such kinds and amounts as will exactly meet the needs of a particular cow, the ration is said to be balanced. That is, the nutrients or materials in the feeds are exactly in balance with the materials or nutrients required by the several functions of the animal machine. It is highly desirable to have reserve power in a machine, and it is no less desirable to provide the cow with more nutrients than are actually used in the various body functions. In other words, it is better to err in over feeding slightly than under feeding; however, maximum profits result only when the proper amount is

fed. This amount can be determined in a practical way by balancing the ration according to a feeding standard.

Succulent Feeds Desirable. The dairy cow more than any other animal requires considerable water. In addition to that required by other classes of livestock, the milking cow requires water for milk production. Because of the great amount of feed which a heavy producing cow requires, she needs considerable water. Dairy cows, therefore, should not only be provided with all the clean, pure water they will drink, but also with succulent feeds which are high in water content. Succulent feeds seem to possess properties other than the nutrients they contain. It is the experience of all dairymen who have fed succulent feeds, such as corn silage, roots or soilage crops, that the cows gloss, show improved physical condition, and apparently utilize to better advantage the nutrients received from dry feeds. Perhaps this property of succulent feeds is quite as important as the nutrients they contain. The adage, "An apple a day keeps the doctor away," has much to commend itself in the human diet. Other fresh vegetables and fruits are no less important in forestalling the liberal use of spring tonics. Possibly the succulent feeds for dairy cows have a similar and equal importance in their diet.

Provide Palatable Feeds. Dairy cows should be enticed to eat all they will, provided they use the feeds for milk production. Feeds which are pleasant and agreeable to the taste will be eaten in larger amounts, and possibly with greater benefit to the cow. The good feeder will cater to the palate of his dairy herd just as the good cook will guard the flavor and seasonings of the food she prepares. Feeds vary a great deal in palatability, particularly the roughages. Early cut roughages as a rule are more palatable than the roughages cut later. The method of curing also is important. Hence these facts should be considered in providing the roughage.

Variety Is a Good Safeguard. The dairy cow does not tire of the same feeds; in fact, she prefers to have the same feeds in her ration. This does not mean, however, that the ration should be made up of feeds from the same plant. A balanced ration can be provided from the corn plant; but experimental work at the Wisconsin Station proved that, even though the ration were balanced, it was not complete. To safeguard the health of the cow and be assured that she is receiving the materials she needs, it is best to provide a balanced ration composed from several feeds. It is usually as cheap to balance a ration from a variety of feeds as from one or two, and infinitely more desirable. A given amount of protein from a num-

ber of feeds assures a ration more complete in its protein requirements than from a single feed.

Vitamins in Profitable Feeding

After the discovery of digestible nutrients in feeds, dairymen assumed that a cow was fed a balanced ration when she was provided with these nutrients in the right amount and proportions. In more recent years the need for vitamins have been found as much a necessary part of the ration as the nutrients discovered a century ago so far as complete nutrition is concerned.

The vitamins are usually present in normal feeds grown under favorable conditions. However, feeds have been found to vary in amount and potency in the certain vitamins. Yellow corn, for instance, contains an appreciable amount of vitamin A, while white corn contains very little. Alfalfa hay artifically dried contains more vitamin A than when field cured.

Recent experimental work has definitely proved the need of vitamin A in the ration of dairy cows. A deficiency of this vitamin results in breeding troubles and a general debility which is very detrimental to reproduction as well as the health of the cow. It is also important to remember that all vitamins with the possible exception of vitamin B, come from the feeds which the cow is fed. If the feeds are low or deficient in any or all the known vitamins the physiological functions of the cow will suffer. It is also inmportant to know that the vitamin value of the milk is dependent on the vitamin potency of the feeds fed. Feeds which are devoid of, or deficient in certain vitamins will therefore result in milk low in these vitamins.

It is well, therefore, for the dairyman to give attention to the source of the feeds fed, and the methods of curing of hays fed as these factors affect the vitamin potency of the ration. Until more authentic information on the vitamin potency of the various feeds is known, it is well to feed liberally of legumes and aim to add variety to the ration.

Use of Minerals in Profitable Feeding. Salt has long been known to be necessary to the health and production of all classes of livestock. When livestock is deprived of salt, a loss of appetite occurs, soon followed by a rough coat of hair, lack of vitality and a general poor condition. Dairy cows giving milk will suffer sooner and more keenly if salt is withheld than dry cows or heifers. Hence, salt has a definite function for livestock and must be provided. The most practical method of feeding salt is to keep it before the herd at all times in a trough, so that the herd can eat all it chooses. Cows will not

overeat of salt if they have free access to it. In winter, when the cows do not have access to a supply, it is necessary to add salt to the ration, or in the grain mixture. One pound of salt to 100 pounds of the grain mixture is adequate for most cows. The heavy milking cows should have a little in addition, about one-half ounce daily to every 20 pounds of milk produced. The feeding of salt has been recognized for a long time as a necessary part of a cow's ration and its use and value for dairy cows should not be confused with claims made for other minerals.

Do Cows Need Other Minerals? Cows need minerals such as calcium, phosphorous, and sometimes iodine, but under proper feeding conditions these minerals are provided in the feeds in sufficient amounts for average producing cows.

In a few areas, the soil seems to be low or entirely lacking in certain minerals and the feeds grown on these soils are therefore very low or lacking in such minerals. In these areas, it would be necessary to provide the mineral in an inorganic form, such as is purchased from dealers, or in purchased feeds which have been grown on soil high in minerals.

The two minerals which are used by animals and which are sometimes lacking in the feeds are calcium and phosphorous. Legume hays, particularly alfalfa, are high in calcium. Therefore, if legumes are fed there is little liklihood that average producing cows will need to be fed minerals in addition. The grains and such concentrates as bran, oilmeal and cottonseed meal are all relatively high in phosphorous; so when concentrates are fed the phosphorous is provided.

Experimental work indicates that when average producing cows are fed a good quality legume hay and home grown and commercial feeds, both of which have been grown on soil containing sufficient calcium and phosphorous, it is not necessary to feed minerals.

When to Feed Minerals. When minerals are deficient in the ration, the cow will usually have a depraved appetite and will chew at bones, pieces of leather or even wood. This condition seems to indicate that the feeds furnished are either low in minerals or the cow is not assimilating the minerals present in the feeds. If legume roughages and concentrates are not being fed, these should be provided. If the depraved appetite still persists, feed bone meal, either steamed bone meal or raw bone meal. In all liklihood the feeding of a good quality of legume hay and such concentrates as bran, oilmeal, corn, oats and barley will satisfy the abnormal appetite of the cow.

For **heavy milking cows** it may be desirable to provide

minerals. This can be done by providing raw or steamed bonemeal in a trough much as salt is fed. In fact, many dairymen prefer to mix the bonemeal with the salt in the ratio of one pound of salt to four pounds of bonemeal and allow the cows to eat it at will. In winter, the bonemeal can be added to the grain ration at the rate of three or four pounds of bonemeal to 100 pounds of grain mixture.

When a poor grade of roughage such as wild hay, timothy hay or corn stover is fed in large quantities it might be well to feed finely ground limestone or air slacked lime in the grain ration, allowing three to four pounds of lime to every one hundred pounds of the grain mixture. If bonemeal is available at a reasonable price, this can be used instead of lime. Bonemeal will also provide phosphorous.

Experimental work seems to indicate that minerals can be assimilated in greater quantities when the cows are receiving green feeds, or are on pasture. It also seems likely that good quality legumes, particularly alfalfa, make possible greater assimilation of minerals, particularly calcium. Direct sunshine may also be an aid in the assimilation of minerals. It is good dairy management to allow cows and young stock to remain out of doors whenever the weather permits.

Commercial Mineral Compounds. So many questions are asked by dairymen concerning commercial mineral compounds that it might be well to say something regarding them.

Commercial mineral compounds usually supply calcium and phosphorous and in addition substances which are otherwise provided or not needed by the dairy animal. These other substances may be common salt, sulphur, charcoal, iodine, and various tonics and appetizers. The price of commercial mineral mixtures is usually high for what they contain . When only three of the elements, viz., calcium, phosphoros, and sometimes iodine are needed, why feed a mixture of minerals and other materials which are not needed and may be harmful?

The extravagant claims made for commercial mineral compounds are not justified in the light of experimental work and dairymen can ill afford to pay the price asked for them when equally good results can be obtained with simple mineral mixtures of bonemeal and limestone for one half the price, or less.

Proprietary Feeds Often Profitable. Proprietary feeds are feeds sold under a closed formula, or usually spoken of as "ready mixed feeds."

These feeds are usually prepared so that the nutrients in

them are balanced and in this respect have much to commend them. Better results are often obtained by feeding proprietary feeds largely because of the balance of nutrients and the variety of feeds in the mixture. Some proprietary feeds have in them materials which add greatly to the palatability of the mixture, thus increasing the consumption of feed, which has previously been pointed out as highly desirable.

In the purchase of proprietary feed mixtures, one should ascertain what per cent of **digestible** nutrients are present. A tag bearing the analysis of the mixture should appear on the sack. However, the buyer must bear in mind that the analysis is usually expressed in crude protein, for instance, and not **digestible** crude protein. The analysis may indicate a high content of crude protein, yet, if it is not **digestible**, it has a low feeding value.

It is not only well to know the digestible nutrients in the feeds but also to know the source of the digestible nutrients; that is the various kinds of feeds and proportions of each put into the mixture. If this information is available, the buyer can figure very closely whether or not he can afford to buy proprietary feeds.

Unless the price is very much out of line as compared with home made mixtures, it is often advisable to buy proprietary feeds because of the variety, the palatability, and balance of nutrients. However, the buyer must expect to pay for the services rendered by the proprietary feed companies, and when the proper mixing of feeds is not well understood nor the necessary feeds for home mixing readily obtainable, proprietary feeds can be purchased to good advantage.

Profitable Summer Feeding. Most dairy farmers look forward to spring and the pasture season. Milk production is usually at its maximum when cows are on good pasture and the cows appear in better physical condition. This indicates the value of good pasture for dairy cows. The matter of mineral assimilation by cows on green feed is important, and it is not at all unlikely that other beneficial results come from good pasture. Dairymen should make special effort to provide good pasture for the dairy herd.

Too often the pasture is injured more or less by turning the cattle on when the grass is too young, and the ground soft. The latter condition results in a pasture badly cut up by the hoofs of the cattle. Turning cattle on the pasture when the grass is too young and tender also forces them to eat it down so close that the plant does not get a chance to grow. Plants

in order to grow and develop a root system must have leaves and blades exposed to the sun. If the grass is eaten too close at this stage of growth, it will not have a well developed root system; hence the pasture will suffer later in the season and the total amount of feed greatly decreased. The grass in early spring is also very high in moisture, and as a result the cows must eat a great deal to satisfy their needs. This means considerable tramping over the pasture as well as a large consumption of the immature grass.

It is good dairy practice to allow the grass to get a good start in the spring, and when the cows are put on pasture, feed them silage for the first two or three weeks. The feeding of dry roughage such as wild hay in a feed rack may be followed with good results. The cows crave some dry feeds when eating large quantities of green grass. Besides, these roughare high in carbohydrates, and as the young grass is relatively high in protein in the early part of the pasture season, the dry roughage makes the ration more nearly balanced.

Kinds of Pastures.—In South Dakota much of the pasture land is tilled and has been sown to cultivated grasses or a mixture of grasses. A mixture of grasses for pastures has much to commend it. Where the mixture is made up of early and late varieties a longer pasture season is assured. If, in addition, the mixture has in it legumes as well as non-legumes, a more balanced grass is also provided.

Cultivated Pastures. In eastern South Dakota much of the land now used for pasturing dairy cattle can be cultivated. If the dairy farmer is seeking the highest possible returns from his acres of pasture land he will do well to consider pasture crops which have been tried at the South Dakota Station and found very satisfactory.

Sweet Clover pasture is used quite generally in South Dakota. Replies to a questionnaire sent out to South Dakota dairymen by the Dairy Extension specialist indicated a very general use of sweet clover pasture. All who replied were enthusiastic in their praises of sweet clover pasture and few complained of trouble with bloat.

In the seven years in which the Dairy Department has experimented with sweet clover, the results have been very gratifying, particularly when one considers the rainfall during this period. The table showing the results of these various pasture crops for the eight-year period is evidence that farmers who were enthusiastic about sweet clover as a cultivated pasture knew their pastures.

Alfalfa for pasture has much to recommend it. It is more palatable than sweet clover and is a very close second to sweet clover for the production of milk. It seems to maintain the weight of cows somewhat better than sweet clover. It is also believed that with more nearly normal rainfall alfalfa will produce relatively more pasture than sweet clover. In other words, the sweet clover pasture can stand more drought than alfalfa but with sufficient rainfall, alfalfa will produce more pasture.

Bloat on Legume Pastures. Bloat remains about as perplexing a problem as ever after several years of experimentation with many recommended preventives.

For the first six years of pasturing sweet clover and alfalfa we did not experience a single case of bloat. We fed the cows dry grain and allowed them free access to salt and mineral. They were watered at 11:30 each day. We assumed that the dry feed and the fact that the cows were not allowed to go on the pasture hungry were responsible for no bloat in our trials.

Our assumption, however, proved false when the cows were turned on the alfalfa plot during the first week in September 1933, about five days following a heavy rain. A number of cows bloated during the night and three were found dead the following morning. During the early pasture season in 1934, the cows bloated on both alfalfa and sweet clover pastures in a short time after being turned on pasture. We tried a number of suggested preventives without success.

It seems that under certain favorable conditions cows will bloat. Whether the causative factor or factors are of bacterial, enzymatic, or chemical origin remains to be determined. It may be one or all of these factors working together which produce the excess of gases in the rumen that results in death unless the animal is relieved. The only safe procedure in turning cows on any leguminous pasture is to watch the cows at least for the first two or three hours. If no bloat shows up in this time the cows probably will not bloat unless some change occurs in the pasture conditions.

If cows are taken off the pasture as soon as bloat is noticed and put in the barn or dry lot they probably will get over the condition without any further treatment. A stick or rope placed in the mouth of the cow to cause her to belch will often relieve the bloated condition. If the accumulation of gas has reached the stage where the cow is in acute pain, and goes down, it is usually necessary to puncture the rumen to relieve the gas.

Results of Eight Years of Cultivated Pastures*

	Alfalfa	Sweet Clover	Sudan Grass
Days on pasture	Range 42-98 Av. 68½	Range 20-109 Av. 69	Range 20-89 Av. 47
Average carrying capacity	Per acre 2 cows	Per acre 2.5 cows	Per acre 2.5 cows
Milk produced per acre	lbs. 2919.34	lbs. 3787.71	lbs. 2407.40
Butterfat per acre	lbs. 116.13	lbs. 145.5	lbs. 95.9
Value of fat @ $.30 per lb	per acre $34.84	per acre $43.65	per acre $28.77

* Dairy Dept. S. D. Exp. Sta.

One should bear in mind in interpreting these data that the rainfall was below normal during the period here recorded. No doubt more favorable results would have been obtained with normal or above of rainfall during the pasture season.

No credit has been allowed in the data presented for the grain fed to the cows on the pastures. This would, however, just about offset the value of the skim milk.

The lack of sufficient moisture was an important factor in the length of the pasture season. When the pastures were short so that the cows did not get sufficient feed without supplementing the pasture with dry roughage the cows were taken off. This same procedure was followed in putting the cows on the plots in the spring and taking them off in the fall.

This procedure in handling the pasture plots not only decreased the number of days the cows were allowed on the plots, but also lessened appreciably the feed which could have been obtained had the cows been allowed on the plots until they were eaten down close as is usually the case in pasturing.

One cannot review these data without feeling that cultivated pastures make for profitable milk production.

Silage for Summer Feeding. Where pastures are inadequate to provide succulence during the summer, silage may be fed with good results. During the hot weather, silage will not keep well unless at least two inches is fed off each day. With a large silo and a small herd this is not always possible. The building of a smaller silo for summer use is recommended but not always possible because of the extra expense. Where more than one silo is built, one of them should be built with summer feeding in mind. Silage for summer feeding provides a cheap succulent feed during short pasture or when no pas-

ture is available. In some of the dense dairy sections in other states, the silo is used as a storage place for green feeds, such as mixtures of peas and oats, corn, and even legumes. That is, these crops are cut green and put into the silo and fed as needed.

Soilage for Summer Feeding. Soilage crops are crops cut green for summer feeding. Crops so used are in all stages of growth hence if a number of crops are fed, variety and palatability are assured.

The feeding of soilage is very expensive because of the labor in seeding and harvesting and is hardly practical under South Dakota conditions. Another serious objection to soilage is the uncertainty of the crop in this section because of rainfall. If a dairy farmer depended on a series of soilage crops for summer feeding and one or more of the crops should fail, due to lack of rainfall or some other unavoidable cause, it might prove serious.

Where pastures are not sufficient to provide succulent feeds in summer, silage is the cheapest and on the whole the best succulent feed.

Grain Feeding in Summer Profitable. The feeding of grain in summer is recommended not alone for the immediate increase in production but because of the residual effects. That is, when grain is fed on pasture the milk production may not show an immediate increase, but the following winter or during the succeeding lacation period the cow will produce more.

The amount of grain to feed depends upon the condition of the pasture and the production of the cows. When the pasture is scant, the feed must be increased. During the early part of the pasture season when the grass is abundant probably only the heavy producing cows need to be fed grain. The dairyman must exercise his judgment as to the amount of grain to feed, and only general rules can be given here.

When the pasture is good, one pound of grain to seven or eight pounds of milk for Holsteins and Ayrshires will suffice, and six to seven pounds for Guernseys and Jerseys. On poor pasture, the grain must be increased until one approximates winter feeding conditions. That is, when the pasture is very short, Holsteins and Ayrshires should receive one pound of grain for four to five pounds of milk, and Guernseys and Jerseys one pound of grain for three to four pounds of milk. A succulent roughage should also be provided when pastures are so short that the cows do not get enough to satisfy their appetites. That is, if the cows are grazing all day it would indicate that the pasture is not suffcient to provide the suc-

culent roughage needed. Pastures should be such that the cows can fill up on grass in a comparatively short time and then lie down and chew their cuds.

The grain mixture for feeding on pasture can be made of equal parts by weight of corn and oats during the first part of the pasture season. When the grass becomes more mature and does not contain as much moisture and protein, the grain mixture should be increased in protein. Feeds relatively higher in protein should be added. Bran and oilmeal are usually obtainable and ordinarily furnish protein about as cheap as any feed. They have other properties which also make then very desirable in a mixture.

Profitable Winter Feeding of Dairy Cows. With most dairy farmers the winter offers grave feeding problems. The physical condition of the cows in the spring or before pasture season bears testimony to this fact. In all too many cases the cows are in very poor condition in the spring, showing that they have not been properly fed during the winter. Cows in this condition will require most, if not all, of the pasture season to build up their own bodies. If the pasture is poor, the cows may go into the following winter in poor condition. Profitable production cannot be expected from cows so treated; neither is it good herd management to underfeed at any time.

The dairyman should make ample provision for feeding the herd during the winter months, either by increasing the supply of feed or decreasing the size of the herd. That it pays to feed grain to dairy cows is no longer a disputed question. The following data taken from cow-testing associations in South Dakota fully substantiates this statement.

Relation of Cost of Grain to Profit*

Cost of Grain	$ 4.48	$10.24	$14.77	$19.78	$24.65
Number of Cows	324	297	339	269	182
Pounds of Fat	196	216	241	263	283
Cost of Roughage	$22.27	$22.86	$25.11	$22.52	$24.21
Total Feed Cost	26.75	33.10	39.88	42.30	48.86
Value of Product Above Feed Cost	46.93	53.54	56.75	62.06	64.29

*Taken from leaflet written by Dairy Extension Specialist.

Note that as the cost of grain increased, which means an increase in pounds of grain fed, that the value of the product above feed cost increased. The cost of roughage remained about the same. It is important, therefore, that dairy cows be fed all they can profitably handle. This is economical and profitable feeding as well as good dairy management.

Common Dairy Feeds

Before considering in detail the practices of feeding, a better understanding will be obtained if one bears in mind the characteristics of the feeds used. Therefore a few brief statements concerning the common feeds will not be amiss.

The feeds can be classed as dry roughages, succulent roughages and concentrates. These general classes should be known and their uses understood. This will aid materially in profitable feeding.

Dry Roughages

The dry roughages form a very important part of the ration for dairy cows. No effort should be spared in providing the best dry roughage possible. A good roughage reduces materially the cost of the ration and makes possible more complete utilization of other feeds in the ration. A good roughage will provide sufficient nutrients to maintain the cow, thus leaving the grain the cow consumes for milk production. Dry roughages differ in their nutrient value and other characteristics; hence one should know the nutrient value and the characteristics of the various dry roughages to feed intelligently.

According to very recent statistics from the South Dakota Department to Agriculture, only 142,880 acres of tame hay are grown in the state. This is a decrease of about 40,000 acres since 1920. Tame hay not only includes timothy but other hays such as brome, sudan, etc. The same statistics credit South Dakota with 212,334 acres of sweet clover, 704,368 acres of alfalfa, and 1,870,627 acres of wild hay. The alfalfa acreage has been increased by 287,937 acres since 1920. No sweet clover is listed in 1920.

These statistics indicate the trend in the growing of legumes, and if continued for another decade at the same rat of increase, few dairy farmers will feed any other roughage, except as a filler.

Alfalfa. Alfalfa ranks first as a dry roughage. No South Dakota dairy farmer should be without alfalfa. It can be grown in most sections of the state without special preparation of the soil or other costly methods of planting or harvesting. Alfalfa, when cut and cured at the proper stage, is very palatable and somewhat laxative, desirable characteristics of any feed for winter feeding. Alfalfa is also high in protein and is perhaps the cheapest and all together the best way to provide protein in the ration for the dairy herd. Alfalfa is the highest of all roughages in calcium and a good quality of alfalfa hay is the cheapest and best source of calcium. There is little need

for the purchase of calcium if alfalfa is fed in abundance to the dairy herd at all times. Alfalfa is a roughage even when cut or ground and should be so considered.

Sweet Clover. Sweet Clover is fed in many sections of South Dakota. The feeding value of sweet clover varies more than alfalfa because of the difference in stages of harvesting and curing. Sweet clover should be cut for hay when the first blossoms appear so that the plants will not be too woody. In curing sweet clover, great care should be taken to preserve the leaves and finer stems of the plant. If these are lost in the harvesting process, the feeding value is much reduced. Good sweet clover hay is high in protein, and although not as palatable as alfalfa hay or red colver, is readily eaten. In a feeding trial with the College dairy herd, fine quality sweet clover hay was fed for a period of two weeks and compared with alfalfa which was used as a roughage previous to and following the two weeks of sweet clover feeding. The grain and silage ration remained the same. The cows ate the sweet clover readily and the following table of results indicates its value.

	Length of Period	Holsteins	Ayrshires	Jerseys	Guernseys	Total
Number of cows		10	5	9	5	29
		lbs. milk	lbs. milk	lbs. milk	lbs. milk	lbs. milk
Alfalfa period	2 wks.	3806.6	1040.9	1408.3	757.7	7013.5
Sweet Clover period	2 wks.	3684.6	996.7	1371.3	694.0	6746.6
Alfalfa period	2 wks.	3442.4	888.7	1224.2	626.6	6181.9

An analysis of these data show that there was a gradual decrease in total milk produced. The decrease during the sweet clover period was 266.9 pounds or approximately 4 per cent. The decrease in total milk production between the sweet clover and second alfalfa periods was 564.7 pounds, or approximately 11 per cent. In other words, the decrease in milk production when the cows were changed from alfalfa to sweet clover was less than when the cows were changed from sweet clover to alfalfa, indicating that the sweet clover hay was somewhat better than alfalfa in keeping up the production. (The alfalfa fed the third period was not of as good a quality as the first.)

When a comparison in milk production of the first and third periods, or alfalfa periods, is made with the second or sweet clover period, it seems that there is 148.9 pounds of milk for the two weeks period in favor of the sweet clover. The results of this trial should not be taken to mean that sweet clover is preferable to alfalfa. The slightly better results obtained in this trial might be explained on the difference in quality of the two roughages. The sweet clover was greener and superior in quality to the alfalfa.

A questionnaire sent out to 27 dairy farmers in South Dakota who have fed sweet clover hay for one or more years is significant. All these farmers regarded sweet clover hay as good dry roughage. In reply to the query: "Do you prefer sweet clover hay to alfalfa hay?" of the 27 replies—12 replied, "No"; 13 replied "Equal"; one replied "Mixed"; one replied "Yes". These replies check very closely with the results obtained in the college herd, that good quality sweet clover hay gave results comparable to alfalfa hay. It is not suggested that sweet clover hay replace alfalfa but if the latter cannot be provided in sufficient quantity, sweet clover hay is a good substitute under South Dakota conditions.

Red Clover. Red clover ranks high as a legume roughage. It is palatable and relatively high in protein. Although it does not rank as high as alfalfa in palatability, protein or calcium, it is preferred by many to sweet clover, particularly because of its palatability. Red clover is not so generally grown in South Dakota as either alfalfa or sweet clover; hence is not as generally used as a dry roughage.

Soy Bean Hay. Soy bean hay has a feeding value slightly less than alfalfa. In a trial at the South Dakota Station, the two leguminous roughages were found to be about equal. Three other Stations reported results in which soy bean hay was slightly lower than alfalfa. Soy beans when intended for dry roughage must be seeded on land free of weeds and seeded thick so that the plant will not develop coarse stems. The hay is also difficult to harvest without losing the leaves and finer parts of the plants. The loss of the leaves decreases materially the feeding value of the hay. Soy bean hay should be cut when the beans are in the early dough stage, and cured in cocks to preserve the leaves and finer stems. Because of the expense in handling and uncertainty of a crop under South Dakota conditions soy bean hay probably will not be very generally used as a roughage crop. It can be used however, as an emergency legume crop with good results.

Prairie Hay. No single roughage is as generally fed in South Dakota as wild or prairie hay. The feeding value of this roughage varies so widely depending upon the stage in which it is harvested how it is put up, and the land on which it is grown, that it is difficult to make a general statement. When this hay is grown on upland and is cut in the early stage, it makes a very palatable feed, and is preferred by many farmers to timothy or any other dry roughage except legume hay. Prairie hay is relatively low in protein and in some instances low in minerals. Where it is fed as the only roughage, the concentrate part of the ration must contain more high protein feeds. Prairie hay, which is harvested late and not put up well, is high in fiber and not palatable. This kind of prairie hay should not be fed to dairy cows as their only roughage. The same is true of the lowland or marsh hay, only this is likely to be much coarser and of poorer quality.

Timothy Hay. Timothy hay is not grown very general in South Dakota. It is low in protein and minerals. It lacks in palatability and beneficial physiological effects, hence should not be used for dairy cows unless these nutrients and characteristics of a desirable ration are provided by high protein concentrates. Timothy hay is a good horse feed and therefore commands a higher price than roughages of equal feeding merit for dairy cows. It seldom pays to buy or grow timothy for profitable feeding of dairy cattle.

Corn Fodder. Corn fodder is corn cut just before maturity and shocked in the field. It includes the ear and stalk. Corn fodder cut in this stage and shocked is palatable and the finer parts of the stalk are readily eaten. Corn fodder is low in protein and also in minerals, ranking with timothy hay in these respects. The feeding of whole corn fodder to dairy cows entails considerable loss in uneaten feed, as well as undigested grain. The grinding of the fodder does not add any nutrient value to the fodder, but may increase the amount of feed eaten. The grinding at least makes the handling of the fodder easier. Shredding would also facilitate the handling of the roughage as well as the handling of the manure. When the ears are ground separately and fed as a part of the grain ration, it would seem the cost of shredding would justify this practice.

Corn Stover. Corn stover is corn fodder from which the ears have been removed. It is low in protein, constipating and not palatable unless harvested before maturity and properly cured. Corn stover is not increased in feed value by shredding

or grinding, although it can be handled more conveniently and the refuse used for bedding with greater ease.

Straws. Straws should be used for bedding and not be depended upon for roughage. Dairy cows will eat a little, especially oat straw, and if used at all should be in a stack in the yard or put into the feed rack, where cows can eat at will when out of doors. It will serve as a filler and perhaps provide some heat and energy. Milking cows should not be forced to eat it as their sole roughage, or even any large portion of the roughage. If fed liberal quantities of a good roughage twice a day, they will still eat a little of good quality oat straw. All straws are low in protein and lack palatability. Straws are also constipating, and when fed without succulent feeds may give trouble.

The Use of Emergency Feeds

The past season has forced many dairymen to face a feeding problem previously experienced by only a few. The palatable, nutritious roughages grown so abundantly in South Dakota under normal seasonal rainfall were very scarce or wanting entirely. Hence dairymen found it necessary to resort to emergency roughages of unknown quality and feeding value.

Russian Thistles. The Russian thistle seems to thrive during drought conditions, hence it provides an abundance of forage at a time when cultivated forages make very little or no growth. Very little experimental data on the feeding value of Russian thistles for dairy cows are available. The Russian thistle has been considered a weed rather than a plant which can be used as a roughage. However, a great many cows in South Dakota this year will probably find Russian thistles composing a major part of their dry roughage ration. The information here given concerning the use of Russian thistles for dairy cows is gleaned mostly from reports and inquiries from those who have fed Russian thistles.

There seems to be some difference of opinion about the proper time to cut Russian thistles for hay. The concensus of opinion, however, seems to favor early cutting, that is, cut before the spines form and stack or mow when still quite green. Many farmers have reported a very palatable and nutritious hay when handled in this manner. If the thistles are allowed to mature the spines become hard and sharp. The stems become more woody and the palatability is appreciably lowered.

The chemical analyses of Russian thistles show very high

crude protein content and might lead one to rate them with roughages of corresponding protein content for dairy cows. In fact, one station has reported Russian thistle hay approximately equal to alfalfa for dairy cows.

In answer to questionnaires sent out to dairymen in Canada and several states in this country inquiring for their experiences and opinions on Russian thistles the replies vary from "no good" to equal to alfalfa." A majority of replies, however, indicate that Russian thistles when cut in the proper stage were about equal to wild hay or corn stover.

Russian thistles do have a laxative effect on cows and should therefore be fed with other non-leguminous roughages such as corn stover or wild hay. Russian thistles can also be ensiled. When so handled they should be cut even earlier than when intended for hay.

In a trial at this station, the Russian thistles were ensiled during silo filling time which ocurred the latter part of August that year. We found that the Russian thistle silage heated considerably and much of it was unfit for feed. The silage was very dark in color and although the odor was not at all objectionable we found difficulty in getting the cows to eat it. We also noted that when the silage was dried the spines seem as sharp and stiff as though it had not gone through the ensiling process.

Many dairymen report that Russian thistles provide good pasture and cows will milk fairly well on it alone. The laxative effect of Russian thistles seems more marked when pastured than when fed in any other form. This would be expected.

When the Russian thistle hay is coarse, better results are obtained by cutting or grinding it and sprinkling the cut material with molasses water (1 part of molasses to 4 parts of water). The molasses water improves the feed in palatability as well as increases its nutrient value due to the addition of molasses. Moisture also seems to improve the edibleness of the dry Russian thistle hay by making the spines less objectionable to the animal.

Millet Hay. The drought in 1934 brought out all drought-resisting forages. Farmers seeded as much of these forages as they had land and seed for. Perhaps no single forage was seeded so generally in the drought area as the common millet.

The stands were good and the growth abundant despite the dry weather conditions, and justified the farmers' confidence in millet as an emergency crop under drought conditions. The

College farm seeded several acres and the millet hay is being fed to the college dairy herd this winter alternating with alfalfa hay.

No controlled experiment has been conducted. However, observations indicate that the millet hay is palatable and the cows are doing very well on it. It is preferred over wild hay for dairy cows. Our experience with the growing and feeding of millet for forage leads us to give it high rank as an emergency drought resisting forage. It should be seeded thick and cut when the blossoms appear for the most palatable forage. It is not difficult to cure and harvest, which are factors to consider in any forage crop.

Sudan Hay. Sudan as a hay and pasture crop has increased in popularity very materially in the northern states in the past decade. It is an annual, and a drought resistant forage crop. It is entitled to a place in any system of dairy farm management as a pasture crop and even as a hay crop.

Sudan hay is very palatable and cows produce very well on it. Many dairy farmers report results equal to alfalfa when well cured Sudan hay is fed. Controlled experiments also indicate that Sudan hay is superior to such common non-leguminous hays as timothy and prairie hay and second only to leguminous hays for dairy cows.

The Dairy Department of the South Dakota Station has used Sudan as a pasture crop for several years. The results are very encouraging and the writer does not hesitate to recommended Sudan as a pasture crop under South Dakota conditions. Its carrying capacity of two cows per acre is indicative to its value as a pasture. Sudan also provides pasture at the season of the year when the native pastures are dried up and of little value for grazing.

We have not experienced any danger from prussic acid poisoning in the seven years of the pasture trails. Cows have been allowed on Sudan pasture at various stages of growth, after the growth of the pasture was checked by drought, and even after the pasture plants were frosted. We are cognizant however of the experiences of farmers who have lost cows on Sudan pasture. It may therefore be advisable to turn one or two cows on the pasture and if they are not affected by the poison it should be safe to turn the herd on the pasture.

The Sorghums. Sorghums, particularly cane, have been used very extensively for emergency forage crops throughout the drought area. In most instances they are planted with a drill. By seeding thick the stalks are fine and very little waste or uneaten sorghum forage results.

Cane is a heavy yielder, and will produce a large tonnage with limited rainfall. It is usually handled and fed like corn. When seeded broadcast it can be cut with a mower and put up in cocks.

Cane fodder has a feeding value equal to dent corn fodder. If cut in the immature stage it is sweeter than corn in a corresponding stage of maturity. Cane can also be used with good results for silage either as the sole crop or mixed with corn. Being higher in sugar than corn, cane silage will be higher in acid than silage from corn.

Nondescript Roughage Plants. Because of the drought conditions farmers have harvested anything in some sections of the drought area which they thought might provide roughage for their livestock. We receive a great many inquiries about the feeding value of these plants and we are at a loss how to reply, because there is no authentic experimental data providing information on these plants as feed for dairy cows.

Very often some of these plants will show a crude protein analysis equal to or higher than some of the high protein forages like alfalfa. However, that does not indicate that these plants are of equal feeding value.

Anyone who has a supply of dry roughage made up of weeds and plants of unknown feeding value can perhaps determine for himself the merits of such roughages by feeding them and noting results. If the feeds are unpalatable trouble may be experienced in getting the cows to eat them. The effect of the feed on the flavor of the milk is also highly important. Some weeds will make the milk unfit for use and the cream from such milk may produce a butter so objectionable in flavor that it cannot be marketed.

It is also possible that the feed may have other detrimental physiological effects on the cow. We have received so many inquiries concerning bloody milk that we have wondered whether some weed eaten by the cows may not be a factor. If it is at all financially possible the safest and most profitable course to pursue is to feed wholesome feeds of known and proven nutritive value.

Oat Feed. This is a by-product of the manufacture of oatmeal. It is here referred to as a roughage and an emergency feed. It is comparable to prairie hay in analysis and consists largely of the hulls of the oat kernel. It therefore is more nearly comparable to a roughage than a concentrate feed. It may be classed as an emergency feed crop for this section of the country as it would compete with wild or prairie hay for

dairy cows. Under normal growing seasons the wild hay could be purchased so much cheaper that the oat feed could not be considered.

In feeding value for dairy cows Oat Feed and wild hay are about equal, the hay being somewhat more palatable, however.

Crude Protein In Some Common Weeds Sometimes Used As Dry Roughages *

Variety	Per Cent Crude Protein On Dry Matter Basis
Marshelder	14.06
Russian thistle	12.93
Rough pigweed	16.87
Lamb's quarters	17.62
Fireweed (Burning Bush)	15.56
Foxtail (Pigeon grass)	10.69
Wild sunflower	8.63

* These analysis were furnished by the Agronomy Department, S.D.S.C.

Succulent Roughages

Succulent feeds are very important for dairy cows. The cooling and slightly laxative effect of succulent feeds are important factors in toning up the system of a hard working dairy cow. Dairy cows receiving succulent feed will look as glossy and in as good physical condition in the spring of the year as when on pasture; hence succulent feeds must have great value as a conditioner in addition to the nutrients they furnish. Succulent feeds are high in water and provide heavy producing cows with additional water. Cows receiving succulent feeds will also eat more feed, particularly more roughage. Succulent roughages do for the animal what fruits and succulent vegetables do for the human. This property alone should be sufficient to justify their use.

Corn Silage. Corn silage ranks first among succulent roughages. It is one of the most economical of succulent roughages and is relished by all classes of livestock. Corn silage can be fed the year round and provides a very satisfactory succulent roughage in times of poor pasture. Corn ensiled at the proper stage is very palatable and cows never refuse it. Even when on good pasture, cows will not refuse good silage. In the College herd are cows which have been fed silage every day in the year for fifteen years and they eat it as eagerly as ever.

Corn silage is low in protein hence best results are obtained when fed with a high protein roughage. Its laxative effect, however, makes it valuable as a supplementary feed with prairie hay and other more or less constipating feeds.

Corn should be cut for silage when the kernels are dented and the lower leaves on the stalk are beginning to dry. If cut too immature, a loss in total feed occurs and the silage is too acid. If allowed to get mature and dry, it will not pack well in the silo and much loss of silage from mold will result. Silage from corn cut at this stage is not as palatable as when cut at the proper time. If water is run into the silo at filling time, the silage can be packed; but this adds to the expense of silage, and is inconvenient on most farms because of the large amount of water required.

Milking cows should be fed all the corn silage they will eat twice a day, which will be from 30 to 45 pounds, depending on the size of the cow. A practice frequently followed is to feed the grain on the silage. Whether this practice has any special merit cannot be stated; however, many feeders think it does.

Frozen or moldy silage should not be fed. Frozen silage when thawed and not allowed to stay in this condition too long can be fed without danger to cows and older heifers; but it is well not to feed thawed silage to young calves. Moldy silage should be hauled out with the manure. It is not safe to leave it where cows can get at it as they will eat enough of it to give trouble.

Corn Fodder Silage. It frequently happens that the silo is not large enough to hold all the corn which is available for silage. Corn fodder can be put into the silo at any time of the year. However, when the fodder is dry, sufficient water must be added so that the silage can be packed well. To insure thorough packing, at least two men should be in the silo with instructions to tramp well around the edges.

Corn fodder silage is not as palatable as silage from corn ensiled at the proper stage. Neither will it possess some of the beneficial physiological properties of good silage. However, it will be more palatable than the whole fodder; can be fed and stored with less waste.

Corn Stover Silage. Corn stover silage is inferior to corn fodder silage as it does not have the ears of corn in it. The only advantage in putting stover into the silo is to save storage space and eliminate the waste in handling. The palatability would be somewhat increased but this alone would hardly justify the expense of ensiling.

Sun Flower Silage. In regions too cold to mature corn for silage, sunflowers can be ensiled. Several stations have reported on sunflower silage without very close agreement. The South Dakota Station put up sunflower silage for two years. It was found much inferior to corn silage in palatability. In fact, the stock had to be forced to eat it. Several other experiment stations reported sunflower silage as being unpalatable. Some stations reported sunflower silage equal to corn silage. The following analysis from the South Dakota Station would seem to indicate a lower feeding value than corn silage which the South Dakota feeding trials corroborated.

	Moisture	Ether Extract	Crude Fiber	Cr. Prot.	Ash	N. Free Extract
Corn Silage -----	68.50	1.04	5.79	3.38	1.91	19.38
Sunflower Silage	79.00	0.60	8.04	1.75	1.60	9.03

Corn silage is about three times as high in protein and more than twice as high in nitrogen free extract. The high fiber content in sunflower silage gives it a lower digestibility than corn silage. The experimental work to date would seem to indicate that where corn can be matured sufficiently for ensiling, it should be used for silage. Where corn cannot be grown, sunflowers will serve as a succulent roughage.

Legume Silage. Legumes can be cured and stored as hay with very little waste, and will provide a nutritious, palatable feed in that form. It is questionable whether by ensiling, legumes would be improved in any particular. It would hardly seem profitable, therefore, to go to the expense of ensiling legumes.

A few cases have come to the attention of the writer where sweet clover was ensiled and used as a summer feed, apparently with good results. Although the silage looked very dark and did not have an agreeable odor, the cows seemed to eat it readily. The farmers reported good results and stated they planned to follow the practice of ensiling sweet clover for summer feeding.

Pea and Oat Silage. This crop makes very satisfactory silage. The protein content is higher than in corn silage and it is very palatable. The yield is less than corn. This crop can be put into the silo in the same way as corn and makes excellent feed for summer. It should be cut when the peas are in the dough stage. The crop is used largely for summer feeding and is put into the silo to save time in cutting and also to retain the succulence.

Roots and Tubers

Roots and tubers furnish excellent succulent feeds and should be used more generallythan they are, especially by the dairy farmer who has a small herd and no silo. Roots cost more according to nutrient value to grow, harvest and feed than silage. This is largely the reason why roots are not used more generally in South Dakota.

Mangels. Among root crops, mangels rank high. Mangels are very palatable .and excellent for cows receiving heavy grain rations. They are also easier to grow and harvest than the other root crops. Large cows can be fed from 50 to 60 pounds a day.

Rutabagas and Turnips. These roots are not so palatable as mangels, neither do they yield as high. They are smaller in size than mangels and hence the cost of handling them is also higher. These reasons indicate why rutabagas and turnips are not as generally grown or fed as mangels. There is some danger of tainted milk from feeding large quantities of either rutabagas or turnips.

Sugar Beets. Sugar beets are palatable and high in nutrient value. They are smaller than mangels, therefore cost relatively more to handle. Sugar beets are grown commercially in several sections of South Dakota. The cull beets and tops under these conditions provide succulent feed at a nominal cost. The tops can also be ensiled and fed as needed.

Wet Beet Pulp. Dairymen residing near sugar beet factories can feed the wet beet pulp to good advantage. It is palatable but low in protein and minerals. Therefore, wet beet pulp should be fed with alfalfa hay as roughage. From 50 to 100 pounds of the wet pulp can be fed a day. Wet beet pulp is usually considered worth about one-third as much as corn silage.

Potatoes. Potatoes as a rule are too high in price to feed to dairy cows. Only when the market price falls below 15 cents a bushel can they be used. Potatoes are not as palatable as mangels or sugar beets. They are also more costly to handle; hence they should not be fed to livestock except when the market price is very low and the supply abundant. Milking cows should not receive more than 25 to 30 pounds a day. Larger feeds taint the milk and produce a salvy butter. All roots and tubers must be cut to prevent choking.

Concentrates

South Dakota dairymen are not giving the attention to the concentrate part of the ration that they should for best results.

In some instances no grain is being fed, and in others the scoop shovel method is used. That is, all cows are receiving the same amount of grain, regardless of their needs. Such feeding methods must necessarily be costly, and the results anything but satisfactory.

Before discussing the balancing of feed mixtures and the feeding practices, it will probably add to the discussion which follows if a few of the characteristics of concentrates are pointed out.

Corn. Corn is one of the most generally grown grains in South Dakota and for that reason should be used in the ration. Corn for dairy cows must be ground. In this condition it is extremely palatable and very high in carbohydrates and fats, but low in protein and mineral matter. Corn, therefore, is a fattening and energy producing feed, and not good for producing growth or providing protein in milk. Corn usually is the cheapest source of carbohydrates obtainable, and should be used to provide that nutrient in the ration. Corn meal is a heavy, rather than a bulky feed and should therefore be mixed with bulky feeds such as ground oats and bran.

Corn and Cob Meal. The grinding of the corn and cob makes a feed somewhat bulkier than corn alone. Where no bulky feeds are mixed with the cornmeal, it is well to grind the cob with the corn. The cob has a very low feeding value and requires considerable power to grind; hence its use is recommended only when bulk in the grain ration is lacking.

Hominy. Hominy feed is a by-product of corn and like corn is high in carbohydrates and low in minerals and protein. It is palatable, and is a most excellent feed to increase the carbohydrates in the ration. In South Dakota, ground corn is preferable to hominy because it is home-grown and usually cheaper.

Gluten Meal. Gluten meal is the by-product of starch and glucose manufacture. It is high in protein, being nearly as high as oilmeal, and about two and one-half times as high in protein as bran. Gluten meal is also high in total digestible nutrients. It is heavy and should therefore be fed with some bulky feeds like oats or bran. Gluten meal should be purchased to increase the protein part of the ration; therefore its relative cost should be determined on the cost per pound of protein in it. In the purchase of commercial feeds, it is well to ascertain the digestible nutrients the feed contains. The importance of this has previously been discussed.

Oats. Oats is grown in most sections of South Dakota and

for that reason should be used as a part of the grain ration for dairy cows. Oats is a palatable, bulky feed and high in protein as compared to other home-grown grains. Ordinarily oats is one of the cheapest feeds on the basis of its nutrient value. Because of its relatively high protein content, it is a good feed for growing stock and also for milk cows. Oats is also a good feed to mix with corn as it is higher than corn in protein and also adds the bulk which corn meal needs. With alfalfa and corn silage as the roughages and corn and oats as the grain concentrates, all home grown feeds and all grown in South Dakota, the average producing cow is fed a balanced ration and the young growing stock is provided with the necessary nutrients for growth. A good heavy oat is to be preferred to light oats for dairy cows. The latter is relatively higher in crude fiber. which makes it less digestible.

Barley. Barley is about equal to corn in feeding value. It is slightly higher than corn in digestible crude protein but lower in total digestible nutrients. Barley is probably not quite as palatable as corn but cows will eat it readily. Barley can well be used in the grain mixture as a substitute for corn, when the price of corn is relatively high. If barley and corn are available, both can be used in the grain mixture, thus adding variety.

Rye and Wheat. These grains are seldom used for feeding cattle because of the price. Rye is not as palatable as wheat but is slightly higher in digestible crude protein and total nutrients. Both of these grains compare favorably with barley in nutrient value but are not as generally used.

Wheat Bran. Wheat bran is one of the most popular commercial feeds used by dairymen. It is medium high in digestible protein, high in mineral content, slightly laxative, bulky. palatable and has a cooling effect upon the digestional tract. Because of these properties, bran is preferred to other feeds of equal or higher nutrient value. Bran is an excellent concentrate to mix with home grown feeds such as corn, barley and oats. It provides what the home-grown grains lack in mineral content, palatibility and physiological effects. Bran mashes (bran with hot water poured on) are excellent for fresh cows or cows off feed. These properties of bran should be considered when buying or comparing the price of it with other commercial feeds. This does not mean that one should buy bran regardless of price, but these properties should be weighed before making a choice.

Wheat Shorts. Wheat shorts or middlings contain more of the wheat kernel and is therefore higher in total digestible nutrients than bran; but unlike bran it is heavy, not so palatable, and not laxative. The middlings are not as high in minerals as bran; hence this feed does not supplement home-grown grain feed mixtures as well as bran. Middlings should be used as substitutes for barley and corn rather than as desirable feed to add to a mixture of corn and barley, as bran is.

Linseed Oil Meal. Linseed meal is a popular commercial feed with dairymen. Linseed meal is one of the most palatable feeds on the market. It is laxative and a feed of first rank as a conditioner. It tones up the system and glosses the coat like no other feed will. It is high in digestible crude protein and total digestible nutrients. Linseed meal is usually purchased because of its high protein content, although many farmers plan to feed a small amount of linseed meal as a conditioner. Linseed meal is especially good to add to such home-grown grains as corn, barley and oats. When a low protein roughage is fed, such as wild hay or timothy hay, linseed oilmeal is especially recommended.

Cotton Seed Meal. This concentrate is high in protein, but somewhat lacking in palatability. It usually furnishes one of the cheapest sources of protein but should not be used in a grain mixture unless there are other feeds in the mixture such as bran and oilmeal, or unless a succulent roughage is fed. Even in mixtures containing other laxative grains, cotton-seed meal should be fed cautiously. Experienced feeders recommended not more than three pounds in a grain mixture a day for a heavy fed cow. There is a feeling among many experienced dairymen that heavy feeding of cotton seed meal causes udder trouble and poor handling qualities in cows. Granting that this has at least some basis in fact, cotton seed meal can be used without any harm if used judiciously. It should not be fed to young stock, especially calves.

Soy Beans. In experimental trials at the South Dakota Station, ground soy beans were found to be equal to the old process linseed oilmeal for fat and milk production. So far as could be observed, there was no difference in palatability or its conditioning effect on the cows. Both concentrates seemed equally good. Soy beans when fed in large quantities in the ration are likely to produce soft butter; however, from a practical point of view this is not significant, as it would not be necessary nor profitable to feed such large amounts of soy beans in the ration. Soy beans can be grown with good yields

in most sections of South Dakota; hence this high protein and palatable concentrate should be grown more generally than it is at present.

Soy Bean Oil Meal. Soy bean oil meal is the soy bean from which the oil has been extracted. It is higher in protein than the soy bean and very palatable. In one feeding trial at the South Dakota Station, the meal was found to be about the same as the ground soy beans. The meal is usually cheaper and on an equal feeding value basis is preferred to the ground beans.

Dried Beet Pulp. This feed is high in carbohydrates and relatively low in protein. It is bulky, slightly laxative, and provides a good substitute for silage when soaked in water. Beet pulp is also used extensively for feeding cows on official test. It is soaked either with clean water or molasses water. For the dairyman with a small herd and no silage or roots, beet pulp is recommended.

Dried Brewers' Grains. This is a by-product of barley obtained in the manufacture of malt. Dried Brewers' grains are high in protein (about same as Corn Distillers' grains) and very palatable. When these grains can be purchased on a protein basis as cheap as other high protein feeds they should be given consideration because of their desirable characteristics such as palatability and bulk.

Dried Distillers' Grains. These grains are the by-products from corn and rye used in the production of distilled products. Distillers' grains from corn are superior to those from rye. For some time these products have been off the feed market but are now being quoted and will again be used by dairymen in figuring economical balanced rations.

Distillers' grains from corn are high in protein, being comparable to gluten feed in this respect. They are also very palatable and make an excellent protein addition to a ration. The distillers' grains from rye are only about half as high in digestible protein and also lack the palatability of the corn by-product. In buying Distillers' grain learn whether these are by-products or corn or rye. These grains should be purchased under a guaranteed analysis.

Gluten Feed. Gluten feed is lower in protein than gluten meal and differs from the meal in having the corn bran added. Gluten feed is also somewhat more palatable than gluten meal. It is used more generally in the dairy ration than the meal. It should be purchased on a guaranteed analysis.

Molasses. Molasses is a very good appetizer as well as being fairly high in total digestible nutrients (75 per cent as high as corn). Molasses is usually mixed with water and poured over the feed. Fed in this manner molasses can often become a profitable feed even though high in price considered on a total digestible nutrient basis.

The practice of using molasses as an appetizer is sometimes taken advantage of by unscrupulous feed dealers who will mix molasses with fibrous indigestible roughage materials and weed seeds and sell the product under some fancy name. The mixture may be palatable but of low feeding merit. It is always profitable and advisable to know what one is getting when purchasing feeds.

Preparation of Feed Affects Profits

It is self evident that no processing cost should be added to a feed which does not enhance its value to an amount equal to the cost of preparation. However, experimental work and experience bear out the importance of grinding grain for dairy cows. From 20 to 30 per cent of unground grain will pass through the alimentary tract without losing any of its nutrient value, hence has not been digested. This evidence indicates the need for grinding. Knowing the price of the grain to be ground one can readily ascertain whether it is profitable to grind. For example, assume corn is worth 80 cents per bushel. If 20 per cent is lost if fed whole (.20 x $.80) then 16 cents of feed value is lost by not grinding. Therefore, if a bushel of corn can be ground for less than 16 cents it pays to grind.

It is not neccessary to grind grain fine. In fact cows prefer medium to coarsely ground grain. The cost is also greatly reduced when the grain is coarsely ground.

Young stock and calves seem to prefer the whole grain, and unless it is necessary to grind for the cows, calves and young stock under ten months of age can very well be fed whole grain.

The grinding of roughages presents a very difficult problem. Work at this station and at other experiment stations has produced data which indicate that the grinding of roughages is not necessary and in most cases not profitable. When cows are fed whole corn stover for example, they will eat only the most palatable and nutritious parts of the stalk. When the entire stalk is ground the more palatable parts are mixed with the less palatable and the cow is forced to eat the entire plant. As a result the digestibility will be lower than when only the finer parts of the plant are eaten.

It is doubtful whether it ever pays to grind a good grade of roughage such as alfalfa, so far as its feeding value is concerned. When poorer roughages are high priced and scarce it may be advisable to grind them because there will be a saving of total feed and much which would otherwise be left uneaten, will be consumed, and at least be a factor in the maintenance of the animal. When a poor grade of roughage is ground its palatability may be somewhat enhanced. If the roughage is to be mixed with molasses or some concentrate, a more thorough mixture can be effected which in itself may make grinding advisable, and profitable.

The following conclusions are taken from S. D. Station bulletin number 252.

1. The digestibility of roughage is not increased by grinding or cutting.

2. Dairy cows will eat coarse roughages in greater amounts when these roughages are cut and mixed with concentrates.

3. Cut corn stover is nicer to handle and feed to cows in stanchions than the uncut stover.

4. The cutting or grinding of a good grade of roughage is not advisable, and cutting of coarse or poor grades of roughage can be recommended only when the cost of grinding is low.

5. The saving of labor and the facility with which ground or cut roughage can be stored and fed make the practice advisable under some conditions.

6. The cows increased slightly in weight during the feeding of the ground or cut roughages, but a somewhat greater amount of concentrates was eaten.

How to Buy Feeds Profitably

To buy feeds profitably one must know the digestible nutrients in the feeds and something about the characteristics of the feed such as its palatability, bulk, effect upon the animal, etc. With this information at hand, feeds can be purchased which will supplement the home-grown feeds and the available roughages to best advantage.

In the preceding pages, the characteristics of the most common feeds used for dairy cattle have been given. There are many proprietary or ready mixed feeds on the market

whose characteristics have not been given because they are not so well known. With proprietary feeds, the farmers can ascertain for himself the characteristics and feeding value of the particular feed he is interested in. These feeds are usually sold under closed formulae and only the manufacturer knows what they contain.

Buying Feeds on Protein Content. As a rule, dairy farmers in South Dakota will buy only such commercial feeds as are higher in protein. Carbohydrate feeds can usually be ground cheaper than they can be purchased. Therefore, the purchase of concentrates becomes largely a matter of providing the protein to mix with home-grown grains to balance the ration. If the protein content of a feed is known, the relative cost can readily be determined. For illustration, assume that the choice of a protein feed lay between oil meal or cottonseed meal. Refering to Table 3 in the back of the bulletin, the analysis of the two feeds are found to be as follows:

	Digestible Crude Protein	Total Digestible Nutrients
Linseed oilmeal	30.20 per cent	78.3 per cent
Cottonseed meal	37.60 per cent	80.2 per cent

Assume that the local price for the two feeds is $55.00 a ton for the linseed oilmeal, and $50.00 a ton for the cottonseed meal. To find out which feed is the cheaper source of protein one would proceed as follows: In 100 pounds of linseed meal there is 30.2 of digestible crude protein. Therefore in one ton there would be 20 x 30.2 pounds or 604.0 pounds of digestible crude protein. If one ton of linseed oilmeal cost $55, then one pound of protein in one ton of linseed oilmeal would cost $55 divided by 604.0 or 9.1 cents. Likewise in one ton of cottonseed meal there is 37.6 pounds digestible crude protein, and 37.6 x 20 or 752 pounds of digestible crude protein in one ton. The cost of one ton is $50, therefore the cost of one pound of digestible crude protein is $50 divided by 752 or 6.6 cents for one pound of digestible crude protein in cottonseed meal.

It is apparent at these prices that cottonseed meal is the cheaper source of protein, but there may be other characteristics about the feed which woul make it less desirable than the linseed oilmeal. Cottonseed meal is a constipating feed hence if a roughage such as wild or prairie hay were being fed and

no silage, the ration would be undesirable, and much better results would be obtained by adding a more laxative feed such as oilmeal, even though the cost is somewhat more. In other words, the relative cost of the nutrients in a feed is only one factor to keep in mind in buying feeds, and it is by no means always the most important one. On the other hand, if one desires to add variety to the concentrate mixture, the addition of a small amount of cottonseed meal could be recommended. That is, suppose the farmer were feeding alfalfa hay and silage as roughage and corn or barley as the concentrate part of the ration. With these feeds, a small amount of cottonseed meal would increase the protein content of the ration at a relatively smaller cost and yet be a desirable ration.

The same method of figuring and reasoning would apply to the total digestible nutrients of feeds. That is, by knowing the analysis and price of a feed one can ascertain the cost per pound of total digestible nutrients. This information, together with the characteristics of the feed, would determine whether it should be purchased or not, and how much should be added to the ration.

Feeding Standards and Their Use

Feeding standards are merely the requirements of animals put down in a table form. These requirements have been ascertained by years of experimental work in this and other countries. The present day feeding standards vary considerably from the first standards in use but the general principles underlying all standards are the same; that is, an attempt to provide nutrients in feeds in sufficient amounts to exactly meet the needs of the animal.

When the requirements of the animal are known in terms of digestible nutrients, and the digestible nutrient value of the available feeds are known, one need only provide the feeds in such amounts so that the digestible nutrients of the feeds will balance the digestible nutrient requirements of the animal in question. When this condition prevails, the animal is receiving a balanced ration.

The nutrients or feed materials in feed are spoken of as protein, carbohydrates, fats, minerals and water. When these nutrients are taken into the animal system, they serve distinct functions. The protein is used by the animal to build body tissue, muscles, hair, bones, horns, hoofs, skin and the protein in the milk. The fat and carbohydrates provide heat ,energy,

body fat and sugar in milk. These two nutrients in feeds perform the same function in the animal body, the only difference being that fat is two and one-fourth times as concentrated as carbohydrates. Therefore, one pound of fat will produce as much heat and energy as two and one-fourth pounds of carbohydrates. The mineral is used largely for the building of bones. The blood and body tissue also contain a definite amount and proportion of minerals. Water in the feed is used like the drinking water. A large part of the tissues, bones and milk of dairy animals is water; hence the importance of this nutrient.

In feeding one must keep in mind that none of the other nutrients can be used by the animal as a substitute for protein. In the case of fats and carbohydrates, these nutrients are interchangable so far as their function in the body is concerned. Even proteins can provide heat and energy for the animal body, or do the work of the fats and carbohydrates; but the reverse is not true. Hence one must provide suffiicent protein at all times.

How to Figure a Balanced Ration

Obviously the first step in figuring a balanced ration is to ascertain from a feeding standard the nutrients required. This will depend (1) upon the size of the cow; the larger the cow, the more feed is required to maintain her body; (2) on the amount of milk produced, because the more milk a cow produces the greater the requirement; (3) on the test of the milk. The production of high testing milk requires more nutrients than low testing milk.

The nutrient requirements for the above stated purposes must be obtained from a feeding standard. By referring to the standard given in Table 1, it will be seen that a 1000 pound cow requires .7 pounds of digestible crude protein and 7.925 pounds of total digestible nutrients for body maintenance. If the cow weighs 1500 pounds, she would require half again as much, etc. The nutrient requirement for maintenance increases proportionately to the body weight.

By referring to Table 2, one will find the nutrients required for milk of different tests. Then by knowing the test of the milk, and the quantity of milk produced a day, one can ascertain the pounds of protein and total digestible nutrients required. That is, if the cow produced 40 pounds of 3.6 per cent milk, she would require 2,004 pounds of digestible crude protein, and 12,520 pounds of total digestible nutrients. By adding

what is required for maintenance and milk production, the total requirement of the cow is ascertained. For clarity, it can be put in table form as follows:

1500 pound cow producing 40 pounds of 3.6 per cent milk.

Requirements	Digestible Protein	Total Digestible Nutrients
For maintenance	1.055 lbs.	11.887 lbs.
For milk production	2.004 lbs.	12.520 lbs.
Total nutrients required	3.059 lbs.	24.407 lbs.

The next step is to determine what feeds shall be used to provide the nutrients. This is an important point in profitable feeding and one which deserves much consideration; hence will be deferred for a later discussion. For the purpose of this ration, assume that alfalfa hay, corn silage, ground corn, ground oats, oilmeal and wheat bran are available.

By using the rules for feeding, the amount of dry roughage required by this cow would be about 15 pounds, silage about 40 pounds, and grain mixture about 13 pounds. By ascertaining the nutrients in these feeds, one will readily see whether the nutrients present in the feeds meet the requirements of the cow in question. Refer to Table 3 for the nutrient value of the feeds and set them down in table form as follows:

Feeds Used	Dig. Crude Protein	Total Dig. Nutrients
15 pounds alfalfa hay	1.587 lbs.	7.651 lbs.
40 pounds corn silage	0.480 lbs.	6.720 lbs.
6 pounds corn	0.426 lbs.	4.902 lbs.
4 pounds oats	0.388 lbs.	2.816 lbs.
2 pounds bran	0.240 lbs.	1.193 lbs.
1 pound oilmeal	0.302 lbs.	0.783 lbs.
Total nutrients provided in above feeds	3.423 lbs.	24.065 lbs.
Total nutrients required	3.059 lbs.	24.407 lbs.

* (Refer to Table XIII for weights of grains.)

In comparing the nutrients required with the nutrients provided in the pounds of the various feeds given, we note that the nutrients provided in .36 pounds of protein too high and

less than .34 pounds of total digestible nutrients too low. If one wished to get this exact, the bran or oilmeal could be decreased slightly to reduce the protein, and the corn increased to increase the total digestible nutrients. From the practical feeding standpoint, this ration would be considered balanced. It is not practical to try to get the nutrients provided to balance exactly with nutrients required as the feeds used may or may not be exactly the same as the analysis of the feeds in the table.

It must be kept in mind that "a ration" is the feed for a cow for a period of 24 hours. The ration is usually divided into as many feeds as there are milkings a day. That is, if the cow is milked twice a day, the ration is divided into two equal feeds; three times a day into three feeds.

Balancing the Concentrate Mixture. It is well that the dairy farmer should understand the balancing of rations. However, it is not likely that he will undertake the balancing of rations for all the cows in the herd. This would require more time than the average farmer could find for that purpose. It is also questionable whether the extra time in figuring the ration, mixing and feeding individual balanced rations, would be warranted. The balancing of a concentrate mixture can be done in the same time that it takes to balance the ration for one cow, and the balanced mixture can be used for the entire herd, feeding each animal according to milk production. Most farm dairy herds are made up of cows of about the same production, hence the balanced mixture will do very well. In case there are several cows in th herd whose production is considerably higher than the balance of the herd, and for that reason should have additional high protein feeds, these cows can be fed whatever high proteins are needed in addition to the mixture.

It is also entirely practical and a desirable practice to have two feed mixtures, one intended for the milking herd, the other for dry cows and young stock.

In feeding, the feed cart can be divided into two compartments, each containing a different balanced mixture.

In feeding a mixture, a suitable scoop or pail can be used. The feeder should weigh each mixture to ascertain the weight of a scoop or pail full and then use it for feeding. In this way the feeder can feed the entire herd in a comparatively short time, and the allotment for each animal will not vary sufficiently to make any practical difference. The saving of time fully justifies this method of feeding.

There are several ways of balancing a mixture. In herds where all the cows are of the same breed, or about equal in size, the mixture can be balanced for the typical cow in the herd. That is, estimate the average weight of the cows in the herd, and ascertain the average milk production and test. Then proceed in the same way as when balancing a ration for an individual cow.

A mixture can also be balanced by ascertaining the nutritive ratio of the ration. By providing a nutritive ratio of 1 to 6—7, for the grain mixture and roughage, the ration will be balanced for average producing milk cows when the mixture is fed according to production.

The grain mixture can be made as large as desired by merely increasing each grain in it, in the same proportion. That is, in the case of the grain mixture of the ration just calculated, each grain could be increased 10, 50, or 100 times, etc. If these grains were increased 100 times the mixture would contain 1300 pounds, thus:

6 pounds corn	x 100 equals	600 pounds
4 pounds oats	x 100 equals	400 pounds
2 pounds bran	x 100 equals	200 pounds
1 pound oilmeal	x 100 equals	100 pounds
Weight of mixture		1300 pounds

Concentrate mixtures should be mixed according to weight on the feed room floor and then run through the grinder. The ground mixture can be stored in a bin or sacks and is ready for feeding.

Suggested Feed Mixtures

A few suggestive mixtures have been calculated using different roughages with and without silage. These mixtures are primarily intended for dairymen with cows of average production.

It might be well to emphasize that the balance of nutrients is not all that is necessary in figuring a ration or a mixture. There are other characteristics of a ration or mixture, such as bulk, palatability, succulence, effect upon the cow, effect upon the product, and variety which must be considered. These characteristics may be fully as important at times as the balance of the nutrients.

By referring to the discussion of the various roughages and concentrates, one will find some of the character-

istics of the feeds given. These should be kept in the foreground in mixing feeds for dairy cattle.

How To Use Feed Mixtures

A number of concentrate mixtures have been computed to fit certain roughages. In computing these mixtures, not only balance of nutrients has been considered but the other characteristics of a desirable ration have been kept in mind. These mixtures can, therefore, be adapted to the feeding of a dairy herd without modification.

In many instances the mixture does not contain as many total pounds as most feeders desire. However, this can be increased to any weight of feed desired by merely multiplying each constituent by the same figure. So long as the proportions of the mixture are not changed the various ingredients can be increased to any amount desired. For instance, mixture 1, under group A, may be tripled by multiplying each ingredient by 3, making 1200 pounds of ground corn, 600 pounds of wheat bran, 900 pounds of linseed oilmeal. The mixture can likewise be decreased by dividing by any number desired.

If one should desire exactly one ton of the mixture this can readily be done by ascertaining the factor by which each ingredient must be increased so that the total equals one ton. Using the same mixture for illustration, the total pounds in mixture Number 1 equals 900. One ton or 2000 pounds divided by 900 equals 2 2/9. Therefore if each ingredient in this mixture is multiplied by the factor 2 2/9 the total pounds in the mixture will equal one ton.

In selecting any specific mixture one should first determine the group to which the available roughage or roughages belong. Then select the mixture which contains the feeds available at local feed stores or elevator. If the available roughages used on any particular farm are not listed one should select the group corresponding most nearly to the roughage available. For instance, if one must feed considerable oat straw or other low grade roughage, select mixtures under group A. Or, if one is using considerable millet hay or sudan grass hay and corn silage one of the mixtures under group B would provide a ration balanced for all practical purposes.

Dairymen are urged to try one of these mixtures because

it will not only provide a balanced ration for his herd, but it will also be an economical ration.

A. When wild or prairie hay, timothy hay, or corn stover is the only roughage, feed one of the following grain mixtures:

1.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground corn, 400 lbs	28.4 lbs.	326.8 lbs.
Wheat bran, 200 lbs.	24.0 lbs.	119.3 lbs.
Linseed oilmeal, 300 lbs.	90.6 lbs.	234.9 lbs.
	143.0 lbs.	681.0 lbs.

Per cent protein of grain mixture—15.9
Per cent T. D. N. of grain mixture—75.7
Nutritive ratio of grain mixture—1:3.7

2.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground corn, 200 lbs	14.2 lbs.	163.4 lbs.
Ground barley, 200 lbs.	18.0 lbs.	158.8 lbs.
Wheat bran, 200 lbs.	24.0 lbs.	119.3 lbs.
Linseed oilmeal, 300 lbs.	90.6 lbs.	243.9 lbs.
	146.8 lbs.	685.4 lbs.

Per cent protein in grain mixture—16.3
Per cent T. D. N. in grain mixture—76.1
Nutritive ratio of grain mixture—1:3.6

3.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground oats, 300 lbs.	29.1 lbs.	211.2 lbs.
Ground corn, 400 lbs.	28.4 lbs.	326.8 lbs.
Linseed oilmeal, 350 lbs.	105.7 lbs.	274.0 lbs.
	163.2 lbs.	812.0 lbs.

Per cent protein in grain mixture—15.5
Per cent T. D. N. in grain mixture—77.3
Nutritive ratio of grain mixture—1:3.9

4.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground corn, 200 lbs.	14.2 lbs.	163.4 lbs.
Ground oats, 200 lbs.	19.4 lbs.	140.8 lbs.
Ground soybeans, 350 lbs.	101.8 lbs.	297.2 lbs.
Wheat bran, 450 lbs.	54.0 lbs.	268.5 lbs.
	189.4 lbs.	869.9 lbs.

Per cent protein in grain mixture—15.8
Per cent T. D. N. in grain mixture—72.5
Nutritive ratio of grain mixture—1:3.7

5.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground barley, 400 lbs.	36.0 lbs.	317.6 lbs.
Ground oats, 400 lbs.	38.8 lbs.	281.6 lbs.
Linseed oilmeal, 450 lbs.	135.9 lbs.	352.3 lbs.
	210.7 lbs.	951.5 lbs.

Per cent protein in grain mixture—16.8
Per cent T. D. N. in grain mixture—76.9
Nutritive ratio of grain mixture—1:3.5

6.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground barley, 200 lbs.	18.0 lbs.	158.8 lbs.
Ground oats, 200 lbs.	19.4 lbs.	140.8 lbs.
Gluten meal, 300 lbs.	89.1 lbs.	257.4 lbs.
Wheat Bran, 400 lbs.	48.0 lbs.	238.5 lbs.
	174.5 lbs.	795.5 lbs.

Per cent protein in grain mixture—15.9
Per cent T. D. N. in grain mixture—72.3
Nutritive ratio of grain mixture—1:3.6

Feed one pound of the grain mixture to three pounds of milk for Holsteins and Ayrshires, and one pound of grain to two pounds of milk for Guernseys and Jerseys. Allow the cows all the dry roughage they will eat.

B. When some legume hay is fed with wild hay, timothy or corn stover, and corn silage as a roughage, feed one of the following mixtures.

Feed grain at the rate of 1 pound of grain to 2½ to 3½ pounds of milk and all the silage and dry roughage the cows will eat.

1.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground corn, 400 lbs.	28.4 lbs.	326.8 lbs.
Ground oats, 400 lbs	38.8 lbs.	281.6 lbs.
Wheat bran, 400 lbs.	48.0 lbs.	238.7 lbs.
Linseed meal, 300 lbs.	90.6 lbs.	234.9 lbs.
	205.8 lbs.	1082.0 lbs.

Per cent protein in grain mixture—13.7
Per cent T. D. N. in grain mixture—72.1
Nutritive ratio of grain mixture—1:4.3

2.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground corn, 300 lbs.	21.3 lbs.	245.1 lbs.
Ground oats, 600 lbs.	58.2 lbs.	422.4 lbs.
Ground barley, 300 lbs	27.0 lbs.	238.2 lbs.
Cotton seed meal, 150 lbs.	56.4 lbs.	120.3 lbs.
Linseed oilmeal, 200 lbs.	60.4 lbs.	156.6 lbs.
	223.3 lbs.	1182.6 lbs.

Per cent protein in grain mixture—14.4
Per cent T. D. N. in grain mixture—76.3
Nutritive ratio of grain mixture—1:4.3

3.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground barley, 600 lbs.	54.0 lbs.	476.4 lbs.
Wheat bran, 200 lbs.	24.0 lbs.	119.3 lbs.
Linseed oilmeal, 150 lbs.	45.3 lbs.	117.4 lbs.
Cottonseed meal, 50 lbs.	18.8 lbs.	40.1 lbs.
	142.1 lbs.	753.2 lbs.

Per cent protein in grain mixture—14.5
Per cent T. D. N. in grain mixture—75.3
Nutritive ratio of grain mixture—1:4.3

4.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground barley, 300 lbs.	29.1 lbs.	211.2 lbs.
Ground oats, 300 lbs.	27.0 lbs.	238.2 lbs.
Linseed meal, 200 lbs.	60.4 lbs.	156.6 lbs.
Gluten feed, 100 lbs.	21.3 lbs.	80.8 lbs.
	137.8 lbs.	686.8 lbs.

Per cent protein in grain mixture—15.3
Per cent T. D. N. in grain mixture—76.3
Nutritive ratio of grain mixture—1 :3.9

5.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground corn, 400 lbs.	28.4 lbs.	326.8 lbs.
Ground soybeans, 350 lbs.	101.8 lbs.	297.2 lbs.
Wheat bran, 200 lbs.	24.0 lbs.	119.3 lbs.
Ground oats, 300 lbs.	29.1 lbs.	211.2 lbs.
	183.3 lbs.	954.5 lbs.

Per cent protein in grain mixture—14.7
Per cent T. D. N. in grain mixture—76 4
Nutritive ratio of grain mixture—1 :4.2

6.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground barley, 500 lbs.	45.0 lbs.	397.0 lbs.
Gluten meal, 300 lbs.	89.1 lbs.	257.4 lbs.
Wheat bran, 200 lbs.	24.0 lbs.	119.3 lbs.
Oil meal, 100 lbs.	30.2 lbs.	78.3 lbs.
Ground oats, 400 lbs.	38.8 lbs.	281.6 lbs.
	227.1 lbs.	1133.6 lbs.

Per cent of protein in grain mixture—14.4
Per cent T. D. N. in grain mixture—75.5
Nutritive ratio of grain mixture—1 :4.0

C. When a legume hay such as alfalfa, sweet clover, soy bean hay, or red clover hay is used as dry roughage, fed with corn silage, feed one of the following grain mixtures:

Feed one pound of the grain mixture to every 2½ to 4 pounds of milk and all the legume roughage and corn silage the cows will eat.

1.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground corn, 250 lbs.	17.7 lbs.	204.4 lbs.
Ground oats, 500 lbs.	48.5 lbs.	352.0 lbs.
Ground barley, 200 lbs.	18.0 lbs.	158.8 lbs.
Ground soybeans, 150 lbs.	44.5 lbs.	128.7 lbs.
	128.7 lbs.	843.9 lbs.

Per cent protein of grain mixture—11.7
Per cent T. D. N. in grain mixture—76.7
Nutritive ratio of grain mixture—1:5.6

2.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground barley, 400 lbs.	36.0 lbs.	317.6 lbs.
Ground oats, 400 lbs.	38.8 lbs.	281.6 lbs.
Wheat bran, 100 lbs.	12.0 lbs.	59.6 lbs.
Linseed oilmeal, 100 lbs.	30.2 lbs.	78.3 lbs.
	117.0 lbs.	737.1 lbs.

Per cent protein of grain mixture—11.7
Per cent T. D. N. in grain mixture—73.7
Nutritive ratio of grain mixture—1:5.3

3.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground corn, 500 lbs.	35.5 lbs.	408.5 lbs.
Linseed oilmeal, 200 lbs.	60.4 lbs.	156.6 lbs.
Wheat bran, 100 lbs.	12.0 lbs.	59.7 lbs.
Ground rye, 100 lbs.	9.1 lbs.	81.9 lbs.
	117.0 lbs.	706.7 lbs.

Per cent protein of grain mixture—13.0
Per cent T. D. N. in grain mixture—78.5
Nutritive ratio of grain mixture—1:5.0

4

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground corn, 300 lbs.	21.3 lbs.	245.1 lbs.
Ground oats, 300 lbs.	29.1 lbs.	211.2 lbs.
Ground soybeans, 100 lbs.	29.1 lbs.	84.9 lbs.
Wheat bran, 300 lbs.	36.0 lbs.	179.5 lbs.
	115.5 lbs.	720.7 lbs.

Per cent protein of grain mixture—11.6
Per cent T. D. N. of grain mixture—72.1
Nutritive ratio of grain mixture—1:5.7

5.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground oats, 150 lbs.	14.5 lbs.	105.6 lbs.
Ground barley, 500 lbs.	45.0 lbs.	397.8 lbs.
Gluten feed, 200 lbs.	42.6 lbs.	161.6 lbs.
	102.1 lbs.	664.2 lbs.

Per cent protein of grain mixture—12.0
Per cent T. D. N. of grain mixture—78.1
Nutritive ratio of grain mixture—1 :5.5

6.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground corn, 200 lbs.	14.2 lbs.	163.4 lbs.
Ground wheat, 150 lbs.	13.2 lbs.	118.6 lbs.
Ground oats, 400 lbs.	38.8 lbs.	281.6 lbs.
Oilmeal, 100 lbs.	30.2 lbs.	78.3 lbs.
	96.4 lbs.	545.5 lbs.

Per cent protein of grain mixture—11.3
Per cent T. D. N. of grain mixture—64.1
Nutritive ratio of grain mixture—1 :5.7

D. With a good quality of legume dry roughage, such as alfalfa hay, feed one of the following grain mixtures:

1.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground corn, 100 lbs.	7.1 lbs.	81.7 lbs.
Ground oats, 400 lbs.	38.8 lbs.	281.6 lbs.
Ground barley, 100 lbs.	9.0 lbs.	79.4 lbs.
	54.9 lbs.	442.7 lbs.

Per cent protein of grain mixture—9.2
Per cent T. D. N. in grain mixture—73.8
Nutritive ration of grain mixture—1 :7.0

2.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground corn, 300 lbs.	21.3 lbs.	245.1 lbs.
Ground oats, 200 lbs.	19.4 lbs.	140.8 lbs.
Wheat bran, 150 lbs.	18.0 lbs.	89.4 lbs.
	58.7 lbs.	475.3 lbs.

Per cent protein of grain mixture—9.0
Per cent T. D. N. in grain mixture—73.1
Nutritive ratio of grain mixture—1 :7.1

3.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground barley, 400 lbs.	36.0 lbs.	317.6 lbs.
Ground oats, 300 lbs.	29.1 lbs.	211.2 lbs.
Ground wheat, 100 lbs.	8.8 lbs.	79.1 lbs.
Linseed oilmeal, 50 lbs.	15.1 lbs.	39.1 lbs.
	89.0 lbs.	647.0 lbs.

Per cent protein of grain mixture—10.5
Per cent T. D. N. in grain mixture—76.1
Nutritive ratio of grain mixture—1 :6.3

4.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground corn, 300 lbs.	21.3 lbs.	245.1 lbs.
Ground oats, 400 lbs.	38.8 lbs.	281.6 lbs.
Ground rye, 200 lbs.	18.2 lbs.	163.8 lbs.
Wheat bran, 200 lbs.	24.0 lbs.	119.3 lbs.
	102.3 lbs.	809.8 lbs.

Per cent protein of grain mixture—9.3
Per cent T. D. N. in grain mixture—73.6
Nutritive ratio of grain mixture—1 :6.9

5.

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground barley, 400 lbs.	36.0 lbs.	317.6 lbs.
Gluten feed, 50lbs.	10.6 lbs.	40.4 lbs.
Cottonseed meal, 50 lbs.	15.1 lbs.	39.1 lbs.
Ground oats, 200 lbs.	19.4 lbs.	140.8 lbs.
	81.1 lbs.	537.8 lbs.

Per cent protein of grain mixture—11.6
Per cent T. D .N. in grain mixture—76.8
Nutritive ratio of grain mixture—1 :5.6

Grain Mixture	Dig. Crude Protein	Total Dig. Nutrients
Ground barley, 360 lbs.	27.0 lbs.	238.2 lbs.
Ground corn, 250 lbs.	17.7 lbs.	204.2 lbs.
Ground oats, 400 lbs.	38.8 lbs.	281.6 lbs.
Wheat bran, 50 lbs.	6.0 lbs.	29.8 lbs.
Linseed oilmeal, 50 lbs.	15.1 lbs.	39.1 lbs.
	104.6 lbs.	792.9 lbs.

Per cent protein of grain mixture—10.0
Per cent T. D. N. in grain mixture—75.5
Nutritive ratio of grain mixture—1 ;6.6

(The digestible protein and total digestible nutrients are given for each mixture. To determine which is the cheapest mixture at the local prices of feed, determine the cost of the mixture, then divide the cost by the total digestible nutrients of the mixture. To determine which mixture furnishes protein the cheapest, divide the cost of the mixture by the pounds of digestible crude protein in the mixture.)

Rules for Feeding

If a few simple rules are followed in the feeding of the dairy herd, greater profits will result, and the herd will be better fed.

1. Feed all the roughage a cow will eat twice a day. If no succulent roughage is fed, the cow will eat about two pounds of dry roughage a day for every 100 pounds of live weight.

2. Feed all the succulent roughage a cow will eat twice a day. This will be about three pounds per 100 pounds of live weight.

3. Feed the concentrate feeds according to milk production. If a good legume roughage is fed, allow one pound of grain to every four pounds of milk for Holsetins and Ayrshires and one pound of grain to every three pounds of milk for Jerseys and Guernseys. If a poor roughage like corn stover, timothy hay or wild hay is fed, feed one pound of grain to every three pounds of milk for Holsteins and Ayrshires, and one pound of grain to every two pounds of milk for Jerseys and Guernseys.

Order of Feeding. Dairy cows are creatures of habit, and will respond to regularity and systematic feeding and care more than any other class of livestock. Therefore, whatever routine of feeding, watering, etc., is adopted it should be followed regularly every day.

Silage is often fed first and the grain fed on the silage. This method of feeding may have some merit. Silage and grain should be fed before the dry roughage, otherwise the cows will throw the hay out of the manger to get at the grain and silage.

It is well to feed the hay after milking. This avoids considerable dust which results when hay is handled. It is also a good practice to feed the grain just after milking.

Water milk-cows at least twice a day. During the cold weather the water should be warmed sufficiently to take the chill from it. It pays to give milk cows all the water of the proper temperature they can drink.

Feeding for Milk Production. It has previously been pointed out that milk cows must be fed a ration which is sufficient to provide nutrients for body maintenance and milk production. It is folly to keep so many cows that one does not have sufficient feed for all. It would be better management to cull out the poor producers, and feed those remaining what they should have. This method of procedure has proven

very successful in cow testing associations in increasing production and profits.

In another part of this booklet a number of suggestive grain mixtures have been given to be fed with different kinds of roughages. Decide what class the roughage you are using comes in and then choose one of the concentrate mixtures. Feed the concentrate according to milk production following one of the rules given.

Selecting the Concentrate Mixture. In formulating the concentrate mixtures, the necessary characteristics of a good ration must be kept in mind. The reason for suggesting a number of mixtures is to allow for choice principally on the basis of price. That is, certain mixtures might be cheaper in some localities, hence that would be the mixture to use.

To figure the cost of the mixture proceed as follows: Take for instance mixture number 1 in group A. Assume that ground corn was worth $32 a ton ,wheat bran $30 a ton, and linseed oilmeal $60 a ton. The entire mixture would then cost:

1.

400 lbs. is 1/5 tons—1/5 of $32 equals	$6.40
200 lbs. is 1/10 tons—1/10 of $30 equals	3.00
300 lbs. is 3/20 tons—3/20 of $60 equals	9.00
Cost of mixture	$18.40

The mixture contains 681 pounds of total digestible nutrients. Therefore, one pound of total digestible nutrients would cost 2.7 cents. One pound of digestible protein similarly computed would cost 12.9 cents.

The cost of total digestible nutrients and digestible protein can be figured in the other mixtures and a comparison made on the basis of cost of total digestible nutrients or digestible protein, according to the local prices of feeds in the mixture.

The nutritive ratio and the per cent of protein in each concentrate mixture is also computed. One can tell at a glance what the nutritive ratio of each mixture is, and also what per cent of digestible protein it contains. This information may help in the selection of the mixture best suited to the roughage. For instance, if the wild hay is of poor quality, one of the highest protein mixtures should be chosen. If the timothy hay is a good quality, and contains a small amount of clover, a mixture with the lowest per cent of protein in the group should be selected.

Feeding the Dry Cow

It must not be forgotten that a dry cow requires feed to maintain herself. If the cow is allowed to run down and

get thin during her dry period, she will not give as much milk when she freshens nor have as long a productive life.

A heavy milking dairy cow frequently is not able to consume enough feed during her milking period to provide the nutrients necessary for her body and milk production. She will then draw upon the reserve she has stored in her body. No harm will be done if she is allowed to build up this reserve during her dry period. However, if the cow is not dried up and fed properly during the dry period, she cannot replace the reserve nutrients in her body and will sufler thereby.

When the cow is dry during the pasture season, and the pasture is good, no further feed is necessary. It might be well to keep a supply of bone meal in a trough and allow the cows to eat all they will. This is merely a precaution. In case the mineral supply in the feed has been low and the reserve in the animal body is pretty well depleted, the pasture season is a good time to replenish it.

If the cow is dry during the winter, feed her liberally of legume hay and silage. If she is a heavy milker, feed her in addition from 4 to 6 pounds a day of the herd mixture. If wild or prairie hay is the chief roughage, feed her 6 to 10 pounds a day of one of the mixtures suggested for the milking herd.

A week or ten days before calving the cow should be placed in a box stall and fed a laxative cooling ration. Good quality alfalfa hay and corn silage are good feeds for this purpose. If neither of these roughages are available and prairie hay must be used as roughage, feed 6 to 8 pounds of a concentrate mixture of the following grains: bran, linseed oilmeal, ground oats, mixed in equal parts by weight. Proper feeding before calving will result in less calving trouble. Cows properly fed will rarely have trouble with retention of afterbirth unless disease is present in the herd.

Feeding the Herd Sire

The herd sire is too often neglected not only in feeding, but otherwise. He is made to stand in a stall without sufficient exercise to keep him in good breeding condition. This condition must be corrected if the bull is to have a long life of useful service.

A bull in heavy service can be fed the same grain mixture as the milking herd. From 6 to 8 pounds a day of the same grain mixture which is being fed to the cows, will be sufficient. A large Holstein bull may need eight pounds, a small Jersey bull four to seven pounds.

Legume hay such as alfalfa, sweet clover, or soybean hay

is recommended for the herd sire as well as for the rest of the dairy herd.

The feeding of silage to breeding bulls is not recommended by many. Those who oppose the feeding of silage claim that it has a tendency to make the bull logy and a slow breeder. For bulls in heavy service, it might be well to omit silage from the ration; however, for bulls in light service, particularly if they are being fed a non-leguminous hay, ten to fifteen pounds of corn silage a day will help to keep them in better physical condition.

Feeding the Calves and Heifers

A calf which is worth raising should be so fed that it can grow to its maximum size. In order for the calf to do this, it must be fed feeds which will provide all the nutrients necessary for growth at the time when the natural impulse for growth is the greatest.

In mammals, nature has provided milk as the food best adapted to the growth of its young. The milk from mammals whose young make rapid growth is high in those nutrients which are needed for growth, such as protein and minerals. For instance the milk of rabbits contain 14.4 percent protein as compared to 3.5 percent in cow's milk, and 2.50 percent of ash or minerals as compared to .7 percent in cow's milk. The rabbit doubles its weight in six days, the calf in 47 days. In other words, the rabbit grows about 8 times as fast as the calf. Hence it must have food which will supply the nutrients required.

The calf will do best when fed milk and should be allowed this important food. The first milk which a cow gives after freshening is known as colostrum milk. It is not used for human food in this country and is of no value other than what the calf can get from it. Colostrum milk, however, is very important for the calf. It serves as a laxative and starts the normal functioning of the intestinal tract. It is also valuable in preparing the digestional tract and the system of the calf for the milk. Experimental work and practical experience has indicated the difficulty of raising calves without colostrum milk.

A cow gives colostrum milk for the first six or eight milkings, or three or four days. This is not marketable as milk; hence allow the calf to get it. To avoid bacterial contamination, the writer belives it is better to let the calf draw this milk direct from the udder. If it is milked into a pail and then fed, the temperature of the colostrum milk is not so favorable, and there is a greater opportunity for bac-

terial contamination from the pails, barn air, etc. In addition to the likelihood of greater bacterial contamination by drawing the milk, one has the extra work.

It is also desirable from the standpoint of the cow, particularly if she is subject to milk fever, to allow the calf to nurse for three to four days. The calf will nurse frequently and draw only a small amount of milk each time. This relieves the cow of some of the milk but not sufficient to cause a heavy flow of blood to the udder which is the immediate cause of milk fever.

The objection that the calf is hard to teach to drink out of a pail when allowed to nurse the cow for a time, is not sufficient to overcome the more serious objections in hand feeding the colostrum milk.

When the calf is taken away from its mothers, it may be necessary to withhold the milk for one or two feedings in order to get the calf hungry. This should be sufficient, and no serious difficulty should be experienced in getting the calf to drink from a pail.

In case the dam of the calf has a disease which can be carried through the milk, the calf should be taken away as soon as born, and hand fed milk. If colostrum milk from a healthy cow is available, feed it; otherwise feed normal milk.

The calf should receive whole milk for the first two or three weeks of its life to insure it against the many ailments young calves are subject to. Then if skimmilk is available gradually change over to skimmilk. This change should be made gradually, replacing a part of the whole milk with skimmilk until the calf is receiving all skimmilk. The skimmilk feeding should be continued until the calf is four to six months old. If skimmilk is cheap, it can be fed with good results to calves until they are eight months of age.

The young calf should receive from four to five quarts of whole milk a day for the first week, increasing this amount until the calf is receiving from six to seven quarts at the end of the third week.

If whole milk is being sold at a good price, the change from whole to skimmilk could be made at the end of the second week, making sure that the skimmilk added is sweet and of the right temperature.

The amount of skimming fed can be increased as the calf gets older until nine to ten quarts are being fed a day. At no time should more than ten quarts be fed as the calf will not utilize a larger amount profitably.

The calf should be taught to eat grain and hay as soon as

possible. By placing a handful of ground oats in the manger or in the pail after the calf has drunk its milk, it will soon acquire the taste for feed. Hay kept before the calf will also induce it to nibble and soon it is eating roughage.

A good grain mixture is corn and oats, equal parts by weight. This should be ground for calves until they are five or six months old. From that age until about one year the grain can be fed whole.

A good clean legume roughage should be fed. Alfalfa ranks first because of its fineness, palatability, its high protein and calcium content. Calves will scour if they are not used to eating alfalfa hay. An occasional feed of prairie hay will be beneficial until the calves have become accustomed to the alfalfa.

Raising Calves Without Skimmilk. Where whole milk is sold and no skimmilk is available for calf feeding, the raising of calves becomes a more difficult undertaking. There are several thing one can do in raising calves when no skimmilk is available.

Perhaps the most practical method, but not the most economical one, is to feed the calf whole milk until it is 60 to 70 days old and then wean it. In the meantime, the calf should be taught to eat grain and hay. A grain mixture of four parts by weight of corn, one part of wheat bran, one part of oil meal, and three parts of oats will give good results. Allow the calf all the alfalfa hay it will eat; also all the grain it will eat until the calf is six months old; then limit it to five or six pounds a day.

When a limited amount of skimmilk is available, feed whole milk until the calf is three weeks old then change to skimmilk. Continue feeding skimmilk until the calf is three months old and then wean. Feed the same grain mixture as recommended for the whole milk feeding period.

When neither whole or skimmilk are available, the raising of good calves becomes a difficult problem. Many commercial and home-made calf meals have been tried as a substitute for milk with only partial success. Even when calf meals are used, it is necessary to start the calf on whole milk.

Calf meals are fed as gruel, that is mixed with warm water in the proportion of one part of meal to seven parts of water. A home made calf meal which has been used and proven as good as any contains hominy or ground corn, linseed meal, red dog flour, and dried blood, equal parts by weight.

The feeder must not forget that calves and young stock

are making rapid growth; therefore they require feeds which are high in protein and calcium, materials essential to the building of bones and muscular tissue.

Brief Explanation of Tables

The tables in this bulletin are intended for use by practical dairymen as well as for class room work. So often those who should make use of the data in tables like these, fail to do so, because the tables look too intricate. It is for this reason that a word of explanation is made concerning the adaptability and use of the respective tables.

Table I—states in definite figures how much digestible protein and total digestible nutrients are required to maintain an animal of a certain weight for one day or 24 hours.

Table II—gives the digestible protein and total digestible nutrients required for the production of a given number of pounds of milk, at tests ranging from 3.0 per cent to 6.9 per cent fat. When the requirement for a specific number of pounds of milk is desired which is not indicated in the table—for instance 25 pounds of milk—use the requirements for 20 and 5 pounds and add them.

Table III—expresses in definite figures the digestible protein and total digestible nutrients in a number of feeds. In these tables the total digestible protein and total digestible nutrients have been computed for varying amounts of feed. If a greater amount of any specific feed is used than indicated in the table the digestible protein and total digestible nutrients can be ascertained thus: For example if one is feeding 23 pounds of alfalfa hay, use the amounts of total digestible protein, and total digestible nutrients indicated in 15 and 8 pounds of alfalfa hay, etc.

Table IV—can be conveniently used in ascertaining the cost of one pound of the various home grown feeds at different prices per bushel. For instance when oats are 63 cents per bushel, 1 pound is worth 1.906 cents. If one wished to determine the cost of 1720 pounds of oats, just multiply 1720 x $.01906 equals $32.78. This is easier and quicker than changing the pounds to bushels and then determining the cost of bushels and fractions thereof. The range in price per bushel is from 20 cents to $1.00 which should under most conditions cover the range of prices.

Table V—is similar to Table IV only the prices are based on tons instead of bushels.

Table VI—should be used by every dairyman who must buy feed. The analysis of the feed on which the table is constructed is indicated. D.C.P. means digestible crude protein. T.D.N. means total digestible nutrients. This table has the price per bushel or ton in the first column and the price of 1 pound of digestible protein in the second column. In the third column the price of one pound total digestible nutrients. One can by this table compare the price of protein and T.D.N. of a number of feeds at different prices per bushel or ton. For instance if one is in doubt which is the cheaper feed to buy on a protein basis, oil meal at $52 per ton, or wheat bran at $30 per ton. Referring to the table under the respective feeds we find that one pound of protein in oil meal at the above price costs 8.61 cent. One pound of protein in wheat bran at the above price costs 12.48 cents. In other words one pound of protein in bran is about half again as high in price as in oil meal. Similarly the feeds can be compared on T.D.N. basis.

Table VII—In this table are grouped the high protein feeds. The prices of the feeds are compared on a protein basis. For instance on a digestible protein basis only, wheat bran at $32 per ton, is comparable to linseed oil meal at $80.48 per ton. Putting the same thing in another form—on a protein basis one can afford to pay $80.48 for oil meal per ton, when bran costs $32 per ton.

Table VIII—In this table high carbohydrate feeds are compared on total digestible nutrients, computed to the bushel basis. For example one pound of T.D.N. costs the same in oats at 45 cents per bushel as in corn at 91 cents per bushel. Stated in another way—when oats costs 45 cents per bushel one can afford to pay 91 cents per bushel for corn, on a T.D.N. basis.

Tables IX, X, XI, are self explanatory.

Table XII—Indicates the weight of one cubic foot of silage at various depths, and the capacity in tons of a silo at varying diameters. For instance a silo 16 feet in diameter and 30 feet high will have a capacity of 117.5 tons.

Table XIII—Is self explanatory.

Table XIV—Is a most convenient table to ascertain the exact calving date of cows. When the dates in the serivce column correspond to the breeding date, the date opposite will show the calving date. For instance a cow bred on March 12, is due to calve on Dec. 18, etc.

Table I.—Daily Requirements for Maintenance of Dairy Cows

Weight Lbs.	Digestible crude protein Lbs.	Total Digestible nutrients Lbs.
800	0.560	6.340
850	0.595	6.725
900	0.630	7.132
950	0.665	7.517
1000	0.700	7.925
1050	0.735	8.310
1100	0.770	8.717
1150	0.805	9.102
1200	0.840	9.500
1250	0.875	9.895
1300	0.910	10.302
1350	0.945	10.687
1400	0.980	11.095
1450	1.015	11.480
1500	1.055	11.887
1550	1.085	12.284
1600	1.120	12.680

To use this table ascertain the approximate weight of the cow and put the requirements down thus:

	Digestible Crude Protein	Total Digestible Nutrients
Maintenance requirements for a 1550 pound cow	1.085 lbs.	12.284 lbs.

Table II.—Nutrients Required for Producing Milk of Different Percentages of Fat

Amt. Milk	Per Cent Fat in Milk 3.0		Per Cent Fat in Milk 3.1		Per Cent Fat in Milk 3.2		Per Cent Fat in Milk 3.3		Per Cent Fat in Milk 3.4	
	Pro.	T. D. N.	Pro.	T. D. N.	Pro.	T. D. N.	Pro.	T. D. N.	Pro.	T. D. N.
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	.047	.285	.048	.291	.048	.298	.048	.304	.049	.310
2	.094	.570	.095	.579	.096	.596	.097	.608	.097	.620
3	.141	.855	.142	.869	.143	.894	.145	.912	.146	.930
4	.188	1.140	.190	1.161	.191	1.192	.193	1.216	.194	1.240
5	.234	1.425	.237	1.447	.239	1.490	.241	1.520	.243	1.550
6	.281	1.710	.284	1.735	.287	1.788	.290	1.824	.292	1.860
7	.328	1.995	.332	2.026	.335	2.086	.338	2.128	.340	2.170
8	.375	2.280	.379	2.317	.382	2.384	.386	2.432	.389	2.480
9	.422	2.565	.427	2.618	.430	2.682	.435	2.736	.437	2.799
10	.469	2.850	.474	2.896	.478	2.980	.483	3.040	.486	3.100
20	.938	5.700	.948	5.792	.956	5.960	.966	6.080	.972	6.200
30	1.407	8.550	1.422	8.688	1.434	8.940	1.449	9.120	1.458	9.300
40	1.876	11.400	1.896	11.584	1.912	11.920	1.932	12.160	1.944	12.400
50	2.345	14.250	2.370	14.480	2.390	14.900	2.415	15.200	2.430	15.500
60	2.814	17.100	2.874	17.376	2.868	17.880	2.898	18.240	2.916	18.600
	3.5		3.6		3.7		3.8		3.9	
1	.049	.312	.050	.313	.051	.320	.052	.327	.053	.334
2	.098	.624	.100	.626	.102	.640	.104	.654	.106	.668
3	.148	.936	.150	.939	.153	.960	.156	.981	.159	1.002
4	.197	1.248	.200	1.252	.204	1.280	.208	1.308	.212	1.336
5	.246	1.560	.250	1.565	.255	1.600	.260	1.635	.265	1.670
6	.295	1.872	.301	1.878	.307	1.920	.312	1.962	.318	2.004
7	.344	2.184	.351	2.191	.358	2.240	.364	2.289	.371	2.338
8	.394	2.496	.401	2.504	.409	2.560	.416	2.616	.424	2.672
9	.443	2.808	.451	2.817	.460	2.880	.468	2.943	.477	3.006
10	.492	3.120	.501	3.130	.511	3.200	.520	3.270	.530	3.340
20	.984	6.240	1.002	6.260	1.022	6.400	1.040	6.540	1.060	6.680
30	1.476	9.360	1.503	9.390	1.533	9.600	1.560	9.810	1.590	10.020
40	1.968	12.480	2.004	12.520	2.044	12.800	2.080	13.080	2.120	13.360
50	2.460	15.600	2.505	15.650	2.555	16.000	2.600	16.350	2.650	16.700
60	2.952	18.720	3.006	18.780	3.066	19.200	3.120	19.620	3.180	20.040

Table II.—(Continued)
Nutrients Required for Producing Milk of Different Percentages of Fat

Amt. Milk	Per Cent Fat in Milk 4.0		Per Cent Fat in Milk 4.1		Per Cent Fat in Milk 4.2		Per Cent Fat in Milk 4.3		Per Cent Fat in Milk 4.4	
	Pro.	T. D. N.	Pro.	T. D. N.	Pro.	T. D. N.	Pro.	T. D. N.	Pro.	T. D. N.
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	.054	.341	.055	.346	.055	.352	.056	.359	.056	.366
2	.180	.682	.109	.692	.111	.704	.112	.718	.113	.732
3	.162	1.023	.164	1.038	.166	1.056	.167	1.077	.169	1.098
4	.216	1.364	.218	1.384	.221	1.408	.223	1.436	.226	1.464
5	.269	1.705	.273	1.730	.276	1.760	.279	1.795	.282	1.830
6	.323	2.046	.328	2.076	.332	2.112	.335	2.154	.339	2.196
7	.377	2.387	.382	2.422	.387	2.464	.391	2.513	.395	2.562
8	.431	2.728	.437	2.768	.442	2.816	.446	2.872	.452	2.928
9	.485	3.069	.491	3.114	.497	3.168	.502	3.231	.508	3.294
10	.539	3.410	.546	3.460	.553	3.520	.558	3.590	.565	3.660
20	1.078	6.820	1.092	6.920	1.106	7.040	1.116	7.180	1.130	7.320
30	1.617	10.230	1.638	10.380	1.659	10.560	1.674	10.770	1.695	10.980
40	2.156	13.640	2.184	13.840	2.212	14.080	2.232	14.360	2.260	14.640
50	2.695	17.050	2.730	17.300	2.765	17.600	2.790	17.950	2.825	18.300
60	3.234	20.460	3.276	20.760	3.318	21.120	3.348	21.540	3.390	21.960
	4.5		4.6		4.7		4.8		4.9	
1	.057	.373	.058	.380	.058	.386	.059	.393	.060	.394
2	.114	.746	.116	.760	.117	.772	.118	.786	.119	.788
3	.172	1.119	.174	1.140	.175	1.158	.177	1.179	.179	1.182
4	.229	1.492	.232	1.520	.234	1.544	.236	1.572	.239	1.576
5	.286	1.865	.289	1.900	.292	1.930	.295	1.965	.298	1.970
6	.343	2.238	.347	2.280	.350	2.316	.355	2.358	.358	2.364
7	.400	2.611	.405	2.660	.409	2.702	.414	2.751	.418	2.758
8	.458	2.984	.463	3.040	.467	3.088	.473	3.144	.478	3.152
9	.515	3.357	.521	3.420	.526	3.474	.532	3.537	.537	3.546
10	.572	3.730	.579	3.800	.584	3.860	.591	3.930	.597	3.940
20	1.144	7.460	1.158	7.600	1.168	7.720	1.182	7.860	1.194	7.880
30	1.716	11.190	1.737	11.400	1.752	11.580	1.773	11.790	1.791	11.820
40	2.288	14.920	2.316	15.200	2.336	15.440	2.364	15.720	2.388	15.760
50	2.860	18.650	2.895	19.000	2.920	19.300	2.955	19.650	2.985	19.700
60	3.432	22.380	3.464	22.800	3.504	23.160	3.546	23.580	3.582	23.640

Table II.—(Continued)
Nutrients Required for Producing Milk of Different Percentages of Fat

Amt. Milk	Per Cent Fat in Milk 5.0		Per Cent Fat in Milk 5.1		Per Cent Fat in Milk 5.2		Per Cent Fat in Milk 5.3		Per Cent Fat in Milk 5.4	
	Pro.	T. D. N.	Pro.	T. D. N.	Pro.	T. D. N.	Pro.	T. D. N.	T. D. N.	Pro.
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	.060	.401	.061	.405	.062	.408	.062	.415	.063	.422
2	.121	.802	.122	.810	.124	.816	.125	.830	.126	.844
3	.181	1.203	.183	1.215	.185	1.224	.187	1.245	.190	1.266
4	.242	1.604	.244	1.620	.247	1.632	.250	1.660	.253	1.688
5	.302	2.005	.305	2.025	.309	2.040	.312	2.075	.316	2.110
6	.362	2.406	.367	2.430	.371	2.448	.375	2.490	.379	2.532
7	.423	2.807	.428	2.835	.433	2.856	.437	2.905	.442	2.954
8	.483	3.208	.489	3.240	.494	3.264	.500	3.320	.506	3.376
9	.544	3.609	.550	3.645	.556	3.672	.562	3.735	.569	3.798
10	.604	4.010	.611	4.050	.618	4.080	.625	4.150	.632	4.221
20	1.208	8.020	1.222	8.010	1.236	8.160	1.250	8.300	1.264	8.442
30	1.812	12.030	1.833	12.150	1.854	12.240	1.875	12.450	1.896	12.663
40	2.416	16.040	2.444	16.020	2.472	16.320	2.500	16.600	2.528	16.884
50	3.020	20.050	3.055	20.250	3.090	20.400	3.125	20.750	3.160	21.105
60	3.624	24.060	3.666	24.300	3.708	24.480	3.750	24.900	3.792	25.326

	5.5		5.6		5.7		5.8		5.9	
1	.064	.428	.064	.433	.065	.436	.066	.437	.066	.444
2	.128	.856	.129	.866	.130	.872	.131	.874	.133	.888
3	.192	1.284	.193	1.299	.195	1.308	.197	1.311	.199	1.332
4	.256	1.712	.258	1.732	.260	1.744	.262	1.748	.265	1.776
5	.320	2.140	.322	2.165	.325	2.180	.328	2.185	.331	2.220
6	.383	2.568	.386	2.598	.391	2.616	.394	2.622	.398	2.664
7	.447	2.996	.451	3.031	.456	3.052	.459	3.059	.464	3.108
8	.511	3.424	.516	3.464	.521	3.488	.525	3.496	.530	3.552
9	.575	3.852	.580	3.897	.586	3.924	.590	3.933	.597	3.996
10	.639	4.280	.644	4.330	.651	4.360	.656	4.370	.663	4.440
20	1.278	8.560	1.288	8.660	1.302	8.720	1.312	8.740	1.326	8.880
30	1.917	12.840	1.932	12.990	1.953	13.080	1.968	13.110	1.989	13.320
40	2.556	17.120	2.576	17.320	2.604	17.440	2.624	17.480	2.652	17.760
50	3.195	21.400	3.220	21.650	3.255	21.800	3.280	21.850	3.315	22.200
60	3.834	25.680	3.864	25.980	3.906	26.160	3.936	26.220	3.978	26.640

Table II.—(Continued)
Nutrients Required for Producing Milk of Different Percentages of Fat

Amt. Milk	Per Cent Fat in Milk 6.0		Per Cent Fat in Milk 6.1		Per Cent Fat in Milk 6.2		Per Cent Fat in Milk 6.3		Per Cent Fat in Milk 6.4	
	Pro.	T. D. N.	Pro.	T. D. N.	Pro.	T. D. N.	Pro.	T. D. N	Pro.	T. D. N
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	.067	.450	.068	.456	.069	.462	.070	.469	.071	.476
2	.134	.900	.136	.912	.138	.924	.140	.938	.142	.952
3	.200	1.350	.204	1.368	.207	1.386	.210	1.407	.213	1.428
4	.267	1.800	.272	1.824	.276	1.848	.280	1.876	.284	1.904
5	.334	2.250	.339	2.280	.344	2.310	.350	2.345	.355	2.380
6	.401	2.700	.407	2.736	.413	2.772	.420	2.814	.426	2.856
7	.468	3.150	.475	3.192	.482	3.234	.490	3.283	.497	3.332
8	.534	3.600	.543	3.648	.551	3.696	.560	3.752	.568	3.808
9	.601	4.050	.611	4.104	.620	4.158	.630	4.221	.639	4.284
10	.668	4.500	.679	4.560	.689	4.620	.700	4.690	.710	4.760
20	1.336	9.000	1.358	9.120	1.378	9.240	1.400	9.380	1.420	9.520
30	2.004	13.500	2.037	13.680	2.067	13.860	2.100	14.070	2.130	14.280
40	2.672	18.000	2.716	18.240	2.756	18.480	2.800	18.760	2.840	19.040
50	3.340	22.500	3.395	22.800	3.445	23.100	3.500	23.450	3.550	23.800
60	4.008	27.000	4.074	27.360	4.134	27.720	4.200	28.140	4.260	28.560

	6.5		6.6		6.7		6.8		6.9	
1	.072	.477	.073	.478	.074	.485	.075	.491	.076	.498
2	.144	.954	.146	.956	.148	.970	.150	.982	.152	.996
3	.216	1.431	.219	1.434	.222	1.455	.225	1.473	.228	1.494
4	.288	1.908	.292	1.912	.296	1.940	.300	1.964	.304	1.992
5	.360	2.385	.365	2.390	.370	2.425	.375	2.455	.380	2.490
6	.433	2.862	.438	2.868	.444	2.910	.450	2.946	.456	2.988
7	.505	3.339	.511	3.346	.518	3.395	.525	3.437	.532	3.486
8	.577	3.816	.584	3.834	.592	3.880	.600	3.928	.608	3.984
9	.649	4.293	.657	4.302	.666	4.365	.675	4.419	.684	4.482
10	.721	4.771	.730	4.780	.740	4.850	.750	4.910	.760	4.980
20	1.442	9.542	1.460	9.560	1.480	9.700	1.500	9.820	1.520	9.960
30	2.163	14.313	2.190	14.340	2.220	14.550	2.250	14.730	2.280	14.940
40	2.884	19.084	2.920	19.120	2.960	19.400	3.000	19.640	3.040	19.920
50	3.605	23.855	3.650	23.900	3.700	24.250	3.750	24.550	3.800	24.900
60	4.326	28.626	4.380	28.680	4.440	29.100	4.500	29.460	4.560	29.880

NOTE: To use this table ascertain the test and amount of milk produced. By referring to the test of the milk, one can ascertain the nutrients required, e.g.—42 pounds of 3.8 per cent milk. Under 3.8 per cent test the requirements for 40 lbs. of milk is, digestible protein .2.080 lbs., total digestible nutrients 13.080 lbs., add to this the requirements for 2 pounds of milk which is digestible protein .104 pounds, total digestible nutrients .654 pounds, making a total of 2.184 pounds of digestible protein and 13.734 pounds total digestible nutrients. This must be added to the requirements for maintenance to secure the total requirements of the animal in question.

Table III.—Nutrients Contained in a Given Number of Pounds of the Most Important Feeds

DRY ROUGHAGES

Amt.	Digestible crude protein	Total digestible nutrients
	Mixed Hay (½ clover, ½ timothy)	
Lbs.	Lbs	Lbs.
5	0.254	2.463
6	0.305	2.956
7	0.356	3.448
8	0.407	3.941
9	0.458	4.434
10	0.509	4.927
11	0.559	5.419
12	0.610	5.912
13	0.661	6.405
14	0.712	6.897
15	0.763	7.390
	Red Clover Hay	
5	0.369	2.480
6	0.442	2.976
[illegible]	0.516	3.472
8	0.590	3.968
9	0.664	4.464
10	0.738	4.960
11	0.811	5.456
12	0.885	5.952
13	0.959	6.448
14	1.033	6.944
15	1.107	7.440
	Alfalfa Hay	
5	0.529	2.550
6	0.634	3.060
7	0.740	3.570
8	0.846	4.080
9	0.952	4.590
10	1.058	5.101
11	1.163	5.611
12	1.269	6.121
13	1.375	6.631
14	1.481	7.141
15	1.587	7.651

Amt.	Digestible crude protein	Total digestible nutrients
	Soybean Hay	
Lbs.	Lbs.	Lbs.
5	0.530	2.715
6	0.636	3.258
7	0.742	3.801
8	0.848	4.344
9	0.954	4.887
10	1.060	5.430
11	1.166	5.973
12	1.272	6.516
13	1.378	7.059
14	1.484	7.602
15	1.590	8.145
	Alsike Hay	
5	0.395	2.365
6	0.474	2.838
7	0.553	3.311
8	0.632	3.784
9	0.711	4.257
10	0.790	4.730
11	0.869	5.203
12	0.948	5.676
13	1.027	6.149
14	1.106	6.622
15	1.185	7.095
	Sweet Clover Hay	
5	0.545	2.535
6	0.654	3.042
7	0.763	3.549
8	0.872	4.056
9	0.981	4.563
10	1.090	5.070
11	1.199	5.577
12	1.308	6.084
13	1.417	6.591
14	1.526	7.098
15	1.635	7.605

Table III.—(Continued)
DRY ROUGHAGES

Amt.	Digestible crude protein	Total digestible nutrients	Amt.	Digestible crude protein	Total digestible nutrients
Corn Fodder			**Corn Stover**		
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
5	0.185	2.404	5	0.099	1.821
6	0.222	2.884	6	0.118	2.185
7	0.259	3.365	7	0.138	2.549
8	0.296	3.846	8	0.158	2.913
9	0.333	4.327	9	0.178	3.277
10	0.370	4.808	10	0.198	3.642
11	0.407	5.288	11	0.217	4.006
12	0.444	5.769	12	0.237	4.370
13	0.481	6.250	13	0.257	4.734
14	0.518	6.731	14	0.277	5.098
15	0.555	7.212	15	0.297	5.463
Timothy Hay			**Redtop Hay**		
5	0.140	2.447	5	0.240	2.702
6	0.168	2.937	6	0.288	3.243
7	0.196	3.426	7	0.336	3.782
8	0.224	3.916	8	0.384	4.324
9	0.252	4.405	9	0.432	4.862
10	0.280	4.895	10	0.480	5.405
11	0.308	5.384	11	0.528	5.945
12	0.336	5.874	12	0.576	6.486
13	0.364	6.363	13	0.624	7.026
14	0.392	6.853	14	0.672	7.567
15	0.420	7.342	15	0.720	8.107
Prairie Hay			**Oat Hay**		
5	0.150	2.407	5	0.235	2.276
6	0.180	2.890	6	0.282	2.731
7	0.210	3.370	7	0.329	3.186
8	0.240	3.852	8	0.376	3.641
9	0.270	4.335	9	0.423	4.096
10	0.300	4.815	10	0.470	4.552
11	0.330	5.296	11	0.517	5.007
12	0.360	5.778	12	0.564	5,462
13	0.390	6.259	13	0.611	5.917
14	0.420	6.741	14	0.658	6.372
15	0.450	7.222	15	0.705	6.828

Table III.—(Continued)
DRY ROUGHAGES

Amt.	Digestible crude protein	Total digestible nutrients	Amt.	Digestible crude protein	Total digestible nutrients
Sudan Hay			**Rye Straw**		
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	0.037	0.514	1	0.007	0.412
2	0.074	1.028	2	0.014	0.824
3	0.111	1.542	3	0.021	1.236
4	0.148	2.056	4	0.028	1.648
5	0.185	2.570	5	0.035	2.060
6	0.222	3.084	6	0.042	2.472
7	0.259	3.598	7	0.049	2.884
8	0.296	4.112	8	0.056	3.296
9	0.333	4.626	9	0.063	3.708
10	0.370	5.140	10	0.070	4.120
11	0.407	5.654	11	0.077	4.532
12	0.444	6.168	12	0.084	4.944
13	0.481	6.682	13	0.091	5.356
14	0.518	7.196	14	0.098	5.768
15	0.555	7.710	15	0.105	6.180
Millet Hay			**Sorghum Fodder**		
1	0.050	0.550	1	0.007	0.717
2	0.100	1.100	2	0.014	0.342
3	0.150	1.650	3	0.021	0.513
4	0.200	2.200	4	0.028	**0.684**
5	0.250	2.750	5	0.035	0.855
6	0.300	3.300	6	0.042	1.026
7	0.350	3.850	7	0.049	1.197
8	0.400	4.400	8	0.056	1.368
9	0.450	4.950	9	0.063	1.539
10	0.500	5.500	10	0.070	1.710
11	0.550	6.050	11	0.077	1.881
12	0.600	6.600	12	0.084	2.052
13	0.650	7.150	13	0.091	2.223
14	0.700	7.700	14	0.098	2.394
15	0.750	8.250	15	0.105	2.565
Wheat Straw			**Barley Straw**		
1	0.007	0.367	1	0.009	0.423
2	0.014	0.734	2	0.018	0.846
3	0.021	1.101	3	0.027	1.269
4	0.028	1.468	4	0.036	1.692
5	0.035	1.835	5	0.045	2.115
6	0.042	2.202	6	0.054	2.538
7	0.049	2.569	7	0.063	2.961
8	0.056	2.936	8	0.072	3.384
9	0.063	3.303	9	0.081	3.807
10	0.070	3.670	10	0.090	4.230
11	0.077	4.037	11	0.099	4.653
12	0.084	4.404	12	0.108	5.076
13	0.091	4.771	13	0.117	5.499
14	0.098	5.138	14	0.126	5.922
15	0.105	5.505	15	0.135	6.345

Oat Straw		Oat and Pea Hay	
1	0.013	0.461	1	0.076	0.519
2	0.026	0.922	2	0.152	1.038
3	0.039	1.383	3	0.228	1.557
4	0.052	1.844	4	0.304	2.076
5	0.065	2.305	5	0.380	2.595
6	0.078	2.766	6	0.456	3.114
7	0.091	3.227	7	0.532	3.633
8	0.104	3.688	8	0.608	4.152
9	0.117	4.149	9	0.684	4.671
10	0.130	4.610	10	0.760	5.190
11	0.143	5.071	11	0.836	5.709
12	0.156	5.532	12	0.912	6.228
13	0.169	5.993	13	0.988	6.747
14	0.182	6.454	14	1.064	7.266
15	0.195	6.915	15	1.140	7.785

Table III.—(Continued)
SUCCULENT FEEDS

Amt.	Digestible crude protein	Total digestible nutrients	Amt.	Digestible crude protein	Total digestible nutrients
Corn Silage			**Sunflower Silage**		
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	0.012	0.168	1	0.010	0.126
2	0.024	0.336	2	0.020	0.252
3	0.036	0.504	3	0.030	0.378
4	0.048	0.672	4	0.040	0.504
5	0.060	0.840	5	0.050	0.630
6	0.073	1.008	6	0.060	0.756
7	0.084	1.176	7	0.070	0.882
8	0.096	1.344	8	0.080	1.008
9	0.108	1.512	9	0.090	1.134
10	0.120	1.680	10	0.100	1.260
20	0.240	3.360	20	0.200	2.520
30	0.360	5.040	30	0.300	3.780
40	0.480	6.720	40	0.400	5.040
Potatoes			**Sugar Beets**		
1	0.011	0.173	1	0.013	0.115
2	0.022	0.346	2	0.026	0.230
3	0.033	0.519	3	0 039	0.345
4	0.044	0.692	4	0.052	0.460
5	0.055	0.866	5	0.065	0.576
6	0.066	1.039	6	0.078	0.691
7	0.077	1.212	7	0.091	0.806
8	0.088	1.385	8	0.104	0.921
9	0.099	1.558	9	0.117	1.036
10	0.110	1.732	10	0.130	1.152
20	0.220	3.464	20	0.260	2.304
30	0.330	5.196	30	0.390	3.456
40	0.440	6.928	40	0.520	4.608
Mangels			**Rutabagas**		
1	0.010	0.064	1	0.010	0.094
2	0.020	0.129	2	0.020	0.189
3	0.030	0.193	3	0.030	0.283
4	0.040	0.258	4	0.040	0.378
5	0.050	0.322	5	0.050	0.472
6	0.060	0.387	6	0.060	0.567
7	0.070	0.451	7	0.070	0.661
8	0.080	0.516	8	0.080	0.756
9	0.090	0.580	9	0.090	0.850
10	0.100	0.645	10	0.100	0.945
20	0.200	1.290	20	0.200	1.890
30	0.300	1.935	30	0.300	2.835
40	0.400	2.580	40	0.400	3.780

Table III.—(Continued)

Amt.	Digestible crude protein	Total digestible nutrients
Corn, Dent		
Lbs.	Lbs.	Lbs.
¼	0.017	0.204
½	0.035	0.408
1	0.071	0.817
2	0.142	1.634
3	0.213	2.451
4	0.284	3.268
5	0.355	4.085
6	0.426	4.902
7	0.497	5.719
8	0.568	6.536
9	0.630	7.353
10	0.710	8.170
Corn, Flint		
¼	0.011	0.210
½	0.023	0.421
1	0.046	0.842
2	0.092	1.684
3	0.133	2.526
4	0.184	3.368
5	0.230	4.210
6	0.276	5.052
7	0.322	5.894
8	0.368	6.736
9	0.414	7.578
10	0.460	8.420
Oats		
¼	0.024	0.176
½	0.048	0.352
1	0.097	0.704
2	0.194	1.408
3	0.291	2.112
4	0.388	2.816
5	0.485	3.520
6	0.582	4.224
7	0.679	4.928
8	0.776	5.632
9	0.873	6.336
10	0.970	7.044

Amt.	Digestible crude protein	Total digestible nutrients
Corn and Cob Meal		
Lbs.	Lbs.	Lbs.
¼	0.015	0.193
½	0.030	0.390
1	0.061	0.781
2	0.122	1.562
3	0.183	2.343
4	0.244	3.124
5	0.305	3.905
6	0.366	4.686
7	0.427	5.467
8	0.488	6.248
9	0.549	7.029
10	0.610	7.810
Barley		
¼	0.022	0.198
½	0.045	0.397
1	0.090	0.794
2	0.180	1.588
3	0.270	2.382
4	0.360	3.176
5	0.450	3.970
6	0.540	4.764
7	0.630	5.558
8	0.720	6.352
9	0.810	7.146
10	0.900	7.940
Wheat		
¼	0.022	0.197
½	0.044	0.395
1	0.088	0.791
2	0.176	1.583
3	0.264	2.375
4	0.352	3.166
5	0.440	3.958
6	0.528	4.750
7	0.616	5.541
8	0.704	6.333
9	0.792	7.123
10	0.880	7.917

Table III.—(Continued)

Amt.	Digestible crude protein	Total digestible nutrients	Amt.	Digestible crude protein	Total digestible nutrients
Rye Bran			**Sorghum Grain**		
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	0.122	0.751	1	0.075	0.795
2	0.244	1.502	2	0.150	1.590
3	0.366	2.253	3	0.225	2.385
4	0.488	3.004	4	0.300	3.180
5	0.610	3.755	5	0.375	3.975
6	0.732	4.506	6	0.450	4.770
7	0.854	5.257	7	0.525	5.565
8	0.976	6.008	8	0.600	6.360
9	1.098	6.759	9	0.675	7.155
10	1.220	7.510	10	0.750	7.950
Rye Middlings			**Millet Seed**		
1	0.126	0.757	1	0.083	0.840
2	0.252	1.502	2	0.166	1.680
3	0.378	2.253	3	0.249	2.520
4	0.504	3.004	4	0.332	3.360
5	0.630	3.755	5	0.415	4.200
6	0.756	4.506	6	0.498	5.040
7	0.882	5.257	7	0.581	5.880
8	1.008	6.008	8	0.664	6.720
9	1.134	6.759	9	0.747	7.560
10	1.260	7.510	10	0.830	8.400
Hulless Emmer			**Wheat Shorts**		
1	0.119	0.792	1	0.134	0.693
2	0.238	1.584	2	0.268	1.386
3	0.357	2.376	3	0.402	2.079
4	0.476	3.168	4	0.536	2.772
5	0.595	3.960	5	0.670	3.465
6	0.714	4.752	6	0.804	4.158
7	0.833	5.544	7	0.938	4.851
8	0.952	6.336	8	1.072	5.544
9	1.071	7.128	9	1.206	6.237
10	1.190	7.920	10	1.340	6.930
Corn and Cob Meal			**Red Dog Flour**		
1	0.061	0.781	1	0.162	0.808
2	0.122	1.562	2	0.324	1.616
3	0.183	2.343	3	0.486	2.424
4	0.244	3.124	4	0.648	3.232
5	0.305	3.905	5	0.810	4.040
6	0.366	4.686	6	0.972	4.848
7	0.427	5.467	7	1.134	5.656
8	0.488	6.248	8	1.296	6.464
9	0.549	7.029	9	1.458	7.272
10	0.610	7.810	10	1.620	8.080

Table III.—(Continued)

Amt.	Digestible crude protein	Total digestible nutrients
	Rye	
Lbs.	Lbs.	Lbs.
¼	0.023	0.204
½	0.045	0.409
1	0.091	0.819
2	0.182	1.638
3	0.273	2.457
4	0.364	2.476
5	0.456	4.095
6	0.547	4.914
7	0.638	5.733
8	0.729	6.552
9	0.820	7.371
10	0.912	8.191
	Wheat Screenings	
Lbs.	Lbs.	Lbs.
1	0.096	0.650
2	0.192	1.300
3	0.288	1.950
4	0.384	2.600
5	0.480	3.250
6	0.576	3.900
7	0.672	4.550
8	0.768	5.200
9	0.864	5.850
10	0.960	6.500
	Flax Screening	
1	0.111	0.696
2	0.222	1.392
3	0.333	2.088
4	0.444	2.784
5	0.555	3.480
6	0.666	4.176
7	0.777	4.872
8	0.888	5.568
9	0.999	6.264
10	1.110	6.960

Amt.	Digestible crude protein	Total digestible nutrients
	Dried Beet Pulp	
Lbs.	Lbs.	Lbs.
¼	0.011	0.179
½	0.023	0.358
1	0.046	0.716
2	0.092	1.432
3	0.138	2.148
4	0.184	2.864
5	0.230	3.580
6	0.276	4.296
7	0.322	5.012
8	0.368	5.728
9	0.414	6.444
10	0.460	7.160
	Beet Molasses	
Lbs.	Lbs.	Lbs.
1	0.029	0.587
2	0.058	1.174
3	0.087	1.761
4	0.116	2.348
5	0.145	2.935
6	0.174	3.522
7	0.203	4.109
8	0.232	4.696
9	0.261	5.283
10	0.290	5.870
	Cane Molasses	
1	0.001	0.595
2	0.002	1.190
3	0.003	1.785
4	0.004	2.380
5	0.005	2.975
6	0.006	3.570
7	0.007	4.165
8	0.008	4.760
9	0.009	5.355
10	0.010	5.950

Table III.—(Continued)

Amt.	Digestible crude protein	Total digestible nutrients	Amt.	Digestible crude protein	Total digestible nutrients
Ground Soybeans			**Cottonseed Meal**		
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
[illegible]	0.072	0.212	¼	0.094	0.200
½	0.145	0.424	½	0.188	0.401
1	0.291	0.849	1	0.376	0.802
2	0.582	1.699	2	0.752	1.604
3	0.873	2.548	3	1.128	2.406
4	1.164	3.398	4	1.504	3.208
5	1.455	4.247	5	1.880	4.010
Gluten Meal			**Linseed Meal**		
¼	0.074	0.214	¼	0.075	0.195
½	0.148	0.429	½	0.151	0.391
1	0.297	0.858	1	0.302	0.783
2	0.594	1.716	2	0.604	1.566
3	0.891	2.574	3	0.906	2.349
4	1.188	3.432	4	1.208	3.132
5	1.485	4.290	5	1.510	3.915
Dried Brewers Grains			**Rye Dried Distillers Grains**		
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	0.215	0.657	1	0.118	0.547
2	0.430	1.314	2	0.236	1.094
3	0.645	1.971	3	0.354	1.641
4	0.860	2.628	4	0.472	2.188
[illegible]	1.075	3.285	5	0.590	2.735
Corn Dried Distillers Grains			**Flax Feed**		
1	0.224	0.889	1	0.120	0.743
2	0.448	1.778	2	0.240	1.486
3	0.672	2.667	3	0.360	2.229
4	0.896	3.556	4	0.480	2.972
5	1.120	4.445	5	0.600	3.715
Wheat Bran			**Gluten Feed**		
¼	0.030	0.149	¼	0.053	0.202
½	0.060	0.298	½	0.106	0.404
1	0.120	0.596	1	0.213	0.808
2	0.240	1.193	2	0.426	1.616
3	0.360	1.790	3	0.639	2.424
4	0.480	2.387	4	0.852	3.232
5	0.600	2.984	5	1.065	4.041
6	0.720	3.581	6	1.278	4.849
7	0.840	4.178	7	1.491	5.657
8	0.960	4.775	8	1.704	6.465
9	1.080	5.372	9	1.917	7.273
10	1.201	5.969	10	2.130	8.082

NOTE: In this table the number of pounds of digestible protein and total digestible nutrients is computed for various amounts of feed. This table is convenient to use in balancing rations.

e.g.—A ration composed of the following feeds:

	Digestible Crude Protein	Total Digestible Nutrients
12 lbs. alfalfa hay	1.269 lbs.	6.121 lbs.
20 lbs. corn silage	.360 lbs.	5.040 lbs.
7 lbs. corn	.497 lbs.	5.719 lbs.
6 lbs. oats	.582 lbs.	4.224 lbs.
	2.708 lbs.	21.104 lbs.

These feeds contain 2.708 lbs. digestible protein and 21.104 lbs. total digestible nutrients. In balancing a ration the nutrients in the feeds fed must balance the nutrients required by a particular cow.

Table IV.—Cost of One Pound at a Given Price and Weight per Bushel

When a bushel costs	Oats 1 lb. costs	Barley 1 lb. costs	Corn Rye 1 lb. costs	Wheat 1 lb. costs	Cob corn 1 lb. costs
cents	cents	cents	cents	cents	cents
20	0.625	0.417	0.357	0.333	0.286
21	0.656	0.437	0.375	0.350	0.300
22	0.687	0.458	0.393	0.367	0.314
23	0.719	0.479	0.411	0.383	0.328
24	0.750	0.500	0.428	0.400	0.343
25	0.781	0.521	0.446	0.417	0.357
26	0.812	0.542	0.464	0.433	0.371
27	0.844	0.563	0.482	0.450	0.386
28	0.875	0.583	0.500	0.467	0.400
29	0.906	0.604	0.518	0.483	0.414
30	0.937	0.625	0.536	0.500	0.428
31	0.969	0.646	0.554	0.517	0.443
32	1.000	0.667	0.571	0.533	0.457
33	1.031	0.687	0.589	0.550	0.471
34	1.062	0.708	0.607	0.567	0.486
35	1.094	0.729	0.625	0.583	0.500
36	1.125	0.750	0.643	0.600	0.514
37	1.156	0.771	0.661	0.617	0.528
38	1.187	0.792	0.678	0.633	0.543
39	1.219	0.812	0.696	0.650	0.557
40	1.250	0.833	0.714	0.667	0.571
41	1.281	0.854	0.732	0.683	0.586
42	1.312	0.875	0.750	0.700	0.600
43	1.344	0.896	0.768	0.717	0.614
44	1.375	0.917	0.786	0.733	0.628
45	1.406	0.937	0.804	0.750	0.643
46	1.437	0.958	0.821	0.767	0.657
47	1.469	0.979	0.839	0.783	0.671
48	1.500	1.000	0.857	0.800	0.686
49	1.531	1.021	0.875	0.817	0.700
50	1.562	1.042	0.893	0.833	0.714
51	1.594	1.062	0.911	0.850	0.728
52	1.625	1.083	0.928	0.867	0.745
53	1.656	1.104	0.946	0.883	0.757
54	1.687	1.125	0.964	0.900	0.771
55	1.719	1.146	0.982	0.917	0.786
56	1.750	1.167	1.000	0.933	0.800
57	1.781	1.187	1.018	0.950	0.814
58	1.812	1.208	1.036	0.967	0.828
59	1.844	1.229	1.054	0.983	6.843
60	1.875	1.250	1.071	1.000	0.857
61	1.906	1.271	1.089	1.016	0.871

Table IV.—(Continued)
Cost of One Pound at a Given Price and Weight per Bushel

When a bushel costs	Oats 1 lb. costs	Barley 1 lb. costs	Corn Rye 1 lb. costs	Wheat 1 lb. costs	Cob corn 1 lb. costs
	Cents	Cents	Cents	Cents	Cents
62	1.937	1.292	1.107	1.033	0.886
63	1.969	1.312	1.125	1.050	0.900
64	2.000	1.333	1.143	1.067	0.914
65	2.031	1.354	1.161	1.083	0.928
66	2.062	1.375	1.178	1.100	0.943
67	2.094	1.396	1.196	1.117	0.957
68	2.125	1.417	1.214	1.133	0.971
69	2.156	1.427	1.222	1.150	0.986
70	2.187	1.458	1.250	1.167	1.000
71	2.219	1.479	1.268	1.183	1.014
72	2.250	1.500	1.286	1.200	1.028
73	2.281	1.521	1.303	1.217	1.043
74	2.312	1.542	1.321	1.233	1.057
75	2.344	1.562	1.339	1.250	1.071
76	2.375	1.583	1.357	1.267	1.086
77	2.406	1.604	1.375	1.283	1.100
78	2.437	1.625	1.393	1.300	1.114
79	2.469	1.646	1.411	1.317	1.128
80	2.500	1.667	1.428	1.333	1.143
81	2.531	1.687	1.446	1.350	1.157
82	2.562	1.708	1.464	1.367	1.171
83	2.594	1.729	1.482	1.383	1.186
84	2.625	1.750	1.500	1.400	1.200
85	2.656	1.771	1.518	1.417	1.214
86	2.687	1.792	1.536	1.433	1.228
87	2.719	1.812	1.553	1.450	1.243
88	2.750	1.833	1.571	1.467	1.257
89	2.781	1.854	1.589	1.483	1.271
90	2.812	1.875	1.607	1.500	1.286
91	2.844	1.896	1.625	1.517	1.300
92	2.875	1.917	1.643	1.533	1.314
93	2.906	1.937	1.661	1.550	1.328
94	2.937	1.958	1.678	1.567	1.343
95	2.969	1.979	1.696	1.583	1.357
96	3.000	2.000	1.714	1.600	1.371
97	3.031	2.021	1.732	1.617	1.386
98	3.062	2.041	1.750	1.633	1.400
99	3.094	2.062	1.768	1.650	1.414
100	3.125	2.083	1.786	1.667	1.571

Table V. Cost of One Pound of Feed at a Given Price Per Ton

Price per ton	Cost of 1 lb.	Price per ton	Cost of 1 lb.	Price per ton	Cost of 1 lb.
$ 3.00	.150	$20.00	1.000	$44.50	2.225
3.25	.162	20.50	1.025	45.00	2.250
3.50	.175	21.00	1.050	45.50	2.275
3.75	.187	21.50	1.075	46.00	2.300
4.00	.200	22.00	1.100	46.50	2.325
4.25	.212	22.50	1.125	47.00	2.350
4.50	.225	23.00	1.150	47.50	2.375
4.75	.237	24.00	1.200	48.00	2.400
5.00	.250	24.50	1.225	48.50	2.425
5.25	.262	25.00	1.250	49.00	2.450
5.50	.275	25.50	1.275	49.50	2.475
5.75	.287	26.00	1.300	50.00	2.500
6.00	.300	26.50	1.325	50.50	2.525
6.25	.312	27.00	1.350	51.00	2.550
6.50	.325	27.50	1.375	51.50	2.575
6.75	.337	28.00	1.400	52.00	2.600
7.00	.350	28.50	1.425	52.50	2.625
7.25	.362	29.00	1.450	53.00	2.650
7.50	.375	29.50	1.475	53.50	2.675
7.75	.387	30.00	1.500	54.00	2.700
8.00	.400	30.50	1.525	54.50	2.725
8.25	.412	31.00	1.550	55.00	2.750
8.50	.425	31.50	1.575	55.50	2.775
8.75	.437	32.00	1.600	56.00	2.800
9.00	.450	32.50	1.625	56.50	2.825
9.25	.462	33.00	1.650	57.00	2.850
9.50	.475	33.50	1.675	57.50	2.875
9.75	.487	34.00	1.700	58.00	2.900
10.00	.500	34.50	1.725	58.50	2.925
10.50	.525	35.00	1.750	59.00	2.950
11.00	.550	35.50	1.775	59.50	2.975
11.50	.575	36.00	1.800	60.00	3.000
12.00	.600	36.50	1.825		
12.50	.625	37.00	1.850		
13.00	.650	37.50	1.875		
13.50	.675	38.00	1.900		
14.00	.700	38.50	1.925		
14.50	.725	39.00	1.950		
15.00	.750	39.50	1.975		
15.50	.775	40.00	2.000		
16.00	.800	40.50	2.025		
16.50	.825	41.00	2.050		
17.00	.850	41.50	2.075		
17.50	.875	42.00	2.100		
18.00	.900	42.50	2.125		
18.50	.925	43.00	2.150		
19.00	.950	43.50	2.175		
19.50	.975	44.00	2.200		

Table VI.—Cost of Digestible Protein, and Total Digestible Nutrients

Oats D. C. P. 9.7 T. D. N. 70.4			Barley D. C. P. 9.0 T. D. N. 79.40			Emmer D. C. P. 9.5 T. D. N. 76.5			Corn D. C. P. 7.10 T. D. N. 81.70		
Price per bu.	1 lb. Pro. costs	1 lb. T. D. N. costs	Price per bu.	1 lb. Pro. costs	1 lb. T. D. N. costs	Price per bu.	1 lb. Pro. costs	1 lb. T. D. N. costs	Price per bu.	1 lb. Pro. costs	1 lb. T. D. N. costs
cts.	cents	cents	cts.	cents	cents	cts.	cents	cents	cts.	cents	cents
20	6.41	0.89	35	8.10	0.92	35	9.21	1.14	45	11.32	0.98
21	6.77	0.93	36	8.33	0.94	36	9.47	1.18	46	11.57	1.01
22	7.01	0.97	37	8.56	0.97	37	9.74	1.21	47	11.82	1.03
23	7.41	1.02	38	8.79	1.00	38	10.10	1.24	48	12.07	1.05
24	7.73	1.07	39	9.08	1.02	39	10.26	1.27	49	12.32	1.07
25	8.05	1.11	40	9.26	1.05	40	10.52	1.31	50	12.57	1.09
26	8.38	1.15	41	9.49	1.08	41	10.79	1.34	51	12.83	1.11
27	8.70	1.20	42	9.72	1.10	42	11.05	1.37	52	13.08	1.14
28	9.02	1.24	43	9.95	1.13	43	11.31	1.40	53	13.33	1.16
29	9.34	1.29	44	10.18	1.15	44	11.58	1.43	54	13.58	1.18
30	9.66	1.33	45	10.41	1.18	45	11.84	1.47	55	13.83	1.20
31	9.99	1.37	46	10.65	1.21	46	12.10	1.50	56	14.08	1.22
32	10.31	1.42	47	10.88	1.23	47	12.37	1.54	57	14.33	1.25
33	10.63	1.47	48	11.11	1.26	48	12.63	1.57	58	14.58	1.27
34	10.95	1.51	49	11.34	1.28	49	12.89	1.60	59	14.83	1.29
35	11.27	1.55	50	11.57	1.31	50	13.15	1.64	60	15.08	1.31
36	11.60	1.60	51	11.80	1.34	51	13.42	1.67	61	15.34	1.33
37	11.92	1.64	52	12.03	1.36	52	13.68	1.70	62	15.59	1.35
38	12.24	1.69	53	12.27	1.39	53	13.94	1.73	63	15.84	1.38
39	12.56	1.73	54	12.50	1.42	54	14.21	1.76	64	16.09	1.40
40	12.88	1.78	55	12.73	1.44	55	14.47	1.80	65	16.34	1.42
41	13.21	1.82	56	12.96	1.47	56	14.73	1.83	66	16.59	1.44
42	13.53	1.86	57	13.19	1.49	57	14.99	1.86	67	16.84	1.46
43	13.85	1.91	58	13.42	1.52	58	15.26	1.90	68	17.09	1.49
44	14.17	1.95	59	13.65	1.55	59	15.52	1.93	69	17.34	1.51
45	14.49	2.00	60	13.89	1.57	60	15.78	1.96	70	17.60	1.53
46	14.82	2.04	61	14.12	1.60	61	16.05	1.99	71	17.85	1.55
47	15.14	2.09	62	14.35	1.63	62	16.31	2.03	72	18.10	1.57
48	15.46	2.14	63	14.58	1.65	63	16.57	2.06	73	18.35	1.59
49	15.78	2.18	64	14.81	1.68	64	16.83	2.09	74	18.60	1.62
50	16.10	2.22	65	15.04	1.70	65	17.10	2.12	75	18.85	1.64
51	16.43	2.26	66	15.27	1.73	66	17.36	2.16	76	19.10	1.66
52	16.75	2.31	67	15.50	1.76	67	17.62	2.19	77	19.35	1.68
53	17.07	2.35	68	15.74	1.78	68	17.88	2.22	78	19.60	1.70
54	17.39	2.40	69	15.97	1.81	69	18.15	2.25	79	19.85	1.73
55	17.71	2.44	70	16.20	1.84	70	18.41	2.29	80	20.11	1.75
56	18.04	2.49	71	16.43	1.86	71	18.67	2.32	81	20.36	1.77
57	18.36	2.53	72	16.66	1.89	72	18.94	2.35	82	20.61	1.79
58	18.68	2.57	73	16.89	1.91	73	19.20	2.39	83	20.86	1.81
59	19.00	2.62	74	17.12	1.94	74	19.46	2.42	84	21.11	1.83
60	19.32	2.66	75	17.36	1.97	75	19.73	2.45	85	21.36	1.86
61	19.65	2.71	76	17.59	1.99	76	19.99	2.48	86	21.61	1.88
62	19.97	2.75	77	17.82	2.02	77	20.25	2.52	87	21.86	1.90
63	20.29	2.80	78	18.05	2.04	78	20.52	2.55	88	22.11	1.92
64	20.61	2.84	79	18.28	2.07	79	20.78	2.58	89	22.36	1.94
65	20.93	2.89	80	18.51	2.10	80	21.04	2.61	90	22.62	1.97
66	21.26	2.93	81	18.74	2.12	81	21.31	2.65	91	22.87	1.99
67	21.58	2.97	82	18.98	2.15	82	21.57	2.68	92	23.12	2.01
68	21.90	3.02	83	19.21	2.18	83	21.83	2.71	93	23.37	2.03
69	22.22	3.06	84	19.44	2.21	84	**22.10**	2.75	94	23.62	2.05
70	22.54	3.11	85	19.67	2.23	85	**22.36**	2.78	95	23.87	2.07

Total VI.—(Continued)
Cost of Digestible Protein, and Total Digestible Nutrients

Wheat D. C. P. 8.80 T. D. N. 79.17			Rye D. C. P. 9.12 T. D. N. 81.91			Grain Sorghum D. C. P. 7.50 T. D. N. 79.50			Proso Millet D. C. P. 8.4 T. D. N. 77.5		
Price per bu.	1 lb. Pro. costs	1 lb. T. D. N. costs	Price per bu.	1 lb. Pro. costs	1 lb. T. D. N. costs	Price per ton	1 lb. Pro. costs	1 lb. T. D. N. costs	Price per ton	1 lb. Pro. costs	1 lb. T. D. N. costs
cts.	cents	cents	cts.	cents	cents	$	cents	cents	$	cents	cents
50	9.50	1.05	40	7.83	0.87	10	6.67	0.63	10	5.95	0.65
51	9.69	1.07	41	8.02	0.89	11	7.33	0.69	11	6.54	0.71
52	9.88	1.09	42	8.22	0.93	12	8.00	0.75	12	7.14	0.77
53	10.07	1.12	43	8.42	0.94	13	8.67	0.82	13	7.74	0.84
54	10.26	1.14	44	8.61	0.96	14	9.33	0.88	14	8.33	0.90
55	10.45	1.16	45	8.81	0.98	15	10.00	0.94	15	8.93	0.97
56	10.64	1.18	46	9.00	1.00	16	10.67	1.01	16	9.52	1.03
57	10.83	1.20	47	9.20	1.02	17	11.33	1.07	17	10.12	1.10
58	11.02	1.22	48	9.39	1.05	18	12.00	1.13	18	10.71	1.16
59	11.21	1.24	49	9.59	1.07	19	12.67	1.19	19	11.31	1.23
60	11.39	1.27	50	9.79	1.09	20	13.33	1.26	20	11.90	1.29
61	11.58	1.29	51	9.98	1.11	21	14.00	1.32	21	12.50	1.35
62	11.77	1.31	52	10.18	1.13	22	14.67	1.38	22	13.09	1.42
63	11.96	1.33	53	10.37	1.15	23	15.33	1.45	23	13.69	1.48
64	12.15	1.35	54	10.57	1.18	24	16.00	1.51	24	14.28	1.55
65	12.34	1.37	55	10.76	1.20	25	16.67	1.57	25	14.88	1.61
66	12.53	1.39	56	10.96	1.22	26	17.33	1.64	26	15.47	1.68
67	12.72	1.42	57	11.15	1.24	27	18.00	1.70	27	16.07	1.74
68	12.91	1.44	58	11.35	1.26	28	18.66	1.76	28	16.66	1.81
69	13.10	1.46	59	11.55	1.29	29	19.33	1.82	29	17.26	1.87
70	13.29	1.48	60	11.74	1.31	30	20.00	1.89	30	17.85	1.94
71	13.48	1.50	61	11.94	1.33	31	20.66	1.95	31	18.45	2.00
72	13.67	1.52	62	12.13	1.35	32	21.33	2.01	32	19.04	2.06
73	13.86	1.54	63	12.33	1.37	33	22.00	2.08	33	19.64	2.13
74	14.05	1.57	64	12.52	1.39	34	22.66	2.14	34	20.23	2.19
75	14.24	1.59	65	12.72	1.42	35	23.33	2.20	35	20.83	2.26
76	14.43	1.61	66	12.92	1.44	36	24.00	2.26	36	21.42	2.32
77	14.62	1.63	67	13.11	1.46	37	24.66	2.33	37	22.02	2.39
78	14.81	1.65	68	13.31	1.48	38	25.33	2.39	38	22.61	2.45
79	15.00	1.67	69	13.50	1.50	39	26.00	2.45	39	23.21	2.52
80	15.19	1.69	70	13.70	1.53	40	26.66	2.52	40	23.80	2.58
81	15.38	1.72	71	13.89	1.55	41	27.33	2.58	41	24.40	2.64
82	15.57	1.74	72	14.09	1.57	42	28.00	2.64	42	24.99	2.71
83	15.76	1.76	73	14.29	1.59	43	28.66	2.70	43	25.59	2.77
84	15.95	1.78	74	14.48	1.61	44	29.33	2.77	44	26.18	2.84
85	16.14	1.80	75	14.68	1.63	45	30.00	2.83	45	26.78	2.90
86	16.33	1.82	76	14.87	1.66	46	30.66	2.89	46	27.37	2.97
87	16.52	1.84	77	15.07	1.68	47	31.33	2.96	47	27.97	3.03
88	16.71	1.87	78	15.26	1.70	48	32.00	3.02	48	28.56	3.10
89	16.90	1.89	79	15.46	1.72	49	32.66	3.08	49	29.16	3.16
90	17.09	1.91	80	15.66	1.74	50	33.33	3.14	50	29.75	3.23
91	17.28	1.93	81	15.85	1.76						
92	17.47	1.95	82	16.05	1.79						
93	17.66	1.97	83	16.24	1.81						
94	17.85	1.99	84	16.44	1.83						
95	18.04	2.01	85	16.63	1.85						
96	18.23	2.04	86	16.83	1.87						
97	18.42	2.06	87	17.03	1.90						
98	18.61	2.08	88	17.22	1.92						
99	18.80	2.10	89	17.42	1.94						
100	18.99	2.12	90	17.61	1.96						

Total VI.—(Continued)

Cost of Digestible Protein, and Total Digestible Nutrients

Price per Ton	Wheat Bran D. C. P. 12.01 T. D. N. 59.69		Gluten Feed D. C. P. 21.3 T. D. N. 80.82		Dried Brewers Grains D. C. P. 21.5 T. D. N. 65.7		Corn Dried Distillers Grains D. C. P. 22.4 T. D. N. 88.9		Rye Dried Distillers Grains D. C. P. 11.8 T. D. N. 54.7	
	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs
$	cents	cents	cents	cents	cents	cents	cents	cents	cents	cents
10	4.16	0.84	2.35	0.62	2.33	0.76	2.23	0.56	4.24	0.91
11	4.58	0.92	2.58	0.68	2.56	0.84	2.46	0.62	4.66	1.01
12	4.99	1.00	2.82	0.74	2.79	0.91	2.68	0.67	5.08	1.10
13	5.41	1.09	3.05	0.80	3.02	0.99	2.90	0.73	5.51	1.18
14	5.82	1.17	3.29	0.87	3.25	1.06	3.12	0.79	5.93	1.28
15	6.24	1.26	3.52	0.93	3.49	1.14	3.35	0.84	6.36	1.37
16	6.66	1.40	3.76	0.99	3.72	1.22	3.57	0.90	6.78	1.46
17	7.07	1.42	3.99	1.05	3.95	1.29	3.79	0.96	7.20	1.55
18	7.49	1.50	4.22	1.11	4.18	1.37	4.02	1.01	7.63	1.65
19	7.90	1.59	4.46	1.18	4.42	1.45	4.24	1.07	8.05	1.74
20	8.32	1.67	4.69	1.24	4.65	1.52	4.46	1.12	8.47	1.83
21	8.73	1.76	4.93	1.30	4.88	1.60	4.69	1.18	8.90	1.92
22	9.16	1.84	5.16	1.36	5.11	1.67	4.91	1.24	9.32	2.01
23	9.57	1.93	5.40	1.42	5.35	1.75	5.13	1.29	9.74	2.10
24	9.99	2.09	5.63	1.48	5.58	1.83	5.36	1.35	10.17	2.19
25	10.40	2.17	5.87	1.55	5.81	1.90	5.58	1.41	10.59	2.28
26	10.81	2.26	6.10	1.61	6.04	1.98	5.80	1.46	11.02	2.38
27	11.23	2.34	6.34	1.67	6.28	2.05	6.03	1.52	11.44	2.47
28	11.66	2.43	6.57	1.73	6.51	2.13	6.25	1.57	11.86	2.56
29	12.07	2.51	6.81	1.79	6.74	2.21	6.47	1.63	12.29	2.65
30	12.48	2.59	7.04	1.86	6.97	2.28	6.69	1.69	12.71	2.74
31	12.90	2.68	7.28	1.92	7.21	2.36	6.92	1.74	13.13	2.83
32	13.31	2.76	7.51	1.98	7.44	2.44	7.14	1.80	13.56	2.92
33	13.73	2.85	7.75	2.04	7.67	2.51	7.37	1.85	13.98	3.02
34	14.14	2.93	7.98	2.10	7.90	2.59	7.59	1.91	14.41	3.11
35	14.60	3.01	8.21	2.17	8.14	2.66	7.81	1.97	14.83	3.20
36	14.98	3.10	8.45	2.23	8.37	2.74	8.04	2.02	15.25	3.29
37	15.39	3.18	8.68	2.29	8.60	2.82	8.26	2.08	15.68	3.38
38	15.81	3.26	8.92	2.35	8.83	2.89	8.48	2.14	16.10	3.47
39	16.22	3.35	9.15	2.41	9.07	2.97	8.70	2.19	16.52	3.56
40	16.64	3.43	9.39	2.47	9.30	3.04	8.93	2.25	16.95	3.66
41	17.06	3.52	9.62	2.54	9.53	3.12	9.15	2.30	17.37	3.75
42	17.47	3.60	9.86	2.60	9.76	3.20	9.37	2.36	17.79	3.84
43	17.89	3.68	10.09	2.66	9.99	3.27	9.60	2.42	18.22	3.93
44	18.30	3.77	10.33	2.72	10.23	3.35	9.82	2.47	18.64	4.02
45	18.72	3.85	10.56	2.78	10.46	3.42	10.04	2.53	19.07	4.11
46	19.13	3.93	10.80	2.85	10.69	3.50	10.27	2.59	19.49	4.20
47	19.55	4.02	11.03	2.91	10.93	3.58	10.49	2.64	19.91	4.30
48	19.97	4.10	11.27	2.97	11.16	3.65	10.71	2.70	20.34	4.39
49	20.39	4.18	11.50	3.03	11.39	3.73	10.94	2.75	20.76	4.48
50	20.80	4.27	11.73	3.09	11.62	3.80	11.16	2.81	21.18	4.57

Table VI.—(Continued)

Cost of Digestible Protein, and Total Digestible Nutrients

	Linseed Meal D. C. P. 30.2 T. D. N. 78.3		Cotton seed Meal D. C. P. 37.6 T. D. N. 80.2		Soy bean Beal D. C. P. 39.7 T. D. N. 84.5		Gluten Meal D. C. P. 29.7 T. D. N. 85.8	
Price per Ton	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs
$	cents	cents	cents	cents	cents	cents	cents	cents
25	4.14	1.60	3.32	1.56	3.15	1.48	4.21	1.46
26	4.30	1.66	3.46	1.62	3.27	1.54	4.38	1.51
27	4.47	1.72	3.59	1.68	3.40	1.60	4.54	1.57
28	4.64	1.79	3.72	1.74	3.53	1.66	4.71	1.63
29	4.80	1.85	3.86	1.81	3.65	1.72	4.88	1.69
30	4.97	1.92	3.99	1.87	3.78	1.76	5.05	1.75
31	5.13	1.98	4.12	1.93	3.90	1.83	5.22	1.81
32	5.30	2.04	4.25	1.99	4.03	1.89	5.39	1.86
33	5.46	2.11	4.39	2.06	4.16	1.95	5.55	1.92
34	5.63	2.17	4.52	2.12	4.28	2.01	5.72	1.98
35	5.79	2.23	4.65	2.18	4.41	2.07	5.89	2.04
36	5.96	2.30	4.79	2.24	4.53	2.13	6.06	2.10
37	6.13	2.36	4.92	2.31	4.66	2.19	6.23	2.15
38	6.29	2.43	5.05	2.37	4.79	2.25	6.40	2.21
39	6.46	2.49	5.18	2.43	4.91	2.31	6.56	2.27
40	6.62	2.55	5.32	2.49	5.04	2.37	6.73	2.33
41	6.79	2.62	5.45	2.55	5.16	2.43	6.90	2.39
42	6.95	2.68	5.58	2.62	5.29	2.49	7.07	2.45
43	7.12	2.74	5.72	2.68	5.42	2.54	7.24	2.50
44	7.28	2.81	5.85	2.74	5.54	2.60	7.41	2.56
45	7.45	2.87	5.98	2.80	5.67	2.66	7.57	2.62
46	7.61	2.94	6.11	2.87	5.79	2.72	7.74	2.68
47	7.78	3.00	6.25	2.93	5.92	2.78	7.91	2.74
48	7.95	3.06	6.38	2.99	6.05	2.84	8.08	2.80
49	8.11	3.13	6.51	3.05	6.17	2.90	8.25	2.85
50	8.28	3.19	6.65	3.12	6.30	2.96	8.42	2.91
51	8.44	3.25	6.78	3.18	6.42	3.02	8.58	2.97
52	8.61	3.32	6.91	3.24	6.55	3.08	8.75	3.03
53	8.77	3.38	7.04	3.30	6.68	3.14	8.92	3.09
54	8.94	3.45	7.18	3.36	6.80	3.20	9.09	3.14
55	9.10	3.51	7.31	3.43	6.93	3.26	9.26	3.20
56	9.27	3.57	7.44	3.49	7.05	3.31	9.43	3.26
57	9.44	3.64	7.58	3.55	7.18	3.37	9.59	3.32
58	9.60	3.70	7.71	3.61	7.31	3.43	9.76	3.38
59	9.77	3.77	7.84	3.68	7.43	3.49	9.93	3.44
60	9.93	3.83	7.98	3.74	7.56	3.55	10.10	3.49
61	10.10	3.89	8.11	3.80	7.68	3.61	10.27	3.55
62	10.26	3.96	8.24	3.86	7.81	3.67	10.44	3.61
63	10.43	4.02	8.37	3.93	7.94	3.73	10.60	3.67
64	10.59	4.08	8.51	3.99	8.06	3.79	10.77	3.73
65	10.76	4.15	8.64	4.05	8.19	3.85	10.94	3.79
66	10.92	4.21	8.77	4.11	8.31	3.91	11.11	3.84
67	11.09	4.28	8.91	4.17	8.44	3.97	11.28	3.90
68	11.26	4.34	9.04	4.24	8.56	4.02	11.44	3.96
69	11.42	4.40	9.17	4.30	8.69	4.08	11.61	4.02
70	11.59	4.47	9.30	4.36	8.82	4.14	11.78	4.08
71	11.75	4.53	9.44	4.42	8.94	4.20	11.95	4.14
72	11.92	4.59	9.57	4.49	9.07	4.26	12.12	4.19
73	12.08	4.66	9.70	4.55	9.20	4.32	12.29	4.25
74	12.25	4.72	9.84	4.61	9.32	4.38	12.45	4.31
75	12.41	4.79	9.97	4.67	9.45	4.44	12.62	4.37

Total VI.—(Continued)

Cost of Digestible Protein, and Total Digestible Nutrients

	St. Middlings D. C. P. 13.9 T. D. N. 69.3		Beet Molasses D. C. P. 2.9 T. D. N. 58.7		Cane Molasses D. C. P. 1.0 T. D. N. 59.5		Dried Beet Pulp D. C. P. 4.6 T. D. N. 71 6		Wheat Screenings D.C.P.9.60 T.D.N 65.0	
Price per Ton	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs
$	cents	cents	cents	cents	cents	cents	cents	cents	cents	cents
10	3.60	0.72	17.24	0.85	50.00	0.84	10.86	0.70	5.21	0.77
11	3.95	0.79	18.96	0.94	55.00	0.92	11.94	0.76	5.72	0.85
12	4.32	0.87	20.69	1.02	60.00	1.01	13.03	0.84	6.25	0.92
13	4.68	0.94	22.41	1.11	65.00	1.09	14.11	0.91	6.77	0.99
14	5.04	1.01	24.14	1.19	70.00	1.18	15.20	0.98	7.29	1.08
15	5.40	1.08	25.86	1.28	75.00	1.26	16.29	1.05	7.81	1.15
16	5.76	1.15	27.58	1.36	80.00	1.34	17.37	1.11	8.33	1.23
17	6.11	1.23	29.31	1.45	85.00	1.43	18.46	1.19	8.85	1.31
18	6.47	1.30	31.03	1.53	90.00	1.51	19.54	1.26	9.37	1.38
19	6.83	1.37	32.76	1.62	95.00	1.60	20.63	1.33	9.89	1.46
20	7.19	1.44	34.48	1.70	100.00	1.68	21.72	1.40	10.42	1.54
21	7.55	1.52	36.21	1.79	105.00	1.76	22.80	1.47	10.94	1.62
22	7.91	1.59	37.93	1.87	110.00	1.85	23.89	1.54	11.46	1.69
23	8.27	1.66	39.65	1.96	115.00	1.93	24.98	1.61	11.97	1.77
24	8.63	1.73	41.38	2.04	120.00	2.02	26.06	1.67	12.50	1.85
25	8.99	1.80	43.10	2.13	125.00	2.10	27.15	1.75	13.02	1.92
26	9.35	1.88	44.83	2.21	130.00	2.18	28.23	1.81	13.54	1.99
27	9.71	1.95	46.55	2.30	135.00	2.27	29.32	1.88	14.06	2.08
28	10.07	2.02	48.27	2.38	140.00	2.35	30.40	1.95	14.58	2.15
29	10.43	2.09	49.99	2.47	145.00	2.44	31.49	2.02	15.10	2.23
30	10.79	2.16	51.72	2.56	150.00	2.52	32.58	2.09	15.62	2.31
31	11.15	2.24	53.45	2.64	155.00	2.60	33.66	2.16	16.14	2.38
32	11.51	2.31	55.17	2.73	160.00	2.69	34.75	2.23	16.67	2.46
33	11.87	2.38	56.89	2.81	165.00	2.77	35.83	2.30	17.19	2.54
34	12.23	2.45	58.62	2.89	170.00	2.86	36.92	2.37	17.71	2.61
35	12.59	2.53	60.34	2.98	175.00	2.94	38.01	2.44	18.23	2.69
36	12.95	2.60	62.07	3.07	180.00	3.02	39.09	2.51	18.75	2.76
37	13.31	2.67	63.79	3.15	185.00	3.11	40.18	2.58	19.27	2.84
38	13.67	2.74	65.52	3.24	190.00	3.19	41.27	2.65	19.79	2.92
39	14.03	2.81	67.24	3.32	195.00	3.28	42.35	2.72	20.31	2.99
40	14.39	2.89	68.96	3.41	200.00	3.36	43.44	2.79	20.83	3.08
41	14.75	2.96	70.69	3.49	205.00	3.44	44.52	2.86	21.35	3.15
42	15.11	3.03	72.41	3.58	210.00	3.53	45.61	2.93	21.87	3.23
43	15.47	3.10	74.14	3.66	215.00	3.61	46.69	3.00	22.39	3.31
44	15.83	3.17	75.86	3.75	220.00	3.70	47.78	3.07	22.92	3.38
45	16.19	3.25	77.58	3.83	225.00	3.78	48.87	3.14	23.44	3.46

Table VI.—(Continued)
Cost of Digestible Protein, and Total Digestible Nutrients

	Alfalfa Hay D. C. P. 10.6 T. D. N. 51.60		Sweet Clover Hay D. C. P. 10.9 T. D. N. 50.7		Red Clover Hay D. C. P. 7.38 T. D. N. 49.6		Alsike Clover Hay D. C. P. 7.9 T. D. N. 47.3		Soy Bean Hay D.C.P. 10.6 T D N 54.3	
Price per Ton	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs
$	cents	cents	cents	cents	cents	cents	cents	cents	cents	cents
5	2.36	0.49	2.29	0.49	3.39	0.50	3.16	0.53	2.36	0.46
6	2.83	0.58	2.75	0.59	4.06	0.61	3.80	0.63	2.83	0.55
7	3.30	0.68	3.21	0.69	4.74	0.71	4.43	0.74	3.30	0.64
8	3.77	0.78	3.67	0.79	5.42	0.81	5.06	0.85	3.77	0.74
9	4.25	0.87	4.13	0.89	6.09	0.91	6.70	0.95	4.25	0.83
10	4.72	0.97	4.59	0.99	6.77	1.01	6.33	1.06	4.72	0.92
11	5.19	1.07	5.05	1.08	7.45	1.11	6.96	1.16	5.19	1.01
12	5.66	1.17	5.51	1.18	8.13	1.21	7.60	1.27	5.66	1.11
13	6.13	1.26	5.96	1.28	8.80	1.31	8.23	1.37	6.13	1.20
14	6.61	1.36	6.42	1.38	9.48	1.41	8.86	1.48	6.61	1.29
15	7.08	1.46	6.88	1.48	10.16	1.51	9.49	1.59	7.08	1.38
16	7.55	1.55	7.34	1.58	10.83	1.62	10.13	1.69	7.55	1.47
17	8.02	1.65	7.80	1.68	11.51	1.72	10.76	1.80	8.02	1.57
18	8.49	1.75	8.26	1.77	12.19	1.82	11.39	1.90	8.49	1.66
19	8.97	1.84	8.72	1.87	12.87	1.92	12.03	2.01	8.97	1.75
20	9.44	1.94	9.18	1.97	13.54	2.02	12.66	2.11	9.44	1.84
21	9.91	2.04	9.64	2.07	14.22	2.12	13.29	2.22	9.91	1.93
22	10.38	2.14	10.10	2.17	14.90	2.22	13.93	2.33	10.38	2.03
23	10.85	2.23	10.56	2.27	15.57	2.32	14.56	2.43	10.85	2.12
24	11.33	2.33	11.01	2.37	16.25	2.42	15.19	2.54	11.33	2.21
25	11.80	2.43	11.47	2.47	16.93	2.52	15.82	2.64	11.80	2.30
26	12.27	2.52	11.93	2.56	17.60	2.63	16.46	2.75	12.27	2.39
27	12.74	2.62	12.39	2.66	18.28	2.73	17.09	2.85	12.74	2.49
28	13.21	2.72	12.85	2.76	18.96	2.83	17.72	2.96	13.21	2.58
29	13.69	2.82	13.31	2.86	19.64	2.93	18.36	3.07	13.69	2.67
30	14.16	2.91	13.77	2.96	20.31	3.03	18.99	3.17	14.16	2.76
31	14.63	3.01	14.23	3.06	20.99	3.13	19.62	3.28	14.63	2.86
32	15.10	3.11	14.69	3.16	21.67	3.23	20.26	3.38	15.10	2.95
33	15.57	3.20	15.15	3.25	22.34	3.33	20.89	3.49	15.57	3.04
34	16.05	3.30	15.60	3.35	23.02	3.43	21.52	3.59	16.05	3.13
35	16.52	3.40	16.06	3.45	23.70	3.53	22.15	3.70	16.52	3.22

Table VI.—(Continued)
Cost of Digestible Protein, and Total Digestible Nutrients

Price per Ton	Timothy Hay D. C. P. 2.8 T. D. N. 48.95		Prairie Hay D. C. P. 3.0 T. D. N. 48.2		Corn Fodder D. C. P. 3.7 T. D. N. 48.1		Corn Stover D. C. P. 1.98 T. D. N. 36.4		Sudan Hay D.C.P. 3.7 T.D.N. 51.4	
	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs
$	cents	cents	cents	cents	cents	cents	cents	cents	cents	cents
1	1.79	0.10	1.67	0.10	1.35	0.10	2.53	0.14	1.35	0.09
2	3.57	0.20	3.33	0.21	2.70	0.21	5.05	0.28	2.70	0.19
3	5.36	0.31	5.00	0.31	4.05	0.31	7.58	0.42	4.05	0.29
4	7.14	0.41	6.66	0.41	5.40	0.42	10.10	0.56	5.40	0.39
5	8.93	0.51	8.33	0.52	6.76	0.52	12.63	0.71	6.76	0.49
6	10.71	0.61	10.00	0.62	8.11	0.62	15.15	0.85	8.11	0.58
7	12.50	0.71	11.66	0.73	9.46	0.73	17.68	0.99	9.46	0.68
8	14.28	0.82	13.33	0.83	10.81	0.83	20.20	1.13	10.81	0.78
9	16.07	0.92	14.99	0.93	12.16	0.94	22.73	1.27	12.16	0.88
10	17.85	1.02	16.66	1.04	13.51	1.04	25.25	1.41	13.51	0.97
11	19.64	1.12	18.33	1.14	14.86	1.14	27.78	1.55	14.86	1.07
12	21.42	1.23	19.99	1.24	16.21	1.25	30.30	1.69	16.21	1.16
13	23.21	1.33	21.66	1.35	17.56	1.35	32.83	1.84	17.56	1.26
14	24.99	1.43	23.32	1.45	18.91	1.45	35.35	1.98	18.91	1.36
15	26.78	1.53	24.99	1.56	20.27	1.56	37.88	2.12	20.27	1.46
17	30.35	1.74	28.32	1.76	22.97	1.77	42.93	2.40	22.97	1.65
16	28.56	1.63	26.66	1.66	21.62	1.66	40.40	2.26	21.62	1.55
18	32.13	1.84	29.99	1.87	24.32	1.87	45.45	2.54	24.32	1.75
19	33.92	1.94	31.65	1.97	25.67	1.97	47.98	2.68	25.67	1.84
20	35.70	2.04	33.32	2.07	27.02	2.08	50.50	2.82	27.02	1.94
21	37.49	2.14	34.99	2.18	28.37	2.18	53.03	2.97	28.37	2.04
22	39.27	2.25	36.35	2.28	29.72	2.29	55.55	3.11	29.72	2.14
23	41.06	2.35	38.32	2.39	31.07	2.39	58.08	3.25	31.07	2.23
24	42.84	2.45	39.98	2.49	32.42	2.49	60.60	3.39	32.42	2.35
25	44.63	2.55	41.65	2.59	33.78	2.60	63.13	3.53	33.78	2.43

Table VI.—(Continued)
Cost of Digestible Protein, and Total Digestible Nutrients

Price per Ton	Red-top Hay D. C. P. 4.8 T. D. N. 54.1		Oat Hay D. C. P. 4.7 T. D. N. 45.5		Corn Silage D. C. P. 1.2 T. D. N. 16.8		Mangels D. C. P. 1.0 T. D. N. 6.45		Sugar Beets D.C.P. 1.3 T.D.N.11.5	
	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	1 lb. T. D. N. costs	1 lb. Pro. costs	
$	cents	cents	cents	cents	cents	cents	cents	cents	cents	cents
1	1.04	0.09	1.06	0.11	4.55	0.30	5.00	0.78	3.85	0.43
2	2.08	0.18	2.12	0.22	9.09	0.60	10.00	1.55	7.69	0.87
3	3.12	0.27	3.18	0.33	13.63	0.89	15.00	2.33	11.54	1.30
4	4.16	0.37	4.25	0.44	18.18	1.19	20.00	3.10	15.38	1.74
5	5.21	0.46	5.31	0.55	22.72	1.48	25.00	3.88	19.23	2.17
6	6.24	0.55	6.37	0.66	27.27	1.79	30.00	4.65	23.07	2.61
7	7.29	0.65	7.44	0.77	31.81	2.08	35.00	5.43	26.92	3.04
8	8.33	0.74	8.50	0.88	36.36	2.38	40.00	6.20	30.77	3.48
9	9.37	0.83	9.57	0.99	40.90	2.68	45.00	6.98	34.61	3.91
10	10.41	0.92	10.63	1.10	45.45	2.98	50.00	7.75	38.46	4.35
11	11.45	1.01	11.69	1.20	49.99	3.27	55.00	8.53	42.30	4.78
12	12.49	1.10	12.76	1.32	54.54	3.57	60.00	9.30	46.15	5.22
13	13.53	1.20	13.82	1.43	59.08	3.87	65.00	10.08	49.99	5.65
14	14.57	1.29	14.88	1.54	63.63	4.17	70.00	10.85	53.84	6.08
15	15.61	1.38	15.94	1.65	68.17	4.46	75.00	11.63	57.69	6.52
16	16.66	1.48	17.00	1.76	72.72	4.76	80.00	12.40	61.54	6.95
17	17.69	1.57	18.07	1.87	77.26	5.06	85.00	13.18	65.38	7.39
18	18.74	1.66	19.13	1.98	81.81	5.36	90.00	13.95	69.22	7.82
19	19.78	1.76	20.19	2.08	86.35	5.65	95.00	14.73	73.07	8.26
20	20.82	1.85	21.26	2.20	90.90	5.95	100.00	15.50	76.92	8.69
21	21.86	1.94	22.32	2.30	95.44	6.25	105.00	16.28	80.76	9.12
22	22.90	2.03	23.38	2.42	99.99	6.55	110.00	17.05	84.61	9.56
23	23.94	2.12	24.50	2.53	104.53	6.84	115.00	17.83	88.46	9.99
24	24.98	2.22	25.51	2.64	109.08	7.14	120.00	18.60	92.30	10.43
25	26.02	2.31	26.57	2.75	113.62	7.44	125.00	19.38	96.15	10.87

NOTE: Table VI is intended primarily for a comparison of cost of digestible protein and total digestible nutrients in feeds at various prices a bushel or ton. E.G.—When corn costs 67c a bushel and oats 44c a bushel, which is the cheaper source of protein and total digestible nutrients? By referring to the table of corn, the first column gives the price; the second column what one pound of digestible protein costs; and the third column what one pound of total digestible nutrients costs. By following the first column until the desired price, or in this case 67 cents a bushel is reached, follow the line to the right. The cost of one pound of protein in corn is 16.8 cents and a pound of total digestible nutrients is 1.46 cents. Proceed in the same way for oats. Oats at 44 cents a bushel, one pound of protein costs 14.1 cents. At these prices, one pound of protein is about two and one-half cents cheaper in oats than corn, and one pound of total digestible nutrients one-half cent cheaper in corn than in oats. By means of this table the cost of digestible protein and total digestible nutrients can be ascertained in the common feeds, and compared. Careful use of this table will aid materially in profitable feeding.

Table VII.—Comparative Price per Ton on Protein Basis

When bran costs	Gluten feed is worth	Brewers grains is worth	Corn distillers grains is worth	Rye distillers grains is worth	Gluten meal is worth	Linseed oil meal is worth	Choice cotton seed meal is worth	Good cottonseed meal is worth	Soy beans is worth	Soy bean meal is worth
$10.00	$17.73	$17.90	$18.65	$ 9.82	$24.72	$25.15	$31.31	$26.31	$27.64	$33.06
11.00	19.50	19.69	20.52	10.80	27.19	27.67	34.44	28.94	30.40	36.37
12.00	21.28	21.48	22.38	11.78	29.66	30.18	37.57	31.57	33.17	39.67
13.00	23.05	23.27	24.25	12.77	32.14	32.70	40.70	34.20	35.93	42.98
14.00	24.82	25.06	26.11	13.75	34.61	35.21	43.83	36.83	38.70	46.28
15.00	26.60	26.85	27.98	14.73	37.08	37.73	46.97	39.47	41.46	49.59
16.00	28.37	28.64	29.84	15.71	39.55	40.24	50.10	42.10	44.22	52.90
17.00	30.14	30.43	31.71	16.69	42.02	42.76	53.23	44.73	46.99	56.20
18.00	31.91	32.22	33.57	17.68	44.50	45.27	56.36	47.36	49.75	59.50
19.00	33.69	34.01	35.44	18.66	46.97	47.79	59.49	49.90	52.52	62.81
20.00	35.46	35.80	37.30	19.64	49.44	50.30	62.62	52.62	55.28	66.12
21.00	37.23	37.59	39.17	20.62	51.91	52.82	65.75	55.25	58.04	69.43
22.00	39.01	39.38	41.03	21.60	54.38	55.33	68.88	57.88	60.81	72.73
23.00	40.78	41.17	42.90	22.59	56.86	57.85	72.01	60.51	63.57	76.03
24.00	42.55	42.96	44.76	23.57	59.33	60.36	75.14	63.14	66.34	79.34
25.00	44.33	44.75	46.63	24.55	61.80	62.88	78.28	65.78	69.10	82.65
26.00	46.10	46.54	48.49	25.53	64.27	65.39	81.41	68.41	71.86	85.96
27.00	47.87	48.33	50.36	26.51	66.74	67.91	84.54	71.04	74.63	89.26
28.00	49.64	50.12	52.22	27.50	69.22	70.42	87.67	73.67	77.39	92.57
29.00	51.42	51.91	54.09	28.48	71.69	72.94	90.80	76.30	80.16	95.87
30.00	53.19	53.70	55.95	29.46	74.16	75.45	93.93	78.93	82.92	99.18
31.00	54.96	55.49	57.82	30.44	76.63	77.97	97.06	81.56	85.68	102.49
32.00	56.74	57.28	59.68	31.42	79.10	80.48	100.19	84.19	88.45	105.79
33.00	58.51	59.07	61.55	32.41	81.58	82.99	103.32	86.82	91.21	109.09
34.00	60.28	60.86	63.41	33.39	84.05	85.51	106.45	89.45	93.98	112.40
35.00	62.06	62.65	65.28	34.37	86.52	88.03	109.59	92.09	96.74	115.71
36.00	63.83	64.44	67.14	35.35	88.99	90.54	112.71	94.72	99.50	119.02
37.00	65.60	66.23	69.01	36.33	91.46	93.06	115.84	97.35	102.27	122.32
38.00	67.37	68.02	70.87	37.32	93.94	95.57	118.98	99.98	105.03	125.63
39.00	69.15	69.81	72.74	38.30	96.41	98.09	122.11	102.61	107.80	128.93
40.00	70.92	71.60	74.60	39.28	98.88	100.06	125.24	105.24	110.56	132.24

Table VIII.—Comparative Price per Bushel on T. D. N. Basis

When Oats Costs	Barley is worth	Corn is worth	Emmer is worth	Wheat is worth	Rye is worth
$0.25	$0.42	$0.51	$0.38	$0.53	$0.51
.26	.44	.53	.40	.55	.53
.27	.46	.55	.41	.57	.55
.28	.47	.57	.43	.59	.57
.29	.49	.59	.44	.61	.59
.30	.51	.61	.46	.63	.61
.31	.52	.63	.47	.65	.63
.32	.54	.65	.49	.67	.65
.33	.56	.67	.50	.70	.67
.34	.57	.69	.52	.72	.69
.35	.59	.71	.53	.74	.71
.36	.61	.73	.55	.76	.73
.37	.63	.75	.57	.78	.75
.38	.64	.77	.58	.80	.77
.39	.66	.79	.60	.82	.79
.40	.68	.81	.61	.84	.81
.41	.69	.83	.63	.86	.83
.42	.71	.85	.64	.89	.85
.43	.73	.87	.66	.91	.87
.44	.74	89	.67	.93	89
.45	.76	.91	.69	.95	92
.46	.78	.93	.70	.97	.94
.47	.79	.95	.72	.99	.96
.48	.81	.97	.73	1.01	.98
.49	.83	.99	.75	1.03	1.00
.50	.85	1.02	.76	1.05	1.02
.51	.86	1.04	.78	1.08	1.03
.52	.88	1.06	.79	1.10	1.05
.53	.90	1.08	.81	1.11	1.08
.54	.91	1.10	.82	1.14	1.10
.55	.93	1.12	.84	1.16	1.12
.56	.95	1.14	.86	1.18	1.14
.57	.96	1.16	.87	1.20	1.16
.58	98	1.18	.89	1.22	1.18
.59	1.00	1.20	.90	1.24	1.20
.60	1.01	1.22	.92	1.26	1.22
.61	1.03	1.24	.93	1.29	1.24
.62	1.05	1.26	.95	1.31	1.26
.63	1.06	1.28	.96	1.33	1.28
.64	1.08	1.30	.98	1.35	1.30
.65	1.10	1.32	.99	1.37	1.32
.66	1.12	1.34	1.01	1.39	1.34
.67	1.13	1.36	1.02	1.41	1.36
.68	1.15	1.38	1.04	1.43	1.38
.69	1.17	1.40	1.05	1.45	1.40
.70	1.18	1.42	1.07	1.48	1.42
.71	1.20	1.44	1.08	1.50	1.44
.72	1.22	1.46	1.10	1.52	1.47
.73	1.23	1.48	1.12	1.54	1.49
.74	1.25	1.50	1.13	1.56	1.51
.75	1.27	1.52	1.15	1.58	1.53

Table IX.—Average Digestible Nutrients in 100 Pounds of Various Feeds

Kind of Feed	Dig. crude protein	Total dig. nutrients
Concentrates Carbonaceous	**lbs.**	**Lbs.**
Barley	9.0	79.4
Beet pulp, dried	4.6	71.6
Corn, dent	7.5	85.7
Corn, flint	7.7	84.2
Corn and cob meal	6.1	78.1
Hominy feed	7.0	84.6
Emmer (speltz)	9.5	76.5
Flax screenings	11.1	69.6
Kafir grain	9.0	80.0
Molasses, beet	2.9	58.7
Molasses, cane	1.0	59.5
Millet, proso	8.4	77.5
Oats	9.7	70.4
Oat feed, low grade	4.1	43.3
Rye	9.9	81.0
Wheat	8.8	79.2
Sorghum grain	7.5	79.5
Red dog flour	16.2	80.8
Wheat screenings	9.6	65.0
Medium Rich in Protein	**lbs.**	**lbs.**
Wheat bran	12.5	60.9
Rye bran	12.2	75.1
Cotton seed feed	14.2	57.7
Germ oil meal	16.5	82.5
Middlings Std. wheat	12.2	69.3
Distillers grains—from rye	11.8	54.7
Distillers grains—from corn	22.4	88.9
Brewers grains—dried	21.5	65.7
Gluten feed	21.6	80.7
Concentrates High in Protein	**lbs.**	**lbs.**
Buckwheat middlings	24.6	76.6
Cocoanut meal	18.6	78.8
Cottonseed meal, choice	37.0	78.2
Cottonseed meal, prime	33.4	75.5
Cottonseed meal, good	31.6	74.8
Flax seed	20.6	102.8
Gluten meal	30.2	84.0
Linseed meal, old process	30.2	77.9
Malt sprouts	20.3	70.6
Peas	19.0	76.2
Soy beans	33.2	94.1
Soy bean meal	39.7	84.5
Dried buttermilk	29.3	84.2
Dried skim milk	32.5	86.7
Dried Roughage	**lbs.**	**lbs.**
Alfalfa hay	10.6	51.6
Clover hay, red	8.6	50.9
Clover hay, alsike	7.9	47.3
Sweet clover hay	10.9	50.7
Soy bean hay	11.7	53.6
Sudan hay	3.7	51.4
Timothy	3.0	48.5
Millet hay, common	5.0	55.0
Pea hay	12.2	56.6
Corn fodder	3.0	53.7
Corn stover	2.1	46.1
Sorghum—fodder	2.8	52.1
Straw—oats	1.0	45.6
Straw—barley	0.9	42.5
Straw—wheat	0.7	36.9

Table IX.—Continued

Average Digestible Nutrients in 100 Pounds of Various Feeds

Kind of Feed	Dig. crude protein	Total dig. nutrients
Straw—rye	0.7	41.2
Straw—flax shives	5.8	37.8
Prairie hay	4.0	47.9
Oat hay	4.5	46.4
Russian thistle hay	5.1	39.2
Rye hay	2.9	46.5
Succulent Roughages	**lbs.**	**lbs.**
Corn silage, well matured	1.1	17.7
Corn silage, immature	1.0	13.3
Corn stover, silage	0.6	12.2
Corn and soy bean silage	1.6	17.4
Oat and pea silage	2.8	17.6
Sunflower silage	1.0	10.6
Roots and Tubers	**lbs.**	**lbs.**
Sugar beets	1.2	14.0
Common beets	0.9	10.2
Carrots	1.0	10.6
Mangels	0.8	7.4
Potatoes	1.1	17.1
Rutabagas	1.0	9.4

(These analyses may vary slightly in case some feeds from those found in Table 3.)

Table X.—Mineral Matter in One Ton of Common Feeding Stuffs

	Lime CaO	Phosphoric Acid P_2O_5
Concentrates—		
Corn	0.4	13.8
Oats	2.8	16.2
Wheat	1.2	17.2
Gluten feed	7.0	12.4
Wheat bran	1.8	59.0
Linseed oil meal	10.2	34.0
Cottonseed meal	7.2	53.4
St. wheat middlings	1.6	42.2
Dry roughages—		
Alfalfa hay	39.0	10.8
Red clover	32.0	7.8
Soy bean hay	34.4	13.6
Prairie hay	1.4	4.7
Timothy hay*	11.4	6.2
Corn stover	13.2	9.0
Wheat straw	5.8	2.6
Skim milk	3.6	4.4
Beet pulp	18.4	4.8
Mangels	0.4	0.8

From Table VII in Feeds and Feeding by Henry and Morrison.
*From Bulletin 229, Minnesota Station.

Table XI.—Average Weight of One Quart of Different Feeds
(Farmers Bulletin 222)

Feed	1 quart weights	Feed	1 quart weights
Alfalfa meal	0.6 lbs.	Gluten feed	1.3 lbs.
Barley (unground)	1.5 "	Gluten meal	1.7 "
Barley meal	1.1 "	Corn germ oil meal	1.4 "
Brewers' grains, dried	0.6 "	German Millet seed	1.6 "
Buckwheat (unground)	1.4 "	Hominy feed	1.1 "
Buckwheat bran	0.6 "	Linseed meal (old process)	1.1 "
Blood meal	1.9 "	Linseed meal (new process)	0.9 "
Beet pulp, dried	0.7 "	Molasses, cane	3.0 "
Beans, navy	1.7 "	Molasses feed	0.8 "
Corn (unground)	1.7 "	Oats (unground)	1.0 "
Corn meal	1.5 "	Oat meal	1.7 "
Corn and cob meal	1.4 "	Oats (ground)	0.7 "
Corn Bran	0.5 "	Oat feed	0.8 "
Corn germ meal	1.4 "	Oat middlings	1.5 "
Cotton seed (unground)	0.8 "	Oat hulls	0.4 "
Cottonseed meal	1.5 "	Rye	1.7 "
Cottonseed hulls	0.3 "	Rye meal	1.5 "
Cocoanut meal	1.5 "	Rye middlings	1.6 "
Cocoanut cake	1.3 "	Rye bran	0.8 "
Cow peas	1.7 "	Rye feed	1.3 "
Distillers' grain, dried	0.6 "	Soy beans	1.8 "
Flax Seed	1.6 "	Soybean meal	1.3 "
Flax feed	0.8 "	Sunflower seed	1.5 "
Flax meal	1.1 "	Wheat (unground)	1.9 "
		Wheat (ground)	1.7 "
		Wheat bran	0.5 "

Table XII.—Estimated Weight of Settled Silage
(From Bulletin 164—Mo. Exp. Station)

Depth of Silage Feet	Average weight of silage to cubic foot to this depth	CAPACITY, Tons					
	Diameter	10 ft.	12 ft.	14 ft.	16 ft.	18 ft.	20 ft.
1	32	1.2	1.3	2.4	3.2	4.0	5.0
2	32.4	2.5	3.6	4.9	6.5	8.2	10.1
4	33.1	5.1	7.4	10.1	13.3	16.8	20.7
6	33.7	7.9	11.4	15.5	20.3	25.6	31.7
8	34.4	10.8	15.5	21.1	27.6	34.9	43.2
10	35.0	13.7	19.7	26.9	35.1	44.4	54.9
12	35.6	16.7	24.1	32.8	42.9	54.2	67.0
14	36.2	19.9	28.6	39.0	50.9	64.3	79.5
16	36.7	23.0	33.2	45.2	59.0	74.5	92.1
18	37.1	26.2	37.7	51.4	67.1	84.8	104.8
20	37.5	29.4	42.4	57.7	75.3	95.2	117.7
22	37.8	32.6	47.0	64.0	83.5	105.6	130.5
24	38.1	35.9	51.7	70.4	91.9	116.1	143.5
26	38.4	39.2	56.4	76.8	100.3	126.8	156.7
28	38.7	42.5	61.2	83.4	108.9	137.6	170.1
30	39.0	45.9	66.0	90.0	117.5	148.5	183.6

(This table is for average corn silage, and would not be applicable to silage put in when immature, or when very dry.)

Table XIII.—Weights of Produce

1 bushel contains	32 qts.
1 bushel wheat weighs	60 lbs.
1 bushel ear corn weighs	70 "
1 bushel shelled corn weighs	56 "
1 bushel Emmer weighs	40 "
1 bushel oats weighs	32 "
1 bushel rye weighs	56 "
1 bushel barley weighs	48 "
1 bushel beans weighs	60 "
1 bushel peas weighs	60 "
1 bushel potatoes weighs	60 "
1 bushel turnips weighs	55 "
1 bushel clover seed weighs	60 "
1 bushel timothy weighs	45 "
1 bushel millet weight	50 "
1 bushel flaxseed weighs	56 "
1 bushel bluegrass weighs	14 "
1 bushel apples weighs	48 "
1 gallon water weighs	8.3 "
1 gallon milk weighs	8.6 "
1 gallon 32% cream weighs	8.3 "
1 ton of settled hay measures	405 cu. ft.
1 ton of loose hay measures	512 " "
1 ton of well settled hay in stack measures	343 " "

Table XIV.—GESTATION TABLE

The Average Period of Gestation with Cattle is 282 Days

Date of		Date of		Date of	
Service	**Birth**	**Service**	**Birth**	**Service**	**Birth**
Jan. 1	Oct. 8	May 6	Feb. 11	Sept. 8	June 16
Jan. 6	Oct. 13	May 11	Feb. 16	Sept. 13	June 21
Jan. 11	Oct. 18	May 16	Feb. 21	Sept. 18	June 26
Jan. 16	Oct. 23	May 21	Feb. 26	Sept. 23	July 1
Jan. 21	Oct. 28	May 26	Mar. 3	Sept. 28	July 5
Jan. 26	Nov. 2	May 31	Mar. 8	Oct. 3	July 11
Jan. 31	Nov. 7	June 5	Mar. 13	Oct. 8	July 16
Feb. 5	Nov. 12	June 10	Mar. 18	Oct. 13	July 21
Feb. 10	Nov. 17	June 15	Mar. 23	Oct. 18	July 26
Feb. 15	Nov. 22	June 20	Mar. 28	Oct. 23	July 31
Feb. 20	Nov. 27	June 25	April 2	Oct. 28	Aug. 5
Feb. 25	Dec. 2	June 30	April 7	Nov. 2	Aug. 10
Mar. 2	Dec. 7	July 5	April 12	Nov. 7	Aug. 15
Mar. 7	Dec. 13	July 10	April 17	Nov. 12	Aug. 20
Mar. 12	Dec. 18	July 15	April 22	Nov. 17	Aug. 25
Mar. 17	Dec. 23	July 20	April 27	Nov. 22	Aug. 30
Mar. 22	Dec. 28	July 25	May 2	Nov. 27	Sept. 4
Mar. 27	Jan. 2	July 30	May 7	Dec. 2	Sept. 9
April 1	Jan. 7	Aug. 4	May 13	Dec. 7	Sept. 14
April 6	Jan. 12	Aug. 9	May 17	Dec. 12	Sept. 19
April 11	Jan. 17	Aug. 14	May 22	Dec. 17	Sept. 24
April 16	Jan. 22	Aug. 18	May 27	Dec. 22	Sept. 29
April 21	Jan. 27	Aug. 24	June 1	Dec. 27	Oct. 4
April 26	Feb. 1	Aug. 29	June 6		
May 1	Feb. 6	Sept. 3	June 11		

MEMORANDUM

MEMORANDUM

MEMORANDUM