Feeding Dairy Cattle

*A series of
articles by
Prof. E. S. Savage
as published
in the
Holstein-Friesian
World*

1917

COPYRIGHT 1917
HOLSTEIN-FRIESIAN WORLD, INC.

In the preparation of the following series the writer has endeavored to give in clear, concise language the application of science to practical feeding. In many cases the material has been written hurriedly without attempt at finished production, because the whole series has been written at odd times, as the duties of class room and laboratory would allow. In every case it has been the intention to state no principle or practice that has not a firm place

in the operations of our best dairy feeders.

In this time of stress the feeding of our animals is difficult. It is hoped that these articles may help feeders to get a firm basis on which to start their plans. The author hopes that after they are carefully read that they may be the stimulation which will cause the reader to study further the practice of other men and to correlate this practice with their own methods.

Ithaca, N. Y.
April 19, 1917.

E. S. Savage

FEEDING DAIRY CATTLE

James
By
E. S. SAVAGE
" "
Professor of Animal Husbandry
Cornell University

A series of articles published
in the Holstein-Friesian World

SYRACUSE, NEW YORK

WATERLOO, IOWA

SF203
S28

CONTENTS

	PAGE
Introduction	5
Introductory—Dairying and Permanent Agriculture.....	7
PART ONE—FEEDING DAIRY CATTLE.	
I. The Composition and Selection of Concentrates.....	11
II. The Manurial Value of Feeds.....	13
III. The By-Products Used in Feeding Dairy Cows.....	17
IV. The Selection and Value of Concentrates.....	22
V. Forage Crops for Roughage.....	26
VI. Curing Hay From the Standpoint of the Feeder.....	30
VII. When to Cut Corn for Silage.....	34
VIII. An Ideal Ration for Dairy Cows.....	36
PART TWO—ADVANCED REGISTRY FEEDING.	
IX. Fitting a Cow for an Advanced Registry Test.....	41
X. Feeding for Advanced Registry Records.....	43
XI. Feeding Test Cows at Cornell University.....	48
XII. Rations Fed to Some Famous Cows.....	53
XIII. The Rations Fed Segis Fayne Johanna.....	59
XIV. Feeding for Long Distance Records.....	62
XV. Summer Rations for Semi-Official Cows.....	65
XVI. Feeding Fat Into Milk.....	67
PART THREE—FEEDING CALVES.	
XVII. Raising Calves on Whole and Skimmed Milk.....	69
XVIII. Raising Calves on Substitutes for Milk.....	72
XIX. Feeding and Management of Yearlings and Two Year Olds.....	75
PART FOUR—MISCELLANEOUS ARTICLES ON FEEDING.	
XX. Feeding Dry Stock.....	79
XXI. Feeding and Care of the Dairy Bull.....	81
XXII. Forage Crops to Supplement Pasture.....	83

©CLA 467169

MAY 23 1917

Introduction

THERE is no subject of more vital importance to the breeder of Holsteins than that of feeding dairy cattle. The breeder must look not only to his breeding operations for a profit, but he must learn to feed carefully and economically in order that the dairy herd that must be carried in connection with all breeding operations may be profitable. His example as a successful dairyman calls attention to the class of his cattle and his work as a breeder and assists his market very materially.

With conditions as they are to-day the demand for the latest thought and a thorough ground work in the most advanced methods of feeding is absolutely essential. The utmost economy must be practiced and an additional source of profit such as the sales that come from a herd of pure bred animals is necessary if the dairy farmer is to obtain the highest possible price for his labor.

And yet the business is inviting to the beginner. It opens new markets and a new source of profit. It offers the only sound way to build up the fertility of the soil. With the economy that must be practiced it instills into the minds of those who embark upon the venture sound business principle. Waste and uneconomical methods have no place in agriculture, particularly in dairy farming, and the dairyman who begins his work under such conditions as prevail to-day learns methods that bring him many dollars in years to come under more easy conditions.

The publication of this book is undertaken by the World in response to a general demand that Prof. Savage's writings as they have appeared during the past year might be preserved in some concrete form for handy reference. Prof. Savage is recognized as an authority upon feeding matters. He has worked in connection with some of the greatest authorities in the country and his work has reflected credit upon himself and his associates. He is in charge of the foundation Animal Husbandry courses at Cornell University and has done considerable experimental and research work in feeding at that institution. His work has been published in bulletin form by the University from time to time, although this book is the first ever written by Prof. Savage covering the entire subject of feeding dairy cattle.

It will be remembered that Cornell University has bred and developed seven pure bred Holstein cows with records from 30 to 35 lbs. of butter in seven days, which work forms the basis of an interesting chapter in Prof. Savage's book. Other chapters dealing with A. R. O. testing have been added, some of them covering experiences of the most noted breeders and feeders in the country in handling World's Champion Holsteins.

The entire subject of feeding dairy cattle as handled by Prof. Savage is based upon actual methods in use by dairymen all over the country. Its chief recommendation is its practicability for there is no plan nor method described in this book that is not subject to the use of the ordinary dairyman upon the ordinary farm. It makes especial reference to the pure bred Holstein because of the fact that it was written for a Holstein newspaper and for Holstein men to read, and because the Holstein is admittedly the dairyman's most economical milk machine. The principles the book contains, however, are applicable to every dairy proposition in all parts of the country.

The Editors of the World acknowledge indebtedness to a number of breeders for photographs which accompany the cuts. The usual courtesy which pervades every Holstein community and forms an important part of the success of every Holstein undertaking has prevailed throughout the preparation of this series of articles by Prof. Savage and its publication by the World.

We feel that we can very strongly recommend Prof. Savage's book to Holstein dairymen. It is a book that any member of the fraternity can peruse with safety and profit for it teaches sound principles in a careful, concise and readily understandable way.

Syracuse, N. Y., May 1, 1917.

THE EDITORS.

HOLSTEINS AT HEART'S DELIGHT FARM—ONE OF THE SHOW PLACES OF AGRICULTURAL AMERICA
"One of the farmers' big questions is how to maintain fertility at least expense"

Introductory

Dairying and Permanent Agriculture

TO establish the basis upon which this paper is founded, we cannot do better than to quote from "The Holy Earth", by L. H. Bailey, what is said beginning the chapter, "The Farmer's Relation":

"The surface of the earth is particularly within the care of the farmer. He keeps it for his own sustenance and gain, but his gain is also the gain of all the rest of us. At the best he accumulates little to himself. The successful farmer is the one who produces more than he needs for his support; and the over-plus he does not keep; and, moreover, his own needs are easily satisfied. It is of the utmost consequence that the man next to the earth shall lead a fair and simple life, for in riotous living he might halt many good supplies that now go to his fellows.

"It is a public duty so to train the farmer that he shall appreciate his guardianship. He is engaged in a quasi-public business. He really does not even own his land. He does not take his land with him, but only the personal development that he gains from it. He cannot annihilate his lands, as another might destroy all his belongings. He is the agent or the representative of society to guard and subdue the surface of the earth, and he is the agent of the divinity that made it. He must exercise his dominion with due regard to all these obligations. He is a trustee. The productiveness of the earth must increase from generation to generation; this also is his obligation."

That last statement is the fundamental: "The productiveness of the earth must increase from generation to generation; this also is his obligation." This obligation works no hardship on the dairy farmer; on the contrary the more closely he carries it out, the more money he himself will make, and so much the better his farm will be when he leaves it than when he takes it in the beginning.

All this is simply saying that every farmer must return to the soil each year, a little more fertility than he takes from it. In no other way is he truly farming; he is simply mining and on most of our farms too much mining has already been done. We must now begin to farm.

The dairy farmer with pure-bred Holstein-Friesian cattle, who is aiming at a high production with that herd, will, without any doubt, keep up the fertility of his farm; and, for that matter, add to its fertility. Let us take the case of a farmer who has 20 cows,

the average production of which he aims to make 10,000 pounds per year. This is a good high aim, but not impossible of achievement, and no one should be satisfied with less. What must this farmer do to make money for himself and at the same time turn over his land to posterity better than he found it? He must do three things. (1) He must grow legumes for roughage and corn silage; (2) he must be careful in the purchase of concentrates; (3) if he sells money crops, he must aim to purchase enough commercial fertilizer to replace the material sold in the money crops. We will suppose that this farmer sells from his farm each year the following: Five cows, weighing 1,000 pounds each; 15 tons of timothy hay, 1,000 bushels of potatoes, and 200,000 pounds of milk. The fertility sold from the farm would be:

	Nitrogen pounds	Phosphoric acid pounds	Potash pounds
Five 1,000-pound cows.....	116.5	77.5	9.0
15 tons timothy hay.....	297.0	93.0	408.0
1,000 bushels potatoes.....	210.0	72.0	318.0
200,000 pounds milk.....	1120.0	380.0	340.0

Therefore this farmer must balance these amounts with the same amount of fertilizing constituents brought onto the farm in one form or another. He can do it by the purchase direct of commercial fertilizers, but is it necessary for him to do this? No, only in part. If he is judicious in the selection of feeds, he can make up a large part of this loss through those that he purchases.

To produce 10,000 pounds of milk in one year, it will be necessary for him to feed each cow at least 12 pounds of a good mixture of grains 250 days in the year. At this rate for the 20 cows, 32 tons at least will be necessary. A good mixture at present prices is 500 pounds distillers' dried grains, 500 pounds hominy feed, 500 pounds wheat bran, 300 pounds gluten feed, 200 pounds linseed oil meal.

This is an example of the kind of mixture that should be fed to bring the most fertility to the farm and a high feeding value also. How much fertility will 60,000 pounds of this mixture add to the soil after it has passed through the dairy cow?

First, we must see what becomes of the nitrogen, phosphoric acid and potash in the feed when it is fed to a dairy cow. She is normally neither gaining or losing live weight, therefore, she is not storing anything in her body except what may go to the foetus, and that is a comparatively small amount during more than one-half the year. There are only three channels through which the fertilizing elements in the feed may disappear, the milk, the manure, and the urine. Seventy-five and five-tenths per cent. of the nitrogen appears in the manure and urine and the balance, 24.5 per cent., appears in the milk. Eighty-nine and seven-tenths per cent. of the phosphoric acid and potash appears in the manure and urine, and the balance, 10.3 per cent., appears in the milk. Therefore, we see that a large part of the fertility purchased in feeds is available to the land. This has never been studied as carefully as it should be in this country, because up to the present, little thought has been

needed to be given on account of the virgin condition of our soils and the immense stores of fertility in them. Of course, these stores are in no way exhausted, but must be conserved. In older countries like England, farmers have had to be careful of the fertility in their soils, and we will turn for a moment to the English law regarding this point.

This law is quoted from "Feeds and Feeding", by Henry & Morrison:

"British practice—in Great Britain, where many of the farmers are long period tenants, the manurial value of feeding stuffs is recognized by law in a manner that tends greatly to the betterment and permanence of her agriculture. The Agricultural Holdings Act, which is the law governing the relations between landlord and tenant, direct that when a tenant is vacating his leasehold he shall be reasonably compensated for the improvements he has made. Among these, credit must be given for the fertilizing value of feeding stuffs which the tenant may have purchased and fed out, and also, under certain conditions for the fertilizing value of grains produced on the farm and fed to stock. In order to furnish data to guide the valuers who serve in settlement between landlord and tenant, after full and extended study, Lawes & Gilbert and later Voelker & Hall, of the Rothamstead Experiment Station, drew up tables showing the compensation to be allowed for the fertilizing value of various feeds. The recommendations, as revised in 1913 and adopted by the Central Association of Agriculture and Tenant Right Valuers, are that the tenant shall be credited as follows for all manure resulting from feeding purchased feeds to stock on the leasehold.

"For all unused manure, or that which has been recently applied to the land, without a crop being grown thereafter, a credit of three-fourths of the total value of the phosphoric acid and potash in the feed is allowed. Because a greater loss of nitrogen commonly occurs in stored manure than in manure dropped in the field by animals at pasture, a credit of 70 per cent. of the total value of the nitrogen is allowed when the stock have been fed at pasture and of only 50 per cent. when they have been fed in the barn or yard."

We all know that in all countries the material written into the law is conservative. Therefore, the following amounts of fertilizing materials estimated from the materials in the feeds in the 60,000 pounds of the mixture above suggested, are conservative estimates. The total available nitrogen, if the feed had been spread on the ground, has been multiplied by one-half, as allowed in the above extract from English law, and the available phosphoric acid and potash by three-fourths. The 60,000 pounds of the mixture has been separated into its different constituents in order that the difference in feeds might be seen.

	Nitrogen pounds	Available in manure Phosphoric acid pounds	Potash pounds
15,000 lbs. Distillers' dried grains.....	368.2	76.5	19.2
15,000 lbs. Hominy feed.....	127.5	139.5	106.8
15,000 lbs. Wheat bran.....	192.0	331.8	182.4
9,000 lbs. Gluten feed.....	182.7	41.7	15.6
6,000 lbs. Oil meal.....	162.6	76.5	57.3
Totals.....	1033.0	666.0	381.3

It will be seen that the above goes a long way towards offsetting the fertility that has been sold off the farm. It almost completely offsets the fertility that is sold in the milk, leaving only that sold in the money crops to be replaced by the farmer.

This brings sharply to light the first fact that we wish to establish, that by the judicious selection of feeds, all the fertility that is sold as market milk may be fully replaced by the fertility in the feeds, even when the fertility in the feeds is conservatively estimated.

In the above tables, comparing milk with the feeds, there is a slight shortage in the nitrogen. We must remember, however, that only 50 per cent. of the available nitrogen in the feed has been computed. Then, if legume crops are grown, whatever of nitrogen is taken from the air is clear gain. This emphasizes the importance of the growing of legumes.

Nothing has been said about the money value of these fertilizing constituents. The writer leaves that for the interpretation of the reader. Nitrogen on the average for the past 10 years has been worth 18 cents per pound, phosphoric acid 4.5 cents, and potash 5 cents. Nitrogen and potash are much more expensive at present. Potash is nearly unavailable, therefore, we see again the importance of getting what we can in feeds. As to choice of feed, without going into detail, the high protein feeds—cottonseed meal, gluten feed, etc.—yield the nitrogen, and the feeds like wheat bran made up of the outer coatings of the kernel, carry the most potash and phosphoric acid.

Upon looking at this first table, we can see that mature animals carry away relatively the least fertilizing elements, therefore, the Holstein breeder, who is feeding his milk and selling mature animals at high prices, is conserving the fertility of his farm. Therefore, the greatest gain to be made in dairy farming, from the standpoint of a permanent agriculturist, is to aim for the best blood there is and to make the surplus stock the main cash crop of the farm.

Then again, if milk must be sold, a glance at the first table will show that if the milk can be sold to a factory, so the skim milk can come back to the farm, or if butter can be made on the farm, a great saving of fertility is made.

Therefore, as far as possible, from the standpoint of a permanent agriculture, the dairy farmers must learn to grow legumes and to market their crops in cream and butter and mature animals at high prices.

Part One—Feeding Dairy Cattle

I. The Composition and Selection of Concentrates

THE question of feeding dairy cattle is largely a question of growing roughage suitable for the cows on the farm; in some cases the growing of a little grain, and lastly and most important of all, the selection of the proper purchased feeds to supplement the ones grown at home.

A feed is grown or purchased for the total digestible material in it. The water and the indigestible matter are of no particular use to the animal and are like the "filler" in a fertilizer. Therefore the study of the selection of feeds either to be grown or to be purchased must be based on the cost of the digestible material and the needs of the cow for certain particular things in her ration. The things needed in a ration are digestible protein, digestible carbohydrates and digestible fat. These are familiar terms to all readers and need no particular discussion here. When a feed is purchased or grown it is for the digestible protein, the digestible carbohydrates and the digestible fat in it. The feeds to be chosen are those in which we can get the most of these things for one dollar.

The ordinary coarse feeds grown on farms are mixed hay, corn silage and cornstalks or fodder. The grains ordinarily grown are corn, oats, barley and buckwheat. We must purchase feeds to properly supplement these feeds we grow at home and study the growing of those that will give us the most at the least cost. For purposes of convenience it is customary to add together the digestible protein, digestible carbohydrates and digestible fat multiplied by $2\frac{1}{4}$ and call the result the total digestible nutrients. This is usually computed on the ton basis. For example: there are in 100 pounds of gluten feed, 21.6 pounds of digestible protein, 51.9 pounds digestible carbohydrates and 3.2 pounds of digestible fat $3.2 \times 2\frac{1}{4} = 7.2$ plus 51.9 plus 21.6 equal 80.7 pounds of total digestible nutrients in 100 pounds of gluten feed. The fat in any feed is worth $2\frac{1}{4}$ times as much as the carbohydrates and protein, therefore the fat is multiplied by $2\frac{1}{4}$ before adding. 80.7×20 equal 1614 pounds of total digestible nutrients in one ton (2000 pounds) of gluten feed. Therefore when we buy a ton of gluten feed for \$33.50 as quoted below, we pay the \$33.50 for the 1614 pounds of digestible material in the ton. One hundred pounds of total digestible material in gluten feed would cost \$2.08. In this way the cost of digestible material in all feeds may be calculated and the results used as a basis in the selection of the crops that shall be grown for

roughage and in the selection of the supplements that must be purchased. Such a table is worked out below as the basis for the selection of the proper feeds to purchase at the present time to go into a ration.

In all rations for dairy cattle there must be sufficient protein. In the ordinary roughages grown on the farm and in the grains grown on the farm there has been a lack of protein, so the second thing to be considered in the purchase of feeds is the amount of protein in each. To make this a matter of easy consideration the feeds listed below are divided into high protein, medium protein and low protein groups. How to make use of this grouping will be explained later.

As for roughages all that need to be said is that on the basis of the cost of digestible nutrients alone the roughage that all dairymen must grow is corn silage. In no other crop can so much be obtained for one dollar as in corn silage. Next in importance is the growing of legume hays. The possession of a sufficient quantity of good corn silage and of good clover or alfalfa hay gives us the finest kind of a start in the selection of the feeds that shall make up the ration. No farmer can afford to be without these roughages.

Now to make this lesson definite we will proceed to the selection of the concentrates which we would choose to make a mixture to supplement good clover hay and corn silage in a ration. Below as a starting point is given a table of the feeds commonly listed by feed dealers, arranged according to high, medium and low protein content.

COMPOSITION OF CONCENTRATES.

	(High Protein)	Per cent digestible protein	Total digestible nutrients in one ton	Cost per ton	Cost of 100 lbs. total dig. nut.
1. Cottonseed meal.....		37.0	1564	\$37.50	\$2.40
2. Linseed oil meal.....		30.2	1558	37.00	2.37
3. Distillers' dried grains.....		22.4	1778	32.75	1.84
4. Gluten feed.....		21.6	1614	33.50	2.08
5. Brewers' dried grains.....		21.5	1314	28.50	2.17
6. Malt sprouts.....		20.3	1412	28.50	2.02
(MEDIUM PROTEIN)					
7. Flour middlings.....		15.7	1564	30.00	1.92
8. Wheat mixed feed.....		12.9	1340	26.75	2.00
9. Wheat bran.....		12.5	1218	24.50	2.01
(LOW PROTEIN)					
10. Ground oats.....		9.4	1400	35.10	2.51
11. Ground barley.....		9.0	1588	35.00	2.20
12. Hominy.....		7.0	1692	30.00	1.77
13. Corn meal.....		6.9	1676	30.90	1.84
14. Dried beet pulp.....		4.6	1432	26.50	1.85

The figures in the last column are obtained by dividing the cost per ton by the total digestible nutrients in one ton of each feed and multiplying the result by 100. It is this column and the amount of protein in each feed which guide us in the proper selection of the feeds. This is the proper starting place. This knowledge must be supplemented by a thorough knowledge of the peculiar usefulness of each feed in milk production.

To insure the proper amount of protein in the ration, about one-half of the feed should be chosen from among those containing a high amount of protein. The following mixture is suggested, taking all of these things into account:

500 lbs. hominy.....	\$ 7.50
500 lbs. distillers' dried grains.....	8.19
500 lbs. mixed feed.....	6.69
300 lbs. gluten feed.....	5.03
200 lbs. oil meal.....	3.70
<hr/>	
2000 lbs. (one ton).....	\$31.11

It is seen that 1000 pounds of this mixture is made up of distillers' grains, gluten feed and oil meal. The oil meal was not chosen as yielding total nutrients very cheap, but because the writer wishes particularly to have a little oil meal in his ration. All the others in the suggested mixtures will be found to yield total digestible nutrients the cheapest.

The author has found this method of great assistance in studying the relative values of feeds and in forming a basis for the choice of feeds. The prices quoted are those of a wholesale dealer on the basis of a Rochester freight rate at the time this article was written (1916).

The above mixture is advised with practically any roughage. It would go particularly well with clover hay and corn silage. If no silage is available it will be noticed in the table that dried beet pulp and malt sprouts are relatively cheap feeds. They make excellent succulent feeds if soaked eight or ten hours before feeding. Not as much other grain would be needed with these soaked grains.

II. The Manurial Value of Feeds

ALL true farmers believe in a system of farming which is a little better than permanent agriculture. A system of permanent agriculture means one in which as much fertility is added to the soil each year as is taken off the farm crops, thus the farm is permanent. Every good farmer believes in having his fields a little richer and better each year than they were the year before, and that means that he must have added a little more fertility than he has taken away. If he does this he is carrying on a system which is more than permanent. Consequently, one of the big questions is how to maintain fertility at the least expense. Some help on this question is the aim of this paper.

Nowhere has the Great War hit the farmer much harder than it has in the cost of fertilizers. The cost of nitrogen per pound the last ten years has averaged about 18 cents, of phosphoric acid 4.5 cents and of potash 5 cents. Due to the war, nitrogen now costs in an available form 20 to 25 cents per pound; phosphoric acid about 6 cents, and potash is scarcely available at all. When quoted the price is given varying from 30 cents to 50 cents per pound, but it can scarcely be purchased at any price. Therefore anything at

SCENE ON A CENTRAL NEW YORK FARM

"The dairy farmer with pure bred Holstein-Friesian cattle will keep up the fertility of his farm"

this time that will help keep up the fertility of the farm will be of great service. One source that must not be overlooked is the fertilizing constituents in feeds. Here is where the dairy farmer has an advantage over his neighbors, hay and grain farmers, because he has a lot of manure to use, and is a big purchaser of feeds. From a manurial standpoint how can he get the most for his dollar in maintaining and building up the fertility of his farm? There are two main things that he must know, and concerning them he must put his knowledge into practice. First, he must know in which feeds he will get the most fertility. Secondly, he must so care for the manure and urine that none of the fertility will be lost. We will endeavor to show first how much fertility there is in the common feeding stuffs and show how he may quickly compare feeds on this basis.

No one questions the importance of growing all the legume roughage that it is possible to grow. In this we have a happy combination of circumstances. On practically every dairy farm in the whole country it is possible to grow either clover or alfalfa. These hays make the foundation of the ration and are ideal roughages. In growing them the farmer gets one fertilizing constituent, nitrogen, to some extent free from an inexhaustible source, the air. The amount of nitrogen gathered in this way by large crops of legumes amounts to a great deal, and adds directly to the permanent value of the land at practically no cost to the farmer. In addition to roughage he may grow some grain, but rarely does a farmer grow enough to feed his own cows. Therefore he must be familiar with the fertilizing constituents of the feeds that he must purchase to supplement those that he raises.

When feed is first fed to an animal only that portion is available as a fertilizer which passes out from the animal in the manure and urine. The percentage of each fertilizing constituent which will appear in the manure varies with the animal. With a mature horse, neither gaining nor losing live weight, all the nitrogen, phosphoric acid and potash in the feed must appear in the manure and urine, otherwise the horse would of necessity gain in weight.

The percentages of nitrogen, phosphoric acid and potash recovered in the manure and urine from different animals as given by Henry and Morrison are as follows:

PROPORTION OF NITROGEN, PHOSPHORIC ACID AND POTASH
OF FEED WHICH IS VOIDED BY ANIMAL

	Nitrogen per cent	Phosphoric acid and potash per cent
Horse at work.....	100.0	100.0
Fattening ox.....	96.1	97.7
Fattening sheep.....	95.7	96.2
Fattening pig.....	85.3	96.0
Milch cow.....	75.5	89.7
Calf, fed milk.....	30.7	45.7

These percentages are higher than the amounts recovered in common practice. For calculation in the choice of feeds for a

ration it has been deemed best to adopt the plan given in English law which governs the relations between landlord and tenant. The following principles of English law as recommended and adopted by the Central Association of Agriculture and Tenant Right Valuers are quoted from Henry and Morrison:

"For all unused manure or that which has been recently applied to the land without a crop being grown thereafter, a credit of three-fourths of the total value of the phosphoric acid and potash in the feed is allowed. Because a greater loss of nitrogen commonly occurs in stored manure than in manure dropped in the fields by animals at pasture, a credit of 70 per cent of the total value of the nitrogen is allowed when the stock have been fed at pasture and only 50 per cent when they have been fed in barn or yard.

"When one crop has been grown since the application of the manure, a part of the fertility thereby being used up, the credit allowed is only half that stated above. It is realized that the beneficial effects of farm manure persist much longer than two years, but owing to the difficulties of checking records for a longer period, the compensation is not extended over a greater time. The principle of the English law, as set forth, should be drafted into every lease drawn between landlord and tenant in this country."

In accordance with these principles the following table has been computed:

MANURIAL VALUES PER TON.

Feed	Cost per ton	Manurial value per ton	Net cost per ton
Corn meal.....	\$31.00	\$ 3.37	\$27.63
Hominy feed.....	30.00	4.62	25.38
Gluten feed.....	31.00	7.91	23.09
Flour wheat middlings.....	30.00	5.13	24.87
Wheat bran.....	24.00	7.81	16.19
Wheat mixed feed.....	25.00	6.08	18.92
Ground oats.....	33.00	4.53	28.47
Ground barley.....	35.00	4.42	30.58
Malt sprouts.....	28.00	10.10	17.90
Brewers' grains, dried.....	29.00	8.37	20.63
Cottonseed meal, choice.....	38.00	15.87	22.13
Linseed oil meal, old process.....	35.00	11.87	23.13
Beet pulp, dried.....	28.00	3.01	24.99
Distillers' grains, dried.....	31.00	9.43	21.57

The manurial values here given are those computed on the basis that a dairy cow returns in the urine and manure 50 per cent of the nitrogen and 75 per cent of the phosphoric acid and potash in the feed as fed. The value has been circulated by multiplying the pounds of nitrogen by 18 cents, the phosphoric acid by 4.5 cents and the potash by 5 cents.

Objection may be made that no such values are ever recovered in ordinary practice. Attention is therefore called again to the first table, which says on good authority that 75.5 per cent of the nitrogen and 89.7 per cent of the phosphoric acid and potash are returned by a dairy cow, and then consider that the percentages,

50 for nitrogen and 75 for phosphoric acid and potash, are used from the law. All men know how conservative are the figures written into law. Again, we have used low prices as compared with the present prices for nitrogen, phosphoric acid and potash.

Concerning the care of the manure and urine, again it must be emphasized that more than half of the manurial value of each feed is in the nitrogen. Practically all of the nitrogen of the feed is returned in the urine. Therefore all the urine must be absorbed and the manure so kept that no fermentation or heating can take place. The best method is to spread it over the fields every day. In case this is not possible it is at least possible to prevent leaching of the pile. Heating is hard to control, but tramping it down hard will help. If the manure can be stored in a place where it can be tramped hard by animals very little heating will take place. This might be accomplished with young stock.

III. By-Products Used in Feeding Dairy Cows

DAIRY farmers will be troubled to procure feed for their cows during the next six months if the indications at present are of any value. On account of the war and the great demand for cereals for human food, good prices are bound to be high even with a great crop this year. Therefore this article has been planned to give some additional information concerning the by-products that may be used in feeding dairy cows. This article may be dry reading but it is hoped that there is valuable information in it for the dairyman who will take the time to read it through.

All the concentrates that may be used for dairy cattle may be put into three groups for convenience in arranging proper mixtures. These groups are a high protein group, medium protein group and a low protein group. The high protein group contains those feeds with a nutritive ratio of 1 : 3 or narrower, the medium protein group those feeds between 1 : 3 and 1 : 6, and the low protein group those feeds with a nutritive ratio of 1 : 6 or wider.

In general it may be said that a mixture of feeds in which at least one-half by weight are high protein feeds will be a good mixture to feed. One-third of the mixture by weight should be made up of bulky feeds. The high protein feeds have in general the highest manurial value and so on down to the low protein feeds which have the lowest manurial value.

Many, many farmers choose feeds according to the protein content of the feed almost entirely. This is a very important thing to consider but is incorrect if it is the sole factor considered. Feeds have a value in direct proportion to the total digestible matter in them in all rations with sufficient digestible protein. Only when the ration as a whole, considering both roughage and concentrates, is lacking in protein does a high protein feed have a value above the value of a low protein feed, having the same that digestible nutri-

ents per ton, except that the high protein feed always has the greatest manurial value.

CORN AND ITS BY-PRODUCTS: With the above introduction we may now consider somewhat in detail the by-products that may be used. The manufacturing process using corn as raw material give us as foods for dairy cows, distillers' dried grains, gluten meal and gluten feed in the high protein class; germ oil meal in the medium class; corn bran and hominy feed in the low protein class. Corn meal and corn and cob meal come in this latter class although not by-products.

Distillers' grains, from the manufacture of alcohol and whiskey, are one of the finest feeds for their high protein content and the large amount of total digestible material. They are also bulky. They may well form the foundation of a ration.

Gluten meal differs from gluten feed in that the corn bran is not added in the case of the meal. This makes the meal less bulky and with a high protein content. Gluten feed has the corn bran in it. Corn bran is like wheat bran and is somewhat more valuable. Corn bran, gluten meal and gluten feed all arise in the manufacture of starch and glucose from corn. There is not much gluten meal on the market. Gluten feed may be used as a high protein feed and naturally is classed with cottonseed meal where bulk is not needed. Distillers' grains would be chosen if bulk is needed in the mixture.

Hominy comes from the manufacture of hominy grit for human consumption. It is somewhat more valuable than corn meal for dairy cows and will keep better in bulk. These corn by-products are all very useful in feeding. Germ oil meal also arises in the process of starch and glucose manufacture. It is the cake remaining after oil is expressed from the germs or pits of the corn kernel.

WHEAT AND ITS BY-PRODUCTS: Wheat gives us several medium protein by-products. Ground wheat itself falls into the low protein class. Wheat bran, standard wheat middlings, flour wheat middlings, and red dog flour are all separated mechanically in the process of flour making from wheat. They increase in total digestible matter and decrease in bulkiness in the order named. The finer products are not so good in dairy rations as wheat bran. However, all may be used if the total bulk of the mixture is properly acquired through the use of other feeds. The relative value may be computed by means of the amount of total digestible nutrients. Reference to the table in this article will show this. Wheat mixed feed is the mixture of the mill run of all these separated wheat by-products. That is, if the wheat bran, standard wheat middlings, flour wheat middlings and red dog flour from one hundred bushels of wheat milled into flour were all mixed together, the results would be the mixed feed from such milling. Good mixed feed is more valuable than wheat bran.

RYE BY-PRODUCTS: Rye mixed feed is practically the only by-

product from rye. It is a medium protein feed of practically the same value as wheat mixed feed but is not so palatable.

BARLEY BY-PRODUCTS: Ground barley is in the low protein class and is as valuable as corn or hominy feed. When manufactured into beer we get two by-products, malt sprouts and brewers' dried grains. Both these feeds are bulky and high in protein. They are both more valuable than wheat bran but are not so valuable as the high protein grains such as distillers' dried grains and gluten feed. There seems to be a prejudice against these feeds and if fed by weight it will be found that they are valuable. They are so bulky that one is deceived and apt to underestimate their value when fed by measure. Malt sprouts are valuable as a source of succulence if wet up when one has no silage. In the opinion of the writer these feeds when properly mixed with others, have a valuable commensurate with their content of total digestible nutrients.

OAT BY-PRODUCTS: In the milling of oats the same by-products analogous to those from the milling of wheat arise. They are not generally marketed as such, but for the most part find their way into ready mixed feeds. Care should be taken in the purchase of ground oats to see that too many hulls are not present. Ground oats are often made from light oats. The writer has seen a difference of four per cent. in the crude fiber content of two cars of ground oats bought at the same price at the same time from two well rated companies.

COTTONSEED MEAL, LINSEED OIL MEAL AND MISCELLANEOUS BY-PRODUCTS: Cottonseed meal arises in the production of cottonseed oil from cottonseed. It is a very valuable by-product in the high protein group. It is much like gluten feed. Either of these may be safely fed to the extent of four pounds per day per cow. In a ration in which both cottonseed meal and gluten feed are found, not more than four pounds of both should be fed. Much has been said about the trouble that these two feeds cause, but from the fact that so much of both are fed in the best dairies, it seems to the writer that fears are groundless in feeding them in moderation.

Linseed oil meal is a by-product from flax in the manufacture of linseed oil. This feed has a great value because of its laxative effect as well as its value as a feed in itself.

Cocoonut oil meal and peanut oil meal sometimes are on the market. They are much the same in effect as the other oil meals and are valuable in proportion to their digestible nutrients.

Dried beet pulp is very valuable, particularly when succulent feed is needed. It wets up readily and is very palatable.

Many other feeds might be mentioned. A farmer might well study the possibility of buying a car of grain screenings or of salvage grain and make that the basis of his feeding operations. Screenings are as valuable as wheat bran when of good quality and the value of salvage grain would depend on the kind and the amount of damage. Screenings from wheat are separated from the wheat

FAIRVIEW KORNDYKE PIETERTJE
World's Champion junior two-year-old

LADY PONTIAC JOHANNA
World's Champion senior three-year-old

before it is milled and when of good quality consist mainly of weed seeds and broken grains of wheat. Screenings should always be ground. The ground screenings are now run into wheat bran and wheat middlings in many mills. Salvage grain is grain damaged by fire or water and afterwards kiln dried. As a rule it is well liked by animals.

PRECAUTIONS: In the purchase of concentrates of all kinds the tag should always be examined to know whether the analysis is up to the standard or average of that particular feed or not. The experiment station of nearly every state publishes a bulletin on the analysis of the feeds used in that state. Every reader of "The World" should provide himself with these tables of analysis and buy on analysis and on the content of total digestible nutrients. Agricultural newspapers, experiment stations, farm bureaus are all ready and willing to give information along these lines. Much money can be saved and made by the intelligent buying of feeds.

A brief table is appended showing the grouping of feeds and their relative values on the basis of total digestible nutrients in one ton of each:

GROUPS OF FEEDS

HIGH PROTEIN

	Total digestible nutrients in one ton
Distillers' dried grains.....	1778
Gluten meal.....	1680
Gluten feed.....	1614
Brewers' dried grains.....	1314
Malt sprouts.....	1412
Buckwheat middlings.....	1532
Prime cottonseed meal.....	1510
Linseed oil meal.....	1558

MEDIUM PROTEIN

Germ oil meal.....	1650
Wheat bran.....	1218
Standard wheat middlings.....	1386
Flour wheat middlings.....	1564
Red dog flour.....	1584
Wheat mixed feed.....	1340
Rye mixed feed.....	1490

LOW PROTEIN

Corn and cob meal.....	1562
Corn meal.....	1676
Hominy feed.....	1692
Corn bran.....	1462
Ground wheat.....	1602
Ground rye.....	1620
Ground barley.....	1588
Ground oats.....	1408
Ground buckwheat.....	1268
Dried beet pulp.....	1432
Molasses.....	1184
Wheat screenings.....	1340

IV. The Selection and Value of Concentrates

BY way of introduction to this paper a few of the requirements in a ration for dairy cows may be stated with benefit because these factors must be uppermost in one's mind when he is selecting and buying the concentrates for his ration. Seven factors must be considered: bulk, digestibility, the "balance" of the ration, variety, suitability of the feeds, palatability and, finally, the cost of the ration. These factors should be thought of carefully in selecting concentrates. The "balance" of the ration and the cost are the two factors which will be explained a little further before making the selection according to present prices. The other factors explain themselves in their names.

BALANCED RATION.

To-day we have a somewhat different conception of the term "balanced ration" than was formerly held. In the past the term balanced meant practically the nutritive ratio of the ration and nothing else. That is, a ration was said to be balanced if there was one pound of digestible protein to five and four-tenths pounds of carbohydrates and fat, 1:5.4. It was considered necessary to balance the ration quite closely. To-day the best feeders agree that plenty of protein in a ration is fundamentally essential, but the range of the nutritive ratio has been set at wider limits. We now set the limits at 1:4.5 and 1:6.0. It is even thought that in sections where carbohydrates in feeds are the cheap nutrient that the wider limit may be wider than 1:6.0, although to the writer it would seem that a careful study of the paper on Manurial Values would show that wide rations for dairy cows would be advisable only under very exceptional conditions. The narrow limit 1:4.5 is set at that point purely because more protein than this may injure the health of cows. Many rations as narrow as 1:3.0 are fed. We have no adverse criticism of this practice. It is suggested, however, that cows on such narrow rations should be carefully watched.

The new thoughts of scientists, borne out by practical feeding trials, tell us that while the nutritive ratio and plenty of protein are important, some other things are also very important in a properly balanced ration. Much evidence is being brought out, particularly with growing animals, that not only is it necessary that there be sufficient protein present, but that the kind of protein is important. The importance of this in feeding dairy cows is apparent when we think that for nine months out of every twelve the cow is growing a young calf as well as caring for herself and manufacturing milk. The best way in practice to be sure of this point is to have a good variety in the ration with several plants represented. Later on we are going to know more definitely about the individual feeds and recommend specifically on this point, but at present we can only advise a variety of proteins.

Again the mineral matter in rations is receiving considerable

attention and study. To insure a sufficient and suitable supply of mineral matter in the feed it seems absolutely necessary to feed legumes, and the most satisfactory legume from this standpoint is alfalfa. Therefore in our present idea of a balanced ration we must consider the individual feeds, the specific proteins that they supply and the mineral matter that they contain as well as the mere balance of the nutrients. I wish we might say specifically at the present time just what all these necessary things are and definitely that this feed supplies this and that feed supplies some other necessary thing, but in the present state of our knowledge we can only urge variety and legume hays.

THE COST OF THE RATION.

The other important factor on which the selection of feeds is based is cost. The proper way to select concentrates to supplement roughage is to start with the selection of the five or six feeds that are truly the cheapest on the market and then make up a proper mixture taking into consideration all the other factors.

To make this lesson clear and concrete we will take present quotations (1916) and select the six feeds that are truly the cheapest. Those feeds are truly the cheapest which give us the most digestible material for one dollar.

The following table has been prepared to show which feeds at recent quotations give us the most digestible material for one dollar. This table has been computed both before the manurial value has been taken out and after on a net basis:

Feed	Price per ton whole-sale ester rate	Pounds digestible nutrients in 1 ton	Cost of 100 lbs. total digestible nutrients	Manurial value of 1 ton	Net cost per ton	Net cost of 100 lbs. total digestible nutrients
Corn meal.....	\$35.30	1676	\$2.09	\$3.37	\$31.93	\$1.91
Hominy	33.00	1692	1.95	4.62	28.38	1.68
Gluten feed.....	28.75	1614	1.78	7.91	20.84	1.28
Malt sprouts.....	25.25	1412	1.79	10.10	15.15	1.07
Wheat mixed feed.....	28.00	1340	2.09	6.08	21.92	1.64
Flour middlings.....	30.25	1564	1.94	5.13	25.12	1.60
Distillers' dried grains	30.50	1778	1.72	9.43	21.07	1.18
Wheat bran	25.50	1218	2.09	7.81	17.69	1.45
Ground barley.....	35.00	1588	2.20	4.42	30.58	1.93
Ground oats.....	32.80	1408	2.30	4.53	28.27	2.00
Brewers' dried grains..	27.50	1314	2.09	8.37	19.13	1.49
Cottonseed meal.....	37.00	1564	2.37	15.87	21.13	1.36
Oil meal	37.00	1558	2.37	11.87	25.13	1.62
Dried beet pulp.....	27.00	1432	1.89	3.01	23.99	1.67

The pounds of total digestible nutrients in one ton in the third column of this table are found by adding the pounds of digestible protein, the pounds of digestible fat after the fat has been multiplied by 2.25. This is the digestible material which we pay for. The rest, from the standpoint of the feeder, is waste. Then it is reasonable to select those feeds for the mixture of concentrates which will give the most digestible material for one dollar. To make this selection easy the fourth column is given. This column gives us the cost of 100 pounds of total digestible nutrients in each

AN IOWA CORN CROP IN JUNE

The dairyman should make ample provision for each year's corn crop in his farming operations

of these feeds. For example, \$2.09 is the cost of 100 pounds of digestible material in corn meal at the price given.

The second part of the table is computed to take into account the manurial value of the feeds. The manurial value has been computed with nitrogen at 18 cents per pound, phosphoric acid at 4.5 cents and potash at 5 cents, most conservative prices at present, and on the same basis as given in the article on Manurial Values in a preceding article.

Every farmer when he is thinking of buying feeds should prepare such a table with the prices submitted by the person from whom he expects to purchase. If one does not wish to do this for himself he should have his Farm Bureau Manager in his county do it for him or even request that his feed dealer do it for him to show him the feeds which are truly the cheapest. (Cornell Reading Course bulletin 117 gives all the necessary data for this.) The pounds of total digestible nutrients in one ton do not change, so may be used over and over again. This figure for any feed not in this list may be computed easily from any book or bulletin on computing rations. The column giving the manurial value per ton may be considered fixed, although these prices would of course vary with the price of nitrogen, phosphoric acid and potash. They are probably accurate enough for comparing the relative value of feeds.

SELECTING THE MIXTURE.

On the basis of the cost of 100 pounds of total digestible nutrients the cheapest seven feeds, one-half the list, in order of cheapness are distillers' dried grains, gluten feed, malt sprouts, dried beet pulp, flour middlings, hominy feed, wheat bran. Not considering manurial values then, we would suggest the following as a good mixture:

- 500 lbs. distillers' dried grains
- 400 lbs. gluten feed
- 500 lbs. hominy feed
- 300 lbs. wheat bran
- 300 lbs. oil meal

This mixture would contain about 23 per cent of total protein and would make a balanced ration with practically any kind of roughage. Two of the relatively cheapest feeds, malt sprouts and dried beet pulp, have been left out because the writer would suggest that if either of these be used that it should be wet up and fed separately. If a farmer does not have silage this would be the advisable thing to do. Feed the equivalent of three or four pounds of the dried pulp or malt sprouts daily and cut dry grain somewhat. Flour middlings are not used because bran is better and only a little more expensive. Oil meal has been put in although eleventh in the list because of a personal liking for oil meal in a ration if not wholly out of the question on account of price. The oil meal would not be needed except for variety if silage is available and perhaps not needed at all if the beet pulp or malt sprouts are fed wet.

If manurial values are given credit the seven cheapest feeds in the list in order are malt sprouts, distillers' dried grains, gluten feed, cottonseed meal, wheat bran, brewers' dried grains, flour wheat middlings. The following suggestion is made on this basis:

400 lbs. distillers' dried grains
400 lbs. gluten feed
200 lbs. brewers' dried grains
300 lbs. wheat bran
500 lbs. hominy feed
200 lbs. cottonseed meal

Here again malt sprouts come high in the list and could be used to advantage fed wet. There are several factors against malt sprouts. Weed seeds are present many times, and may germinate after passing through the cow. Further, according to some authorities, the value of the protein in malt sprouts is not high. Therefore the use of malt sprouts may be more or less questionable.

This the writer offers as a basis for the proper selection of feeds. We invite criticism. It is merely a mathematical method of studying prices and the selection must always be modified by one's knowledge of what the feed will do. The writer has given one example in putting oil meal in the first mixture because he likes oil meal in a ration.

V. Forage Crops For Roughage

THERE is one great forage crop in the United States which is head and shoulders above all others except perhaps alfalfa. That crop is corn. Corn is king of the cereal grains and for all dairy farmers is king of the roughages. No dairy farmer can afford to continue without a silo. This statement cannot be made too strong. Therefore the main part of this article shall be a plea for silage on every dairy farm.

Early each spring every farmer should plan for a crop of corn for next winter's feeding, and if he does not have one plan to buy and build the silo in the late summer. Estimating thirty pounds per head per day for 180 days' feeding, a silo which will hold 100 tons will furnish silage enough for liberal feeding for a herd of 35 mature cows or the equivalent. A silo 16 feet in diameter and 30 feet deep will hold upwards of 100 tons with some allowance for settling from the top after filling.

The yield per acre of good varieties of corn for silage on good land will average eight to ten tons per acre. Therefore plan for ten acres of corn if you have 35 cows, build a good silo and be on a firm foundation for feeding in the winter.

Silage is the cheapest forage that can be grown. To prove this a comparison is made with hay. Silage is worth for feeding, one-third the value of good clover hay. This is a safe and simple way of calculating the value of silage and may be shown to be true in several ways.

1. There are 354 pounds of total digestible nutrients in one

ton of corn silage; in one ton of red clover hay, 1,018 pounds of total digestible nutrients. Therefore, on this basis three tons of silage are more than equal to one ton of hay. If hay is worth \$12 per ton, silage is worth \$4 per ton.

2. Look at the cost of production of silage. Can it be produced for \$4 per ton?

The best estimate to which the author has access is the following table taken from "Feeds and Feeding" by Henry & Morrison. This shows the cost well below \$4 per ton:

COST PER ACRE OF CORN SILAGE.

	Minnesota 201 acres	Illinois 147 acres	Ohio 115 acres
Land rental.....	\$3.75	\$5.28	\$3.81
Manure or fertilizers.....		3.73	1.46
Seed	1.06	.42	.28
Labor growing and cutting crop.....	5.19	12.26	14.63
Labor filling silo.....	4.12		
Twine	.36	.41	.18
Coal	.42	.46	.25
Rental of power for cutter.....	1.39	1.21	1.36
Interest and depreciation on farm machinery	1.56	1.76	1.34
Miscellaneous	1.13	.58	.42
Total cost per acre.....	\$18.98	\$26.11	\$23.73
Cost per ton, 10 tons per acre.....	\$1.90	\$2.62	\$2.37

Computed in another way, one ton of silage in the corn belt will contain 5 bushels of corn at \$.50, equals \$2.50, plus \$1 per ton of putting the corn into the silo, equals \$3.50 per ton. This again checks below one-third the value of hay. Other methods may be used in checking up and in every case it will be found that silage is the cheapest roughage produced, considering its value from the point of succulence, which means health and milk with dairy cows, and food value.

A second great point in favor of silage is the cost and ease of storage. This is shown easily by a comparison with the storage of hay. A 100 ton silo 16 x 30 feet will have in it 6,040 cubic feet. To store the equivalent 30 tons of hay will require 15,000 cubic feet of barn room at least as costly in construction.

This brings up the question of first cost for those who must build new silos. A careful study of the comparative costs of the different types of silos based on the 100 ton size yields the following data:

Wooden stave silos cost \$1.50 per ton capacity; solid concrete type \$2.50 per ton; cement block \$4 per ton, and vitrified hollow tile \$5.50 per ton. If we add this cost of the silo to the cost of production given above, a valuation of \$4 per ton for the silage covers the entire cost of a stave silo in one year. Therefore can any dairyman afford to be without silage?

The next great question is the question of hay. Computed from the 1910 census, the following table gives the average yield per acre from alfalfa, clover, timothy and corn on an air dry basis:

1. ALFALFA HARVEST AT THE FARM OF W. C. HUNT, NEAR FAYETTEVILLE, N. Y. 2. BUILDINGS AT PINE GROVE FARMS

RETURN PER ACRE OF ALFALFA AND OTHER CROPS.

	Yield per acre, lbs.	Dig. crude protein, lbs.	Total dig. nutrients, lbs.
Alfalfa hay.....	5040	529	2672
Clover hay.....	2440	183	1263
Timothy hay.....	2440	68	1174
Corn (ears and stover).....	3440	140	1964

This shows in no uncertain way why the acreage of alfalfa has doubled during the last ten years and puts this crop ahead of any other dry roughage. Alfalfa hay forms the best supplement to corn silage. The man who has both alfalfa and corn silage has gone a long way in solving his feeding problems. Therefore after planning for silage all dairy farmers should turn their attention to the production of alfalfa. We need not go into detail. A glance which shows the comparative production of total digestible nutrients per acre and the comparative production of digestible protein is all that is needed. Then couple this evidence with the fact that the alfalfa crop is perennial through at least five years when a good stand is secured. Therefore the foundation is silage and alfalfa.

A very significant statement was once made to the writer by a New York farmer who had had much experience with alfalfa in the alfalfa belt. He said: "If you will do as much for the clover plant as you are willing to do for the alfalfa plant in the way of preparation of the seed bed, lime, etc., the clover plant will do as much for you." There is a chance for much reflection on this. We do a great deal for alfalfa. Perhaps if we were more careful of our clover and did a little more for it, it would greatly repay us. This gentleman practices a short rotation of clover, potatoes, corn, oats and clover again. When asked if he did not want a hay crop which would stay down more than one year, he said he wanted the clover sod for his potatoes. On some fields he seeded timothy with the clover and used the timothy for a cash crop. Timothy and mixed grasses are a very poor substitute for clover or alfalfa hay for feeding dairy cattle.

Soy beans, cowpea hay and hay from oats and peas are all crops that may be utilized for a leguminous roughage for next winter.

Every breeder of Holstein-Friesian cattle should enter his animals in advanced registry. A valuable roughage to have on hand for this purpose to supplement silage and hay is roots. The best feeders advise the growing of the "Detroit Red" table beet for this purpose. Mangels will yield more per acre. "Norbiton Giant" is a large red variety of mangels for fall and early winter feeding, and "Golden Tankard" is a yellow variety which keeps better for late winter and spring feeding. Potatoes may be used, but ordinarily are not worth more than 15 cents a bushel compared with other crops.

Some interest is being shown in sweet clover and perhaps under special conditions this crop might be used.

Finally it may be said that the author wishes this thought to stick, that roughage for dairy cattle for the greatest and most economical production must lie on a very few common crops, and every farmer must bend his energies to perfect his knowledge of the production of these rather than seek new crops. These crops are: 1. Corn for silage. 2. Alfalfa hay, or, failing this, clover hay. 3. Roots for special high production of milk.

Nothing has been said on varieties except for roots or on cultural methods. It is hard to make general statements on these points in a short article. The author prefers to leave these points to individual inquiry when the local conditions pertinent to each farm may be stated.

VI. Curing Hay From the Standpoint of a Feeder

THE farmer who raises hay to feed to his own stock has a different problem from the farmer who raises hay to sell. The latter has only one object in view, to raise as much dry weight per acre as he can, of a quality which will command a high price. The feeder is raising as much forage as he can per acre most economically; he wishes to have the hay as highly digestible as possible and as palatable as possible.

The ideal hay from the feeders' standpoint must be bright in color and have a fine clean aroma. These two factors are important to make the hay properly palatable. If the hay is to be highly digestible all of the leaves must be retained. This is an important factor in the curing of all legumes. It has been found at the Colorado Experiment Station that 40 to 60 per cent. of the weight of alfalfa hay is in the leaves. In these leaves are four-fifths of the protein and more than one-half of the carbohydrates other than fiber, and more than one-half of the fat. By careful work it was found that under very favorable conditions, for every ton of hay taken from the field, 350 pounds were lost in the leaves broken off. In one instance, under unfavorable conditions, for 2000 pounds of hay cured 3000 pounds were lost in broken leaves and stems, that is, more was lost than saved. The portion saved under such conditions is the less valuable part, the woody stems and coarser leaves. The leaves of timothy and other grasses do not break off easily.

The last factor of great importance is the freedom from dust and mold. Under some circumstance on land that has flowed or on new seeding the hay may be very dusty and dirty due to dirt from an external source. But most of the dust in hay comes from the growth of bacteria and molds. These can only be kept down by proper care in curing.

With this introduction we may divide the rest of the discussion into two parts: 1. Some of the methods used in making hay. 2. When to cut timothy, clover and alfalfa as typical hay crops most generally raised.

Three things must take place in making hay: 1. The water

content should be reduced to somewhat below 20 per cent. There is some fermentation going on, caused by bacteria. 2. The curing process must control this so that the aroma of the hay will be best to make the hay palatable and so that there will be practically no dust. 3. Hay must be exposed as little as possible to the sun to prevent bleaching. This is again important from the standpoint of palatability.

Careful experiments have been made which show that dried grass has the same nutritive value as fresh grass. Two portions of the same field have been cut and equal amounts fed to a cow, one portion fresh and an equal portion of the fresh material carefully dried before feeding. The milk production was the same. In all practical cases, however, one cannot cure hay without some exposure and loss, therefore the cured hay never has quite the same feeding value as the fresh material. The loss from the sun is comparatively small. The greatest loss always occurs when bleaching takes place from rain. In one experiment hay exposed to three rains lost 60 per cent. of the crude protein, 41 per cent. of the carbohydrates other than fiber, and 33 per cent. of the fat. In this case 31.7 per cent. of the total dry matter was lost.

It is difficult to write any method of curing. Probably the ideal way to cure hay, particularly clover and alfalfa, is to mow after the dew is off, then rake and cock the hay when well wilted and while hot. Cock into small cocks. Then open out the next day or the second day in large flakes, shaking the hay as little as possible to prevent loss of leaves. The main reason back of this process is that the leaves and stems are still alive until nearly dry. The life processes still go on and the one that helps in the curing is that the water continues to move from the stems to the leaves. If the hay is allowed to wilt too much the leaves will become completely dry before the stems have dried out sufficiently. When well cocked this movement of water will continue and leaves and stems all dry out together. In the cock too, about the right amount of fermentation will develop to give the hay its best color and aroma. Of course by this method bleaching is reduced to a minimum. If hay caps are used perhaps it is best if the cocks are not disturbed at all the day after the hay is cut. Many times the cocks may be opened after the dew is off the next morning and the hay sufficiently cured to be stored the day after it is cut. A modification of this method is to cut the hay in the late afternoon, cock up the next day and house it the next. In good weather these methods work out very well.

Any modification in the interest of speed and economy almost always means curing in the windrow without cocking. This is all right for mixed grasses, timothy and all hay with a minimum of legumes in it. But methods involving frequent tedding and much exposure to the sun, cause bleaching and then in case of rain the very greatest loss because of the maximum surface exposed. Exposure to dew is always bad except when freshly cut. When cut

SILAGE EQUIPMENT ON AN IOWA FARM
The silo is the badge of the dairyman. Silage is the dairyman's most economical feed

in the late afternoon the first night's exposure to dew does little harm. A more extensive use of hay caps in the curing of legumes will improve the quality of our legume hay very much. Hay should be put into the barn as dry as possible but at the same time there must be moisture enough to cause the hay to pack well. The ability to decide just when hay is right to go in is an art and no rule can be given. Authentic instances of spontaneous combustion are on record, therefore one must take no chance by putting in the hay too green.

WHEN TO CUT TIMOTHY, CLOVER AND ALFALFA.

The proper time to cut hay is when the largest yield per acre can be obtained commensurate with highest quality. With timothy hay this is when in full bloom. The Missouri Station in an experiment showing average results for three seasons give us the best data:

YIELD OF TIMOTHY CUT AT DIFFERENT STAGES.

	Dry matter per acre lbs.	Total digestible matter lbs.
Coming into blossom.....	3411	1908
Full bloom.....	3964	2113
Seed formed.....	4089	2030
Seed in dough.....	4038	1914
Seed ripe.....	3747	1754

It will be seen that at full bloom the most digestible matter is yielded. The farmer who wishes to sell his hay would not cut it until after the seed had formed in order to get the greatest yield of dry matter per acre. Practice tells us that for feeding most animals the early cut timothy is the best. Horses, however, may utilize to good advantage hay cut later. A like table from Illinois and Pennsylvania gives comparable results on red clover:

YIELD AND NUTRIENTS IN AN ACRE OF MEDIUM RED CLOVER.

Stage of Growth when cut	Yield of hay per acre lbs.	Total nutrients lbs.
Illinois—Hunt:		
Full bloom.....	3600	2309
Heads three-fourths dead.....	3260	2231
Pennsylvania—Jordan:		
Heads in bloom.....	4210	3419
Same heads dead.....	4141	3202
Heads all dead.....	3915	3153

This shows that the proper time to cut clover is when in full bloom.

With alfalfa a different problem is involved. Here the second crop must be considered. Two general rules are observed: 1. Cut when about one-tenth in bloom. 2. Cut when new shoots appear at the crown. In general it seems best to observe the second rule in the interest of the next crop. In many sections it is practically impossible to cure the first crop of alfalfa. Although apart from the subject of hay making it may be mentioned here that one way to conserve this first crop under unfavorable weather conditions is to put it into the silo as one would put in corn. The

resulting silage is not as valuable as corn silage but is a valuable silage nevertheless.

Finally, not enough thought is given to the relation between quality of hay and its nutritive value. High nutritive value is always found in the best cured hay. Hay making as an art or science is something more than simply getting the hay dry enough to go into the barn.

VII. When to Cut Corn For Silage

THE determination of the proper time of cutting corn for silage has passed through an interesting history.

When silage was first made it was thought that the corn plant must be very green in order to make proper silage and much of the valuable part of the crop lost as we shall see. As silos have become more and more common the corn plant has been harvested later and later, until now it is the custom, and the proper one, to wait as long as possible in order to get more maturity, with increased keeping qualities.

In order to study the subject carefully and to find out the reason for the practice of waiting until the corn is as near mature as possible we must study the nutrient content of the corn plant at different stages of maturity.

This is best shown in a table taken from "Modern Silage Methods", published by the Silver Co., Salem, Ohio:

CHEMICAL CHANGES IN THE CORN CROP.

Yield per Acre	Tasseled July 30 lbs.	Silked Aug. 9 lbs.	Milk Aug. 21 lbs.	Glazed Sept. 7 lbs.	Ripe Sept. 23 lbs.
Gross weight.....	18045.0	25745.0	32600.0	32295.0	28460.0
Water in the crop.....	16426.0	22666.0	27957.0	25093.0	20542.0
Dry matter.....	2619.0	3078.0	4643.0	7202.0	7918.0
Ash	138.9	201.3	232.2	302.5	364.2
Crude protein.....	239.8	436.8	478.7	643.9	677.8
Fiber	514.2	872.9	1262.0	2755.9	1734.0
N. F. E.....	653.9	1399.3	2441.3	3239.8	4827.6
(Starch, sugar, etc.)					
Crude fat.....	72.2	167.8	228.9	260.0	314.3

A careful study of this table will show some very interesting things. The huge increase in the amount of dry matter per acre comes between the milk stage and the glazing stage. There is a still further increase before ripening. After the glazing stage there is a change in the carbohydrates. The amount of fiber per acre drops more than 1000 lbs. before the corn is ripe, and the more soluble carbohydrates, starches, sugars, etc., increase more than 1500 lbs. An increase in the dry matter per acre, with every day up to maturity, tells us that the later we put off putting the corn into the silo up to the time the corn is ripe, the more food per acre we are getting in our crop. All groups of nutrients except the fiber show an increase with every day and the loss in fiber is more than made up by the increase in other carbohydrates. Fiber is the hardest nutrient to digest and the percentage of fiber that is

digested is less than the percentage of any other nutrient. Therefore the total digestibility of the corn plant will increase towards maturity.

From the average of twenty-one careful trials, with more than twelve different varieties of corn, it has been found that between tasseling and ripening the dry matter in the plant will increase 193 per cent., the crude protein 98 per cent. These averages have been compiled from several sources and bear out the statements given in detail above in the table. It is seen that when the plant has reached its full height, it has really only begun to store up food for use in the form of silage. These tables show conclusively how foolish it is to grow corn of large varieties for silage, and how much better it is to plant the corn no thicker than to allow it to mature fully, with the largest possible proportion of ears.

Therefore, due to the larger proportion of food value as corn approaches maturity, we can say without any doubt, that the time to cut corn for silage is as near maturity as possible. The only reason for not waiting until the corn is ripe is that there is danger that the silage may not pack well. This may be overcome in part by the addition of water, as will be discussed under treatment suggested for frosted corn.

A third reason, apart from the increased amount of nutrients and less fiber is in the fact that there is more of the carbohydrates in the form of starch as the plant approaches maturity than in the form of sugar. This fact has an important bearing on the keeping quality of the silage. The more sugar there is present the farther fermentation will go and the more acid will result. The better quality of silage is that that is least acid. Then, too, the losses in food value which occurred in the silage after it was stored in the silo, in the early days, often ran as high as 20 per cent. According to the best authorities, the loss need not be above five per cent. if the corn is reasonably mature before cutting and the silage is properly packed. The writer has many times seen gallons of liquid, nearly of the consistency of syrup, run out from the bottom of silos when the corn was put in too green. The silage in such a silo is sure to be very acid. While not injurious, acid silage is not so palatable, certainly not so nutritious, and indicates that there has been a greater loss than necessary in the silage after storage.

SILAGE FROM FROSTED CORN.

In the colder parts of the top tier of states in the United States, if we are going to leave our corn in the field until it is fully glazed, or even later, often it is going to get frosted. There is now enough experience on this point to enable us to say that frosted corn will make just as good silage as other corn if properly cared for. First, the corn that has been frosted must be cut at once, because if left in the fields it will shatter and lose some in this way if it dries out too much. Then if the frosted corn is rained on very much the same losses will occur as would occur if the corn were cut and shocked.

When frosted corn is cut into the silo water enough must be added to make the silage pack well. Practically it is nearly impossible to do this unless the blower type of silage cutter is used. Then the water is introduced into the blower and the silage is thoroughly and evenly wet. Water enough will be added if a good stream, without much pressure, is run into the blower with a three-quarter inch hose. The writer has had two years' experience with silage made from frosted corn in this way and when fed it could not be distinguished from ordinary silage.

We would advise, then, that when there is a blower cutter available and a stream of water then can be introduced into the blower, corn should be allowed to mature beyond the glazed stage before it is cut. We would even suggest that some chance be taken with early frosts in order to get a more matured plant with the very evidently greater food value than there is if cutting is put off until the kernels are fully glazed.

VIII. An Ideal Ration For a Dairy Cow

THE point of view in this paper is the proper ration for a dairy cow after she has freshened and is in full flow of milk. How shall we feed her to get maximum production? Farmers wish to know what is the "best" dairy ration. The answer must always be in terms of the surroundings on each person's own farm. Perhaps it will be best to begin the discussion with a definition of the "best" dairy ration. That ration is the best which will bring about the greatest production at the least cost, and in looking at production in these days we must look at the records that the cows make as well as the actual milk produced. There is more money in the record and in the offspring than in the milk itself. The best breeders of pure-breds look at the milk as a by-product.

Before the ration itself can be considered, a breeder must look to the conditions surrounding his herd. We will only stop to consider these for a moment and just barely call attention to them. These things are five: kindness, light, pure air, pure water and an abundance of salt.

Every animal in a dairy herd, which is well managed, will be so tame that the owner and attendants may catch her easily at any time in the open lot. A dog, be he ever so gentle, is of little use in connection with a dairy herd. A club or whip has no place in a dairy barn. Light and ventilation explain themselves. We must supply all the light and pure air possible. It is not costly to provide light in a stable, neither is it very costly to provide very efficient means of ventilation in old stables if the owner is a live, hustling manager with his mind open to the best in his power for the comfort of his animals. All the dairy papers and experiment stations are ready at any time to help and suggest means of bettering stable conditions with plans which may be had for the asking. Most of

these plans are simple and economical and farmers are fully capable of putting them into execution.

Cows should be watered at least twice a day. The water should be pure and if possible, at all times of year it should be free from ice. If cows have a place to drink where ice does not form, and when they are watered twice a day, it does not seem necessary to artificially warm the water. The danger is to avoid chilling the animal so that she will not have to stand and shiver after drinking. Any system which will furnish pure water and which works so that the cow gets all that she requires, at least twice in twenty-four hours, is a good watering system.

A cow should be furnished with about one ounce of salt every day. The practice of our best dairymen varies. The writer would suggest feeding each cow about two ounces three times a week, either in the grain feed or simply thrown into the manger any time during the day. So much for five fundamental conditions which must be made right in every herd for the best results. We may now turn our attention to the consideration of the ration itself.

In this series of papers on feeding we like to be definite even if the papers are not so smooth in their general effect. In considering the formulation of an ideal ration, there are seven factors, that should be considered. They are:

1. Bulk.
2. Digestibility of the feeds.
3. The relation of the nutrients—that is, the “balance” or nutritive ratio of the ration.
4. The variety of feeds.
5. The suitability of the feeds to the animal and the products.
6. The palatability of the feeds.
7. The cost of the ration.

1. Bulk. Dairy cattle demand a certain amount of bulk in the ration. This is secured by feeding succulent feeds. Dry grain and hay do not meet this condition or factor. Therefore silage or roots must be fed, and to meet ideal conditions we must furnish both. This is closely connected with the factor of palatability, a succulent ration is more palatable to a dairy cow. A good definite rule is to feed one pound of dry roughage per hundred pounds of live weight. When feeding both silage and roots, more than this may be advisable.

2. Digestibility. We should always try to arrange the crops so that the most highly digestible feeds will be available. Roughage must be fed but the hay must always be well cured. There is probably no chance for straw in an ideal ration. The concentrates must not be too bulky. About one pound to the quart is a good rule to follow in the mixing of grain rations.

3. Relation of the nutrients. Much has been said concerning the balancing of rations and the nutritive ratio. The writer believes that the nutritive ratio should not be outside of 1: 4.5 to 1: 6. This means one pound of digestible protein to 4.5 pounds to 6 of

digestible carbohydrates and the fat in the ration. Most farmers do not care to compute the nutritive ratio of their ration or have not learned to do so. It is advisable to know this because this relation is very important. However, if we make sure that at least one-half the grain mixture is made from foods containing 20 per cent. of crude protein, the nutritive ratio will fall between the limits 1:4.5 to 1:6 in almost every case.

4. Variety. No ration has sufficient variety unless there are three grains in the mixture. A good check is to have three or more grains in the mixture and to have at least four plants represented in the whole ration, taking into consideration in this check both the roughage and the concentrates. This is important in getting a sufficient amount of mineral matter and all the different nutrients required.

5. Feeds suitable to the individual animal and to the product are always necessary.

6. Palatability is very important in large production. Here is the place where the individuality of the animal is concerned. In a general herd ration, if there is succulent food in abundance at all times of year, the ration will be palatable to practically every individual and it is probably not worth while to have more than one general mixture. In feeding a cow an ideal ration for a special record, it is best to study her whims and personal likes. If roots can be provided, the most palatable way to feed the grain is on sliced roots.

7. Most important of all to most farmers is the factor of cost. The more valuable the animal and the more we can get for the offspring, the less we need to look at the cost of the ration. If a man is keeping the cows that meet the ideal that he should have, he can afford to feed them all they can eat of the very best foods all the time. However, ideal rations may be selected with a great deal of attention paid to relative costs. The method of choosing concentrates has been given and need not be repeated here.

Lastly, must be mentioned the amount to be fed. On full production with good cows, it is hardly necessary to mention this—it will be found the most economical practice in the end to feed for the first six months of the lactation period all the grain the cow can consume. Of course, this means all she will consume according to her normal appetite and does not mean crowding. About one pound of grain to three and one-half pounds of milk will ordinarily be sufficient.

With the above rules in mind, the following ration is suggested as approaching the ideal for a cow weighing 1100 pounds and producing forty pounds of milk per day, testing 3.5 per cent. butter fat:

- 10 pounds alfalfa hay
- 30 pounds corn silage
- 30 pounds mangels (sliced)
- 12 pounds grain

This grain mixture is suggested:

- 500 pounds distillers' dried grains
- 300 pounds gluten feed
- 200 pounds wheat bran
- 200 pounds ground oats
- 400 pounds hominy feed
- 200 pounds oil meal
- 200 pounds cottonseed meal

The writer is fully aware that in the above, the oats, the oil meal and the cottonseed meal are high in price, but in this paper the ideal ration is being considered, and the above ration is the best that we know how to put together.

For those who would not wish to mix so complicated a mixture, the mixture given before will check with the factors concerned:

- 500 pounds hominy
- 500 pounds distillers' dried grains
- 500 pounds wheat mixed feed
- 300 pounds gluten feed
- 200 pounds oil meal

If roots are not available it might be well to purchase dried beet pulp and soak up about three or four pounds per cow and feed the grain on this soaked beet pulp in place of sliced roots.

In case no roots or beet pulp are fed, a little more grain would be advisable.

ORMSBY JANE SEGIS AAGGIE

One of the World's most famous Holsteins. Her two records are both above 44 lbs.

NO. 1

NO. 2

NO. 3

NO. 4

1. TIEJE QUEEN DEKOL

3. BANOSTINE BELLE DEKOL

2. GLEN ALEX QUEEN DEKOL

4. DUCHESS SKYLARK ORMSBY

Note—Tietje Queen De Kol and Gen Alex Queen De Kol are the only forty-pound dam and daughter. They were the oldest and youngest forty-pound cows of the breed at the time their records were made

Part Two—Advanced Registry Feeding

IX. Fitting a Cow For An Advanced Registry Test

THE best preparation for large advanced registry records is in proper breeding. The quickest way to get a herd properly bred is through the influence of the sire. Presumably this article is to be on the care and management and the feeding of cows that are to be tested for advanced registry, but the writer cannot refrain from introducing it with a few words on breeding. There is not much to be said on the feeding of animals about to be tested. The grain mixtures to be recommended are based on a few simple principles that can be put in a few words, and those words will be given a little further along.

A farmer who is going to test his animals regularly and keep it up, must school himself to the point where he will be willing to pay big money for the head of his herd. No volumes on fitting or on feeding are going to help him any nor make large records for him on animals that have not been well bred from the start, to give them the constitution and capacity to handle the feed necessary to produce the milk and fat.

Therefore study the breeding of your herd and the individuals, and study the breeding of those animals that are making the big records all the time. Then the sooner that you get the sire with the right kind of breeding and get the right kind of breeding in the cows to which he can be bred, the sooner the large records will come to your herd. We do not mean by this that feed and care are not important, for they are all important. But first of all let us get the cows and the bull and get to breeding right.

Then right on top of breeding comes experience. And the only way to get experience in testing is to test. A great many young breeders hesitate to begin testing because they think too much of the expense of it. It is expensive. But the plunge has to be taken sooner or later, and the sooner the better. The easiest time to put an A. R. O. record on a cow is when she is a heifer. Each year makes the requirement that much higher. Even if the records are low they are always worth more than they cost. It is so much better to say that this or that cow has an A. R. O. record than to try to sell her or her calf when she has no record at all. If she is registered she is entitled to a record. And any farmer with any knowledge of feeding at all can at least cause his animals to make requirements. Many times he will be surprised with the results.

So begin, and begin now. With a beginning will come experience and interest. Then will come the great desire to have the best that is going and with those, with common sense, this means the beginning of their real success in the dairy farming business.

Before beginning the actual feeding suggestions, the writer wishes to quote a little from a bulletin written by Professor T. L. Haecker, of Minnesota. In the handling of highly bred animals, and particularly of those we expect to test, kindness and even pampering will bring in good returns. Professor Haecker says this very well and we take the liberty to quote him:

"We know of many instances where the best of dairy cows were kept, and where good methods of feeding were practiced; and still results fell far short of what might reasonably be expected, simply because the animals did not receive that kindly treatment which is so essential to a cow giving much milk over a long period. The herd as a whole should always be moved slowly. Never hurry a cow or strike her or speak loudly or harshly. A gentle voice and a caressing touch are quite as potent as is digestible protein. If you so handle the cows that they are fond of you, you have learned one of the most important lessons that lead to profitable dairying. The most successful milk-producers are always in close touch with every cow in the herd. The milk-producer has to do with motherhood, in which affection always plays an important part. A cow's affection for the calf prompts the desire to give it milk; if you gain her affection she will desire to give you milk. If you have not been in the habit of caressing the cows, the time to inaugurate the practice is when they approach the time of calving, as it is at that particular time when they take kindly to grooming and to gentle rubbing of the udder."

In taking up suggestions for the feeding and management of animals that are tested we will take the heifers first. The preparation of a heifer for testing must begin when she is born. She must be grown well from the start. Much has been said about getting young stock too fat and thus destroying their dairy qualities and inducing them to lay on fat after calving rather than to turn all the feed into milk and butter fat. Some careful experiments have been made by Professor Eckles on this point and the results seem to favor keeping the heifer somewhat fat for the best results in test when the time comes. Eckles fed one heifer on rich and abundant rations from birth to calving, while another was kept poor and thin. After calving the milk of the well-fed heifer tested over 4 per cent while that of the poor heifer tested 3 per cent. After calving the fat heifer declined in weight and the percentage of fat in the milk remained about constant. The weight of the thin heifer remained about the same. After several weeks the weight of the fat heifer became constant and the percentage of fat in the milk declined somewhat. In the end the percentage of fat in the milk of both heifers was practically the same for the remainder of the lactation period. Observation by others has led to the same con-

clusion. Therefore it would seem to be wise to grow heifers well and fatten them somewhat before calving. There is no evidence to show that heifers treated in this way will be of poorer dairy temperament than heifers of the same breeding that have been grown on less grain and more roughage, heifers that have made equally good growth in frame but are not so fat at time of calving.

It may be well to let heifers that are to be tested after their first calf get well developed before breeding. This means to breed them to drop their first calves at thirty months. The strain of testing the first lactation and consequent high milk production may keep them from growing as well during this first lactation period. Then it is a good plan to milk them a full twelve months this first lactation period to form a habit of holding out well.

Good silage and legume hay is the foundation of the ration in the preparation period. The list of grains from which to choose is not long. Corn, oats, barley, wheat bran and oil meal are enough to choose from. A good mixture is:

- 30 pounds of corn meal or hominy
- 30 pounds of wheat bran
- 30 pounds of ground oats
- 10 pounds of oil meal

Barley might be substituted for the corn meal and oats in part. This is simply a good growing ration and a fattening ration when fed in sufficient quantity. The feeder will feed enough in connection with the roughage to get the heifers as fat as he thinks they should be. This will mean four to six pounds a day, practically from one year old to the time of calving, except on the very best of pasture.

The same mixture does very well for mature cows that are to be tested. Sometimes it is necessary to feed mature animals 10 to 12 pounds per day to get them in proper condition. It is the usual custom to rest cows that are to be tested a long period before. It has always seemed to the writer that a period longer than twelve weeks is not necessary and perhaps it is detrimental to the best interests of the breed if the rest period is longer than eight to ten weeks.

X. Feeding For Advanced Registry Records

IN offering suggestions in the feeding of individual cows which are being tested for advanced registry records, it is assumed that these animals have been rested for a period of eight to twelve weeks after having been carefully dried off. It is supposed that they have been well fed and cared for, that they have calved and cleaned all right and that they are in good flesh. Perhaps it is well to have them more than in good flesh, they should be fat for the best results.

While a large number of records have been made directly after calving in the first three weeks, on the average a cow does not strike her best gait until about three weeks after she has dropped her calf. She should be treated carefully from the start and watched, milked and cared for just as if she were doing her best at

WANDEMERE BELLE HENGERVELD
World's Champion junior four-year-old

FANCHER FARM MAXIE
World's Champion senior four-year-old

all times and if she shows a tendency to strike her gait early, then it is well to be ready for it and take all advantage of such a condition. Applications for a supervisor should be made with the proper authorities early enough to insure having one when one is needed. Getting a supervisor within two or three days of the time actually needed is almost entirely a question of making an application early enough, months before one really needs him. The experiment station or college authorities who send out the supervisors and authenticate the records are always very willing to cancel applications or to defer the time when a supervisor shall be sent if a reasonable notice is given by the breeder that he wishes his application cancelled or wishes his test deferred. Therefore to be on the safe side, send in your application about three months before the time you will actually want the supervisor on the ground and then cancel or defer if necessary according to the way the cows show up. A little attention to this matter of early application will help the breeders to get supervisors when they want them and will help the authorities that authenticate the records to give better satisfaction to the breeder.

After a cow freshens and has straightened out she may be fed on good roughage and about four or five pounds per day of the grain mixture that was recommended for fitting, that is, a mixture of 30 lbs. of wheat bran, 30 lbs. of hominy feed, 30 lbs. of ground oats and 10 lbs. of oil meal. It may be said that since writing the last article the writer has learned that many breeders like to feed more oil meal than is suggested above during the last three or four weeks before calving, particularly when a large grain ration is fed. If everything goes all right the cow may be changed to the test ration three or four days after calving and the amount of grain gradually increased to the limit of her appetite. The increase should not be made faster than one pound per day except in some individual cases when the feeder knows his animal thoroughly well and knows that she can stand a more rapid increase than this.

THE TEST RATION: For roughage the first requisite seems to be alfalfa hay, or, if this is not obtainable, clover hay, corn silage with as much grain in it as possible and beets. The "Detroit Red" table beet seems to be preferred by most breeders. Mangels give nearly as good results. "Norbiton Giant" is a good variety of red mangels, but is not as late a keeper as the yellow fleshed variety, "Golden Tankard." As to methods of feeding the roughage, most feeders slice the beets and feed the grain on them while the cow is being milked. It is usually best to milk four times in each twenty-four hours at intervals of six hours. This means from ten to fifteen pounds of sliced beets at a feed with a quarter portion of the grain mixture poured on the beets. If the cow does not have access to water whenever she wants it she should be watered before each milking. She can then be fed silage twice a day and hay twice a day, alternating the feed of these roughages between milkings. It

is good practice to feed all the hay and silage she will eat, always seeing to it that her appetite is kept keen for all her food.

THE MIXTURE OF CONCENTRATES: The writer suggests the following as a good mixture of concentrates:

- 500 pounds distillers' dried grains
- 300 lbs. gluten feed
- 400 pounds wheat bran
- 400 pounds hominy feed
- 200 pounds oil meal
- 200 pounds cottonseed meal

This mixture of concentrates has given good satisfaction in a number of instances.

No exact directions can be given as to the amount of concentrates that shall be fed. This must be decided by the feeder. The size of the animal, her appetite, capacity, condition of flesh, are all characteristics which have an important bearing on the question of the amount to feed. Some cows are what is known as good feeders; others must be carefully watched. Sometimes it seems that the best way to handle a cow is to force her appetite to its limit until she is almost off feed. If she can be kept up to this limit it seems to have the effect of causing her to test high. If there is an indication that she may go off feed a good thing to do is to change her ration to the mixture of 30 lbs. of wheat bran, 30 lbs. of ground oats, 30 lbs. of hominy and 10 lbs. of oil meal, for a couple of feeds and reduce the amount even to two pounds. This sudden change of mixture and reduction of amount will cause her, many times, to come back on her feed at once with vigorous appetite. If a fluctuation in per cent of butter fat is caused by this sudden change it is likely to be toward a higher plane. To those who have a quantity of good ground oats on hand, it might be well to put some ground oats in in place of some of the bran and hominy feed.

The principles on which these suggestions for rations are based are simple. Alfalfa hay is good in itself and may be particularly useful in furnishing an abundant supply of lime, particularly in long time tests. The silage and beets are cooling and laxative. The mixture of concentrates suggested is properly put together to furnish a bulky mixture, plenty of easily digestible material, plenty of variety and an abundance of protein. Such large variety will probably insure a sufficient supply of the proper protein constituents and vitamins and things of this nature about which not very much is definitely known beyond the fact that the lack of an almost infinitely small amount may be the limiting factor in any given ration.

A study made by a student, Mr. W. L. Houck, under the writer's direction about two years ago may be of interest in this connection. Mr. Houck wrote to the ten breeders and feeders of the cows holding the highest yearly semi-official records in each of the four leading dairy breeds, Holstein-Friesian, Guernsey, Jersey and Ayrshire. He received answers to twenty-two letters out of the forty. He tabulated the results and found that the following feeds occurred in the rations the following number of times:

Alfalfa hay.....	12
Clover hay.....	None
Mixed hay.....	11
Beets or mangels.....	18
Corn silage.....	17
Pasture.....	11
Carrots.....	9

It is interesting to note that no one of the twenty-two breeders reported the use of clover hay; it was either mixed hay or alfalfa. Soiling crops were used in a few scattering cases. Pasture of course shows many times in these reports because these were reports on yearly record feeding. It is not likely that pasture would constitute any great part in the feeding for short time tests for seven or thirty days.

For the concentrates used, we have the following record:

	Times
Distillers' dried grains.....	14
Gluten feed.....	16
Wheat bran.....	22
Hominy feed.....	9
Oil meal.....	18
Cottonseed meal.....	13
Ground oats.....	16
Corn meal.....	7
Ground barley.....	5
Dried beet pulp.....	9
Unicorn dairy feed.....	1
Molasses.....	2

To the writer, these reports are very interesting and in a later paper, it is proposed to give the mixtures used by several of the feeders and breeders who have succeeded in making large records both in short time and in long time tests. It will be noticed that in the suggested mixture above those feeds are used that are most often found in the rations of the more successful feeders except that most of them, 16 out of 22, like to have ground oats in the mixture. The writer has already suggested that it might be better to use ground oats in place of a part of the wheat bran and hominy. Corn meal is nearly as often used as hominy. Hominy is likely to give better satisfaction. Dried beet pulp is used many times and is particularly useful when wet up in case one does not have mangels or beets. It can be used in place of corn silage, but the times when pure-bred breeders find themselves without corn silage and alfalfa hay when testing should be so seldom as never to require notice.

OTHER SUGGESTIONS: Most breeders prefer to keep their animals in a cool, very well ventilated stable free from drafts. The cows should be blanketed. Very careful handling and quiet should prevail at all times. Occasionally an individual will be found who will respond to an extra amount of some particular feed, such as gluten feed, ground oats, oil meal, etc. In case this is known to the feeder, it goes without saying that she may receive regularly or from time to time, a pound or two of this particular feed, clear, on top of a little less amount of the regular test mixture that is being fed to other test cows. Attention to little details of comfort and

individuality will be repaid many times in bigger results on the part of the cow being fed.

XI. Feeding Test Cows at Cornell University

SEVEN cows bred by Cornell University have made records of thirty pounds or more of butter, 80 per cent fat. These animals have been bred and developed under the direction of Professor H. H. Wing and are all the offspring of one cow who was herself an inferior individual. They show in a very clear way what can be done with well bred sires in the improvement of a herd.

The care of the herd and its feeding and management have been under the direct supervision of George W. Tailby, Jr., who has had charge of the herd since 1906 under Professor Wing. The following table gives the cows, date of record, age, and the record itself:

Cow	Date of Record	Age of Cow	Milk lbs.	Fat lbs.	80% Butter lbs.
Clista Cora, 117997.....	March 1913	3-11-29	447.8	24.129	30.161
Glista Ernestine, 117999	April 1913	4- 3- 5	548.3	24.410	30.512
Glista Omicron, 69034....	April 1914	10- 1- 6	569.0	25.282	31.603
Glista Eglantine, 118000	April 1914	5- 4-27	580.7	25.911	32.388
Glista Coreva, 134891....	March 1916	6- 1- 2	593.1	27.264	34.080
Glista Draba, 134893.....	March 1916	6- 2-23	645.8	24.059	30.074
Glista Erica, 134897.....	Nov. 1915		619.1	28.230	35.288

All of these records have been made at Cornell University except that of Glista Erica. Glista Erica was purchased when a heifer by E. A. Powell of Syracuse and developed by him.

Glista Ernestine in December, 1915, increased her 1913 record to 625.7 pounds of milk, 24.940 pounds of fat, 31.175 pounds 80 per cent butter. She is now (November, 1916) again being tested and has increased her record to 33 pounds of butter. The same year Glista Eglantine practically duplicated her 1914 record by making 663.0 pounds of milk, 25.888 pounds of fat, 32.360 pounds 80 per cent butter. These records show that some University cows have made 30 pound records each year since 1913. Since these cows have consistently made good records, it may be of some public interest to state how they have been fed. Therefore the feeding for the first four records made will be given in detail.

GLISTA CORA.

Prior to freshening she was dry about two months. During the time that she was dry she was not given any special care, being fed the same as the other stock when dry. No attempt was made to fatten her, as is usually the case when most pure-bred animals are dry. At the time of calving she was in fair condition, not what one might call fat. Starting with the second day from freshening she was milked three times each day and was not fed over six pounds of grain per day for the first four days. Beginning the fourth day the grain allowance was gradually increased to 12 pounds per day. The test was started on the 6th day. At the beginning of the test she was getting 12 pounds of grain, 35 pounds of beets (man-

gels), 30 pounds silage and what alfalfa hay she would eat readily. Now the grain ration was gradually increased to 15 pounds per day. An attempt was next made to increase the grain allowance to 18 pounds and the beets to 45 pounds per day. But as soon as the 18 pound mark was approached she went off feed. She was cut down to 6 pounds grain and 35 pounds beets per day. Thus it will be seen that she practically went back where she started. The grain and beets were now gradually increased until she was again getting 15 pounds grain and 45 pounds of beets. On the fifth day after the test was started she was changed from three milkings to four milkings per day. At the time of changing, she dropped off a little in milk production but the test was unusually high. The test of one milking was as high as 6.8% butter fat. When milked four times a day she was getting only 16 pounds grain, 50 pounds beets and the same allowance of silage and hay as when first started. By milking her four times a day the amount of milk increased about three pounds per day. The test was run twelve days. The best seven consecutive days were the first seven. This was perhaps due to the caked condition of her udder during the fore part of the test. However, during the last five days she averaged better than three pounds of fat per day, there being only one day that fell below the three pound mark.

The grain mixture fed during the test consisted of 100 pounds of distillers' dried grains, 50 pounds of wheat bran, 100 pounds of ground oats, 100 pounds of hominy, 100 pounds of oil meal, 100 pounds of buckwheat middlings and 60 pounds of cottonseed meal. This is not an especially heavy ration for test cows, as probably many feeders would mix 100 pounds of cottonseed meal and 100 pounds of gluten feed into this mixture. Charcoal is seldom if ever left out of the test ration by many of the breeders.

The treatment that this cow received before and during the test was the same that is given the entire university herd with the exception that during the test she was watered after each milking. The silage was fed once a day, in the morning, and the hay was fed at night only. This is the custom of feeding silage and hay to the entire herd and as she stood in the row with the milch cows the system of feeding was not changed. She was turned out in the yard with the entire herd each day. During the fore part of the test she was quite uneasy because for the first few days after freshening the calf was permitted to remain with her.

At the time of freshening Glista Cora was 3 years, 11 months and 29 days old. This placed her in the class of senior three-year-olds. In this class there were only nine cows that exceeded her in the production of butter fat for seven days. The best cow in this class had a record of 26.886 pounds of butter fat, which exceeded Cora's record by only 2.756 pounds fat, as her record was 447.8 pounds of milk, which contained 24.13 pounds of butter fat. The average test for the week was 5.388% fat.

This record is what might be called a test of what the cow was

NO. 1

NO. 2

NO. 3

NO. 4

NO. 5

1. GLISTA CORA

4. GLISTA EGLANTINE

2. GLISTA ERNESTINE

3. GLISTA COREVA

5 GLISTA OMICROM

Five of the seven thirty-pound cows bred and developed at Cornell University in the Animal Husbandry Department, with which Prof. Savage is officially connected

capable of doing. No attempt was made to see how large a record could be made with her.

Here is an excellent example of improvement by the use of the right kind of a sire. The foundation of the University herd was a cow named Glista. She was quite inferior as a producer, her record for the year at full age being only 225 pounds of butter fat. Now in the fourth generation from Glista we have Glista Cora with a yearly production of 388 pounds of butter fat as a two-year-old with the first calf and a seven day record of over 30 pounds of butter as a three-year-old.

GLISTA ERNESTINE'S RECORD.

Glista Ernestine was the second Holstein-Friesian cow owned by the New York State College of Agriculture at Cornell University to make a seven-day record of over 30 pounds of butter. On February 7, 1913, Glista Ernestine gave birth to a fine bull calf which weighed 109 pounds. Her age at the time of calving was 4 years, 3 months and 5 days, she being only about 2 months older than Glista Cora, the cow that made over 30 pounds of butter a month previous. During the best seven consecutive days, she gave 528.1 pounds of milk containing 24.309 pounds of butter fat. The average test for the week was 4.6% and the average number of pounds of milk was 75.4. The largest amount of milk produced in 24 hours was 80.8 pounds.

At the time of calving, Glista Ernestine was not in a fleshy condition. Her udder was quite large and considerably caked. The test started on the seventh day from calving. While the conditions under which this cow made her record were very much the same as those under which Glista Cora made 30 pounds of butter, however there are some differences that should be noticed. for the first seven days of the test, Glista Ernestine came within .943 pounds of fat of producing 24 pounds. At this time the test ration was changed so that it consisted of 100 pounds of distillers' dried grains, 50 pounds of wheat bran, 100 pounds of ground oats, 100 pounds of oil meal, 100 pounds of buckwheat middlings, and 150 pounds of cottonseed meal. This is the same as the ration fed Glista Cora, except that instead of 60 pounds of cottonseed meal, it contained 150 pounds.

After she was getting this ration for a few days, Glista Ernestine increased from 70 pounds of milk per day to 76 pounds. As the per cent of fat in the milk was nearly the same as when she was producing 70 pounds, it is seen that the amount of fat was increased by an increased production of milk and not by an increase in the test. It appears that the second ration was considerably better than the first.

The largest ration that Glista Ernestine received in a 24-hour period in the test was 24 pounds of grain, 45 pounds mangels, 40 pounds of silage and all the alfalfa hay she would eat.

Since Glista Ernestine was past 4 years of age at the time of calving, she is classed as a junior four-year-old. In this class she

ranked twelfth. At no time during the test was she milked more than three times per day. This is, therefore, probably the best record ever made by a cow milked three times per day.

GLISTA OMICRON AND GLISTA EGLANTINE.

In the winter of 1914 two cows made records of over 30 pounds of butter. Glista Omicron was over ten years old and had been dry for ten weeks at the time of calving. Her record for seven days was 569.0 pounds milk and 31.063 pounds butter and for fourteen days 1,095.1 pounds milk and 60.397 pounds butter. When she freshened, Glista Eglantine, was about five and one-half years old, and had been dry for twelve weeks. On account of retained afterbirth her record was not begun until twenty-one days after calving. Her seven-day record was 580.7 pounds of milk, 32.388 pounds butter. Glista Eglantine is a daughter of Glista Omicron. Both cows were in good condition at the time of calving, but were not extremely fat.

The grain mixture used was the same as that fed during the winter to the college herd, viz: 300 pounds of Ajax flakes, 200 pounds of cottonseed meal, 200 pounds of hominy, 100 pounds of wheat bran, 100 pounds of ground oats and 100 pounds of gluten feed. The cows were milked four times a day and fed at the time of milking. The ration was gradually increased after calving. On account of the laxative effect of the mangels and alfalfa when fed in large amounts, the grain mixture after 16 pounds was reached was changed by adding more gluten and during the greater part of the test, the general plan of feeding was as follows: 4:30 A. M., 5 pounds of grain mixture and 1 pound gluten, 10 pounds mangels and 10 pounds corn silage; 10:30 A. M., grain as before, 15 pounds mangels and what hay they would eat up clean—about 5 or 6 pounds; 4:30 P. M., grain, 15 pounds mangels; 10:30 P. M., grain, 15 pounds mangels and hay. They were watered after feeding and at several other times during the day. Whenever they did not eat their grain with the usual relish, the amount of grain was reduced at the next feeding or 4 or 5 pounds of a mixture of equal parts of wheat bran, ground oats, hominy and oil meal was substituted. They were kept lightly blanketed during the most of the test and were curried and brushed every day. One of the cows was kept in a box stall and the other occupied her usual place in the herd.

The test mixture that has given very good satisfaction in advanced registry feeding, at Cornell University, has been as follows:

- 500 pounds distillers' dried grains
- 300 pounds gluten feed
- 300 pounds wheat bran
- 200 pounds oil meal
- 200 pounds cottonseed meal
- 400 pounds hominy feed
- 100 pounds wheat middlings

XII. The Rations Fed Some Famous Cows

THIS series of articles has been written largely for the young breeder and feeder who is just starting in the business. It is the wish of the writer to be of service to as many as possible on the question of feeding, to bring to many the experience of others on feeding questions. This article then will give as far as we can, the actual feed mixtures used, the amount fed and other things of that nature with some of the high record cows of the Holstein-Friesian breed. To get the data for the article a letter was sent to the owners or feeders of the 10 highest seven-day record cows and the 10 highest semi-official record cows furnished by Superintendent Gardner, December 5, 1916. The answers to this letter have been very satisfactory, and the writer wishes to thank these men personally who have co-operated in the preparation of this article.

Young feeders and breeders like to know what the most successful feeders in the breed have used in getting the wonderful records that are now being made. It is a great source of satisfaction that the successful feeders and owners are so ready to tell us just the manner in which it has been accomplished.

THE FEEDS USED.

First of all it seems best to list all the feeds used in the feeding of the cows here considered with the number of times each is found among the rations. This will tell us the most popular feeds.

Concentrates:

Ground oats	6	times
Wheat bran	6	"
Wheat middlings.....	1	"
Gluten feed.....	4	"
Gluten meal	1	"
Distillers' dried grains.....	6	"
Cottonseed meal.....	3	"
White Cross feed.....	1	"
Linseed oil meal.....	3	"
Brewers' dried grains.....	2	"
Hominy	3	"
Malt sprouts.....	1	"
Ground barley.....	1	"
Dried beet pulp.....	1	"
Molasses	1	"

Below are given the roughages used in the six rations considered:

Roughages:

Corn silage	5	"
Alfalfa hay.....	5	"
Clover hay.....	1	"
Roots	5	"
Green crops	2	"
Pasture	2	"
Timothy hay.....	1	"

It is noted that the most important concentrates used for this purpose are ground oats, wheat bran, distillers' grains, gluten feed, oil meal, hominy and cottonseed meal. Alfalfa hay, corn silage and beets are the most important roughages. The rations shown

here and given in previous articles should teach convincingly that it is unnecessary to go outside this list for feeds and that nothing is gained by doing so. It is time that the idea that large records are being made with secret formulae should be driven out of the heads of our breeders. It is foolish to think that secret formulae and drugs are necessary to produce these records. Our breeders must get to work and learn the arts of breeding and skillful feeding and forget all this foolishness about drugs and secret formulae. If you have the cow that is capable of doing it through her inheritance and if you have the skill to feed her and care for her the above list of feeds is all that is necessary.

HESTER AALTJE KORNDYKE, 133222.

It is right that we should begin the discussions of feeding the individual cows with the ration of Hester Aaltje Korndyke, 133222, owned by M. J. Smiley of South Dakota, and bred by W. O. Wilcox of New York. Her highest seven-day record at the time this article was written, (January 3, 1917), was 621.1 pounds of milk containing 37.416 pounds of butter fat computed to equal 46.772 pounds of 80 per cent butter. Mr. Smiley wrote the author willingly and very fully and definitely when asked how he managed and fed Hester Aaltje Korndyke. We cannot improve the letter, so it is given in full:

"It is with pleasure that I am sending you the ration used in making the record of Hester Aaltje Korndyke, and I ask that you write me and let me know just what you think of the same, where you think it could be improved and all about it.

"This cow ran upon a wild grass pasture all summer without grain until about two months before she freshened, then she was taken and put on tame grass and given a feed consisting of ground oats, bran and oil meal (linseed) which was gradually increased until she got about 12 pounds per day.

"At freshening she was not fat, but in just fine milking shape and in the best of spirits. The calf was allowed to stay with her for about three days, when it was weaned and her feed gradually changed to the following mixture:

Ground oats.....	180 pounds
Bran	60 "
Shorts	40 "
Continental gluten.....	40 "
Gluten meal.....	40 "
Cottonseed meal.....	40 "
White Cross feed.....	40 "
Oil meal 20 per cent of each feed.	

"The 'White Cross feed' is a feed put out by the Albert Dickenson Seed Company and is supposed to be a balanced ration. In ordering some other feed last winter I ordered a small amount of this and we used it simply to get it used up and out of the way.

"The above grains were mixed and weighed, and as each feed was weighed out 20 per cent of the feed was made oil meal, which was kept separate until that time.

"The greatest amount that Hester would take at any time was

24 pounds of the grain and meal mixture fed with sliced mangels, of which she ate large quantities, usually a bushel basket at each feed, or about 34 pounds.

"This was fed every six hours before milking and at the hours of 4, 10, 4 and 10. Three times a day she received alfalfa hay, third cutting; this was fed at 7 A. M., 1 P. M. and 7 P. M., what she cared for.

"No silage or other feeds were used. Salt was before her at all times and running water where she could reach it all the time.

"Of the mangels she seemed to never get enough and would hunt them out from the other feed, so that it was necessary to put the grain on top of the mangels and in that way, in a measure, compel her to eat it.

"Hester was in a box stall and was out only once during the first 45 days of her test. She seemed at all times and appears now in the best of health, eating heartily all the time.

"I forgot to mention that before freshening and while on the tame grass pasture she received alfalfa hay night and morning in addition to the grain spoken of. She was turned out every day till the day of freshening, no matter what the weather, and was given no feed at that time, so she could wander around in that way getting a lot of exercise. She was groomed twice a day at all times.

"I think this covers the entire field as near as I can and hope it is the information you desire."—M. J. Smiley.

DUCHESS SKYLARK ORMSBY, 124514.

Next we will discuss the feeding of this great cow, whose yearly record at the age of five years was 27,761.7 pounds of milk, testing 4.34 per cent. butter fat, containing 1205.09 pounds of fat, 1507.36 pounds of 80 per cent butter.

John B. Irwin of Minnesota sent a record of the amount of feed consumed by Dutchess Skylark Ormsby during her entire test. It is unnecessary for us to copy it all. The December feed record, the second month of the test, gives us a very good idea of how she was fed. Her complete ration for the month was:

- 124 pounds wheat bran.
- 124 pounds ground oats.
- 93 pounds Continental gluten (distillers' grains).
- 124 pounds brewers' dried grains.
- 77 pounds oil meal.
- 75 pounds hominy.
- 868 pounds corn silage.
- 455 pounds alfalfa hay.
- 930 pounds roots.

In December she produced on the above feed, 2,834.6 pounds of milk, containing 126.990 pounds of butterfat, a percentage of 4.48.

MAY ECHO SYLVIA 227325.

H. Lynn has written a very good letter concerning the feeding of May Echo Sylvia 227325 of Avondale Farm, Ontario, Can., Arthur C. Hardy, proprietor. This Canadian cow has made a very creditable record of 853.7 pounds of milk containing 32.804 pounds of fat, a percentage of 3.84. This computes on the 80 per cent.

NO. 1

NO. 2

NO. 3

NO. 4

1. KEYSTONE BEAUTY PLUM JOHANNA
3. QUEEN PIEBE MERCEDES

2. MAY ECHO SYLVIA
4. HESTER AALTJE KORNDYE

basis to 41.050 pounds of butter. Mr. Lynn writes essentially as follows:

"The ration was composed of the following feeds:

Bran	207 pounds
Distillers' dried grains.....	336 "
Ground oats.....	156 "
Gluten	142 "
Hominy	114 "
Oil meal	40 "
Salt	10 "
Good silage, mangels or cattle beets, alfalfa hay.	

"She ate an average per day of 28 pounds of grain, the above mixture, also 120 pounds roots, 25 to 30 pounds silage and whatever alfalfa hay she would clean up. There always was an abundance of water in her stall to drink at her own free will. She was, of course, fed at each milking at the hours of 5 and 11. The method used in feeding was as follows: At 5 a. m. she got 7 pounds of grain, 30 pounds of beets, mixed together, or the roots put in the manger first and the grain on top. While the cow was eating this the milking was being done. Hardly ever was there a milking that she did not have this all cleaned up by the time she was milked. Immediately after the milking she was given 10 pounds of silage. She was then left till about 7:30 a. m., at which time she was fed whatever alfalfa hay she would clean up nicely. Following this she was then cleaned or brushed and taken out for a little outdoor exercise.

"She would then lie down and rest feeling as fresh as a daisy. At 11 a. m. she was always up with her head over the stall looking for her next ration, which was the same as the morning feed with the exception of the hay. At the 5 p. m. milking she was fed exactly the same as the 5 a. m. and at 11 p. m. she got only the grain and roots. No doubt this cow would have eaten more had I given it to her, but you know so many mistakes have been made by too much feed that I don't care to take too many chances, especially on cows doing such work as we have done on so many of our good ones."

This letter has been copied at length because it shows good, typical feeding and good management.

QUEEN PIEBE MERCEDES 154610.

This cow stands fourth in the list of yearly record cows with 30,230.2 pounds of milk containing 1,111.56 pounds of fat, a percentage of 3.68. This computes to 1,389.45 pounds of 80 per cent. butter. G. R. Melin, manager of the cattle department for E. C. Schroeder of Minnesota, the owner of this cow, writes as follows:

"The grain ration was made up of the following:

- 3 parts wheat bran
- 2 parts ground oats
- 1 part ground barley
- 1½ parts oil meal
- 1½ parts Ajax Flakes

"Of this the average consumption was about 20 pounds per day.

In the way of roughage she received per day :

4 lbs. dried beet pulp
24 lbs. mangels and sugar beets
20 lbs. ensilage
10 lbs. alfalfa hay

"At no time during her test was this cow pushed to the limit. At the beginning, instead of trying to make a large seven-day record, we took her gradually and I believe that we were well rewarded."

MAPLECREST PONTIAC APPLICATION 141158—BANOSTINE BELL
DE KOL 90441.

These two cows are owned by the Maplecrest Stock Farm Company, Ohio. Dan Dimmick writes as follows, concerning them :

"It is a little hard for me to give the grain mixture fed to these cows, as they were fed differently along through the year, but the principal grain ration was :

Bran	200 pounds
Ajax Flakes.....	200 "
Ground oats.....	200 "
Oil meal.....	100 "
Cottonseed meal.....	200 "
Buffalo gluten.....	100 "

"The above ration was fed nearly altogether to Maplecrest Pontiac Application. There were more changes on Banostine Belle De Kol, which I would not be able to give as I have no memorandum of them. After having the above ration, each cow had about 12 pounds of beets and about 3 pounds of ensilage, and then what alfalfa hay she could eat, four times per day."

Maplecrest Pontiac Application's yearly record is : milk, 23,421.2 pounds ; fat, 1075.44 pounds ; a percentage of 4.59. This computes to 1,344.30 pounds of 80 per cent. butter. Banostine Belle De Kol gave in one year 27,404.4 pounds of milk containing 1,058.34 pounds of fat, a percentage of 3.86. This computes to 1,322.925 pounds of 80 per cent. butter.

KEYSTONE BEAUTY PLUM JOHANNA 161646.

James E. Stevenson of the Hornless Holstein Farms of Clark's Summit, Pa., writes as follows concerning the feeding of Keystone Beauty Plum Johanna, whose yearly record is 25,787.5 pounds of milk, containing 1,035.77 pounds of fat, computed to 1,294.7 pounds of 80 per cent. butter, with a test of 4.02 per cent. :

"The grain ration fed Keystone Beauty during her test consisted of 100 pounds each of the following feeds : Cottonseed meal, wheat bran, O. P. linseed meal, dried brewers' grain, distillers' grains, buffalo gluten, hominy, ground oats, and 10 pounds of salt. For roughage during the winter she had timothy hay, corn silage, and some of the time clover hay. During the summer she was fed green alfalfa, peas and oats. During the summer the hominy of her grain ration was increased to 200 pounds. She was pastured for three hours a day.

"Probably the most valuable of any of the feeds is the dried beet pulp. During the winter we fed molasses with it, mixing the

molasses with water and soaking the beet pulp with it. To show you the value of the beet pulp in making this record, about a month before she finished we ran out of beet pulp and the boys thought that they would substitute fresh beets, turnips and cabbage in its place. They fed her all she could eat of these vegetables and roots, but in spite of this she fell off 10 per cent. in production. We had our mark set for 1300 pounds of butter and expected to make it with a good margin, but because of our inability to get any beet pulp we missed it by a small margin. She was fed four times a day, beet pulp each time, and ensilage and hay twice a day during the winter."

NOTES.

In going over these rations one is struck with the general similarity of the mixtures, and it can be said that probably a mixture of equal parts of the leading feeds given in the first table will be as efficient a mixture as any. The record comes from good feed to be sure, but does not come from the fact that one man combines feed in a very definite formula which gives him wonderfully different results from other feeders.

Again it is striking that the world's seven-day record cow had no silage in her ration. This again confirms the opinion that the greatest factors are the cow and the skill of the feeder.

We have, in this article, given the methods of men from widely separate parts of the country, Ontario, Minneapolis, Pennsylvania and Ohio. This should be a strong lesson that these records are not made by the use of drugs and secret formulae, but are the results of skillful work with wonderful cows with a relatively limited number of feeds. Many more letters might be copied but the material given here covers well the methods and feeds in general use.

XIII. The Ration Fed Segis Fayne Johanna

AFTER writing the article on the feeding of some of the leading cows of the Holstein-Friesian breed, Segis Fayne Johanna 114658 made the remarkable record of 40.544 pounds of butter fat, 50.68 pounds of 80 per cent. butter, from 722 pounds of milk.

Advice from Mr. Niemann, the manager of Oliver Cabana's Pine Grove Farm herd, gives the grain ration fed to Segis Fayne Johanna as follows:

Distillers' dried grains.....	200	pounds
Wheat bran.....	200	"
Ground oats.....	125	"
Gluten feed.....	125	"
Cottonseed meal.....	100	"
Linseed oil meal.....	80	"
Salt	15	"
Powdered charcoal.....	10	"

Mr. Niemann says that this cow received, during the test, 28 pounds of this mixture in four equal feeds. In addition she was fed two pounds of cottonseed meal, one-half pound at each feeding.

SEGIS FAYNE JOHANNA The World's first 50-lb. cow

This makes the total concentrates 30 pounds per day.

For roughage, Segis Fayne Johanna received 40 pounds corn silage, 32 pounds of wet beet pulp and molasses, 100 pounds roots and 12 pounds of alfalfa hay. The roughage was also fed in four equal feeds, except the hay, which was fed in three feeds, the mid-night feed of hay being omitted.

This statement of Mr. Niemann, regarding the feeding of this cow, bears out the general statement made on another page in the other article, that one does not need to go outside of the general well known by-products to make up a proper test ration. That this is a proper test ration this 50-pound record proves beyond any doubt. Again this description of the ration that Segis Fayne Johanna received should silence the criticism made regarding such high records, that unusual feeds or drugs of any kind are used. That such is not the case we now know.

It will be interesting to calculate this ration in detail and compare it with some of the leading standards now in use, check up the nutritive ratio and study its mechanical makeup a little. Below is given the ration in detail, computed on a one-day, 24-hour basis:

	Feeds	Dry matter	Digestible protein	Digestible carbo-hydrates	Digestible fat	Total digestible nutrients
12	lbs. Alfalfa hay.....	10.968	1.272	4.680	.108	6.192
40	lbs. Corn silage.....	10.520	.440	6.000	.280	7.080
100	lbs. Mangels	9.400	.800	6.400	.100	7.400
10	lbs. Beet pulp, dried....	9.180	.460	6.520	.080	7.160
6.75	lbs. Distillers' dr. grns	6.305	1.512	2.727	.783	6.001
6.75	lbs. Wheat bran.....	6.068	.844	2.808	.203	4.111
4.23	lbs. Ground oats.....	3.773	.397	2.174	.173	2.961
4.23	lbs. Gluten feed.....	3.862	.914	2.195	.135	3.414
5.36	lbs. Cottonseed meal....	4.958	1.983	1.168	.461	4.192
2.69	lbs. Linseed oil meal....	2.445	.812	.877	.180	2.096
7.3	lbs. Molasses	5.417	.073	4.249		4.322
Totals.....		72.896	9.507	39.798	2.503	54.929

There is nothing unusual about this ration except that it is one of the largest that has come to the attention of the writer. A consumption of 72.896 pounds of dry matter in 24 hours is an unusually large amount. The nutritive ratio is 1:4.8, which is a normal nutritive ratio for a cow producing so much milk and fat.

In the mechanical makeup of the ration there are some things to which attention may well be called. The method of feeding the beet pulp on Pine Grove Farm is a little different from the method on most farms in that molasses is added to the water used to soak the pulp. Mr. Niemann explained to the writer that the method is to put about two quarts of feeding molasses, blackstrap, in a fourteen quart pail and add enough hot water to fill the pail. The dried beet pulp is put into a box and this molasses and water poured on it, allowing the beet pulp to take up all it will of the liquid. Segis Fayne Johanna was fed eight pounds of this mixture at each feed, or 32 pounds per day. The exact mixture is the following: 50 pounds of dried beet pulp, 12 quarts of feeding molasses and 36 quarts of hot water. In the other article on feeding, atten-

tion is called to the fact that Mr. Stevenson, in discussing the feeding of Keystone Beauty Plum Johanna, puts much stress on the value of beet pulp in the ration when fed with molasses on it.

Fifteen pounds of salt in 830 pounds of concentrates is more than is usually put in. It may be that this large amount of salt makes the ration more palatable. The powdered charcoal adds no food value to the ration. Charcoal is said by some physicians to have a beneficial effect on the digestion, serving to keep the digestive tract in a more normal condition. It is probably not absorbed but aids in some mechanical way merely by its presence. It will be noted that with 200 pounds of distillers' dried grains, 200 pounds of wheat bran, and 125 pounds of ground oats in 830 pounds of concentrates, the ration is a very bulky one. This probably accounts for the good condition of the animal and her ability to consume so much feed. All feeders for high production make up their grain mixture of at least one-half bulky foods.

If we check up this ration with the feeding standard now most commonly in use, the modified Wolff Lehman standard, given in the last edition of "Feeds and Feeding", by Henry & Morrison, we would find that the standard to maintain an average production of 103 pounds of milk per day, testing 5.6 per cent. butter fat, suggests 9,261 pounds of digestible protein and 59.14 pounds of total digestible nutrients. This comparison shows that this cow is using the feed she is getting just as average cows do. Her great record is due to the fact that she is able to consume and metabolize these extraordinary amounts of feed. It is not necessary to feed her quite so much total digestible nutrients as is required by the standard, because individually she is taking some milk and fat off her back. Segis Fayne Johanna weighed about 1900 pounds before she freshened, so she is probably willing to lose some fat.

Pine Grove Farms is to be congratulated on this wonderful record, and the reason that this cow could make it is probably largely due to the good care, attention to ventilation, rest and quiet that are all so insisted upon in their test barn.

XIV. Feeding For Long Distance Records

FIRST, we should define the term, long distance record. The author likes to think that the champion long distance dairy cow is the cow that will make a creditable seven-day record, follow it up with a good yearly record, and continue this sort of work for several years, producing a calf every year. The average productive life of a cow should be at least five years, with five calves. The profit in the pure bred business comes largely from the sale of the young stock, and this means numbers produced and large record. The cow should be tried out every year for a seven-day record in the hopes that she may improve her previous record.

The fitting of a cow for a seven-day test each year gives her a big start on her year's record, even if she does not improve her

previous weekly record. Fifteen or twenty pounds of fat a week on the start of a yearly record makes a big difference in the yearly total. The easiest time to get this high production of fat seems to be about three weeks after calving. A study of many seven-day records show that most of them are made at about that time.

THE FUNDAMENTAL PRINCIPLES.

It is well to review at this time just what the food is used for. A cow making a long distance record is going to be a hard working animal all the time. After she freshens, she is under a tremendous load producing milk. Soon she is bred, and then to the work of milk production is added the labor of growing a foetus. The work of milk production demands a liberal supply of protein because the solids in milk are nearly 27 per cent. protein. This protein can only be derived from the feed that the cow eats. Then the growth of the foetus demands a liberal supply of protein. All the needs of the animal from a physiological point of view and from a commercial point of view also point to a liberal supply of protein in the feed. This means a relatively narrow ration, except when dry. The dry period is the time when there is the largest demand for protein for the foetus. From this standpoint, therefore, even when dry, the cow should have a liberal supply of protein. Any excess protein can be used for energy purposes. Commercially, there is no longer any reason for having a scanty supply of protein in the feed, because high protein feeds do not cost at present, pound for pound, any more than the low protein feeds. During the dry period the cow is laying on fat. A liberal supply of protein will help in this. The protein does not seem to be used in the actual formation of the body fat, but has a guiding influence in the nutrition of the animal at this time, causing the animal to fatten more readily with less expenditure of feed.

The carbohydrates of the feed are used for the manufacture of the milk sugar. The solids of the milk are about one-third sugar. This may be made from the carbohydrates of the feed or from the fat in the feed or from the protein, when there is more protein or fat than is needed for other purposes. Then the carbohydrates are used directly as a source of energy, either for direct consumption or stored as fat to be drawn upon later for energy purposes. Body fat in the young foetus or in the mother, is made in large part from the carbohydrates. In this sense the carbohydrates are as essential and as important as the protein, except in so far as the protein of the feed has special uses, and because of its nitrogen has a high manurial value. A pound of protein and a pound of carbohydrates have the same feeding value from the standpoint of energy.

The fat of the feed may be used to form body fat or milk fat or may be burned at once to yield energy. One pound of fat in the feed has two and one-fourth times as much energy as a pound of carbohydrates or protein. Therefore, fat is said to be two and one-fourth times as valuable as carbohydrates or protein. The

fat has no special functions except as above outlined. A high amount of fat in a feed would not make a higher percentage of fat in the milk.

The amount of ash or mineral in the feed of cows has probably not received the attention that it should. This question is being carefully and thoroughly studied at the present time. Results of these studies will have an important bearing on long distance feeding. The question seems to center around the supply of lime and phosphorus. A large variety in the ration and legume roughage will solve this question as far as it can be solved at present.

FEEDING PRACTICE.

Between lactations the cows on these long tests will go dry eight to ten weeks. A good grain mixture to be fed at this time with alfalfa hay and silage and perhaps a few roots, is 30 lbs. homing feed, 30 lbs. ground oats, 30 lbs. wheat bran and 10 lbs. of oil meal. Feed liberally of this mixture and get the cow to fatten somewhat. If she is only dry for eight or ten weeks you cannot get her too fat.

Keep her on a rather light ration, using this same mixture for three or four days after calving, when she may be put on the test mixture and her allowance raised to the limit of her appetite. Whenever she shows signs of going off feed she may be fed a meal or two of the same mixture that has been suggested for her when dry.

She must be fed alfalfa hay or clover hay if she is going through two or three hard lactations. She must have good corn silage. She must have table beets or mangels. As a suggested grain mixture to be used as a test ration, the following is used by one of the best feeders and breeders of Holstein-Friesian cattle:

- 300 pounds distillers' dried grains
- 100 pounds oil meal
- 100 pounds hominy
- 100 lbs. cottonseed meal
- 100 pounds ground oats
- 100-200 pounds wheat bran
- 100-200 pounds gluten feed

Such a mixture with alfalfa hay would give an abundance of protein. It may be modified in a hundred ways, but is efficient as it stands.

If handled and fed as suggested, to the limit of her appetite, a cow should produce heavily. She must be watched carefully and kept hungry. Alfalfa hay, silage, mangels and grain form the basis of the ration at all times of the year, but advantage may be taken of pasture, if exposure to bad weather is not allowed and the cow is pastured only when flies do not plague. She must be pampered and protected and watched. Care will be rewarded. Cows that are worth while are entitled to all they will eat all the time.

XV. Summer Rations For Semi-Official Cows

THERE is not much difference between the summer rations for semi-official cows and the rations fed at other times of year. The principles are the same, plenty of succulent feed and a good grain ration. The cows that have made the best semi-official records have not depended very much on pasture, although many of them have been allowed some pasture. Pasture is undoubtedly ideal so far as the feed is concerned. The drawbacks are many, however. The cow must spend much energy in getting her feed and in making a high semi-official record; she has not the energy to spare for this extra work. Second, if she must depend much on pasture, she is exposed to all kinds of weather. This is not good for her. She must not be chilled. Third, and worst of all, if she goes to pasture in the day time, she is open to the attack of flies. There seems to be no fly remedy on the market as yet that is completely a repellent. They will keep them off for a while but their effect will not last for the full day.

Therefore it seems best to depend on soiling crops and a good grain ration. If the cows are turned to pasture at all they should be carefully sprayed and watched so that as little trouble can come from flies as possible. The cows should be petted and pampered more or less and fed all they will possibly eat all the time. Their individual likes and dislikes may be studied to good advantage, and the cows pleased in this way. The secret is in getting them to eat and keep in good health. They cannot make the best use of this food if they must use the energy for other purposes than milk production or are distracted by improper stabling or exposure to bad weather and flies.

The author happens to have at hand the detailed feed records for May, June, July, and August, of two cows that have made over 1000 pounds of butter fat in one year. The feeding of these cows for these summer months must have been good or they never could have made these high records.

The first was fed as follows:

May, 1914. 17.5 lbs. grain daily of the following mixture: 3.8 lbs. bran, 2 lbs. hominy, 3 lbs. ground oats, 1 lb. each, wheat feed, flaxseed meal, and oil meal; 4.5 lbs. distillers' dried grains, 1.2 lbs. gluten, 14 lbs. roots, 46 lbs. ensilage, 10 lbs. alfalfa hay, pasture one hour.

June, 1914. 15.5 lbs. grain daily of the following mixture: 5 parts bran and corn, distillers' dried grains, 1.5 part hominy, 4 parts ground oats, 5 parts cottonseed meal, 1 part each, Bartlett's sugar malt, Buffalo gluten, flaxseed meal and oil meal; 3 lbs. beet pulp, 41 lbs. ensilage, 10 lbs. green alfalfa, and 11 lbs. alfalfa hay.

July, 1914. 18 lbs. grain daily, same mixture as given in June; 2 lbs. beet pulp, 15 lbs. each, red beets and green alfalfa; 10 lbs. sweet corn, 42 lbs. ensilage, 11 lbs. alfalfa hay.

August, 1914. 15.2 lbs. grain daily, 14 lbs. of the following

mixture with 1.2 lbs. oat feed added daily: 4 lbs. bran, 2.5 lbs. hominy, 3.5 lbs. ground oats, 5.5 lbs. corn, distillers' dried grains, 2 lbs. Bartlett's sugar malt, 5 lbs. Buffalo gluten, 1 lb. each, cottonseed meal, and O. P. oil meal; 2 lbs. beet pulp, 20 lbs. beets, 15 lbs. each, sweet corn and alfalfa; 36 lbs. ensilage, 9.5 lbs. alfalfa hay.

Another cow that made 1000 lbs. of butter fat in one year was fed as follows:

May, 1913. 10 lbs. grain daily of the following mixture: 250 lbs. bran, 50 lbs. each, hominy, cottonseed meal, and oil meal; 100 lbs. gluten, 3 lbs. beet pulp, 2 lbs. molasses, hay, with pasture.

June, 1913. 19 lbs. grain daily of the following mixture: 250 lbs. bran, 50 lbs. each, hominy, ground oats, cottonseed meal and oil meal; 3 lbs. beet pulp, 2 lbs. molasses, green feed.

July, 1913. 18 lbs. grain daily of the following mixture, on 1st and from 11th to 31st; 15 lbs. daily from 2nd to 11th: 250 lbs. bran, 50 lbs. each, hominy, cottonseed meal, ground oats, and oil meal; 100 lbs. gluten, 3 lbs. each, molasses and beet pulp; corn fodder from 1st to 15th; clover from 17th to 31st.

August, 1913. 18 lbs. grain daily of the following mixture: 250 lbs. bran, 50 lbs. each, hominy, cottonseed meal, and oil meal; 100 lbs. gluten, 3 lbs. each, beet pulp and molasses; corn fodder, alfalfa, clover, with pasture.

The first grain mixture is a little more complicated than the second, due to the addition of sugar malt, not a common feed, and it is doubtful if it made the ration any more efficient because the record of the second cow is practically as great as that of the first.

To show the kind of feeding practiced at Cornell University, the feeding of a young cow for the months of May, June, July, and August, is given. She made a yearly record of 620 lbs. of butter fat, was dry eight weeks and then made a seven-day record of 24 lbs. of butter fat, which puts her in the 30-lb. class and she is now going well in this lactation. Her 30-day record in the present lactation is 2481.1 lbs. milk, 94.129 lbs. butter fat.

Her feed record for May, June, July, and August, 1915, is as follows:

May. 15 lbs. daily of the following grain mixture: 300 lbs. distillers' dried grain, 200 lbs. hominy, 200 lbs. wheat bran, 200 lbs. cottonseed meal, 100 lbs. gluten feed, 50 lbs. corn silage, 11 lbs. of hay. The last of the month the hay was dropped and some green grass fed.

June. 12 lbs. daily of the same grain mixture as in May. All the green feed (grass, peas and oats, etc.) she would eat.

July. 14 lbs. daily of the same grain mixture as in May; 50 lbs. green alfalfa until July 17th; July 18 to 24, 30 lbs. peas and oats silage; July 25 to 31, 30 lbs. corn silage.

August. 9 to 14 lbs. daily of the same grain mixture as in May; 30 to 35 lbs. daily of corn silage; some pasture and hay.

These three statements of actual rations fed show the kind of ration, the feeds used, and illustrates again the need for succulence,

variety, plenty of bulk, and plenty of protein in the ration.

A study of many rations fed by many different feeders will show that they do not depart widely from these methods, and the feeds listed in these rations will cover those generally used.

The following is suggested as a grain mixture for the summer:

500 pounds hominy
500 pounds distillers' dried grains
300 pounds wheat bran
300 pounds gluten feed
200 pounds oil meal
200 pounds ground oats

XVI. Feeding Fat Into Milk

EVER since interest in high production records was stimulated by the dairy breed associations, breeders have looked for ways and means of raising the normal percentage of fat in a given individual cow's milk for seven, thirty, or longer periods of days, including semi-official and official yearly records. The writer has never yet seen but one way of doing this successfully. Many breeders have been sure that they had a way, but no one way has been successful enough to give that breeder any lead over others. And so far as the writer is aware no method has ever been tested out carefully and scientifically except one. That one method is to fatten an animal before the testing period and then feed her carefully so that she will lose her body fat and put it into the pail. This method has been described in a previous paper and is really so well known among breeders that test that it is unnecessary to give it much more consideration here.

And after all, what would the economic effect of a successful method to feed fat into milk in a short time test amount to? The partial success of feeding fat into milk by means of fattening the cow before testing, has already brought seven-day records into more or less disrepute as real evidence of production. The law of conservation of energy holds true no less with animals than with machines, and if a method of changing body substance into milk fat is found, the same amount of food must be used to produce the body substance at some time in the course of the period between the birth of two calves.

No, in the opinion of the writer, breeders who seek to find a method to increase the percentage of fat in the milk of any individual for any period of time, short of the whole life of the individual, is not doing himself or the breed any real good. The breeders of the Holstein-Friesian breed had better give their attention to the study of methods of breeding, which may on the one hand increase the normal fat content of the milk of the breed, if that is deemed desirable, and which must be done at the expense of a less quantity of milk, and on the other, to methods of breeding which will increase the capacity of the breed as a whole, to utilize feed above maintenance and change it into milk. Suppose a method

should be found which would cause a cow to test higher than her normal inherited percentage for seven or thirty days or even a year. What good would that do the breed? Until it was established beyond doubt that a certain breeder was doing something which was influencing the production of his individuals for short periods of time, of course he would make money, but it would be a great boon to the breed if some way could be found to enable a cow to turn more food into milk; but it is the firm conviction of the writer that it is futile to look for methods of this kind except through breeding for greater capacity and production. This kind of work will permanently better the breed.

To be sure of his ground, the writer has looked over rather carefully the literature on this subject in recent years, by consulting the Experiment Station record. The only positive evidence that appeared was found in Bulletin 100, by C. H. Eckles, of the Missouri Experiment Station. Eckles' work was wholly along the line of feeding the animal previous to the beginning of the test and getting her fat. When this was done the percentage of fat in the milk would be high during the first part of the lactation period. The effect persisted to a more or less extent through the whole lactation period. This kind of feeding is to be advised, because undoubtedly the capacity of the animal to produce is increased in a perfectly legitimate and normal manner, and it is a case of actually turning more feed into milk.

The experiments along the line of the specific effects of different feeds have been very numerous, but any positive effect of any one feed or combination of feeds is shown to be short and slight. It is probable that in many cases the effect could be shown to be within the limits of experimental error if a careful study were made.

A number of experiments on the use of the extracts from certain glands of the body, particularly the pituitary gland, for the purpose of increasing the percentage of fat in milk, and also for increasing the amount secreted, have given positive results for short periods of time, but these results usually have been followed by corresponding periods when the amount and quality have been below normal.

Some positive results have been obtained by feeding a large amount of oil and fat in the ration. These experiments also have been attended without permanent results which would influence one to recommend definite procedure even for a short time test.

In conclusion the author must confess that he sees little hope for any method for really increasing the fat percentage in milk, except through breeding and rations, feeding to produce cows nearer the ideal that is held for the breed in question. The true method to get cows with high records is to breed for size and capacity, and perhaps if that is the desire and ideal of the breed, to select for a higher percentage of fat.

Part Three—Feeding Calves

XVIII. Raising Calves on Whole and Skimmed Milk

THE raising of dairy young stock is a very important problem for our farmers. The feeding and management of stock is fully as important as the breeding, although we are likely to say that breeding is more important. It is in this sense, the animal must have the quality if it is going to do the work in the world that is expected of it. First, after being well born, comes the necessity of being well fed as a calf. This will be the subject of this and the next paper. This paper will consider the growing of young calves on milk.

There are three possible ways of growing calves on milk:

1. The use of nurse cows, good producers but of grade breeding.

2. The growing of the calf on whole milk.

3. The growing of the calf on skim milk.

The growing of calves by means of a nurse cow does not need any particular explanation. A good cow costing \$50 to \$75 should be able to care easily for two calves and grow them in the very best possible condition. This method lends itself to practice in those places where there is abundant pasture on cheap land, and it goes without saying that this method would produce the very best calves. But as is shown in a table a little farther on, this is of course a very expensive method.

The second method is also expensive, but is the method used by the breeders who are growing the best stock. This method means the feeding of the calf on whole milk after two or three days, while he is left with his mother. This method is also expensive, but there is a bloom and finish put on the calf that cannot be obtained in any other way. The best breeders are not content with feeding in any other manner. The details will not be discussed because all details are practically the same as when feeding skim milk. This method of feeding is the one on which, by far, the majority of breeders must depend, and it will be discussed in detail. It seems best to take up the discussion by weeks in order to be definite.

The First Two Weeks.—After the calf is born he should be left with his mother for two or three days. Perhaps until the eighth milking. The writer has always considered the eighth milking "good" to save for home or market purposes. The milk of the first six or seven milkings is called colostrum. This is necessary to the

health of the calf because it is laxative and has a good effect on the digestive system. It has always seemed to the writer that the best way for the calf to get the colostrum is by suckling the mother. It is best for the mother too. If the calf does not attempt to suckle the mother by the time he is three or four hours old he should be helped up and assisted in getting his first meal.

He should get whole milk for at least ten days. If at all practicable it is best to feed him for the first ten days, three times a day, one and one-half quarts at a meal. After the tenth day, if he is good and strong, he may be fed twice a day and receive two quarts (four pounds) at a meal. The temperature of the milk should always be at 90 degrees to 100 degrees F. A thermometer costs twenty-five cents. Always try the temperature of the milk with a thermometer and know that it is at the proper temperature when fed. The temperature is one of the most important points to have correct in feeding. Beginning with the eleventh to the fourteenth day the calf may be changed to skimmed milk.

The Third Week.—Take a full week from whole milk to skimmed milk, changing at the rate of one pound per day. The skimmed milk must be sweet, free from foam, and at a temperature of 90 degrees to 100 degrees F.

The Fourth Week and Thereafter.—The calf may now have more milk as his appetite and condition demand. Do not over-feed him. There is much more danger from over-feeding than from under-feeding. Mix into each feeding of skimmed milk a teaspoonful of soluble blood flour. This blood flour may be obtained from your feed dealer. It is simply dried ground blood and is a by-product from the large abattoirs. Insist that the kind you buy be very finely ground, because coarsely ground dried blood will settle out when mixed in the milk, and it should stay in suspension. Blood flour is expensive but the amount fed is very small and is worth many times its cost. Its particular usefulness is twofold, it is very good high protein food in itself, and secondly, it keeps the bowels of the calf in good condition and overcomes any tendency to digestion troubles.

Roughage.—At four weeks of age the calf will begin to eat food other than milk. The best roughage for him is second or third cutting of bright, well cured alfalfa hay. On those farms where alfalfa hay is not available, the second cutting of clover hay is best. With a little care practically every farmer in the State of New York can put up a little cutting of clover hay for his calves. If neither of the above kinds of hay are available, use the best quality of hay that can be secured. Let the calf have all the hay he will eat.

After the calf is six months old he may have a little silage.

The Grain Mixture.—At about the time at which the young calf will begin to eat a wisp of hay, he will eat dry grain. The mixture that has given the writer much satisfaction is the following: 30 lbs. wheat bran, 30 lbs. ground oats, 30 lbs. corn meal and 10 lbs.

oil meal. The calf should be fed all he will eat of this mixture in a box nailed to the side of his pen. Never feed a calf dry grain in the pail from which he gets his milk, nor mix the grain in with his milk. When three or four weeks old, after he has finished drinking his milk, put some of the above mixture in his mouth. He will soon learn to like it. At the same time have some of this mixture in the feed box in his pen. He will soon find the box and eat regularly. Feed all the grain he will eat up clean after having his milk. Some feeders keep feed before their calves all the time.

Care and Management Other Than Feeding.—Besides feeding there are some other things in the care of calves that should be mentioned. More than all else is cleanliness and dryness. The pens should be kept clean and dry. The temperature of the stable may be rather low and the calves will grow and thrive if kept dry and clean and are well fed. The pens should be cleaned often and kept well bedded. In warm weather particularly, the calves should have access to clean water.

Many farmers turn their calves out to pasture when too young. In New York, a good practice is, keep in the barn during the summer all calves born after February 1st. These young calves may be turned out to night pasture if one is available. They are too young to pick their own living without some extra food, so that it seems best to feed them in the barn the first summer. In the pasture flies plague them so that they do not grow well.

Dehorning Calves.—In herds where it is desirable that all the animals shall be dehorned, the best time is to dehorn the young calves before they are three weeks old. This may be done by rubbing the little nubs of horns with a stick of caustic potash. This may be purchased at any drug store. When using it, precaution should be taken that it does not come in contact with the hands. This is easily done by wrapping in paper the end of the stick that is held in the hand.

Clip the hair away from the button of horn. Dip the end of the stick of caustic potash into water and rub the horn hard with it until the skin all around the button is raw and bleeds a little. This is necessary in order to wholly destroy the horn tissue. Be careful that the caustic liquid does not run down into the eyes of the calf.

This seems like a cruel practice, but in reality it is a most humane one, because it does not hurt the calf very much, and dehorning a mature animal is very painful and more or less dangerous. Cattle that have been dehorned are more docile, cannot injure each other, or the attendant, and are probably more productive. The sores made by the dehorning process will quickly heal and need no attention. The thing of greatest importance is to do a thorough job, making sure that the horn button is absolutely destroyed. If only a part is destroyed a stubby misshaped horn will grow and a poorly shaped head will result.

Much trouble is sometimes experienced from scours arising

from indigestion. This trouble is to be prevented rather than cured. It may be prevented by proper feeding. The above directions have been followed in a herd of sixty calves this winter and the calves have made an average gain of ten pounds and over per week. Blood meal has been used religiously, and when a little trouble has come the only treatment that has been necessary has been to cut down the food at least one half and to add a pint of clear lime water for a feed or two. Then bring the calf gradually to full feed again.

The following table shows the comparative cost of feeding according to the three methods mentioned:

Food	Pounds average daily gain	Feed cost of 100 lbs. of grain
Skimmed milk.....	1.5	\$2.26
Whole milk	1.9	7.06
Running with dam.....	1.8	4.41

This table is from the actual results in handling a total of forty-two calves divided about equally into three lots. The feed cost would vary with the locality, but shows a comparison that might reasonably be expected. The comparison shows that skimmed milk is by far the least expensive, and a daily gain of 1.5 pounds will give a heifer that will be so well developed that it will be very difficult to recognize her from her sister, raised on whole milk, when both reach the age of two years.

XVIII. Raising Calves on Substitutes for Milk

ON many farms there is need for method of feeding calves with a small amount of milk. The breeder has not yet reached the place in his business where he can afford to feed his calves on whole milk, although this is by far the best method for raising the calves to get that fine finish desired by buyers of the best bred stock. Neither is there available a supply of skimmed milk. The small breeder must send his raw milk to market and if he is to raise the herd and breed it up according to his own individual ideas, he must breed and raise his own young stock. How can he do this with a minimum of whole milk?

There are two general ways open to him: (1) He can purchase and feed the commercial calf meals on the market. (2) He can mix up his own calf meal. Both of these ways have been tried out carefully on many farms and at several experiment stations, so that we know that good dairy heifers can be raised on substitutes for milk. In tests of these calf meals alongside check groups raised on skimmed milk at two years of age, it has been found that there is no difference in development. The young calves do not grow quite as fast at first but soon pick up after six months of age and at two years of age, there is no appreciable difference. In our experience there has been no difference in productive ability that can in any way be attributed to the fact that the calves were raised on substitutes for milk.

The importance of this cannot be overestimated. We must interest all our dairy farmers to raise and breed their own stock. Many farmers do not raise their own stock simply because they can not see any way to raise the calves without milk. Therefore they maintain their herds by purchase. It is a great gain for the industry of dairying every time a farmer can be interested to improve his herd by his own breeding.

COMMERCIAL CALF MEAL.

Feed manufacturers in the past few years have greatly increased the number of commercial meals on the market. They are all much alike as to ingredients. It will not be possible to name all the commercial calf meals on the market or to give their ingredients. Each farmer in selecting his calf meal must judge of its merits. Since we cannot name them all and give results for each, it is only fair that we do not name any. It is suggested that those meals will probably give the best results which are made up from the ingredients that we know to be suitable for feeding young animals. It is required by law that all the ingredients be named. If there seems to be any ingredients in the mixture that might not be suitable do not feed that meal but buy another which has suitable ingredients.

Feed the commercial calf meal that you select according to the methods suggested by the manufacturer. In trials conducted by the author, covering a period of eight years, with several commercial feeds, the methods recommended by the manufacturers have been followed generally with good results. We have had no trouble in getting calves to gain at least one pound per day with commercial calf meals, and gains of 1.5 pounds per day have been common. No one should be satisfied with a gain of less than one pound per day. All the precautions and methods of supplementary feeding, to be used with skimmed milk, must be scrupulously carried out with commercial calf meals, because these meals are a much more artificial way of feeding than skimmed milk and more likely to cause trouble. Extra care must be taken not to over-feed.

The one thing that the author would emphasize with the commercial calf meals, is the fact that they are too high in price. They cost from \$60 to \$70 or more per ton retail, whereas a good home mixed calf meal has given better results than the average commercial meal at a cost of \$40 to \$50 per ton.

A HOME MIXED CALF MEAL.

The Purdue University Experiment Station has used extensively a home mixed calf meal, simple in its make-up and within the reach of all. Any feed dealer can procure the ingredients, if you insist that he get them for you. You should be able to mix it at present prices of feeds, for \$50 or less per ton, with the ingredients purchased at retail. The mixture is equal parts, by weight, of linseed oil meal, hominy feed, red dog flour, and soluble blood flour. The table below suggests the method of using the home mixed calf meal.

A GROUP OF YOUNG CALVES ON A MICHIGAN HOLSTEIN FARM

Table showing the daily amount of milk, calf meal and water required by calves of various birth weights and various ages :

Birth weight of calves lbs.	Daily ration at 5 days of age	Daily ration at 7 days of age	Daily ration at 20 days of age	Daily ration at 30 days of age	Daily ration at 40 days of age
	Milk lbs.	Milk Meal lbs. oz.	Milk Meal Water lbs. oz. lbs.	Milk Meal Water lbs. oz. lbs.	Meal Water oz. lbs.
40	5	6 2	4.5 8 2	1 13 5	14 6
50	5	6 2	4.5 8 2	1 13 5	14 6
60	6	7 2	5.0 9 2.5	1 14 6	15 7
70	6	7 3	5.0 9 2.5	1 14 6	15 7
80	7	8 3	5.5 10 3	1 15 7	16 8
90	7	8 3	5.5 10 3	1 15 7	16 8
100	8	9 4	6.0 11 3.5	1 16 8	17 8
	Calf to be taken from water to the cow and fed from bucket at this age.		Begin adding meal after ten days of age.		If calf is doing well, discontinue milk feeding after this age.

This table is taken from Purdue University, Department of Agricultural Extension bulletin No. 44, published in January, 1916.

This table may be followed in detail or a simple rule used by the writer, which checks almost exactly with the table, is to mix one pound of dry meal with eight pounds of water at 100 degrees Fahrenheit and use this gruel just as one would skim milk, taking five weeks for the complete change from milk to gruel.

The one thing to be careful about in using this method of raising calves is not to over-feed. Several lots of good looking calves have been raised by the author and no trouble has been experienced in getting the calves to grow at least one pound per day per head. Much better gains may be made with Holstein calves when the feeder uses care enough and makes pets of his charges.

XIX. Feeding and Management of Yearlings and Two-Year-Olds

FROM the standpoint of the best development of the heifer at the least cost, fall-dropped calves are preferred. But this is not possible for all calves since it is necessary and wise to control the breeding of the herd so that the milk flow is maintained at about the same rate for the herd through the year. When a farmer can turn out about so much milk per day through the whole year, he can command a better market because of the uniformity of the amount of his product.

It is not wise to pasture during their first summer, calves dropped after January or February first. Flies bother the young calves too much. Calves that are born before January first seem to stand their first summer on pasture all right and make good gains. Therefore, the cost of raising a heifer dropped during the fall is likely to be less than that of one dropped later because of the greater utilization of pasture. Pasture is very cheap feed any way it is computed unless one has to give a greater valuation than \$50 per acre to the land.

If skimmed milk is available it may be used to good advantage until calves are a year or more old, although it is not at all necessary after eight months. It will probably give greater returns, fed to younger animals, than to those over eight months. When calves or other young stock are on pasture there is no greater pleasure to them than a cool, dark basement, into which they may run during the heat of the day and get rid of the flies. If the basement is made rather dark the flies will leave them.

If any of the herd of calves seem a little unthrifty it is a very good thing to arrange matters so that these can have a little grain to supplement the pasture. Of course there are any number of feeds available for this purpose. A mixture that is a favorite one with the author for all young stock is the one already mentioned in feeding calves, 30 pounds hominy, or corn meal; 30 pounds of ground oats; 30 pounds of wheat bran, and 10 pounds of oil meal. If pasture is good perhaps no grain will be needed during the best months. The amount of grain necessary for heifers is about four pounds per day up to the time of calving, of such a mixture as the above. All the good clover hay and silage that she will eat, and four to six pounds of grain, will keep the heifer in good growing condition and put her in the right shape for dropping her first calf. There are many other feeds and mixtures as good as the one given above. Space will not be taken to give other mixtures. Distillers' dried grains, gluten, cottonseed meal after one year of age, brewers' dried grains, malt sprouts, barley, buckwheat middlings, etc.; all make excellent ingredients and may be used for rations for growing stock. Some high protein feed should always be included in the mixture to enable the animal to make satisfactory growth. Experience and observation prove that the animal which grows the most regularly and rapidly during the first two years of her life will make the most satisfactory producer.

Many times it is said that feeding fattening foods is to be avoided, and much fat on a heifer is considered wrong by many. It is the writer's impression that there is little danger from getting a heifer too fat. Keep her growing and in good condition all the time. In this paper the amount of grain has been placed at four to six pounds. It seems to the writer that this is a good plan in feeding, to allow them to fix the total amount of the ration by feeding all the silage and hay that they will eat.

The time at which heifers should be bred is an important point to be considered in the management of heifers. There is a tendency among pure bred breeders to breed at 20 months of age or even later. A few figures from a good pure bred herd on this point gives a good reason for early breeding.

Thirty-three animals produced their first calf before they were 30 months old. Their two-year record was 6026 pounds. Their three-year record was 6780. Eighteen animals that produced their first calf at 36 months or a little later made an average of 7460 pounds of milk in their third year. The first lot has produced at

the end of their year almost 13,000 pounds of milk against 7500 for the second lot. In later years the second lot did not appear to do any better than the first lot. Until she becomes a milk producer the heifer yields no income. There are four good reasons for breeding early in addition to the above: (1) Constantly recurring periods of heat are as much a check on the heifer's growth as the development of the foetus. (2) Reproductive organs may become deranged if breeding is put off. (3) The condition of pregnancy has a marked stimulative effect upon the young animal during the first months. The assimilative functions are increased provided the heifer is furnished with an abundance of food. (4) It seems to be easier to develop a milk-secreting capacity when the heifer produces young at an early age. If put off sometimes the heifer shows a tendency towards beefiness. On the whole it seems best to have the heifer drop her first calf at 24 months. In conclusion, this paper is a plea for liberal feeding of heifers and early breeding.

PAUL CALAMO KORNDYKE

One of the most noted show ring winners of recent years

OAK DE KOL OLLIE HOMESTEAD

First prize winner at the 1916 National Dairy Show

Part Four—Miscellaneous Articles on Feeding

XX. Feeding Dry Stock

ALL authorities on dairying agree that cows should have a rest between lactation periods. Opinions differ as to what the length of that period should be. Pure bred breeders who do much advanced registry testing are often accused of milking their large seven-day record cows only six months in the year. This criticism is for the most part unfounded. A cow needs to make a big yearly record. From reliable sources of information it seems that two months is about the correct length of time for a cow to rest. From data on 496 cows in a cow testing association, those cows dry for two months produced more butter fat and made a larger net profit per year than those which were allowed to rest only one month.

Eckles, of Missouri, regards a period of six weeks long enough unless the cow is thin in flesh. So far as there is available data it seems to make no difference in average annual returns per cow, whether the lactation period is nine, ten or twelve months long, so long as there is a rest period of six to eight weeks between lactation periods. It is usually best, however, to plan the breeding of the herd so that each cow will produce a calf once a year.. Whether all the cows will be bred to come in in the fall or spring must depend on the market for milk and the market for stock. A little attention to time of breeding will enable a breeder to keep the amount of milk produced daily uniform for the year. His particular market may be better for his surplus stock at one time of year than at another. For the greatest success all these points must be considered in fixing the time for breeding each cow.

There are some cows that it is difficult to dry off. All cows should be dried off gradually. If the cow is giving a lot of milk when it comes time to begin the rest period, her concentrate allowance should be withheld, and if necessary, her roughage limited to timothy hay, although it is seldom necessary to go to this extreme. Milk her once a day for several days, then but once in two days and so on, gradually lengthening the period between milkings. When she produces ten pounds per day or less milking may be entirely discontinued with safety, although the cow must be carefully watched to see that the milk becomes re-absorbed.

After the cow is dry she should be fed liberally on roughage. Alfalfa hay and corn silage are good at this time. Scientists, notably Forbes of Ohio, are beginning to study carefully the amount of

the different minerals removed in the milk. The amount of lime is particularly large and the ration fed during the lactation period does not seem to supply enough lime in such a form that it can be easily assimilated. Therefore more lime is removed in the milk than is assimilated from the feed during a given lactation period. This lime can only come from the skeleton of the animal. She must restore this amount while dry. This, then, is one very important reason for feeding leguminous roughage. Legumes furnish a large amount of lime in a form more easily assimilated.

Succulent feed is important at this time, as at all times, in feeding dairy cattle. It is healthful, cooling, and keeps the animal in the very best condition.

The grain ration may be made up from various feeds. Variety is not so important nor is bulk at this time. The mixture may be made from any feeds fattening in nature, for the aim now is good health and vigor and some added fat. The author has used the following mixture of concentrates most successfully in feeding dry cows:

- 600 pounds hominy feed
- 600 pounds ground oats
- 600 pounds wheat bran
- 200 pounds linseed oil meal

This mixture will put the cows in first class physical condition and will insure proper growth of the foetus. Another mixture used for two-year-old heifers soon due to freshen for the first time, and to dry mature cows was:

- 500 pounds gluten feed
- 500 pounds ground oats
- 500 pounds hominy feed
- 400 pounds wheat bran
- 100 pounds oil meal

Oil meal, though usually relatively expensive, is particularly valuable at this time to put the cows in good condition. The exact makeup of the mixture will depend, as so often said in this series of articles, on the feeds available at home and the relative cost of total digestible nutrients in those concentrates that must be purchased. The principles on which the above mixtures rest are relative cost of digestible nutrients, a good amount of high protein feeds and the rest fattening feeds with a little oil meal as a conditioner.

It is a common statement among the most progressive dairymen that the grain fed at this time brings in the greatest returns of any, in that it means a larger, stronger calf, a cow in stronger, better condition to stand the strain of parturition and a good send-off into a new lactation and a good high production. The fat on her back while dry, by a cow of good dairy temperament, will all eventually return to the milk pail, in that she will lose in weight during a period of four or five weeks after calving and her milk will be richer in fat during this period than it otherwise would. Both of these facts are borne out by the results of careful experiments at the Missouri Experiment Station.

The amount of concentrates to be fed daily will depend on the roughage. With a liberal supply of the best roughage, when grain is not exceedingly high, four pounds a day should be fed. With valuable cows, when records are in view, ten to twelve pounds would not be excessive.

In conclusion, it may be interesting to note some of the rations fed to dry cows in a country where the cows are just "roughed" through the winter. Monrad says that in Norway cows are often wintered on small farms on straw, birch leaves, reindeer moss and horse dung, cooked and given as a mash with straw and leaves. Herring, fish offal and seaweed have been used in the same way. The annual yield of milk under such conditions was 1600 to 1800 pounds. The cow has always responded wonderfully to every improvement in the method of caring for and feeding her since these primitive dairy methods were in operation.

PERTINENT INFORMATION.

Criticism of pure bred breeders, tending to show that they milk large record cows but six months in a year, is unfounded.

Two months is about the correct length of time that cows should rest between lactation periods.

The time when cows should freshen is dependent upon the market for milk and the market for stock.

A little attention in time of breeding will enable a breeder to keep the amount of milk produced daily uniform through the year.

All cows should be dried off gradually.

Leguminous roughage should have a large place in the ration of dry cows. It furnishes lime in a form easily assimilated.

Expenditures for grain to be fed to dry cows bring in the greatest return. They mean a larger, stronger calf, a cow better able to stand the strain of parturition and a good send-off in a new lactation period of high production.

A cow always responds wonderfully to every improvement in methods of caring for and feeding her.

XXI. Feeding and Care of the Dairy Bull

MUCH is written and said about the feeding and the care for the dairy cow. Some times a short paragraph or two is written about the method of leading or exercising the bull, but very few men have a true appreciation of the importance of the bull in the herd, and he does not come in for his share of the study of feeding, exercise and care. In feeding the dairy cow the results are at once apparent. In feeding and caring for the bull the results are not at once apparent, and often times the bull is dead before his real value is known. The writer has in mind the care of a very prepotent bull, that was the sire of several thirty-pound daughters, but his value was not recognized and he was not kept. He was sacrificed early, not because he was poorly fed or cared for, perhaps, but this may have had something to do with it. If he had

been properly cared for and kept in the best condition it perhaps would not have been so easy for the owner to sacrifice him, and he would have been kept longer and his value, through his daughters, recognized before it was too late.

In breeding and managing pure breeds we cannot put too much attention on the bull. He is so important. At present, in raising pure bred cattle, we are taught that nearly all is in the breeding, and that the good or ill that there is in the offspring is purely the result of heredity and that nothing can be acquired during the life of the individual that can be transmitted. Undoubtedly this is all true, except perhaps in one particular, that is, in size and capacity. Feeding and care and management do have an effect on size and on constitution, and in the opinion of the writer, there is some transmission of these characteristics to the offspring. Good environment and liberal feeding will aid judicious selection very materially in increasing the size and capacity of the individuals in any given family.

If this is true, then how great is the importance of properly growing the males that are to be used for service, and how great is the importance of properly feeding, exercising them and caring for them during their use in the herd. The individual female in a given herd of twenty animals influences the outcome of only one mating in any single year. The individual bull puts his influence into twenty matings every year and stamps his individuality on twenty offsprings, where an individual cow affects only one offspring. The care, feeding and management in this herd, then, of the bull is as important from a breeding standpoint as the care and management of all the cows put together and twenty times as important as the care and management of any single female of the herd. We do not wish to exaggerate this point and we do not think we have. We are only trying to emphasize and drive it home. The income from the breeding of the herd is always more important than the income from milk, and in many of our best and largest herds the milk is practically a by-product.

THE YOUNG BULL.

For the first six months of his life the young bull will be treated as his sisters are treated. Skimmed milk, or whole milk in some cases, with good hay, a little silage and all the grain he will eat, and an opportunity to grow and exercise some, is all that he will require. Calves born before January first may be pastured the first summer if grained a little to secure maximum growth. If born after January first, it is better to keep them up, at least during the day, to be rid of the fly nuisance. A good grain mixture is three parts of an equal mixture of weight of hominy feed, wheat bran, ground oats, with one part of oil meal. Good legume hay, silage and four to six pounds of the above grain mixture should be very liberal feeding for the second six months. Perhaps the above suggestions are too liberal. Maximum growth is what is wanted and if that can be attained with less feed, that is all that is necessary.

The bull at twelve months is not to be considered mature by any means, but he should be ringed and taught that the one who controls him is master. If he has not been taught before, he should be taught to lead and be handled every day. If this is done and he knows who is master, a bull will rarely become ugly or hard to manage. At ten to twelve months he can be used for light service.

From now on exercise is the all important thing. Unless there is a particular reason for it, all animals, males and females, should be dehorned as calves. The sooner this becomes the fashion and it becomes the recognized thing, a great thing for the comfort of our animals and their caretakers will have been accomplished. When this has been done bulls may be turned together and they will get a great deal of exercise pushing and ramming each other around and will be much quieter and easier to handle.

Exposure to the weather will do no harm and is a positive factor for good if the exposure is not undue. Practically all that is needed, except in very severe climates, is a shed closed on three sides and open on the warm side to the paddock, where the bulls may run.

In herds where only one bull is kept, additional means must be provided to secure more exercise than the bull will take of his own accord. Then in herds where sales are going on all the time, and it is necessary to keep the herd bull in more or less of a show condition, he must be regularly exercised in a more artificial manner. A tread power will do this or he may simply be led or driven. The important thing is exercise and plenty of it. One of the most valuable bulls of the Holstein-Friesian breed is given two miles every day on the road. The owner considers that the time thus spent is more valuable than the same time spent in any other way.

The feed that the bull is given must be commensurate with the service and his condition. He should not be too fat, but must be in good rig. Clover or alfalfa hay, ten to fifteen pounds of silage, and two to ten pounds of grain is indicated. The silage should be restricted or he may become too paunchy to reach the cows. The grain mixture may be the one given above or a similar one, or may be the regular grain mixture given the herd. It should not be fattening, but should be rather bulky with plenty of protein, with at least a pound a day of oil meal.

In conclusion, we again call attention to the great value of the bull, value lost sight of because it is not so apparent each day as is the daily milk yield of the cows, but there, nevertheless; and to the great necessity of exercise for the aged herd bull every day, and then more exercise.

XXII. Forage Crops to Supplement Pasture

IT is a well known fact among dairymen that cows that once go down in milk do not readily come back again. Therefore it is very important that the milk flow be maintained on pasture. An expenditure for concentrates and forage crops at this time to main-

tain as nearly as may be the milk flow that is obtained on the flush of pasture, is probably the best investment for feed that the dairyman can make during the entire year. It does not seem to be enough, however, to feed concentrates entirely as a supplement, nor is it economical to do so. It seems to be as necessary to provide succulent feed, concentrates and perhaps some dry roughage, at this time when the cows are on pasture, as it is in winter when the cows are in the barn. We will take up the question of roughage first.

The writer is of the opinion that it is good practice to feed some hay in summer when the pastures begin to go dry. Some dairymen think it best to feed a little hay even at the flush of pasture. The writer is of this opinion but does not urge the practice, but would merely call it to the attention of dairymen as a subject for thought and perhaps trial.

We are convinced, however, that the cheapest and most convenient way to supplement pasture is to feed silage. Here are some of the reasons: First, it has been conclusively demonstrated in several trials that the cows will produce as much, seem as comfortable and keep up their appetites just as well when fed silage and grain and perhaps a little hay when on pasture, as when fed green crops, grain and hay when on pasture. Second, from any experiments that the writer has seen, the cost has always been in favor of the silage.

There is every reason to believe the two main facts just cited. In addition: (1) It is difficult to get proper succession of crops so that each is in its choicest condition when fed. Some crops will have to be fed when a little too green, others will have to be held too long. (2) It is necessary to plant small areas at different times, which is a nuisance in busy seasons. (3) When pastures suffer from drought the worst, and green crops are most needed, the green crops are also the poorest and lowest yield. With silage, an abundance of succulent feed is carried from year to year, and the effect of drought easily and most economically offset. (4) Green crops must be harvested in small quantities in all kinds of weather. It is practically necessary to harvest some every day because it is impossible to pile them even in small piles without some loss in palatability.

When silage is grown large fields are fitted most economically. The best use of labor and machinery is made in planting, cultivating, and harvesting the crop. Silage is of uniformly high quality at all times. Greater yields per acre are obtained with silage than with many crops used in a green crop system.

The only reason the author can find in favor of the growing of green crops, to supplement silage, is the value of variety in the ration, and the fact that it may not be best to feed a cow continuously on silage the year round. She will get some rest, however, in a system with silage as the only supplement, because in nearly every locality there is a flush season of pasture when probably

neither a succulent supplement nor a grain supplement will be needed.

The method of supplementing pasture with silage alone, grades into a second plan which involves the intermittent use of the silo. Advantage is taken of alfalfa and clover and a crop or two of peas and oats, when these crops are in prime condition, and silage is used in between. There will be some loss of silage in intermittent use, but the amount is small when the silage is near the bottom of the silo, because it is so tightly packed and fermentation has stopped. Care should be taken to keep the surface of the silo level, and to leave it as smooth and as little disturbed as possible when pitching off the last lot, when planning to use a green crop for a time. This plan has been used at Cornell University with success and with little loss. Which ever plan is used, the greatest success will be obtained if two silos are available, one with a larger diameter for winter feeding and one with a less diameter for summer feeding. The smaller the diameter the less surface will be exposed at any time and consequently the less chance of loss.

The third method of supplementing pasture will involve the use of green crops alone, and means a succession throughout the summer from about July 1st to November 1st. Such a succession may be obtained with the use of the following crops. The table is computed on the basis of the needs of 50 cows. The table is adapted from a table given in "Feeds and Feeding", by Henry and Morrison, and is quoted from Professor Voorhees of New Jersey. This plan then would be applicable to the latitude of southern New York, New Jersey, Pennsylvania, Ohio, etc.

Crop	Acres	Date of seeding	Period of cutting
Peas and oats.....	2	April 2	June 26-July 4
Peas and oats.....	2	April 11	July 5-July 10
Peas and oats.....	5	April 19	July 11-July 22
Southern white corn.....	2	May 2	July 23-Aug. 3
Barnyard millet.....	2	June 19	Aug. 4-Aug. 19
Soy beans.....	1	June 1	Aug. 20-Aug. 25
Cow peas.....	1	June 10	Aug. 26-Sept. 1
Second cutting clover or 3rd cutting alfalfa			Sept. 2-Sept. 16
Pearl millet.....	2	July 1	Sept. 17-Oct. 1
Cowpeas.....	1	July 24	Oct. 1-Oct. 5
Mixed grasses.....			Oct. 5-Nov. 1

It is not claimed that the above outline is the best that may be suggested. It is merely a suggestion to indicate the crops that may be used for the purpose discussed in this paper, with the probable acreage needed for fifty cows, the time of seeding, and the approximate time when the crop would be in prime condition to be fed green. Each individual dairyman must work out his own system. All dairyman must feed some supplementary feeds and can best plan his work through the use of silage.

The mixture of concentrates to be fed on pasture does not present a very serious question. Enough must be fed with the green crops or silage to maintain the milk flow. Do not let the cows shrink. A somewhat heavier mixture may be fed than in winter

Feeding Dairy Cattle

if the market considerations should demand such. The concentrates should be chosen as indicated in the earlier articles in this series. High protein feeds should constitute one-half the mixture of concentrates and bulky foods perhaps about one-third the mixture by weight. If the market would indicate such a choice, the following would serve the purpose to good advantage:

- 500 pounds corn meal
- 400 pounds distillers' dried grains
- 500 pounds mixed feed
- 400 pounds gluten feed
- 200 pounds cottonseed meal

PIETERTJE HENGERVELD SIR KORNDYKE
Third prize winner at the National Dairy Show, 1916

For Men Who Lead

THE World is for leaders. It is for the men who want the best—in cattle—in information regarding them—in newspaper service, including news, editorials and pictures.

It is a weekly newspaper printed for the breed. Its motto is, "Worthy of the Breed," and the hoisting of this flag means that the World must live up to a high standard to be worthy of the noble Holstein-Friesian cow and an adviser to the men whose fortunes are associated with her success.

The World reaches more real live red-blooded Holstein men to-day than any other paper of its class. It goes to them in a way that they like to have their trade paper appear, cleanly printed, beautifully illustrated and carefully edited. Its a pleasure for them to pick it up and to read it.

Your message carried to this class of buyers through the medium of the Holstein-Friesian World is thus guaranteed a hearing. These men who buy and sell Holsteins will listen to you if you talk to them through the World. If you are not advertising in the World you are not doing yourself or your herd full justice.

Let us tell you more about our advertising rates, space, etc., and let us help you plan a campaign of advertising. Address either office.

HOLSTEIN-FRIESIAN WORLD

Syracuse, N. Y.

Waterloo, Iowa

LIBRARY OF CONGRESS

0 002 821 994 5