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DAIRYING IN OKLAHOMA

SECTION ONE

SOME RESULTS OBTAINED IN FEEDING DAIRY COWS

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SECTION TWO

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SECTION THREE

CARE AND MANAGEMENT OF DAIRY CATTLE

BY C. I. BRAY, ANIMAL HUSBANDRY

STILLWATER, OKLAHOMA

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SECTION ONE

Some Results Obtained In
FEEDING DAIRY COWS

BY ROY C. POTTS
Department of Dairy Husbandry

Part I—Alfalfa vs. Cowpea Hay.
Part II—Prairie vs. Bermuda Hay.
Part III—Roots vs. Wheat Pasture.
Part IV—Bermuda vs. Prairie Pasture.

INTRODUCTION

The results of the feeding experiments with dairy cows reported in this bulletin by Professor Potts were obtained during the year ending September 1, 1907. The cows used in the feeding experiments were leased by the Agricultural Experiment Station from a dairyman who was supplying milk to customers in the City of Stillwater. The general plan of conducting the feeding work given in this bulletin was to select a number of cows of about equal weight and production and divide them into two lots. Then, to compare the two rations, one lot was fed for two weeks on one ration and then changed to the other ration for two weeks, and thus alternately fed throughout the feeding period. Lot 1 was always fed the opposite ration of Lot 2.

The results obtained in the feeding work are divided into four parts as follows:

Part 1.—A Comparison of Alfalfa vs. Cowpea Hay.
Part 2.—A Comparison of Prairie vs. Bermuda Hay.
Part 3.—A Comparison of Roots vs. Wheat Pasture.
Part 4.—A Comparison of Prairie vs. Bermuda Pasture.

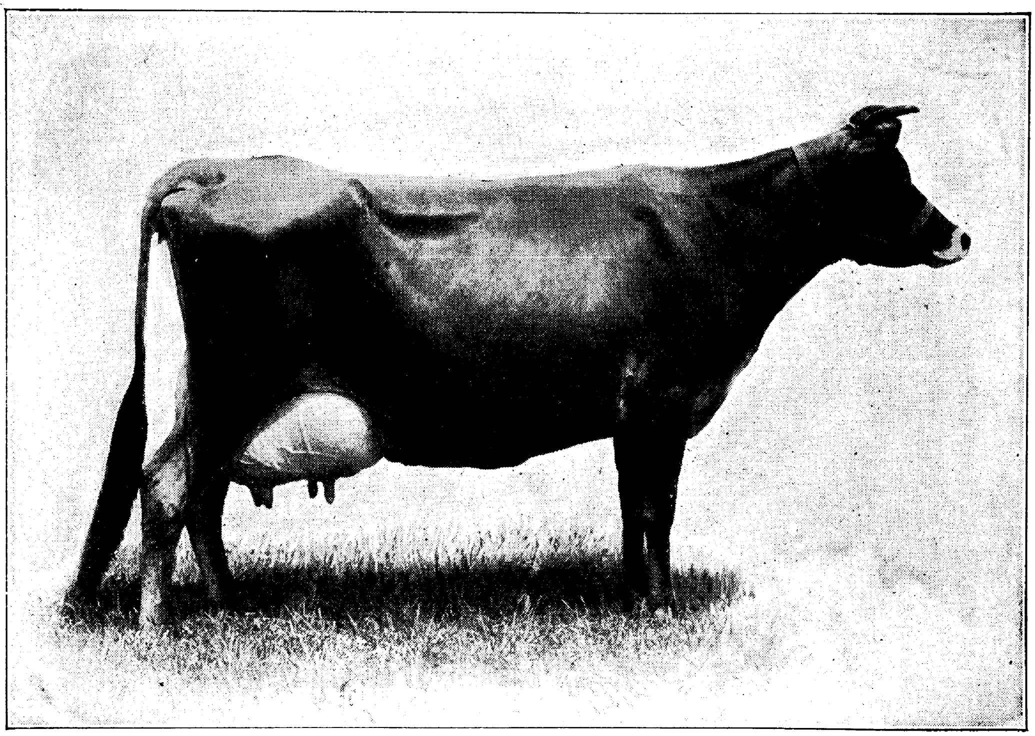
OBJECTS OF THE EXPERIMENTS

Much land in Oklahoma is not adapted to the production of alfalfa, which is considered the best hay crop for dairy cattle feeding. This land, however, is adapted to the growing of cowpea hay, and as cowpea hay is rich in protein and had been grown very successfully, there arose the question: "What is the comparative feeding value pound for pound of alfalfa and cowpea hay?"

The extensive setting of Bermuda on lands where it could be cut for hay and its questionable value as a hay crop for feeding dairy cows led to a test of its feeding value for dairy cows in comparison with the native prairie hay which can be cut from the unbroken prairie pastures.

A comparison of roots vs. wheat pasture is given in Part III. Wheat pasture was quite generally used in winter and spring feeding as it supplied a nutritious and succulent part of the ration. Roots might be considered a substitute for wheat pasture. At present corn and kafir silage is taking the place of both of them, and probably will on most dairy farms be used entirely as a substitute.

A comparison of Prairie vs. Bermuda pasture is given in Part IV. The higher protein content of Bermuda grass as compared with prairie grass, as shown by chemical analysis, was generally known, and the greater tonnage production per acre of Bermuda hay over prairie hay when the Bermuda lands were properly handled was also generally recognized. Would the dairy cow, when allowed to graze at will over pastures of these grasses, obtain better results as indicated by her milk and butterfat production when on Bermuda than on prairie pastures?



Jersey Cow, Bosnian's Anna

Champion in International Show, Chicago, 1910; was on test for Advanced Register and made over 600 pounds of butter while traveling thousands of miles over the fall show circuits, proving that beauty and productive ability could be satisfactorily combined in the same animal. The Jersey is a medium sized breed, gives rich milk, and produces butter economically. Colors, fawn, brown, squirrel gray or black, with or without white spots.

PART I

ALFALFA VS. COWPEA HAY FOR DAIRY COWS

A comparison of alfalfa and cowpea hay, as indicated by the milk and butterfat produced by seven cows in a twenty weeks' feeding period is reported here. The experiment was conducted as per the plan outlined below. The results and data may be subject to some criticism as they have not been verified by later experiments. The grain mixture fed and nutritive ratio of the ration also might be criticised from the standpoint of scientific feeding; however, this ration is used quite generally by farmers in the State, and the results indicate in a general way what they would expect to obtain.

PLAN OF THE EXPERIMENT

The cows were divided into two lots. Cows numbered 2 and 10 were high grade Jerseys. The others were grade Shorthorns.

Lot 1 consisted of cows numbered 2, 10, 9 and 20. Lot 2 of cows numbered 7, 17 and 4. The first two weeks (14 days) Lot 1 was fed the ration containing alfalfa hay, and then for two weeks the ration containing cowpea hay. Lot 2 was fed the cowpea hay ration the first two weeks, and then for two weeks the alfalfa ration. Throughout the twenty weeks' feeding period the alternating change of rations every two weeks with each lot was continued. At the beginning of a new period each cow was given the same weight of alfalfa or cowpea hay she closed with two weeks previous, and then the quantity was increased or diminished as she would eat more or less of it. All waste feed was cleaned out as fast as any accumulated in the manger, and this was deducted from that given, so that in the tables the figures give only what was consumed. Very little waste accumulated, as both the alfalfa and cowpea hay were free from weeds and carefully cured.

The grain mixture was composed of 1 part cotton seed and 2 parts corn meal.

The feed given to each cow was carefully weighed and the weights accurately recorded and kept.

The milk produced was weighed at each milking. Composite samples were taken daily of each cow's milk and tested weekly for butterfat.

The cows were weighed before feeding each morning on three successive days each two weeks, the first day being the last day of the period before the ration was changed.

The following is a summary of the results of the ten weeks' feeding period of each cow on each ration:

Table of Feed Consumed and Milk and Butter Produced By Each Cow

No. of Cow	Weight of Cow During Experiment		Pounds Hay Consumed		Pounds of Grain Consumed	Pounds of Milk Produced	Pounds Butter-fat Produced
2	Beginning	632	Alfalfa	803	702	1150	64.815
	End	663	Cowpeas	869.5	700	1148	66.133
10	Beginning	828	Alfalfa	953	835	1425	66.250
	End	860	Cowpeas	1122	830	1385	66.304
9	Beginning	888	Alfalfa	915	840	1127.5	52.952
	End	873	Cowpeas	1141	840	1445	55.929
20	Beginning	855	Alfalfa	918	827	1516.5	62.913
	End	858	Cowpeas	1053.5	840	1416.5	62.911
7	Beginning	812	Alfalfa	1053.5	840	1416.5	62.911
	End	782	Cowpeas	756	838	1365.5	52.945
17	Beginning	960	Alfalfa	1060	840	1397.5	58.796
	End	977	Cowpeas	969	840	1341	55.713
4	Beginning	932	Alfalfa	1167	840	1393.5	62.579
	End	957	Cowpeas	953	840	1273	56.021

In this table it will be noted that the quantity of grain fed to each cow while she was consuming the different hays was about the same, so the influence of grain on production with both hays was nearly the same. It will also be noted that some cows showed a preference for the alfalfa by consuming more of it than of the cowpea hay, as with 7, 17 and 4, while the others had a greater desire for the cowpea hay. These differences are probably due to individual preference of the cows, so have but little significance.

A summary of the food and production of all the cows shows but little appreciable difference in the feeding value of the two kinds of hay.

Summary Table of Food Consumed and Production

Total Pounds Hay Consumed By 7 Cows in 70 Days.		Pounds Grain Consumed	Pounds of Milk Produced	Pounds Butterfat Produced	Per Ct Fat in Milk
Alfalfa	6777.5	5715.5	9370	420.604	4.49
Cowpeas	6904	5728	9074	415.958	4.58

The results do not show a great difference in these two hays. The farmer who has not the land adapted to the growing of alfalfa has in cowpea hay a close substitute for alfalfa.

Summary of Conclusions

1. There was an apparent individual preference shown by some of the cows for alfalfa and by others for the cowpea hay.

2. With some cows there was as much as 20 per cent more of one hay consumed than of the other.

3. Of the total amount of each hay consumed by the cows there was a little less than 2 per cent more of the cowpea hay than of the alfalfa.

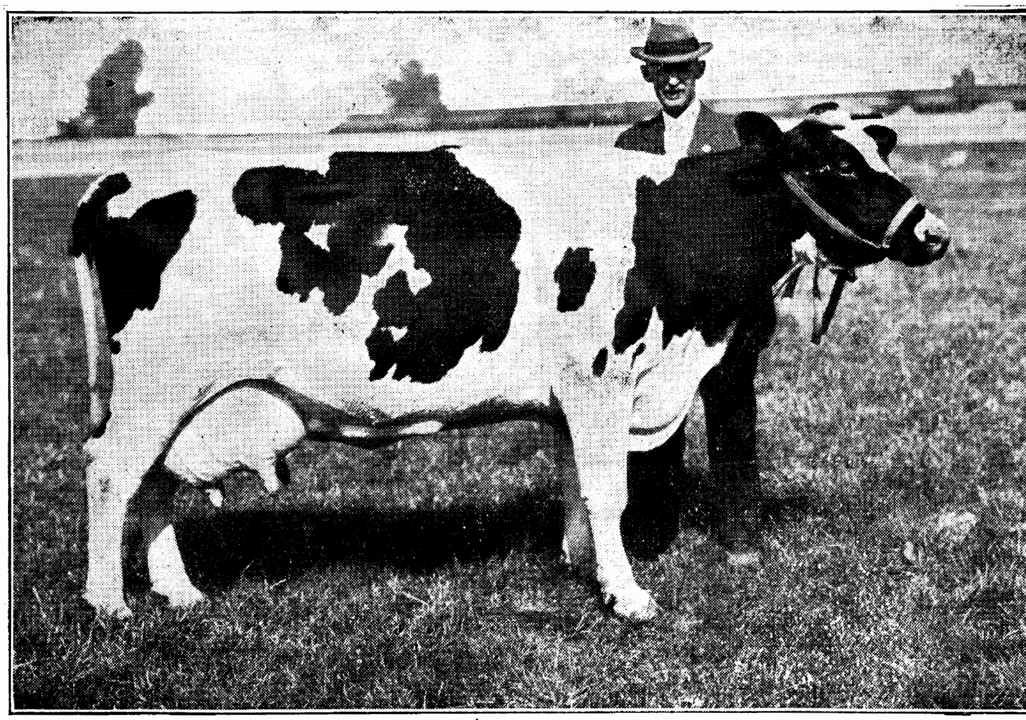
4. For milk and butterfat production, cowpea hay seems to have a feeding value closely equal to that of alfalfa, and we believe that where cowpeas can be successfully grown and alfalfa cannot, the dairy cattle feeder will find them his best feed as a dry roughage.

PART II

PRAIRIE VS. BERMUDA HAY FOR DAIRY COWS

This experiment was conducted as per the outline and plan of the experiment reported in Part I.

The prairie hay used was of good quality, being grown on the Station Farm. The Bermuda was of fine quality, being obtained at three cuttings from the first year's crop, which made over five tons per acre that year.



Holstein Cow

Champion at International Dairy Show, 1910. A good producing type, as well as a show animal. The Holstein is the greatest milk producing breed, and though the per cent of butterfat is lower than with some other breeds, the total amount of butter produced is often very great. The record for butter production for one year is held by a Holstein. They are large cattle, and should be given abundance of good feed and pasture for best results. Color black and white.

Eight grade Shorthorn cows were selected from the herd for this feeding experiment.

They were divided into two lots of as near equal weight and production as possible. One lot was fed two weeks on the prairie ration and the other on the Bermuda. Then the rations were reversed during the next fourteen days, and alternately each two weeks throughout the feeding period of sixteen weeks.

The grain mixture used in this experiment was composed of 2 parts cottonseed and 1 part cottonseed meal.

The feeding, milking and weighing of the cows was conducted as stated in the plan of the experiment reported in Part I of this bulletin.

Following is a summary of the data for each cow of the pounds of feed consumed and milk and butterfat produced in the sixteen weeks:

Table of Feed Consumed and Milk and Butterfat Produced By Each Cow

No. of Cow	Kind of Hay.	Pounds Hay Consumed	Pounds Grain Consumed	Pounds Milk Produced	Pounds Butterfat Produced
8	Prairie	682	672	986	48.069
	Bermuda	541	672	940.5	46.568
12	Prairie	646.5	560	834.5	45.253
	Bermuda	532	560	765	41.719
6	Prairie	683	672	941.5	48.681
	Bermuda	576	644	811.5	41.442
22	Prairie	643.5	560	640	36.959
	Bermuda	565	560	594.5	34.658
13	Prairie	673.5	560	544.5	25.239
	Bermuda	532.5	560	556.5	26.272
19	Prairie	703	644	561	26.369
	Bermuda	554	672	555.5	26.970
28	Prairie	708	672	1193.5	53.600
	Bermuda	524	672	1066	48.570
11	Prairie	699	560	1006.5	48.490
	Bermuda	469.5	560	949.4	45.378

Some explanation may be due here about this lot of cows. They were average cows as their milk records indicate. Numbers 28 and 11 were just fresh, and 22 and 19 had been in milk about eight weeks. The other four had been fresh for five months. No. 13 began to decline in her milk flow about the fifth week and dropped about one pound of milk per week for the rest of the feeding period, and went dry soon afterward, so her records are not the most satisfactory, but are given more to show her greater desire for prairie than for Bermuda hay.

It will be noted that with every cow except Nos. 6 and 19 the pounds of grain eaten with each hay was the same, but with those two the lesser number of pounds (28 pounds) was placed with opposite hays so that the total number of pounds of grain fed with each hay was the same, and any error arising would in a measure be balanced.

It will also be noted that each cow consumed more of the prairie than of the Bermuda hay, and produced more milk and butterfat from that ration with the exception of Nos. 13 and 19.

The following is a summary table giving the quantity of each food consumed and of milk and butterfat produced by the eight cows during the eight weeks they were fed each kind of hay:

Summary Table of Food Consumed and Production

Total Pounds Hay Consumed by 8 Cows in 56 Days.		Pounds Grain Consumed	Pounds Milk Produced	Pounds Butterfat Produced	Per Cent Fat in Milk
Prairie	5439	4900	6816.5	332.662	4.90
Bermuda	4294	4900	6238	317.580	5.09
Increase on prairie hav	1145		578.5	15.282	

It is apparent here that the prairie hay was more palatable for the dairy cow than Bermuda hay, since more of it was consumed. Prairie hay also gave the larger production of milk and butterfat.

Other Data on Bermuda and Prairie Hay

The following data was obtained from four of the cows which were continued on separate rations of either Bermuda or prairie hay for eight weeks following the close of the sixteen weeks' feeding period, which is reported above. Two of these cows were fed exclusively on the grain ration with all the prairie hay they would eat, and two on the Bermuda with grain. The grain mixture fed was composed of 2 parts cottonseed and 1 part cottonseed meal.

This work was taken up March 18, 1907, after they had been on dry feed for nearly twenty weeks. The usual decline in milk flow begins at this season.

Table of Feed Consumed and Milk and Butter Produced By Four Cows on Continued Feed of Either Prairie or Bermuda Hay for Eight Weeks

Cow No. 8

Pounds Bermuda Hay.		Pounds Grain.	Pounds Milk.	Pounds Butterfat.
First week	66	84	98.5	5.20
Second week	59	84	103.5	5.17
Third week	70	84	107.5	6.81
Fourth week	62	84	106.0	6.15
Fifth week	64	84	104.5	5.85
Sixth week	68	84	103.0	5.46
Seventh week	70	84	77.0	4.00
Eighth week	67	84	67.5	2.70
Total	526	672	767.5	41.34

Cow No. 11

Pounds Bermuda Hay.		Pounds Grain.	Pounds Milk.	Pounds Butterfat.
First week	63	70	101.0	4.44
Second week	59	70	90.0	4.50
Third week	52	70	90.5	4.34
Fourth week	47	70	86.0	4.04
Fifth week	45	70	74.0	3.62
Sixth week	39	70	71.5	3.23
Seventh week	42	70	61.5	2.93
Eighth week	39	70	59.5	2.50
Total	386	560	634.0	29.60

Cow No. 6

Pounds Prairie Hay.		Pounds Grain.	Pounds Milk.	Pounds Butterfat.
First week	87	84	103.5	5.38
Second week	95	84	111.0	5.55
Third week	98	84	109.0	5.23
Fourth week	98	84	94.0	5.07
Fifth week	110	84	91.5	5.03
Sixth week	112	84	83.5	4.50
Seventh week	112	84	62.0	3.66
Eighth week	110	84	48.5	2.67
Total	822	672	703.0	37.09

Cow No. 12

Pounds Prairie Hay.		Pounds Grain.	Pounds Milk.	Pounds Butterfat.
First week	86	70	74.0	5.82
Second week	95	70	110.5	5.97
Third week	98	70	111.5	5.89
Fourth week	98	70	99.0	5.35
Fifth week	101	70	86.5	5.36
Sixth week	98	70	88.5	5.19
Seventh week	98	70	73.0	4.82
Eighth week	97	70	61.0	3.72
Total	771	560	704.0	42.12

It will be noted that with all the cows there was a great decline in milk flow. The point in particular which this table illustrates is that there was an increased amount of prairie hay consumed by No. 6 and a gradual diminishing of Bermuda by No. 11, while Nos. 8 and 12 held to about the same amount of the separate rations as they started with at the beginning of the period. With both the cows fed Bermuda, more grain was consumed than of hay. From the results obtained we may draw the following conclusions:

Summary of Conclusions

1. The Bermuda hay did not seem to be as palatable for the dairy cows as prairie hay, since less of it was consumed.

2. It was not so conducive to a large flow of milk as it produced about 9 per cent less milk and 5 per cent less butterfat.

3. For economical production, the prairie hay gave the larger yields and better returns.

4. It would not be economical for a farmer to set his best land to Bermuda with the intention of cutting it for hay for dairy cows, but rather to set Bermuda on the rougher uplands, draws and waste land, and use it more generally as a pasture grass.

PART III

ROOTS VS. WHEAT PASTURE

In this experiment the production of four cows, which were given 10 pounds of roots, (sugar beets) daily in addition to their regular ration is compared with that obtained on the alternate weeks when they were allowed to graze one hour per day on wheat pasture and no roots were fed, the purpose being to determine if 10 pounds of roots were equal to one hour grazing on wheat pasture. This experiment began March 18 and ended April 15, 1907. The grain mixture fed was composed of 1 part cottonseed and 2 parts corn meal.

The following is a summary of the results obtained from each cow when on wheat pasture one hour daily:

No. of Cow	Number of Weeks Fed	Pounds Cowpea Hay Consumed	Pounds of Grain Consumed	Hours on Wheat Pasture	Pounds of Milk Produced	Pounds Butter-fat Produced
3	2	92	168	14	355.5	13.69
18	2	117	168	14	258.5	9.82
25	1	63	59	7	130.0	4.68
29	1	67	84	7	134.0	6.70
Total	6	339	479	42	878.0	34.89

The following is a summary of the results obtained from each cow when fed 10 pounds of roots (sugar beets) daily:

No. of Cow	Number of Weeks Fed	Pounds Cowpea Hay Consumed	Pounds Grain Consumed	Pounds Roots Consumed	Pounds Milk Produced	Pounds Butter-fat Produced
3	2	141	168	140	330	13.18
18	2	145	168	140	257	9.52
25	1	51	45	70	136.5	4.64
29	1	70	84	70	144.5	6.35
Total	6	407	465	420	868.0	33.69

Conclusions

A comparison of the foregoing tables indicates that one hour grazing on wheat pasture is more than equivalent to 10 pounds of roots, since the production as a whole was greater while the cows were on the pasture and less dry hay was consumed. With one cow (No. 25) we note an increased consumption of grain and hay when on the pasture.

PART IV

BERMUDA VS. PRAIRIE PASTURE

This experiment began July 1 and ended August 26, 1907. Six cows were selected for this experiment. Cows Nos. 1, 3 and 9 were pastured on Bermuda the first two weeks, while Nos. 10, 15 and 18 were on prairie pasture. Then the two lots were transferred on the pasture for the next two weeks and then again transferred each two weeks during the eight weeks of the experiment. The grass on the two pastures was considered about equal. The cows when on the Bermuda pasture were tethered on a twenty-foot rope tied to a stake, which was moved three or four times daily. Water was carried to the cows twice daily when tethered out. No grain was fed during this experiment.

The following is a summary of the results of each cow for four weeks on each pasture:

No. of Cow.	Kind of Pasture.	Pounds of Milk Produced.	Pounds Butterfat Produced.
1	Bermuda	334.5	14.560
	Prairie	297.0	13.240
3	Bermuda	381.0	14.088
	Prairie	272.5	9.757
9	Bermuda	767.5	27.786
	Prairie	590.0	22.039
10	Bermuda	282.0	13.527
	Prairie	341.0	15.900
15	Bermuda	436.0	15.213
	Prairie	402.0	13.398
18	Bermuda	147.5	3.998
	Prairie	164.5	4.866

In this table it will be noted that cows numbered 10 and 18 here "proved the exception to the rule" and placed their largest production while on the prairie pasture.

The following summary table of the production of all cows indicates a higher food value for the Bermuda pasture:

Kind of Pasture.	Pounds Milk Produced.	Pounds Butterfat Produced.
Bermuda	2348.5	89.17
Prairie	2067.0	79.00

These results are very gratifying in favor of the Bermuda and in contrast to the results of the Prairie vs. Bermuda Hay experiment given in Part II proves that Bermuda is essentially a pasture grass.

The chemical composition of Bermuda hay when compared with prairie hay, as obtained at the Oklahoma Experiment Station*, is as follows:

* Bulletin No. 90, Oklahoma Experiment Station, 1910.

	Water	Ash	Protein	Fiber	Nitrogen-free Extract	Fat	Number Analysis
Bermuda, first year average	7.38	9.13	18.72	21.57	40.71	2.49	18
Bermuda, second year average	6.52	8.03	11.91	24.85	46.60	2.09	16
Bermuda, third year average	10.74	6.43	11.95	24.15	44.84	1.89	13
Oklahoma prairie hay	8.116	7.671	4.375	35.063	42.636	2.137	4

The reported production of dry, cured hay, of which the Bermuda analyses given above were obtained, was as follows:

First season 5,850 pounds per acre,
Second season, 1,635 pounds per acre.
Third season, 1,667 pounds per acre.

During the season of 1906, 28,260 pounds of cured Bermuda hay was cut from a plot of two and one-half acres at three cuttings, which is a yield of 5.08 tons per acre. This yield is reported in the October, 1906 Press Bulletin of the Oklahoma Experiment Station, which states that "land of the very same nature adjoining this field does not produce over one-half ton of prairie hay of inferior quality".

Conclusions

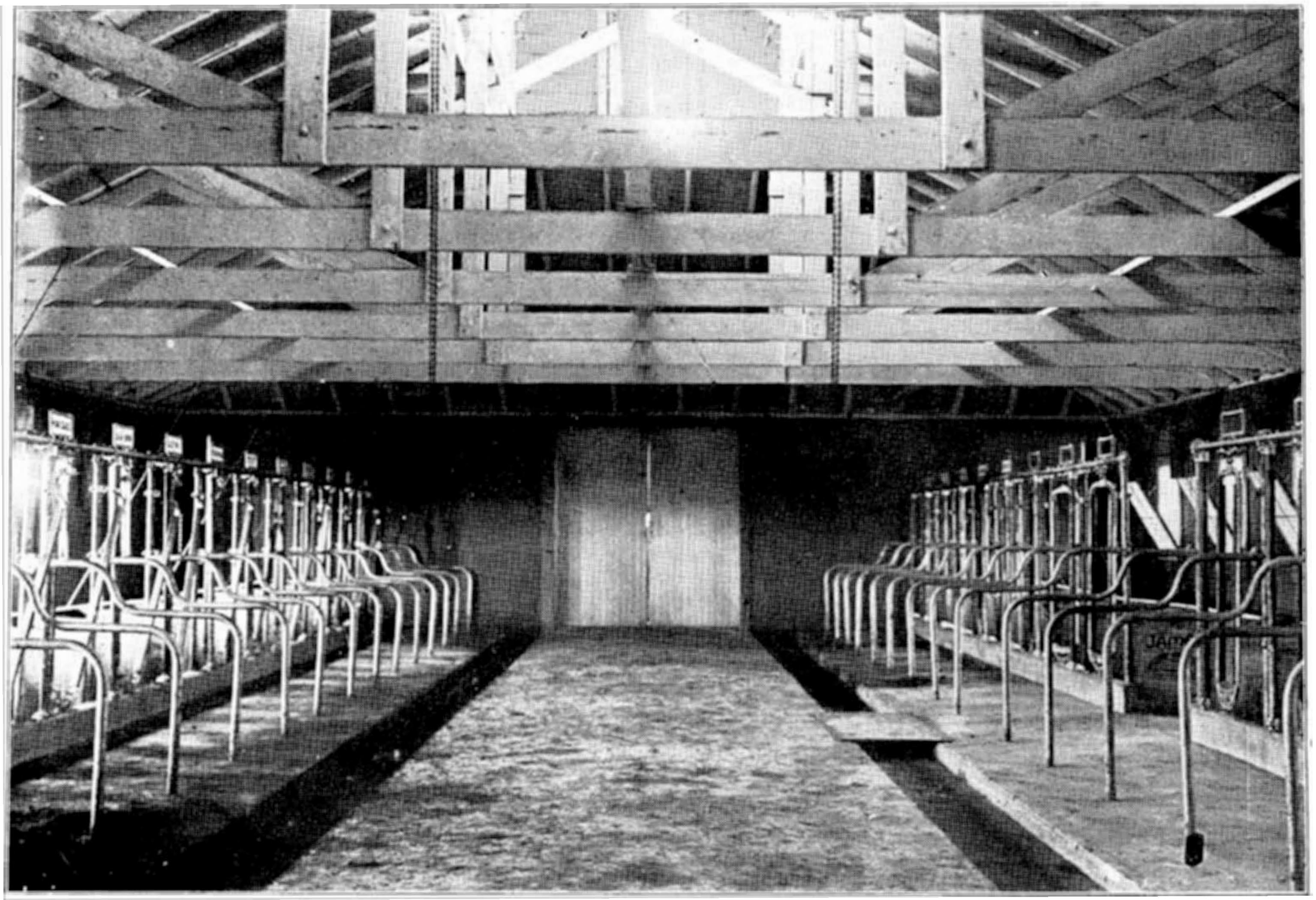
1. The results indicate a higher feeding value for the Bermuda pasture grass than for the prairie.

2. Four of the six cows produced more milk and butterfat when on the Bermuda pasture.

3. The total milk production was 13.6 per cent higher when the cows were on the Bermuda pasture.

4. The total butterfat production was 13.8 per cent higher when the cows were on the Bermuda pasture.

5. A comparison of these results with those given in Part II would indicate that Bermuda is more valuable as a pasture grass than as a hay and should be so used.



Interior View of Oklahoma A. and M. College Dairy Barn

Sanitary and permanent construction is represented in this view. The production of pure milk calls for absolute cleanliness. Economy demands permanence.

SECTION TWO

PRINCIPLES OF FEEDING, FEEDING DAIRY CATTLE AND EXPERIMENTS IN MILK PRODUCTION

BY C. I. BRAY
Department of Animal Husbandry

Part I—Principles of Feeding, With Notes on Feeding Stuffs.
Part II—Notes on Feeding Dairy Cows.
Part III—Experiments in Feeding Dairy Cattle.

PART I

PRINCIPLES OF FEEDING, WITH NOTES ON FEEDING STUFFS

On account of the numerous inquiries regarding feeding stuffs and the calculation of rations it may be advisable before discussing practical methods of feeding to give briefly the principles of animal nutrition and a short study of feeding stuffs and feeding standards.

The subject may be divided into at least three parts:

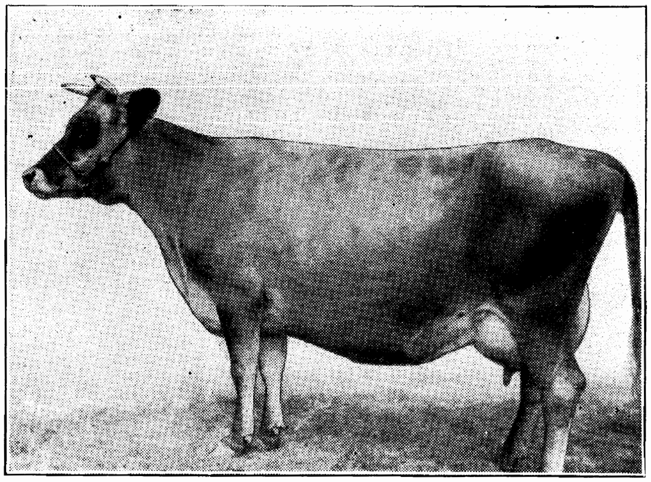
1. A consideration of the nature and values of feeding stuffs, and the nutrients they contain.
2. A study of the individual requirements of animals, and how these may best be satisfied.
3. In addition to these, and the relation of each to the other, the stock feeder must consider the market cost of feedstuffs, and the cost of production of animal products.

Scientific stock feeding, therefore, may be said to deal with the problem of supplying, without waste, all necessary nourishment for any class of farm animals, taking into consideration the question of economy and financial profit.

General Composition of Feeding Stuffs

For convenient classification, plant substances are grouped under the following heads:

1. Protein (nitrogenous material), which may be represented by wheat gluten, similar to lean meat or the white of egg. This is used to build up the internal organs, muscles and nerves, especially in the young animal.



Carrie Gordon's Best

The first cow in Oklahoma to enter the Advanced Register of the American Jersey Cattle Club on a year's test. Record 8,545 pounds milk, 496 pounds butter. Other cows in herd have since tested as follows: Janet Carter, 521 pounds butter; Eminent's Beth, 515 pounds butter; Fox's Owaneco, 478 pounds butter. Total for four cows, 2,010 pounds butter, or 1 ton 10 pounds. Owned by Oklahoma A. and M. College Animal Husbandry Department.

2. Carbohydrates, represented by sugars, starches and the digestible part of the fiber. These supply heat and energy, and may be stored in the body in the form of fat.

3. Fats or oils, such as cottonseed oil, corn oil, etc., which fulfill the same uses in the body as the carbohydrates, but have more than double the heat and energy value.

4. Fiber, or woody matter, only a small part of which is digestible.

5. Mineral matter or ash. This remains when a sample is burned. Is needed for the building of the animal skeleton. Examples are: Lime, salt, phosphorus and potash.

6. Water, which is present in greater or less amounts in all feedstuffs, has no direct nutritive value, but is required in large quantities in the animal body.

Classification of Feeds

Feedstuffs are classified according to the relative proportions of the above groups of substances in each, as follows:

Concentrates, feeds containing a large amount of digestible nutrients, such as cereal grains, mill feeds, etc. **Roughages,** bulky feeds containing a large amount of fiber, as corn stover, straw, hay or cottonseed hulls. **Succulent feeds,** those containing a large amount of water, as silage and roots. **Nitrogenous feeds,** those containing a proportionally large amount of protein. Examples: Cottonseed meal, linseed meal and alfalfa. **Carbonaceous feeds,** those containing a large proportion of starches and sugars, as corn or kafir corn.

The following table taken from Henry's "Feeds and Feeding" shows the average amount of digestible nutrients and mineral or fertilizing constituents in our common feedstuffs, as determined by many Experiment Stations. As only the digestible part of a feedstuff is of use to the animal, this table shows the **digestible nutrients** rather than the chemical composition:

TABLE I

Digestible Nutrients in Feedstuffs

Name of Feed	Total Dry Matter in 100 lbs.	Digestible Nutrient			Fertilizing Constituents in 1000 lbs.		
		Crude Protein	Carbohydrates	Fat	Nitrogen	Phosphoric Acid	Potash
Concentrates—over 20% protein:							
Peanut cake	89.3	42.8	20.4	7.2	76.2	20.0	15.0
Cottonseed meal	93.0	37.6	21.4	9.6	72.5	30.4	15.8
Linseed meal—new process	91.0	31.5	35.7	2.4	60.0	17.4	13.4
Linseed meal—old process	90.2	30.2	32.0	6.9	54.2	16.6	13.7
Gluten meal	90.5	29.7	42.5	6.1	54.8	3.3	0.5
Soy beans	88.3	29.1	23.3	14.6	53.6	10.4	12.6
Peanut kernels	92.5	25.1	13.7	35.6	44.6	12.4	12.7
Over 10% protein							
Cowpeas	85.4	16.8	54.9	1.1	32.8	10.1	12.0
Cottonseed	89.7	12.5	30.0	17.3	29.4	10.5	10.9
Wheat middlings	88.8	13.0	45.7	4.5	27.0	26.3	15.3
Wheat bran	88.1	11.9	42.0	2.5	24.6	26.9	15.2
Oats	89.6	10.7	50.3	3.8	18.2	7.8	4.8
Oatmeal	92.1	11.9	65.1	6.7	23.5	......	......
Carbonaceous—less than 10% protein							
Corn meal	85.0	6.7	64.3	3.5	14.7	6.3	4.7
Corn and cob meal	84.9	4.4	60.0	2.9	13.6	5.7	4.7
Wheat	89.5	8.8	67.5	1.5	19.0	5.5	8.7
Rye	91.3	9.5	69.4	1.2	18.1	8.6	5.8
Barley	89.2	8.4	65.3	1.6	19.2	7.9	4.8
Buckwheat	86.6	8.1	48.2	2.4	17.3	6.9	3.0
Rice	87.6	6.4	79.2	0.4	11.8	1.8	0.9
Rice bran	90.3	7.6	38.8	7.3	19.0	2.9	2.4
Rice polish	89.2	7.9	58.6	5.3	19.0	26.7	7.1
Kafir corn meal	90.1	5.2	41.3	1.4	17.9	......	......
Ground kafir corn heads	86.4	4.2	42.4	1.2	14.7	......	......
Sorghum seed	87.2	4.5	61.1	2.8	14.6	8.4	3.4
Broomcorn seed	87.2	4.6	42.2	1.5	15.8	7.2	5.2
Milo maize	91.0	4.9	44.8	1.3	17.1	......	......
Dried roughage—best grade, leguminous							
Alfalfa hay	93.2	11.1	39.1	0.6	24.7	6.1	17.9
Hairy vetch	88.7	11.9	40.7	1.6	27.2	9.7	24.4
Soy bean hay	88.2	10.6	40.9	1.2	23.8	......	......
Cowpea hay	89.5	5.8	39.3	1.3	14.3	5.2	14.7
White clover	90.3	11.5	42.2	1.5	25.1	7.8	13.2
Red clover	84.7	7.1	87.8	1.8	19.7	5.5	18.7
Second grade roughage							
Corn fodder	57.8	2.5	34.6	1.2	7.2	5.4	8.9
Timothy hay	86.8	2.8	42.4	1.3	9.4	3.3	14.2
Kentucky bluegrass hay	86.0	4.4	40.2	0.7	12.5	4.0	15.7
Bermuda hay	92.9	6.4	44.9	1.6	17.1	......	......
Johnsongrass hay	89.8	2.9	45.6	0.8	11.5	......	......
Prairie hay	90.8	3.0	42.9	1.6	9.9	......	......
Sorghum fodder—Hoard's Dairyman	59.7	1.5	37.3	0.4	......	......	......

Name of Feed	Total Dry Matter in 100 lbs.	Digestible Nutrient			Fertilizing Constituents in 1000 lbs.		
		Crude Protein	Carbohydrates	Fat	Nitrogen	Phosphoric Acid	Potash
*Kafir corn, field cured	90.35	2.15	x 53.5	......	......	......	......
Third grade roughage							
Corn stover—ears removed	59.5	1.4	31.2	0.7	6.1	3.8	10.9
Corn husks	49.1	0.8	33.8	0.2	4.0	......	......
Wheat straw	90.4	0.8	35.2	0.4	5.0	2.2	6.3
Oat straw	90.8	1.3	39.5	0.8	5.8	3.0	17.7
Millet straw	85.0	0.9	34.3	0.6	6.5	1.8	17.3
Soybean straw	89.9	2.3	40.1	1.0	6.8	2.5	13.2
Cottonseed hulls	88.9	0.3	33.2	1.7	6.7	4.3	10.4
Green Roughage—Leguminous							
Alfalfa	28.2	3.6	12.1	0.4	7.7	1.3	5.6
Red clover	29.2	2.9	14.9	0.7	7.0	1.5	4.8
Cowpeas	16.4	1.8	8.7	0.2	3.8	1.3	4.6
Soy bean	24.9	3.1	11.0	0.5	6.4	1.4	5.6
Non-Leguminous							
Fodder corn	20.7	1.0	11.9	0.4	2.9	1.1	2.9
Kafir corn	18.4	0.8	9.7	0.4	2.9	1.3	4.5
Teosinte	9.9	0.9	4.9	0.2	2.2	0.6	9.2
Yellow milo maize	16.8	1.1	9.3	0.3	2.7	1.1	5.7
Sorghum fodder	20.6	0.6	11.6	0.3	2.1	0.7	3.4
Sugar cane	15.8	0.5	9.5	0.3	1.9	0.9	4.4
Pasture grass	20.0	2.5	10.1	0.5	5.6	2.6	7.4
Kentucky Bluegrass pasture	34.9	2.8	19.7	0.8	6.6	......	......
Bermuda pasture	28.3	1.3	13.4	0.4	3.5	......	......
Wheat forage	22.7	1.7	12.0	0.4	3.8	1.6	6.0
Oats forage	25.0	2.6	11.0	0.6	5.6	......	......
Common millet	20.0	0.8	11.0	0.2	2.4	0.7	4.7
Succulent feed—Silage							
Corn silage	26.4	1.4	14.2	0.7	4.3	1.1	3.7
Corn—ears removed							
Sorghum silage	23.9	0.1	13.5	0.2	1.3	1.5	1.9
Millet silage	26.0	0.2	13.1	0.6	2.7	1.4	6.2
Roots, etc.							
Potato	20.9	1.1	15.7	0.1	3.4	1.6	5.8
Sugar beet	13.5	1.3	9.8	0.1	2.9	0.8	3.7
Flat turnip	9.9	0.9	6.4	0.1	2.1	0.9	3.4
Carrot	11.4	0.8	7.7	0.3	1.8	0.9	2.6
Sweet potato	28.9	0.8	22.9	0.3	2.4	0.8	3.7
Dwarf Essex rape	15.0	2.0	8.1	0.2	3.7	......	......
Garden pumpkin	19.2	1.4	8.2	0.4	2.9	1.6	0.9
Dried beet pulp	91.6	4.1	64.9	12.9	12.9	2.2	3.1
Miscellaneous feeds							
Cow's milk	12.8	3.4	4.8	3.7	5.8	1.9	1.7
Cow's milk—colostrum	25.4	17.6	2.7	3.6	28.2	6.6	1.1
Skimmed milk	9.4	2.9	5.3	0.3	5.0	2.1	2.0
Buttermilk	9.9	3.8	3.9	1.0	6.4	1.7	1.6
Whey	6.2	0.6	5.0	0.2	1.0	1.1	2.0
Meat meal	89.3	66.2	......	13.4	114.0	81.1	......
Dried blood	91.5	60.8	......	2.5	135.0	13.5	7.7
Tankage	93.0	50.1	......	11.6	86.2	139.0	3.0

*Oklahoma Bulletin 37, extra dry sample.
xCarbohydrates and fat combined.

USES OF FEED IN THE ANIMAL BODY

The various uses of feed in the animal body are as follows:

1. Maintenance.—(a) Repair of internal organs, skeleton, muscles, nerves, etc., that are continually being worn away, even in the resting animal. (b) Animal heat; and energy, used by heart, lungs and digestive organs.

2. Work and Energy.—Supplying the extra energy required by working animals, race horses, etc.

3. Growth.—Building up the bony framework, muscles and vital organs, etc., of young animals.

4. Fattening.—Storing of excess nutrients in the body in the form of fat.

5. Milk production in dairy cows and other brood females, including both the materials made into milk and the energy used in making it.

Definitions

The following definitions, adapted from Henry's "Feeds and Feeding", are given in explanation of terms frequently used:

1. A **ration** is the feed allowed for one day, whether given at one time or in portions at different times.

2. A **maintenance ration** furnishes just enough of the several nutrients so that a resting animal will neither gain nor lose weight.

3. A **balanced ration** furnishes the several nutrients: Protein, carbohydrates and fat, in such proportion and amount as will **properly** and **without excess** nourish a given animal for twenty-four hours. A balanced, fattening ration will differ in character from a work ration, or growing ration, or dairy ration.

A **wide ration** contains a large proportion of digestible carbohydrates compared with the protein. A **narrow ration** contains an amount of protein more nearly equal to the carbohydrates.

The Nutritive Ratio is the ratio between the digestible protein and the combined digestible carbohydrates and fat in a foodstuff or ration. To find the nutritive ratio multiply the pounds fat by 2¼, add the pounds carbohydrates and divide by the pounds of protein.
A ratio expressed as 6.7 in the following table means that the carbohydrates and fat combined are 6 7-10 times as much as the protein.

Feeding Standards

After years of careful experimentation with various classes of farm stock, feeding standards have been formulated showing amounts of each food nutrient required by certain animals per day to give the best results without waste. While not absolutely correct, they are valuable guides to intelligent feeding.

Selections From Wolff-Lehman Feeding Standards

Animal	Per Day per 1000 lbs. Live Weight Digestible Nutrients					
	Pounds Dry Matter	Pounds Crude Protein	Pounds Carbo-hy-drates	Fat	Pounds Nutri-ents	Nutri-tive Ratio
Oxen—at rest in stall	18	0.7	8.0	0.1	7.5	11.8
Oxen—at light work	22	1.4	10.0	0.3	9.7	7.7
Milch cow giving 11 lbs. milk daily	25	1.6	10.0	0.2	10.2	6.7
Milch cow giving 16.6 lbs. milk daily	27	2.0	11.0	0.4	12.2	6.0
Milch cow giving 22 lbs. milk daily	29	2.5	13.0	0.5	14.4	5.7
Milch cow giving 27.5 lbs. milk daily	32	3.3	13.0	0.8	16.0	4.5
Young dairy stock 2-3 months old, weight 150 lbs.	23	4.2	13.0	2.0	21.0	4.5
6-12 months old, wt. 500 lbs.	27	2.0	12.5	0.5	13.7	6.8
18-24 mos. old, wt. 900 lbs.	26	1.5	12.0	0.3	11.8	8.5

Selections From Haecker Feeding Standards

Taken from Henry's "Feeds and Feeding"

	Pounds Crude Protein	Pounds Carbohy-drates	Fat
For support of the 1,000-lb cow	0.700	7.00	0.100
Add for each lb. of 3.0 per cent milk	0.040	0.19	0.015
Add for each lb. of 4.0 per cent milk	0.047	0.23	0.018
Add for each lb. of 5.0 per cent milk	0.051	0.27	0.021
Add for each lb. of 6.0 per cent milk	0.067	0.31	0.024
Example—			
Cow giving 22 lbs. of 4 per cent milk daily	1.73	12.06	0.496
Cow giving 22 lbs. of 6 per cent milk daily	2.04	13.16	0.520
Cow giving 11 lbs. of 4 per cent milk daily	1.21	9.35	0.270

NOTE 1.—These standards are for 1,000 pounds weight of animal. Small breeds or young animals usually require a little more feed in proportion to their weight, and large animals use less. For example, the ration for a 750-pound animal would be about 8-10 as much as for a 1,000-pound animal, and for a 1,500-pound animal about 1 2-5 times as much.

NOTE 2.—It is not considered necessary for rations to be exactly according to the standard. The standards are intended as guides which may be followed as closely as is expedient, but which may sometimes be modified to suit the available feed supply. The *dry matter* column in the above table is supposed to mark the maximum amount and not the minimum limit. This will prevent the feeder from making out too bulky a ration. Five or six pounds less dry matter may be used. A silage ration is very often short on dry matter, yet no less valuable on that account.

NOTE 3.—The column headed "Pounds Nutrients" in the Wolff-Lehman standards was put in by Lehman in an attempt to indicate the relative amount of food value required. This column is not used in balancing feed rations, but is of interest as showing the varying needs of animals.

Calculating a Balanced Ration

Example: To compute a balanced ration for a 1,000-pound cow giving twenty-two pounds milk daily, using the Wolff-Lehman standard and the table of digestible nutrients:

	Dry Matter	Digestible Nutrients		
		Protein	Carbohydrates	Fat
W. L. standard	29 lbs.	2.5	13.0	0.5

It is usually advisable to begin by selecting from the feedstuffs immediately at hand, taking first the amount of roughage a cow would eat up clean when fed grain in addition. Taking as a trial ration 10 pounds of alfalfa hay, 40 pounds corn silage and 4 pounds corn-and-cob meal, we consult Table I and find that 100 pounds of each feed contains the following:

	Dry Matter	Pounds Digestible Nutrients in 100 lbs.		
		Protein	Carbohydrates	Fat
100 lb alfalfa hay	93.2	11.1	39.1	0.6
100 lbs corn silage	26.4	1.4	14.2	0.7
100 lbs. corn-and-cob meal	84.9	4.4	60.0	2.9

Dividing these amounts by 100 and multiplying by the number of pounds of each feed chosen, we have as follows:

Example.—Dry matter in corn-and-cob meal 84.9 divided by 100 multiplied by 4 equals 3.4, the amount in 4 pounds meal.

	Dry Matter	Protein	Carbohydrates	Fat
10 lbs. alfalfa hay	9.32	1.11	3.9	.06
40 lbs. corn silage	10.60	.56	5.7	.03
4 lbs. corn-and-cob meal	3.40	.18	2.4	.12
Total trial ration	23.32	1.85	12.0	.21
Wolff-Lehman standard	29.00	2.50	13.0	.50

This is evidently much below the standard in protein, fat and dry matter. As we have already selected about all the rough feed the cow can eat, such as cottonseed meal and wheat bran, the meal being also rich in fat. Turning to Table I again we find as follows:

	Dry Matter	Protein	Carbohydrates	Fat
100 lbs. cottonseed meal	93.0	37.6	21.4	9.6
100 lbs. wheat bran	88.1	11.9	42.0	2.5

Taking 1½ pounds of each and adding to the trial ration above we get the following:

Feed	Dry Matter	Protein	Carbohydrates	Fat
Trial ration (as above)	23.32	1.85	12.00	.21
1½ lbs. cottonseed meal	1.40	.56	.33	.15
1½ lbs. wheat bran	1.32	.18	.63	.04
Total	26.04	2.59	12.96	.40
Wolff-Lehman Standard	29.00	2.40	13.00	.50

As this corresponds closely to the standard, we may assume that the ration will fulfill all the requirements of a 1,000-pound cow giving twenty-two pounds milk daily.

Calculated Ration

Roughage	Concentrates
10 lbs. alfalfa hay	4 lbs. corn-and-cob meal
40 lbs. corn silage	1½ lbs. cottonseed meal
	1½ lbs. wheat bran

The following sample rations are taken from various authorities:

I

20 lbs. alfalfa hay
4 lbs oats
3 lbs. corn meal

II

30 lbs. kafir silage
8 lbs. Bermuda hay
3 lbs. corn-and-cob meal
2 lbs. wheat bran
2 lbs. cottonseed meal

III

25 lbs. silage
15 lbs. sorghum hay
2 lbs. oats
3 lbs. kafir corn
2 lbs. cottonseed meal

IV

10 lbs. cowpea hay
10 lbs. corn fodder
5 lbs. corn
2 lbs. kafir corn
3 lb cottonseed meal

With coarse fodders such as sorghum hay or corn fodder it is understood that the cow is to be allowed all she will eat, allowing for waste of coarse stalks.

Other Considerations

In addition to the use of the feeding standard, other things may be considered by the feeder which are not taken into account by the standards:

1. Cost of feedstuffs. The feeder should select such feeds that will supply the right amount of feed at the least cost.

2. Palatability. Other things being equal, animals make the best use of feed that they relish.

3. Succulence. Feeds such as pasture grass, silage, roots, or soiling crops, have a good effect on growth and production aside from the value of the nutrients they contain.

4. Quality of Product. A cow producing twenty-two pounds of 5 per cent milk should have more feed, size being equal, than one giving the same amount of 3 per cent milk.

5. Economy of Production. It is usually more economical to feed home grown roughness, even if coarse, than to buy other kinds, although the ration may not be exactly balanced.

6. Type of Animal Fed. An animal of improved form and quality will make better use of a heavy ration than a poor animal will.

7. Character of Nutrients. Owing to the large amount of fiber in such roughages as wheat straw, corn stover, etc., the nutrients they contain are not so valuable per pound as those contained in the concentrates. At the same time the roughages usually contain more nutriment per dollar's worth than the concentrated feeds.

9. Variety in a Ration Is Desirable. The nutrients from five or six different feedstuffs are usually better liked and more efficient than the same amount from only two feedstuffs. This does not mean a sudden changing from one kind of feed one day to another the next. It is preferable to have several different kinds of feed, but the same amount of each **each day.**

9. Manurial Value of Feedstuffs. One of the benefits of feeding livestock is the improvement of the land by the mineral matter purchased in feedstuffs. A ton of corn contains $7.24 worth of fertilizing material (Henry's "Feeds and Feeding"), a ton of bran $13.08 worth, and a ton of cottonseed meal $30.72 worth, estimated at the market price of $0.18 per pound nitrogen and $0.05 per pound potash and phosphoric acid. Some of this will be retained by the animal, especially young, growing animals; and some will be lost or wasted, but much of it will be returned to the soil. This is worth the notice of the feeder who hesitates about buying a high priced concentrate on account of its initial cost.

NOTES ON FEEDING STUFFS

Concentrates

Oil Bearing Seeds and Their By-Products.—Cottonseed meal supplies protein at a smaller cost per pound than any other of our feedstuffs, and when fed in reasonable quantities per day is a very economical feed and well liked by cattle. Not more than three or four pounds should be fed to cows for any great length of time. It is only harmful to stock when fed in excess, but should not be fed to young calves or to pregnant females within two months of parturition. Cottonseed is worth about two-thirds as much per ton as cottonseed meal and is rich in protein anl oil. Experiments with dairy cows have shown that roasted cottonseed is slightly better than raw seed. On account of the oil contained, it may cause scouring if fed in excess. Caddo cake is produced by the cold pressing system of extracting cottonseed oil and contains the hulls as well as the kernel of the cottonseed. According to the results obtained by the Louisiana Experiment

Station three pounds of Caddo cake are as valuable for feeding dairy cows as two pounds of meal and one pound of hulls.

Linseed meal has the same feeding value as cottonseed meal, but costs more. It is very palatable and puts a good finish on show stock. For heavy producing cows a pound or two of linseed meal will improve the ration considerably. It is a first class feed for calves. Cottonseed meal produces a firm butter with a high melting point; linseed meal produces a softer butter.

Wheat and Its By-Products.—Wheat is very nutritious but is too high priced for ordinary use for stock feeding. Shrunken or cracked kernels taken out by the fanning mill make good feed, but being of a heavy nature should be mixed with other feeds. Wheat bran is a standard feed for dairy cattle and young stock and is relished by all animals. It is not so cheap a source of protein as cottonseed meal, but may be fed more liberally. Wheat middlings or shorts are slightly richer and more nutritious than bran. Mill run is the mixture of bran and middlings as it comes from the mill, and is a valuable feedstuff.

Corn and Its By-Products.—Corn is the standard grain feed of this country, is especially rich in starchy nutrients, and contains a considerable amount of oil. It is an ideal fattening food, but is not well suited to dairy cows and young, growing animals unless balanced with some feed that is richer in protein and mineral matter. Corn-and-cob meal has been found of equal value, pound for pound, to pure corn meal. There is little nourishment in the cob, but it makes the meal more bulky and easier to digest. Gluten meal and germ meal, by-products from the starch factories, are rich in nitrogen and oil, and are first class feeds for dairy cattle. Kafir corn, sorghum seed and milo maize will probably take the place of Indian corn for the Oklahoma farmer, and are about nine-tenths as valuable per pound as corn. They should usually be ground for cattle feeding.

Cowpeas are a good feed for all classes of stock, but are usually too high priced. They are especially valuable for balancing a corn ration.

Rye, barley and oats are good stock feeds, especially the latter, but usually cost too much to be used economically. The by-products of the rice mills—rice bran and rice polish—are not very common in this State. Rice bran is about three-fourths as valuable as wheat bran, and is not readily relished by cattle. Rice polish is very nutritious, having about the same value as wheat bran.

Dried Roughage (nitrogenous).......Our best hays come from the legumes, which are very rich in protein and leave the ground in better shape for other crops. These include alfalfa, the clovers, beans, vetches, soybeans and cowpeas. Alfalfa hay is relished by all kinds of stock. Cowpea hay is very rich in nitrogen and makes a good roughage to balance a corn and kafir corn ration. Soybean hay has given better results per ton than alfalfa hay. The hairy vetch is used sometimes for winter pasture. Careful curing is essential in making hay of the legumes. Bermuda, while it is true grass and not a legume, is especially rich in crude protein and makes good hay as well as pasture.

Carbonaceous Roughage.—Prairie hay, most commonly used in Oklahoma, is practically equal to timothy hay, which is the standard hay in the North. The coarser roughages—corn fodder, kafir corn fodder and sorghum hay—will always be used largely in Oklahoma for feeding cattle. A ton of good corn fodder is nearly equal in feeding value to a ton of prairie hay and is a cheaper feed. Among the coarsest roughages we have corn stover and wheat and oat straw. Husked corn stover alone will almost keep an animal through the winter, but should be fed with some concentrated feed. Kafir stover is about equal to corn stover. Oat straw makes a good roughage for wintering cattle, while wheat straw is not so valuable and is used mostly for bedding. Cottonseed hulls may be used to advantage when they can be bought cheaply. They are about equal to good oat straw, not so valuable as corn stover per ton, and have about two-thirds the feeding value of hay, according to results obtained at several Stations.

Green Roughage.—Alfalfa makes a good soiling crop as it is very palatable and nutritious and grows continuously throughout the season. It will not ordinarily yield as much per acre as corn, kafir or sorghum. Green fodder corn may be used to advantage during the fall, but does not yield so much per acre in Kansas and Oklahoma as the sorghums and kafir corn. There is some danger in the use of kafir corn and sorghum during the summer, as when mature, especially after a drouth, it sometimes contains prussic acid, and in such condition is very fatal to stock. Usually no harm results from the use of the cured fodder or silage.

Succulent Feed (Silage).—Silage is a standard dairy feed on account of the succulence which it adds to a ration. There are no data available on the digestibility of kafir corn silage, but where used it gives good results and is probably about nine-tenths as valuable as first class corn silage. Corn, kafir corn and similar feeds are about the only crops that may be used in the silo successfully. Alfalfa has been made into silage, but is more profitable cured as hay. Green cowpea forage and soybean hay do not usually make good silage alone, but when mixed with corn, sorghum or kafir corn in the silo improve the quality of the silage.

Roots.—Roots are used largely in some countries for feeding cattle and sheep, but are not used much in this State. They have the same effect upon an animal as silage, increasing the milk flow, toning up the digestive system and improving the handling qualities. They cost more to raise per ton than silage and are not so desirable on that account. Dried beet pulp gives excellent results. It is usually soaked in water before feeding, but is also fed dry. It makes a good addition to a dairy ration, is used by many feeders of high producing cows, and has the same effect on the cow as roots or silage.

Patent Stock Feeds.—There are many patent dairy feeds, meal feeds, etc., on the market that should be examined well before purchasing. Many such feeds are good, while others are made up of light oats, oat hulls, chaff, mill sweepings and weed seeds, etc., mixed with cheap molasses. A sample of one such feed sent to the College contained about a dozen species of noxious weed seeds, a quantity sufficient to seed down a farm.

Medicinal Stock Feeds and Condition Powders.—Some highly advertised stock feeds are on the market, supposed to be of great value to stock when one tablespoonful per day is mixed with their feed. Experiments have shown these claims to be fictitious, the feeds usually being made up of linseed meal, wheat bran, common salt, etc., to which have been added such appetizers as gentian, saltpeter, red pepper, allspice and other condiments. These tonic mixtures can be made up at home at an expense of not over five cents per pound.

PART II

NOTES ON FEEDING DAIRY COWS

(See also other considerations in feeding, page 22.)

1. Dairy cattle return more digestible food nutrients for feed consumed than any other stock, and pay well for good feeding.

2. A good ration may not make a poor cow profitable, but may make a lot of difference in the returns from a good cow.

3. About half of a dairy ration is used to maintain the body of the cow. It pays to feed the other half and produce the milk.

4. Feed all the good roughage the cow will clean up. Silage and alfalfa hay make a first class combination. Where corn will not grow, use kafir for making silage.

5. Rations should be made up to suit the temperament of the cow. A cow that fattens too readily should get a larger proportion of nitrogenous feed such as wheat bran and alfalfa. A cow that gets poor in flesh may be given a ration containing more corn.

6. Begin on heavy rations gradually, and be equally careful in making changes from one ration to another entirely different.

7. Regularity in feeding is important. Two feeds per day are as good as three. The cow has a more capacious digestive system than the horse and can do without a midday meal. Cows on test may be fed more often.

8. Feed only what an animal will clean up readily. Feed left in the trough spoils the cow's appetite for the next meal and is worse than wasted.

9. The order of feeding concentrates and roughage is not of special importance. When possible mix the grain food and the rough food together. If not, it is customary to feed the concentrates first.

10. The cow gives her largest and most profitable yields of milk under what we might call "spring pasture" conditions. This is because we have at this time, first, an abundance of feed, secondly, low priced feed, third, palatable feed, fourth, succulent feed, fifth, a balanced ration, sixth, plen ty of good water (usually), seventh, comfort, freedom from extreme heat or cold. Successful dairying is based on the duplication of these conditions all through the year.

11. The gains from liberal feeding are not always shown immediately, but may bring in good dividends later. This is especially true with young cows. Cows kept in good condition during the fall will give more milk through the winter on the same feed than cows that have been allowed to run down in flesh.

12. As the dairyman is in business for profit, he should, other things being equal, use such feedstuffs as will supply the required amount of nourishment at the least cost. If, for instance, he receives the equivalent of 12 cents per gallon for his milk, his income depends on whether he can produce that milk for 5 cents, 10 cents or 15 cents per gallon. While many other factors may affect the cost price of milk, the cost of the daily ration will make a considerable difference either in his favor or against him. No set rule can be given as to the cheapest feeds to buy. Prices change from year to year, and local conditions may change prices considerably. Low priced feeds are not necessarily the cheapest. Cottonseed meal, for instance, at $26.00 per ton will supply digestible protein at 3½ cents per pound, while with wheat bran at $22.00 per ton it would cost 9 cents per pound. The wheat bran, of course, has other points in its favor.

13. Low priced rations are usually obtained by using plenty of home grown feedstuffs, especially silage and soiling crops. The nutrients in roughage are usually cheaper thon those in concentrates. Twenty-seven pounds of Bermuda hay would make a balanced ration for a thousand-pound dairy cow giving twenty-two pounds of milk daily if the cow could eat that much. Seventeen pounds corn chop and one pound cottonseed meal would supply the same amount of nourishment, but would cost nearly two-thirds as much more. As the cow would not eat such a large amount of hay alone, it is necessary to feed some grain food, but the more good roughage she can be induced to eat the cheaper her ration will be.

14. **Feeding Concentrates.**—Various rules are given as guides to the dairyman for feeding the right amount of concentrates. A common rule is to give one pound grain feed for each three or four pounds milk produced per day, or for each pound of butter produced per week. Another rule, somewhat harder to follow, is to feed so that

the cow will neither gain nor lose in weight. Exceptions must be made in case of dry cows, or those about to freshen. Allowance must also be made for the quality of milk produced. The best rule to follow is to keep records and try out the cow until the ration is found on which she will make the most profit. Some cows will respond to an increase in the amounts allowed above, while others would not.

PART III

FEEDING DAIRY CATTLE

(Taken from Annual Report, 1911.)

The following experiments will prove of interest to those engaged in feeding dairy cattle. As it was not possible to have a large number of cattle in each section, the results obtained may possibly be offset in some cases by the individuality of the cows used, but, on the whole, they are likely to correspond closely with the results that might have been obtained from a larger number.

The first experiment shows the value of cottonseed meal in lessening the cost of a ration. Although the difference is slight, it must be remembered that these cows were unused to cottonseed meal at the time the experiment started. The second experiment is perhaps of greater interest as it deals with a problem about which we often receive inquiries regarding the value of silage made from dry corn stalks. As stated later, the Indian corn for silage could not be put in the silo for about a month after it was ready, and consequently should be considered as other dry stover, the grain yield in 1910 being very small. This fodder when put in the silo was well soaked with water, and the following experiment shows how it was used to advantage with alfalfa hay when compared with alfalfa hay alone as roughage.

In order to carry out these feeding trials with cottonseed meal and silage, twelve cows were divided into four approximately equal lots of three each. Two lots were used in the work with cottonseed meal and two in the work with silage. The experiments began on January 1, 1911. The division of lots was based on, (1) the amount of milk given in the December four-week period; (2) the per cent of decrease or increase in milk yield during that time, and (3) on the time of previous freshening and advance of lactation period. Each cow selected was approximately the equal of a corresponding animal in the opposite lot. During December all lots were fed the same rations, consisting of alfalfa, silage, bran, corn chop and a little cottonseed meal. The feeding trials lasted eight weeks, the cows being exchanged at the end of the first four-week period, January 28, so that those receiving the cottonseed meal ration the first four weeks got no meal the second period, and vice versa. All rations cost approximately 16½ to 17 cents per day per cow, the concentrates ranging from seven to eight pounds per cow per day. The roughage was regulated according to the amount that each animal would eat up clean. Feeds were valued at the following rates: Cottonseed meal $27.00 per ton, bran and corn chops, $23.00; alfalfa hay, $12.00, and silage $2.00 per ton.

Experiment With Cottonseed Meal

In this feeding trial two lots of three cows each of about equal productive capacity were fed as follows: For one four-week period, January 1-28, Lot 1 was fed a ration of 4 pounds wheat bran, 4 pounds corn chop, and an average of 8 pounds alfalfa hay and 25 to 28 pounds silage, the latter being of inferior quality. Lot 2 was fed a similar hay and silage ration with 3 pounds cottonseed meal and 2 pounds each of bran and chops. At the end of the first period, January 28, Lot 1 was changed over to the cottonseed meal ration and Lot 2 given the ration containing no meal, and fed for four weeks more. At the beginning of the second period the silage was noticeably poorer in quality and the quantity fed had to be reduced gradually to about sixteen pounds per day and the hay increased correspondingly. During the last week of the first period a caw in Lot 1 contracted udder trouble, and for this reason her record is not included. In Hables I. II and III are given the details of the experiment, with a summary of results in Table IV:

Experiment With Cottonseed Meal

TABLE I—MILK RECORD

Showing records for four four-week periods, including two periods previous to beginning of experiment, when on equal rations, with normal rates of decrease in milk production, also the milk production during the tests, with the altered rates of decrease:

Name	Days in Milk Jan. 1	Pounds Milk Nov. 8 to Dec.3	Pounds Milk Dec,4 to 31	Per Cent De-crease	Pounds Milk Jan. 1 to 28	Per Cent De-crease	Pounds Milk Jan. 29 to Fed.26	Per Cent De-s creae
Ida	122	435	423	....	365	....	319	....
June A	83	367	360	....	326	....	349	....
Total		802	783	2.37	691	11.7	668	3.33
Annie	146	484	464		464		481	
Polly	57	372	361		299		290	
Buttercup	162	444	407		369		380	
Total		1300	1232	5.20	1132	8.10	1151	1.70

(Showing records for four four-week periods, including two periods previous to beginning of experiment, when on equal rations, with normal rates of decrease in milk production, also the milk production during the tests, with the altered rates of decrease.)

TABLE II—FEED RECORD

	First Four Weeks January 1-28						Second Four Weeks January 29-February 25					
	Cottonseed Meal.	Wheat Bran.	Corn Chop.	Alfalfa.	Silage.	Cost of Feed.	Cottonseed Meal.	Wheat Bran.	Corn Chop.	Silage.	Alfalfa.	Cost of Feed.
Lot 1—Fed no Cottonseed Meal.							Lot 1—Fed Cottonseed Meal.					
Ida	....	112	112	222	744	....	84	56	56	301	518	....
June A.	....	112	112	222	748	....	84	56	56	301	518	....
Total	....	224	224	444	1492	$ 9.30	168	112	112	602	1036	$ 9.50
Lot 2—Fed Cottonseed Meal.							Lot 2—No Cottonseed Meal.					
Annie ...	84	56	56	222	804	....	....	112	112	315	546	....
Polly ...	84	56	56	222	792	....	....	112	112	315	518	....
B. Cup	84	56	56	224	836	....	....	112	112	315	574	....
Total	252	168	168	669	2432	$13.70	....	336	336	945	1638	$15.03

TABLE III

Showing total milk produced and feed eaten, comparing the two periods when each lot was fed cottonseed meal with the two periods wnthout cottonseed meal:

		Cotton Seed Meal	Wheat Bran	Corn Chop	Alfalfa	Silage	Cost of Feed
Without Cottonseed Meal January 1-28							
Lot 1	691 lbs.	....	224	224	444	1492	$ 9.30
Lot 2	1151 lbs.	....	336	336	945	1638	15.03
Total	1842 lbs.		560	560	1389	3130	$24.33
With Cottonseed Meal January 29-February 26							
Lot 1	668 lbs.	168	112	112	602	1036	$ 9.50
Lot 2	1132 lbs.	252	168	168	668	2432	13.70
Total	1800 lbs.	420	280	280	1270	3468	$23.20

NOTE.—The cows produced slightly less milk while on the cottonseed meal ration, but produced the milk with less outlay for feed.

TABLE IV

Summary of Tables I, II and III, Showing Cost of Feed per Gallon of Milk Produced

	Without Cotton Seed Meal	With Cotton Seed Meal
Lot 1 (2 cows)	Jan. 1-28	Jan. 29-Feb. 25
Pounds milk	691	668
Cost of feed	$ 9.31	$ 9.50
Cost per gallon	11.4c	12.1c
Lot 2 (3 cows)	Jan. 28-Feb. 25	Jan. 1-28
Pounds milk	1151	1132
Cost of feed	$15.04	$13.71
Cost per gallon	11.1c	10.4c
Total (5 cows	28 days	28 days
Pounds milk	1842	1800
Cost of feed	$24.33	$23.20
Cost per gallon	11.2c	10.9c

The two rations show very little difference in either amount of milk produced or in cost of production. The cottonseed meal ration was about ½ per cent per day cheaper than the other ration and produced milk at about 3 cents per gallon cheaper. On account of the small number of cows in the experiment and the shortness of the feeding period the results would not warrant the conclusion that the rations were other than equal in feeding value. This would show three pounds of cottonseed meal to be practically equal to two pounds each of bran and corn chop. This is somewhat less than the value placed on cottonseed meal by other investigators, who have considered one pound of cottonseed meal equal to one and one-half pounds wheat bran. Two reasons why the ratio was lower in the present instance is that in the first place the ration was otherwise well supplied with protein from the wheat bran and alfalfa hay, so that the high per cent of digestible protein in the cottonseed meal was more or less an unnecessary addition to the ration. Another reason is that few of the cows in the test were used to cottonseed meal and had just learned to eat it about six weeks before the beginning of the experiment. It will be noticed that Lot 2 increased in milk 1.7 per cent when changed from the cottonseed meal ration to corn and bran, but at an increased cost per gallon. As the object of the experiment was to find out whether cottonseed meal could profitably be substituted for part of the concentrate in a ration as described, we may conclude that cottonseed meal will be found at least as profitable to dairy cows as bran and corn chop at the prices quoted.

Experiment With Corn Stover Silage

Owing to the unusually hot winds during the summer of 1910, that dried up the tassels on the ensilage corn crop, hardly enough ears formed to make two bushels corn per acre. In addition, the cement silo, which was supposed to be ready to fill by August 8, at a time when some of the corn was still green, was not completed until September 5, when part of the corn intended for silage was almost dried up. The best of this fodder was mixed with some green Mexican June corn and the poorest of the stover was used to fill the upper part of the silo.

The silage produced, while distinctly inferior in character, was a much better feed than would be supposed from the kind of fodder put in. In order to test its value an eight weeks' feeding experiment was conducted, substituting this corn stover silage for half of the alfalfa hay in the regular rations. Six cows were used, three in each lot, each getting a concentrate ration of 2 pounds bran, 2 pounds corn chop and ½ pound cottonseed meal per day. The lots were practically equal in productive ability, amount of milk given and length of lactation period, each cow being as nearly as possible the equal of a corresponding cow in the opposite lot. The smaller rate of decrease in Lot 1 over Lot 2 is due to Eminent's Beth, a little heifer that continued to increase in milk production all through the test on both rations, although she had been in milk longer than the others. Lot 1 was fed the concentrate ration mentioned above, and all the alfalfa hay they would eat clean—about seventeen pounds per day. Lot 2 had the same meal ration, about nine pounds alfalfa hay, and from 26 to 28 pounds stover silage. They received these rations from January 1 to 28, having been fed both hay and silage during December. On January 29 the rations were changed, Lot 1 receiving the silage ration and Lot 2 the alfalfa ration. During the second feeding period the silage was a much poorer quality, being pure corn stover, and the amount fed was gradually decreased to about sixteen pounds per day per head, which was all they ate. The hay was also of coarser quality and should not be valued at the same price as at first on account of the greater percentage of refuse.

Experiment With Corn Stover Silage

TABLE I—MILK RECORD

(Showing records for four four-week periods, including two periods previous to beginning of experiment, when on equal rations, showing rates of decrease in milk production both before and during the experiment.)

	Days in Milk Jan. 1.	Lbs. Milk, Nov. 6 to Dec. 3.	Lbs. Milk, Dec. 4-31.	Per Cent Increase.	Lbs. Milk, Jan. 1-28.	Per Cent Decrease.	Lbs. Milk, Jan. 29 to Feb. 28.	Per Cent Decrease.
Lot 1—								
Elner H.	144	496	456		403		394	
E. Beth	154	461	485		498		505	....
Roscoe	133	316	364		345		300	
Total	....	1273	1285	1%	1244	3.2	1297	3.8
Lot 2—								
Kate	63	348	400		388		376	....
Con. Rose	142	413	389		346		309	....
Silvia G.	97	509	460		432		408	....
Total		1270	1285	−1%	1166	7.3	1093	6.3

TABLE II—FEED RECORD

	First Four Weeks January 1-28						Second Four Weeks January 29-February 25					
	Cotton S. M.	Wheat Bran.	Corn Chop.	Alfalfa.	Silage.	Cost of Feed.	Cotton S. M.	Wheat Bran.	Corn Chop.	Alfalfa.	Silage.	Cost of Feed.
Lot 1—No Silage.						Lot 1—Silage.						
Elner H..	42	84	84	488	....	....	42	84	84	329	574	......
Roscoe .	42	84	84	452	....	....	42	84	84	315	546	....
Beth	42	84	84	424	....	....	42	84	84	301	518	....
	126	252	252	1364	....	$15.68	126	252	252	945	1638	$14.81
Lot 2—Silage.						Lot 2—No Silage.						
Silvia	42	84	84	238	956	....	42	84	84	514	....	....
Rose	42	84	84	224	956	....	42	84	84	500	....	....
Kate	42	84	84	224	796	....	42	84	84	494	....	....
	126	252	252	686	2464	$14.00	126	252	252	1508	....	$16.55

TABLE III

Comparison of the two periods when each lot was fed silage, with the two periods when silage was not fed:

	Cottonseed Meal.	Wheat Bran.	Corn Chop.	Alfalfa.	Silage.	Cost of Feed.
Fed Silage						
January 29-February 25						
Lot 1, 1197 lbs......................................	126	252	252	945	1638	$14.81
January 1-28						
Lot 2, 1166 lbs......................................	126	252	252	686	2464	14.08
Total 2363 lbs..............................	252	504	504	1631	4102	$28.89
Fed no Silage						
January 1-28						
Lot 1, 1244 lbs......................................	126	252	252	1364	....	$15.68
January 29-February 25						
Lot 2, 1093 lbs......................................	126	252	252	1508	——	16.55
Total 2337 lbs..............................	252	504	504	2872	——	$32.23

Cost of Producing Milk, Per Gallon

TABLE IV

Summary of Tables I, II and III, Showing Cost of Feed per Gallon of Milk Produced

	Silage Ration.	Without Silage.
Lot 2 (3 cows)	Jan. 1-28	Jan. 29-Feb. 25
Pounds milk	1197	1244
Cost of feed	$14.81	$15.68
Cost per gallon	.105	.107
Lot 1 (3 cows)	Jan. 29-Feb. 25	Jan. 1-28
Pounds milk	1166	1093
Cost of feed	$14.08	$16.55
Cost per gallon	.103	.129
Total—		
Lots 1 and 2 (6 cows)	28 days	28 days
Pounds milk	2363	2337
Cost of feed	$28.89	$32.23
Cost per gallon (Silage)	10.4c (No Silage)	11.7c

The details of the experiment are shown in Tables I, II and III, and the summary is given above in Table IV. The cows produced a few pounds more milk when on the silage ration and produced it more economically. While the results are not as much in favor of silage as might be expected by those acquainted with the real article, it must be remembered that the material out of which the silage was made was more like the corn stalks usually left standing in the fields all winter than like the silage corn usually put into the silo. The experiment will interest those who wrote to inquire whether the sunburned fodder they had on hand last summer could be used in the silo. In these two feeding experiments the cows were not weighed, so that it is not known whether they gained or lost weight on either ration.

Summary

1. Cottonseed meal is one of the cheapest concentrated feeds on the market, food value considered.

2. Fed along with alfalfa, stover silage, wheat bran and corn chop, to cows not previously accustomed to cottonseed meal, this meal reduced the cost of the ration from 3-10 to 8-10 cents per gallon of milk produced.

3. Fed with a ration lacking otherwise in protein, cottonseed meal would show much better results.

4. As noted, 1½ pounds cottonseed meal per day made the cost of production less than when 3 pounds per day was fed. Fed without alfalfa or wheat bran the larger amount would probably have proved the better.

5. Corn stover silage, while not in any way equal to silage made

from green fodder, can be used to good advantage. Fed along with a small amount of alfalfa hay it produced milk at less cost per gallon in all three lots than where alfalfa hay only was used for roughage.

6. The cost of producing a gallon of milk where the stover silage was used was 1.3 cents less than with alfalfa hay.

7. The silo cannot make first class silage out of fourth class stover, but the stover can be kept in a more palatable form in the silo than in the field and should not be allowed to waste. With alfalfa hay at $12.00 per ton the stover silage was worth $4.20 per ton.

8. The food cost of production per gallon of milk was as follows:

REGULAR COLLEGE RATION

1. Regular College Ration.
   - 1½ lbs. cottonseed meal
   - 3 lbs. corn chop
   - 3 lbs. wheat bran

   (7½ lbs.)
   - 25 lbs. silage.
   - 9 lbs. alfalfa hay.

   Cost, per gallon milk, 10.4c.

ALFALFA RATION

2. Same grain mixture as above, 7½ lbs.
   - 18 lbs. alfalfa hay

   Cost, per gallon milk, .11.7c.

COTTONSEED MEAL RATION

3. 3 lbs. cottonseed meal
   - 2 lbs. corn chop
   - 2 lbs. wheat bran

   (7 lbs.)

   Same roughage as in Ration 1.

   Cost, per gallon milk, 10.9c.

NO COTTONSEED MEAL

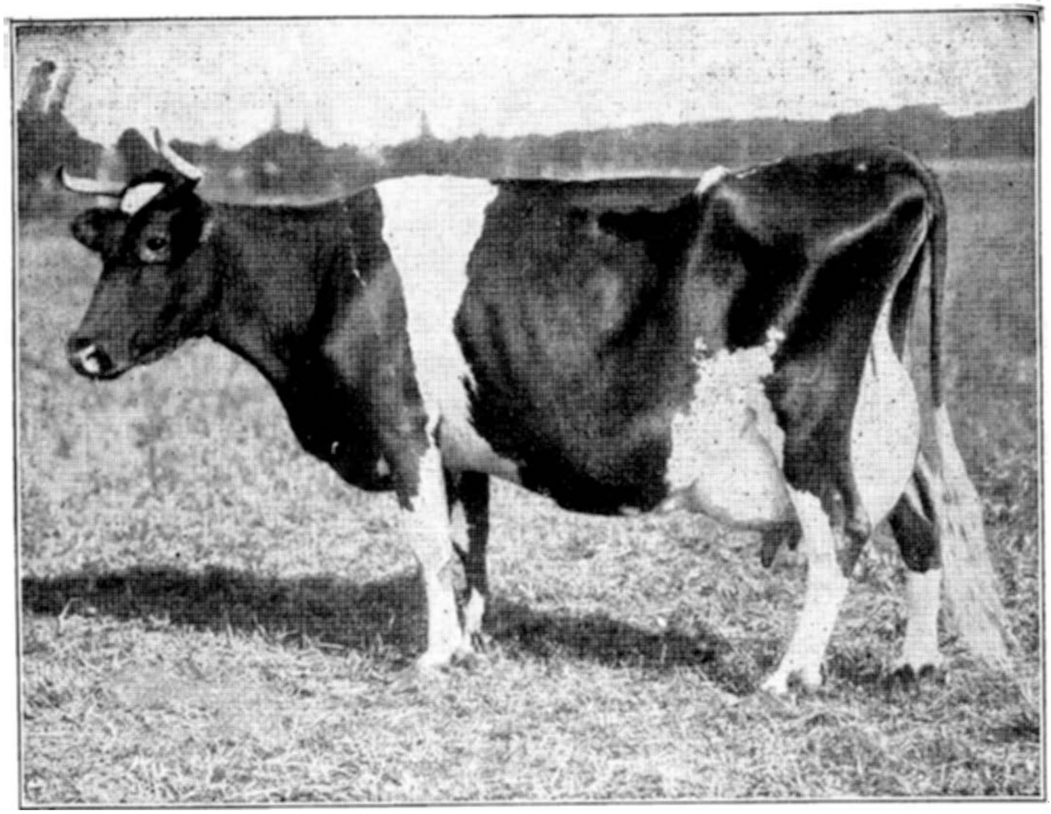
4. 4 lbs. corn chop
   - 4 lbs. wheat bran

   (8 lbs.)

   Same roughage as in Ration 1.

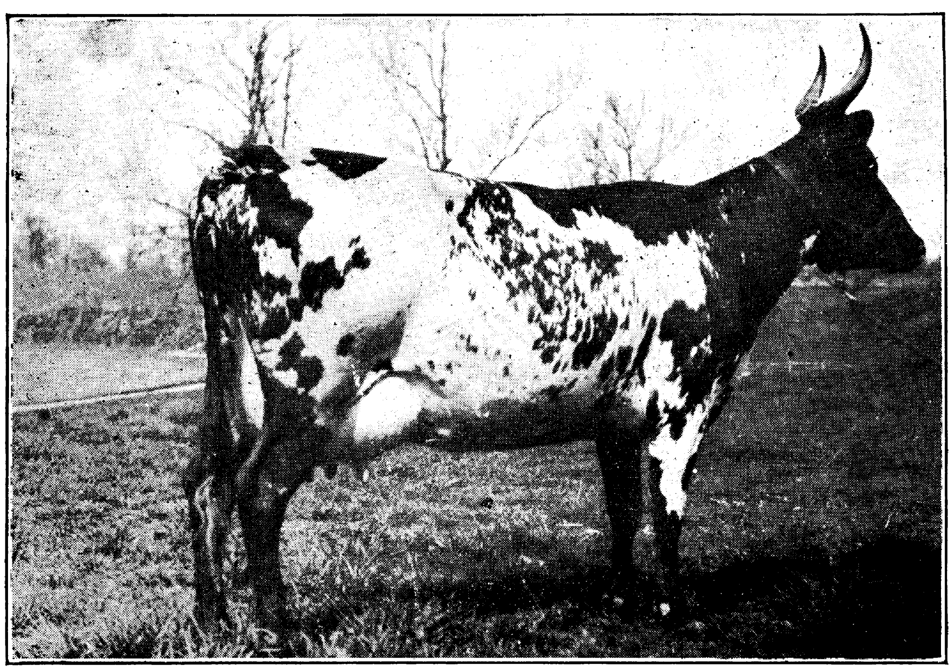
   Cost per gallon milk, 11.2c.

9. These experiments were carried out with too few cattle to draw very definite conclusions from the results, and will probably be duplicated later.



Guernsey Cow, Imp. Hayes Rosie

Once record butter producer of the breed with 14,633 lbs. milk and 833 lbs. butter. Guernsey milk and butter have a rich, yellow color and need no artificial coloring.



Ayrshire Cow, McAlister's Bettie

Champion 3-year-old butter producer of the breed with 14,208 pounds milk and 678 pounds butter. The Ayrshires are second only to the Holsteins as milk producers.

SECTION THREE

CARE AND MANAGEMENT OF DAIRY CATTLE

BY C. I. BRAY
Department of Animal Husbandry

Part I—Building Up the Dairy Herd.
Part II—Care and Management of Dairy Cattle.
Part III—The Silo and Summer Feeding.
Part IV—Dairy Barns and Stables.
Part V—Specimen Dairy Records and Scale of Points for Dairy Cows.

PART I

BUILDING UP THE DAIRY HERD

Breed to Select.—There is no **best** breed, although some are better for certain purposes than others. There are first class cows in every breed, and also many unprofitable ones. Success depends more upon the selection of profitable individuals than upon the breed. The Jersey, Holstein, Guernsey and Ayrshire breeds are considered the standard special purpose breeds, and the Red Polled, Shorthorn and the Brown Swiss the most common dual purpose breeds, being used to some extent for beef production. The Jerseys and Guernseys are considered most economical for production of butterfat, and the Holsteins and Ayrshires are considered more profitable for milk production. The Holsteins should be kept on good pasture and on heavy rations. Profitable animals must be selected on basis of performance (shown by milk and butter records) and developed by care and good feeding. The beginner should consider his market carefully, select the breed he likes best from those most suited to local conditions and then stick with that breed, building up his herd by selection.

Value of a Good Cow.—The dairyman, to be successful, must keep only such cows that pay a good annual profit. Many cows do not pay for their feed, while others may pay from $5.00 to $50.00 per year over expenses. The unprofitable cow is worth only what she will bring on the butcher's block (about thirty dollars). The cow that produces $50.00 profit over all expenses is worth ten cows that produce no profit, both as a breeder and producer, and should at least be valued at

$100.00 to $150.00. It is estimated that a cow producing 200 pounds butter per year just pays her board and is worth $30.00, and that each additional fifty pounds of butter per year makes her worth about one hundred dollars more. A cow producing 400 pounds of butter per year is consequently worth over $400.00, or as much as fourteen or fifteen of the other kind.

Buying vs. Breeding.—Some dairymen depend on the former method to build up their herd, buying fresh cows, breeding to a common sire and selling the young stock and old cows to the butcher. Others breed their own stock, use good sires, keep milk records and develop heifers from their best stock. The first method has only one advantage, that of allowing the dairyman to use all his pastures and buildings for cows that are milking. Recognizing the value of a good cow, the dairyman should always be prepared to buy one that is better than what he has, but it is much safer to depend on breeding up his own herd. The man who depends on buying gets cull stock,usually, unless he pays much more than it would cost to breed it himself. He also runs a big risk of buying diseased cattle with tuberculosis or contagious abortion. The man who breeds up his own stock can develop his heifers to good advantage so that they will be quiet and gentle and also healthy. He will usually be able to build up a good herd more surely and quickly.

Value of a Good Sire.—The sire is half the herd, but if he is a poor one he is pretty nearly all of it. Grade cows may range in value from $25.00 to $250.00 and the sire that can produce the latter kind is worth many times more than the one that produces the $25.00 kind. If a heifer can be produced that when mature will give fifty to 100 pounds more butter or 1,000 pounds more milk per year than her dam the annual profit from such a heifer will accordingly be from $10.00 to $25.00 more than from the foundation cow. If ten such heifers are raised every year the increased profit will be $100.00 to $250.00 more per year; if twenty heifers are raised $200.00 to $500.00 will be gained each year by using a good bull. Consequently it is hard to understand how a progressive dairyman can afford to let a difference of $100.00 or so in the original cost of a herd bull stand between him and an addditional annual income of $500.00. Yet dairymen will buy $25.00 scrub bulls that are worse than useless as improvers of their herds, while pure bred males costing $50.00 to $150.00 more would pay for themselves many times over in the increased value of the young stock produced. The sire that cannot increase the value of the herd is dear at any price. While the owner of a grade herd may not be justified in buying as high priced a sire as the breeder of pure breds, a good animay will always be cheapest in the end.

Selection of a Dairy Sire.—Only a pure bred sire should be used, from ancestors of known merit and of good breed type, masculinity and constitution. Select if possible the son of a first class dairy cow, as the characteristics of the dam are most likely to be reproduced in the heifers of the next generation. The best indication of the value of a bull is the character of his offspring, and this is the safest and surest guide. Many aged bulls with good records and splendid offspring are sold at bargain prices to avoid inbreeding and afford an excellent opportunity to the man who wishes a good bull at moderate cost. Strength and virility must go with good ancestry to make a good sire. The grade sire should have no place in the dairy herd.

Selection of Cows.—Cows may be selected according to type and appearance by men who are good judges, but the only safe and sure basis for selection is the annual milk record.

The keeping of milk records in all parts of the country and in all classes and kinds of herds has shown:

1. That some herds make large annual profits while others make none.

2. That in the best herds there are usually some unprofitable cows, and very many such in the poorer herds.

3. That without records the owners of the herds could not tell with any great degree of accuracy which cows were paying profitably and which were not.

4. That many dairymen would have made a greater yearly profit had they sent half their herd to the butcher at the beginning of the year, thus saving half their feed and labor expenses and getting all the profit from their best cows.

A fact worth noting is that several world's record cows of different breeds, now worth thousands of dollars each, were sold to their present owners for small sums by men who had not taken the trouble to find out what kind of cows they were keeping.

In six herds tested by the Ohio Experiment Station, Herd No. 1 averaged $1.69 profit per cow per year; Herd No. 2, $0.61 loss; Herd No. 3, $1.27 profit; Herd No. 4, $0.60 loss; Herd No. 5, average net profit $32.42; and Herd No. 6, $40.63 net profit per cow. In Herd No. 3 the best cow alone made more profit than all the herd combined; the poorer cows eating up the profits from the good ones. In Herd No. 4, kept at a loss, two cows, purchased from a neighbor who kept records and graded up his herd, made an average profit of $24.13 each. In a similar test made in Connecticut the best herd averaged $32.98 profit per cow per year, while the poorest herd averaged a net loss of $18.60. The best cow tested made $118.55 profit and the poorest cow a net loss of $23.75.

Keeping Records.—It is difficult, therefore, to see how a dairyman can afford to run the risk of keeping unprofitable cows by refusing to keep records. A merchant who could not take time to keep books would soon go bankrupt; and business methods must be the rule on the dairy farm if a profitable business is to be built up. Even if it should take one week's work in a year to keep a good system of records, the time would be well spent if the work of the year were to result in an annual profit of $1,715.00 or a loss of $539.00 as a consequence of keeping records or not keeping them. The time required is really very small. The milk record is the dairyman's barometer; by means of it he can keep checked up on his individual cows, on his milkers and on his system of feeding. By means of it he will notice any increase or decrease in milk flow, and in the latter case be able to avoid trouble by removing the cause. More interest is taken in feeding the cows carefully when their records are kept. A circular balance scale and a sheet of paper properly ruled off, together with the Babcock test, will do the work. Cow testing associations are doing good work all over the country. From ten to twenty or more farmers may club together and agree to pay a qualified man to test their herds each month, sharing expenses equally. This system is particularly valuable to the men with pure bred herds, as they can get their good animals tested for the Advanced Register. Record keeping helps the dairyman to get rid of his "robber" cows, increases his profits and improves his herd.

Weeding Out the Herd.—Cows that prove unprofitable should be sold at once. Those paying only a small profit may be kept until better ones are bought or raised to take their places. Young heifers that do not show up well during their first lactation period may sometimes make a good showing on a second year's trial. Good cows can often be purchased that will pay for their feed, care and cost price in one year and return a good profit besides. Though it is not advisable to depend upon buying cows to replenish the herd, a dairyman should not hesitate to buy a good cow or heifer calf if it is likely to prove better than the average of his herd.

Always sell off the poorest cows and keep the good ones. In this way herds have been brought from an average yearly production of 120 pounds butter to an average of 400 or 600 pounds butter. On the other hand good herds have been ruined by allowing the best cows to be sold because a little more would be offered for them than for the poorer ones.

What Good Grades Can Do.—In the Iowa State Dairy Cow contest, won by the two Guernsey cows, Dairymaid and Jedetta of Pinehurst, a small two-year-old grade Jersey, Mollie W., ranked third with an allowance for age, and another grade ranked eighth with no allowance for age, producing 755 pounds of butter and 11,447 pounds milk. A grade Red Polled cow at the Wisconsin Station had a record of 13,403 pounds milk and 640 pounds butter in one year. She was only two crosses removed from common scrub stock. These records are creditable indeed, as only a relatively small number of pure breds have as good records.

By buying pure bred cows and sticking to one breed any dairyman can greatly improve his herd in a few years if he will keep records and develop his young stock as well as his milking herd by careful and intelligent care in feeding. Many other instances might be given where herds have been doubled and trebled in value by intelligent breeding, at much less expense than would be necessary to build up a pure bred herd of the same efficiency. The man who wishes to raise pure breds ultimately should buy one or two first class pure bred females and by saving all their heifer calves to replace the grades may finally have a good herd of pure breds at little cost and will have gained a great deal of necessary experience with the cheaper grade cows.

PART II

CARE AND MANAGEMENT OF DAIRY COWS

Successful care and management of the dairy cow is based upon a working knowledge of three fundamental facts and a practical application of the same. 1 A cow gives her largest yields of milk at least cost under early summer conditions, and these conditions should therefore be duplicated as nearly as possible the balance of the year. 2. The best type of dairy cow has possibly a more highly developed nervous system than any other domesticated animal, the racehorse possibly excepted, and her productive powers are so intimately connected with this nervous system that a shock of any kind seriously affects production. 3. In a state of nature the cow gives milk only to her calf, the object of her affections, and is more likely to produce to the limit of her ability when treated kindly so that she is well disposed to the one who milks her.

Driving cows with dogs or beating them with sticks cause a direct decrease in both fat test and milk flow. Irregularity in feeding and milking has almost as bad an effect. Cows are creatures of habit and should be fed and milked at regular times to get the best results.

Winter Dairying.—Most progressive dairymen adopt the system of having their cows freshen in the fall. The reasons in favor of this practice are as follows: 1. The market for dairy products is better in the wintertime. 2. The fall-fresh cow will give about one-fifth more milk and butter in the year than the spring-fresh cow. 3. Winter dairying is practically all the year round dairying, giving the farmer a uniform amount of produce to sell. 4. Labor is cheaper during the winter months. 5. The fall-fresh cow can rest during the worst months of the year. 6. Calves dropped in the fall have a good chance to grow during the winter months and can go out on grass in the spring.

The relative cost of feeding in winter or summer will vary under different systems of management. While it may cost less to feed the cows that freshen in the spring, this advantage is offset by the increased prices of the winter produce, leaving a clear gain of the extra amount produced by the fall-fresh cow.

Drying Off Cows.—A cow should be dry for at least six weeks before freshening again. She will raise a better calf and give a larger yield of milk the next lactation period if allowed this rest. Most cows are too easily dried off, but often a persistent milker is found that will milk regularly from one year end to another. To dry off a persistent milker, cut off her grain ration and sometimes part of her water supply, feed her on dry feed, and do not milk out clean. Milk once a day at first then every two days, and so on until the cow gets dry. More liberal feeding can then be given to prepare her for her next year's work.

Milking.—Too much attention cannot be paid to the careful and thorough milking of cows. The last drawn milk is rich in butterfat, but if left in the udder will tend to dry up the cow. A careful, rapid milker will often get enough more milk than a poor milker from the same set of cows to pay his wages, making the inefficient milker a losing proposition at almost any rate of wages. Two or more ounces of milk left at each milking does not merely mean the loss of thirty or forty quarts per year, but means that the cow dries up faster, possibly gives two quarts or a gallon less per day during the latter part of the season, and dries up possibly two months earlier than she should. Poor milking reduces the per cent of butterfat in the milk. Changing milkers is objectionable and should be avoided if possible, except a change from a poor milker to a better one.

Water.—Water is necessary to the wellbeing of the animal body. It carries food through the digestive system, assists in digestion and the absorption of nutrients and in the excretion of waste matter. It is a regulator of the temperature of the body, cooling the surface by evaporation. Water is especially necessary in milk production as milk is 87 per cent water, and a cow giving four, six or eight gallons of milk must drink a corresponding amount in addition to that required by the dry cow. The best results are obtained where the cow can get water at any time, and at a temperature that will induce her to drink the most. Water given twice daily may be sufficient in winter, but one watering should if possible be given between the night and morning feeding. Many devices have been tried for watering cows in the barn in winter, but the simplest method consists of having a continuous concrete manger provided with a drain and that can be easily cleaned of refuse feed. For outdoor watering tanks a tank heater in winter will pay for itself several times over in increased milk production.

A plentiful supply of pure water is invaluable in the summertime and a separate water supply should be in every pasture if possible. While some may be so fortunate as to have good wells or springs, many have to depend on artificial pools, which should be fenced in if possible and the water drawn off on the lower side. Letting the cows wade in their own drinking supply is objectionable, and ropy milk and infected udders are sometimes a result of this practice. The purity of the drinking water is important both for the health of the cow and of those drinking her milk.

Salt.—All domestic animals require salt, and if possible it should always be where they can get it at any time. One-half to one ounce of salt per day is recommended for a dairy cow, and this amount may be mixed with her feed.

Protection Against Flies.—Various species of flies annoy the cattle during the early summer months. They keep the cows from resting during the day and are a trouble during milking time. No successful preventive has yet been discovered. Various repellants such as fish oil, kerosene emulsion, train oil, etc., are sometimes applied and serve to keep many of the flies away, but leave a disagreeable odor around the barn. Ordinary insect powders dusted around the back and neck are said to kill many of the flies. A fine spray of kerosene will cause the flies that it touches to drop off, but will not keep others away. This should not penetrate the hair. Shutting the cows in the stable to protect them from flies has not proved profitable. Experiments show that the damage caused by flies has been more or less exaggerated.

Dehorning.—Cows when dehorned herd together better, do each other little damage, and the weaker and more timid cows have a better chance at the feeding racks or watering troughs. Dehorning is sometimes objected to on the grounds of cruelty, but it is usually more cruel not to dehorn. Any effects of dehorning, usually slight, pass away in a day or two. Dehorning is done to best advantage in the fall when there are no flies. Horns may be cut off with a saw, but dehorning clippers do the work quicker. If a small ring of skin is taken off with the horn it will heal over neatly. Pine tar on a piece of cotton waste makes a good dressing for the wound. Calves may be dehorned with caustic potash.

CARE OF THE DAIRY HEIFER

If the calf is handled and fed rightly during the first year of its growth much will be done toward making it a useful cow. It is not advisable to let a spring calf run on pasture without extra feed during any of the first summer. Even a fall calf should be fed a little extra the first year on pasture, as the extra development will pay well for the feed. Skimmilk, alfalfa and corn and bran are ideal calf feeds. An ideal arrangement for calves in this climate for both winter and summer is to have their box stalls or pens open out into small grass lots so that they can run in or out as they please. If water can be kept in the lot and some shade trees are there it will be all the better. In this way they can go in the barn during either the hot afternoons in the summer or the stormy days in winter, and when it is more comfortable outdoors can go out as they please.

Dairy heifers should be fed an abundance of muscle and bone-building feeds having plenty of bulk in order to build up a strong, healthy body with good constitution and capacity. Alfalfa hay and silage are excellent rough feeds. Heifers of extreme dairy form and breeding may be fed heavier when young than those with a natural tendency to fatten. With a heifer of uncertain type, heavy feeding may develop a tendency to fatten.

It is dougtful whether a heifer should be bred to freshen at less than two years old unless naturally strong and well developed. It is advisable to have heifers freshen in the fall, but when fresh in the spring let them run eighteen months before calving again. This gives them a rest and a chance to finish their growth.

CARE OF COW AT TIME OF FRESHENING

A cow due to freshen should be fed liberally for some time previously so as to get her in good condition for a year's work. She needs it to build up a strong,vigorous calf and develop a good udder. Up to the time a cow drops her fourth or fifth calf, or even later, the udder is capable of increasing in capacity, and much of this development takes place during the few weeks previous to freshening. This is especially true in the case of the young heifer, when the milk glands are first being stimulated. A little care and attention at this time gives returns in the increased productive capacity of the mature cow.

Ground oats, wheat bran, alfalfa hay and silage are safe and nutritious feeds at this time, supplying plenty of nutriment and keeping the digestive system open, thus guarding to a certain extent against milk fever and inflamed udders. Corn, kafir corn and milo may be used in small quantities, but are heating in their nature. Cottonseed meal is not a very safe feed to use at this time and should be avoided. If the cow is in too high condition and the udder is getting too large the feed should be reduced accordingly during the last two weeks and a more laxative diet substituted. If constitpation is noticed it is good practice to give one or two doses of epsom salts, three-fourths to one pound each, on alternate days for a few days before calving.

After freshening the cow should be fed lightly for a week in order to let her regain her strength, then the concentrates may be increased gradually, at the rate of one-half pound to one pound extra every three or four days as long as the milk yield continues to increase in proportion. When the cow reaches her limit the feed may be reduced slightly. Do not attempt to start on full feed too soon.

PART III

THE SILO ON THE DAIRY FARM

The silo preserves green fodder for winter use in a form particularly suitable for feeding dairy cows. The whole crop is saved without the loss of its natural juices. Two and a half times as much dry matter is contained in the silo per cubic foot of space as in the hay-mow. The losses in food nutrients are less in silage than when corn is shocked in the field. Corn stalk disease is avoided by the use of the silo. It is a great improvement on the system of growing green feed for dairy cows in summer as the whole summer's feed can be planted at one time, cut and harvested at one time and stored where it can be fed most conveniently. One acre of kafir corn may produce more succulent feed than several acres of pasture. The silo provides the best substitute for pasture grass in winter and insures the dairyman against drouth and short pastures in summer. Silage is the cheapest and most accessible of succulent winter feeds.

Silage is very palatable, improves the appetite, tones up the digestive system and thins and cools the blood. It is a preventive of digestive troubles, and with dairy cows may lessen considerably the chances of milk fever and garget.

Silage is not a complete feed in itself, though in summer it may be used alone to good advantage. Being watery and cooling in its nature it is a desirable addition to a dry ration, but is rather unsuitable as the only roughage for winter use. It is better to feed at least six or seven pounds of dry roughage per day with the silage. Where hay can be run through the feedcutter and mixed with the silage twelve hours or so before feeding it makes an excellent combination.

It should not be supposed that only a small concentrate ration should be fed because of the grain in the silage. The cow can make better use of grain feed when silage is fed than when on dry hay and at least as much should be given as with other roughage.

Soiling Crops.—The soiling system consists of planting a rotation

Dairy Barn, Oklahoma A. and M. College

Showing steel and concrete silos and part of dairy herd. The silo is an economic necessity in Oklahoma. In combination with the dairy cow it means prosperity for the Oklahoma farmer.

of crops so as to have a continuous supply of green forage for cows all through the summer and fall. Beginning with fall oats or fall wheat, then the first cutting of alfalfa, the dairyman may follow with spring-sown cereals and then with various plantings or cuttings of Indian corn, kafir, cowpeas or sorghum, together with the later cuttings of alfalfa. Small plots of the latter crops must be planted each two or three weeks during the growing season so as to have a new crop at the proper stage of maturity for cutting. The growing of soiling crops may be advocated where a man has fewer cows than would render the building of a silo advisable. Compared with pasturing, more feed can be grown per acre by the soiling system. It is not to be recommended in preference to the summer silo where that can be used. With the silo the crop is planted and harvested with least loss of labor and is always handy for feeding regardless of weather or press of farm work.

SUMMER FEEDING

Pasture.—A good pasture is one of the dairyman's best assets in the summer, though not the only one. By pastures we mean fields of good grass where cows can easily get all they want to eat, and not any and every piece of waste land that may be called a pasture. The great dairy breeds were developed on the rich, low-lying pastures of Holland, the heavy producing fields of the Channel Islands and the valleys of Ayrshire where the cows have to graze over only a few acres daily to get enough for milk production for a large yield of milk. In the Island of Jersey the cows are tethered in rows across the pasture, being moved up onto fresh grass each day.

To improve the pastures and care for them properly may take time, but it will be time well spent. 1. Have some good pasture, such as Bermuda, set out so as to have grass growing over all the fields. 2. Keep weeds cut down and exterminated, as they are almost as detrimental in a pasture as in a grain field; they smother the grass, take moisture from the soil, and will spread over a farm through the seeds in the manure. 3. Divide the pasture so that at least one field may be left to grow up while others are being pastured. With 100 acres or more of pasture it is better to make two or three fields out of it by means of either temporary or peramnent fencing than to allow the cattle to run over the whole field at once. 4. Avoid pasturing too closely, especially in the beginning of the season.

Bermuda is the best pasture grass for the Southern States, is very nutritious, lasts later in the season than any other pasture, and if a hardy variety is set out and not pastured too closely will withstand almost any drouth or frost in Oklahoma. Some early growing grass or clover, as bur clover, may be used to advantage along with Bermuda, which starts late in the season.

Pastures deserve a little better attention than they usually get in the way of reseeding or planting on places that are bare and weedy.

Fields that are badly washed and gullied may be greatly improved by terracing and planting Bermuda.

Supplementing Short Pastures

The question is often raised as to the economy of giving extra feed to cows on pasture. It must be remembered, in order to discuss this intelligently, that the term pasture may be applied or misapplied to any kind of a field on which cows may graze, ranging from rich, luxuriant fields of Bermuda or bluegrass, where cattle may get all they can eat in a short time, down to the almost bare and burned-out weed field where the cow can hardly get a living. Consequently no set rule can be given as to the extra feed that will be needed other than the rules given elsewhere, of keeping the cow up to her maximum of profitable production as indicated by the milk and feed records. Three general rules may be given for feeding in addition to pasture, as follows:

1. On heavy, rich pasture where cows can get all they want to eat in a few hours there will be little gain in milk yield if any from extra feed, and consequently no extra returns to pay for the feed.

2. On average pasture, each pound of grain fed, or its equivalent in other feed, may, with a good cow, be good for at least an extra pound of milk per day. Where milk is selling for 45 cents per gallon (or 5 cents per pound) the economy of such extra feed is easily seen. This rule will only hold good within certain limits, and not with all cows.

3. On poor pasture, failure to supply extra feed to milking cows will mean a serious loss in the milk and butter yield the same as caused by insufficient feeding at any other time. Cows that are allowed to run down in flesh and milk yield during the late summer cannot be brought back to a profitable yield later.

The dairyman should make a study of his individual cows and give extra feed as he finds they can make profitable use of it. Heavy producing cows, such as those giving over three pounds butter, or six or eight gallons milk or more per day should not be expected to get all their feed from pasture. The feeder should not forget the manurial value of concentrated feeds, or that liberal feeding may not show immediate gains, but may cause a great increase in returns later on.

The relative advantages of partial soiling and of the summer silo for supplying summer feed have already been mentioned. With plenty of alfalfa on the farm the dairyman may need no other soiling crop for the early summer, as it yields several cuttings per season without reseeding and lasts until the corn, kafir and sorghum are ready. Grain feeding may be best in the early part of the season.

FEEDING DAIRY CALVES

Whole milk at 16 cents or more per gallon is too expensive to feed to calves, and the butterfat can be economically replaced by grain feed. Skimmilk contains all the feed nutrients of the whole milk except the fat, which is not needed for the dairy calf after two weeks old. Corn meal, kafir meal, ground oats, or linseed meal may be used to advantage as supplementary feeds. The dairy calf may be separated from its dam within a few hours after birth, or, in the case of a weak celf, may be allowed to run with her for three or four days. If the cow shows some indications of garget the calf may aid materially in loosening up the congestion. The advantage of the former method is that the calf may be trained to drink with less trouble, and neither cow nor calf are disturbed materially by the separation.

Milk fed to calves should be warm, sweet and clean, and fed at regular mealtimes in uniform amounts and in clean, scalded buckets. Occasionally very rich milk will be found to disagree with a calf. In this case the milk may be diluted with clean, warm skimmilk or milk having a comparatively low fat content may be substituted. Where sour, acid silage is being fed to the cows, the milk may give trouble to calves with weak digestive powers and a change in feed may be necessary.

A dairy calf of the smaller breeds should get about one gallon of milk per day, divided into three feeds daily for the first ten days and two feeds daily afterward. Calves of the larger breeds will take more. After two weeks old, sweet, warm skimmilk may gradually be substituted for the whole milk and the quantity gradually increased to one and one-half gallons per day, and to two or two and one-half gallons after two and one-half months old. Large calves may be given more. To check scouring in calves, reduce the feed and give one or two teaspoonfuls of dried blood in the milk daily.

Feed the calf clean, nutritious roughage—alfalfa if possible—as soon as it will eat it, and feed all it will eat. This helps to develop a good, strong, capacious digestive system.

Calves require drinking water even when on a full milk ration, and should have it always before them in summer. The water should be warmed for them in winter. Give a good grain ration, but do not overfeed. Corn, ground kafir corn, oats, wheat bran, linseed meal and ground sorghum seed are good grain feeds.

Substitutes for milk, such as gruels, calf meals, infusions of hay, are sometimes used to take the place of milk worth 40 cents per gallon. In the hands of a skilled stockman these may sometimes be used successfully and economically, but are not to be recommended to the careless feeder.

PART IV

DAIRY BARNS AND STABLES

The requirements of a good dairy barn are: 1. Suitable and convenient location. 2. Adequate shelter and comfortable quarters for stock. 3. Special storage room for feed. 4. Sanitary construction and good ventilation, such as would be required in any other factory of human food. 5. Convenient arrangements requiring the minimum amount of labor to do the necessary work of feeding and cleaning out.

It is advisable to have a separate milk house and also that no other animals, hogs especially, be stabled in or near the dairy barn.

Location.—Dairy barns should be conveniently located, if possible on high, well drained ground, so as to admit of perfect drainage, both on the surface and for such underground drains as may be necessary. When built on the level it is advisable to set the level of the floors as high as possible, filling in inside the foundation and then grading toward the barn on the outside. Locate where there can be a good supply of lots for cows, herd bulls, calves, etc., convenient to the barn, that will also be well drained.

Cost of Buildings.—The Oklahoma farmer does not require the same elaborate thick-walled and high priced buildings that are needed in the North. Practically all that is required from the standpoint of shelter is that they be wind and rainproof. Shelter is important. The efficiency of the cow is greatly reduced by being exposed to storms or cold winds in winter. Although feed may be used to keep up animal heat, it is poor policy to use it for that purpose.

Permanent construction is usually the cheapest in the end. Concrete may be used largely for floors and foundations and will prove cheapest in the end.

Convenience.—Another consideration is that of convenience. In feeding, handling and caring for livestock much time may be wasted by unhandy and awkward arrangements. A few days or weeks of careful study before building a barn may save a great deal of work every year that the born is in use. Haymows and feed rooms should be where the feed can be got to the cattle easily. It is not considered a good plan, however, to have a hayloft above a dairy stable, unless a dustproof floor is put in.

Sanitary Construction.—More than half the work of keeping a stable clean and sanitary may be accomplished before a single animal is put in by building floors, mangers, stalls, ceilings and walls so that they can be readily washed, swept or disinfected. Concrete is not only more permanent, and therefore cheaper for the floors of a stable, but is much the most cleanly. Not every one can afford to have stall partitions and stanchion frames made of steel or iron pipe, but if wood must be used, they should be simply and plainly built to afford as little room as possible for dust and dirt to collect. Walls and ceilings should also be made smooth on the inside. They will be much easier to whitewash, cobwebs will not be so likely to collect or so difficult to remove. A stable should be disinfected and whitewashed each year.

Floors.—When laying cement floors, gutters should be laid first with a slight fall to one end. They should be four to six inches deep and fifteen to eighteen inches wide. The distance from gutter to stanchion should be about 4 feet six inches for ordinary cows. Large cows may need 4 feet 10 or 5 feet, while small heifers require only a 4-foot stall. The floor should slope to the gutter from each side. The passage behind the cows should be at least 8 feet wide to allow cows to pass without crowding. The floor should be finished with a wooden trowel rather than a steel one, as the latter makes a smooth, slippery finish that when wet is very difficult for the cows to walk on safely. If drains are to be laid to carry off the liquid manure or the water used in washing the floors, they must be put in before the floor is laid.

Stalls and Fastenings.—For medium sized cows the stalls should be about 3½ feet wide, for large cows 4 feet wide, and for heifers 3 feet wide. The partitions should be too high for the cows to reach over and long enough to prevent them from stepping around on the teats and udders of other cows lying down. In selecting a method to fasten cows in their stalls, the following points should be noted: Security, ease of fastening and unfastening, comfort of the cow, and alignment of the cow with the gutter.

The swing stanchion seems to come nearest fulfilling these conditions. It gives the cow perfect freedom and comfort, keeps her from lying in the gutter or getting her front feet in the manger, is readily closed and unfastened, and is also secure. The rigid stanchion should not be used expect possibly to hold the cow during milking and feeding time. Patent stalls with movable partitions and with chains across the rear of the stall to keep the cow in place are usually expensive, and young, active cattle are liable to get out of them.

Mangers.—A manger should be sanitary and easily cleaned, should be large enough to hold the feed so that the cows cannot throw it out, should be arranged so that the cows cannot get into it with their fore feet, should be partitioned to keep the cow's feed from the others, and should be convenient for feeding and cleaning out refuse. A manger built with cement bottom and the lower part of the sides of the same material, and with removable partitions, will give good results, especially when used in connection with the swinging stanchion. Such a manger can be used to water cattle in in winter and will be easily swept out and cleaned. When used for watering purposes such a manger should be perfectly smooth, should slope slightly but evenly toward one and, and should be provided with a drain to carry off surplus water.

Where there are two rows of cows it makes little difference whether the cattle face each other or face the other way, but the difference is probably in favor of the latter method. Where the cattle face the windows a truck can be driven through to clean out the manure and the cattle get more fresh air than when they face a central feeding alley.

Light and Ventilation.—Plenty of light and fresh air should be provided by putting in large windows on either side of the barn. If the stable faces east and west, the sun should shine in on every part of the stable during each day. These windows may be hinged at the bottom and swung inward so that plenty of air can get in without letting a draft on the cows. In the College stable the Monitor top has windows which may be opened or closed from the floor of the building letting out all warm, foul air that rises to the roof. In large barns of more than one story the King system of ventilation may be used. With this system the cold air is taken in from the outside at the level of the floor and goes up through the wall to the ceiling where it enters the stable. The foul air is collected at the level of the floor by the outlet pipes that go up through the second story to the roof. Another system in use is to remove a few windows in winter and put canvas across the opening. Enough air goes through without letting any direct draft on the cattle.

The Stalless Stable and the Open Shed.—Years ago Professor I. P. Roberts advocated having a large closed shed adjoin the milking stable into which the cows could be turned at night in winter. With the cows dehorned, the shed well bedded and a water trough put in, the cows had practically all the comfort and freedom they would have outdoors in summertime. The plan, while practicable, has not been very generally adopted.

A practicable and convenient plan, in this latitude at least, is to have an open shed in addition to the regular stable opening into a large, well drained lot where the cows can go at will. This will cost a little extra and does not save much of the manure, but there can be no doubt that it is healthy, clean and comfortable for the cows. Feeders of beef steers discovered long ago that their cattle seemed more comfortable and usually put on more flesh when dehorned and turned loose into dry lots or well bedded sheds than when chained in stalls. The writer's previous experience with southern cattle has been that cows seemed to do better outdoors, even on cold nights, than when shut in the stable except, of course, in the case of a cold rain, or snow or sleet storm, no watering devices being in the barn. There is no doubt that the cows in this latitude, accustomed to being outdoors almost all year, do not take to confinement in a stall as readily as the northern cow, accustomed to it all her life. The outdoor system is very satisfactory for handling bulls and young dairy stock. Large box stalls can be used, opening outdoors into dry lots, a separate lot being provided for each group of young stock of similar size or sex, and is equally satisfactory in summer as in winter.

The principal drawback of the closed stable is that it is not always easy to tell when the cattle would be most comfortable indoors, and when not. Often, in fall and spring, a fine evening may be followed during the night by a cold norther or sleet storm; also when kept in on a threatening looking evening the cattle may be sweating by morning owing to a sudden rise in temperature. With an open shed the cattle regulate matters themselves, can keep cleaner and healthier and get all they need of fresh air and water, while the milking stable is also kept fresher and cleaner.

This system of housing breeding stock has much to recommend it and is used a great deal with high class, pure bred breeding males in this country and in Great Britain. Some of the greatest cattle and horses have been kept the year round in paddocks or lots with open stables, enclosed only on three sides. One special merit is that in case of fire valuable stock may be saved that would otherwise be lost. Usually when a barn gets on fire it is too far gone when noticed to permit of entering and turning cattle loose from stanchions or other fastenings, and much valuable stock is lost in this way.

PART V

SOME SPECIMEN RECORD SHEETS

Specimen Daily Milk Record

(Week ending March 18, 1911)

		Laura.	Clara	Polly	Carrie.	Brassie.	Brownie.	Beth.	Ethol's K.
12	A. M.	20.0	16.0	6.0	18.8	11.5		9.0	3.0
	P. M.	17.0	13.5	4.5	17.7	9.5		9.0	2.5
13	A. M.	18.5	16.5	5.5	17.6	11.2		8.0	3.0
	P. M.	16.5	13.0	4.5	16.0	9.4		8.0	2.0
14	A. M.	19.0	14.0	5.5	16.5	11.5		8.0	3.0
	P. M.	16.0	14.5	4.5	16.3	9.5		8.0	2.5
15	A. M.	19.0	16.5	5.0	17.5	11.6	*	9.0	3.0
	P. M.	16.0	12.5	5.0	15.8	9.4		8.5	2.5
16	A. M.	19.5	15.0	5.6	17.1	11.5	6.0	9.0	3.0
	P. M.	17.0	13.5	4.4	16.1	9.6	6.0	9.0	3.0
17	A. M.	20.0	17.5	4.5	16.4	12.0	6.0	9.0	3.0
	P. M.	17.5	14.0	4.5	16.5	9.7	6.0	10.0	2.5
18	A. M.	19.2	17.0	5.0	15.3	11.6	9.0	8.0	3.0
	P. M.	17.0	14.5	4.5	16.4	9.8	8.0	8.0	2.5
Total	....	252.2	208.0	69.0	234.0	147.8	40.0	120.5	38.5

*Fresh March 15.

Specimen Four-Week Feed and Milk Record

	Laura.	Clara	Polly	Carrie.	Brassie.	Brownie.	Beth.	Ethol's K.
Daily ration for week ending March 11:								
Bran	5.0	4	2.6	5.0	3.6	3.0	3.0	2.0
Cottonseed meal	2.5	2	1.3	2.5	1.8		1.5	1.0
Corn chops	5.0	4	2.6	5.0	3.6	3.0	3.0	2.0
Alfalfa	10.0	10	9.0	10.0	10.0	10.0	8.0	8.0
Silage	28.0	28	26.0	28.0	28.0	28.0	24.0	24.0
Pounds of milk	245.0	207	75.0	253.7	147.3		127.0	37.0
Daily ration for week ending March 18:								
Cottonseed meal	2.5	2	1.3	2.5	1.8		1.5	1.0
Bran	5.0	4	2.6	5.0	3.6	3.0	3.0	2.0
Corn chops	5.0	4	2.6	5.0	3.6	3.0	3.0	2.0
Alfalfa	10.0	10	9.0	10.0	10.0	10.0	8.0	8.0
Silage	28.0	28	26.0	28.0	28.0	28.0	24.0	24.0
Pounds of milk	252.0	208	69.0	234.0	147.8	40.0	120.5	38.5
Daily ration for week ending March 25:								
Cottonseed meal	2.5	2	1.3	2.5	1.8	1.0	1.5	1.0
Bran	5.0	4	2.6	5.0	3.6	3.0	3.0	2.0
Corn chops	5.0	4	2.6	5.0	3.6	3.0	3.0	2.0
Alfalfa	12.0	12	10.0	12.0	12.0	12.0	9.5	9.5
Silage	20.0	20	18.0	20.0	20.0	20.0	18.0	18.0
Pounds of milk	249.0	210	69.0	221.5	146.0	114.0	122.0	36.0
Daily ration for week ending April 1:								
Cottonseed meal	2.5	2	1.3	2.5	1.8	1.5	1.5	1.0
Bran	5.0	4	2.6	5.0	3.6	4.0	3.0	2.0
Corn chops	5.0	4	2.6	5.0	3.6	4.0	3.0	2.0
Alfalfa	12.0	12	10.0	12.0	12.0	12.0	9.5	9.5
Silage	20.0	20	18.0	20.0	20.0	20.0	18.0	19.0
Pounds of milk	249.8	191	67.0	213.8	144.2	138.0	125.5	37.5
Total pounds milk	996.0	816	280.0	923.0	586.0	282.0	595.0	149.0

Specimen Feed and Milk Record

(Four weeks ending April 1, 1911)

(Suitable for four-week period, month or year)

Name of Cow.	Lbs. Milk.	Per cent Butterfat.	Lbs. Butterfat.	FEED					Cost of Feed.	Value of Milk.	Profit.
				Cotton-seed Meal.	Corn Chop.	Bran.	Hay (Alfalfa).	Silage.			
Laura	996	4.4	43.8	70.0	140	140	308	672	6.69	21.10	14.41
Clara	816	4.2	34.3	56.0	112	112	308	672	5.84	17.28	11.44
Polly	280	4.4	12.3	36.5	73	73	266	616	4.39	5.93	1.54
Carrie	923	4.8	44.3	70.0	140	140	308	672	6.69	19.54	12.85
Brassie	586	4.6	27.0	50.5	101	101	308	672	5.53	12.42	6.89
Brownie	282	4.0	11.3	17.5	91	91	308	672	4.85	5.97	1.12
Beth	595	5.2	30.9	42.0	84	84	245	588	4.56	12.60	8.04
Ethol's K.	149	4.0	6.0	28.0	56	56	245	588	3.72	3.15	.57

NOTE 1.—The cost of feed should be estimated at current market prices. The feed in this table was estimated at the following prices: Cottonseed meal, $27.00 per ton; corn chop and bran, each at $23.00 per ton; alfalfa hay, $12.00 per ton; and silage at $2.00 per ton, these being the prices paid for the purchased feedstuffs during this period.

NOTE 2.—In making yearly records other items may be included in both the debit and credit columns; for instance, labor, rent and interest may be charged against the cow, and value of calf and value of manure may be charged in her favor. The value of products should be figured according to market prices received during the year (milk 18 cents per gallon). If butter is sold and the skimmilk fed, the cow should be given credit for the value of the skimmilk as well as for the butter.

SCALE OF POINTS FOR DAIRY CATTLE—COW

(Perfect Score)

General Appearance (18 Points)	
Form—inclined to be wedgeshaped	6
Quality—hair fine, soft; skin mellow, loose, medium thickness; secretion yellow; bone clean, fine	6
Temperament—nervous, indicated by lean appearance when in milk	6
Head and Neck (7 Points)	
Muzzle—clean cut; mouth large; nostrils large	1
Eyes—large, bright, full, mild	1
Face—lean, long, quiet expression	1
Forehead—broad	1
Ears—medium size, yellow inside, fine texture	1
Horns—fine texture, waxy	1
Neck—fine, medium length; throat clean; light dewlap	1
Forequarters (5 Points)	
Withers—lean, thin	1
Shoulders—light, oblique	2
Legs—straight, short; shank fine	2
Body (26 Points)	
Chest—deep, low; girth large, with full fore flank	10
Barrel—ribs broad, long, wide apart; large stomach	10
Back—lean, straight, open jointed	2
Loin—Broad	2
Navel—large	2
Hindquarters (14 Points)	
Hips—far apart, level	2
Rump—long, wide	2
Pin Bones or Thurls—high, wide apart	1
Tail—long, slim; fine hair in switch	1
Thighs—thin, long	4
Escutcheon—spreading over thighs, extending high and wide	2
Legs—straight; shank fine	2
Milk Vessels, etc. (30 Points)	
Udder—long, attached high and full behind, extending far in front and full, flexible; quarters even and free from fleshiness	20
Teats—large, evenly placed	5
Mammary Veins—large, long, tortuous, branched with double extension; large and numerous milk wells	5
Total	100

In judging heifers allowance must be made for the undeveloped udder, teats and milk veins, paying special attention to the length and placing of teats and whether the udder is carried well forward and attached high behind. In judging bulls, instead of 20 points for udder and 5 points each for teats and mammary veins, score 4 points for length and wide placing of rudimentary teats, 3 for rudimentary milk veins, 3 points extra for arched, crested neck, 2 points each extra for chest and barrel, 1 point extra for broad, strong head, and 15 points for style, vigor, symmetry and strong, masculine appearance.

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

Stillwater

The following are available publications of the Oklahoma Agricultural Experiment Station:

No. 66—The Water Supply.
No. 67—Miscellaneous Water Analyses.
No. 69—Small Fruits.
No. 72—Tests of Dips as Lice and Tick Killers.
No. 75—A Study of the Bacterial Content of Cream.
No. 87—Corn Culture.
No. 88—Southern Plum Aphis.
No. 89—Chemistry of the Kafir Corn Kernel.
No. 90—A Study of Bermuda Grass.
No. 91—The Twig Girdler.
No. 92—Spray Calendar.
No. 93—Artificial Insemination.
No. 94—Hog Feeding.
No. 95—Varieties of Fruits Raised in Oklahoma.
No. 96—Vitality of Reproductive Cells.
No. 97—Cotton Culture.
No. 98—Cotton or Melon Aphis.
No. 99—Dairying in Oklahoma.
No. 100—Garden and Truck Crop Insect Pests.

Circular No. 6—The Bactericidal Properties of Various Disinfectants.
Circular No. 7—The Value of Cotton Improvement.
Circular No. 12—Summary of Experiment Station Work.
Circular No. 13—Selecting an Orchard Site.
Circular No. 14—Protecting Trees From Rabbits.
Circular No. 15—Some Types of Silos.
Circular No. 18—Experiment Station Work.
Circular No. 19—Spanish Peanuts.
Circular No. 20—Systems of Planting for Orchards.

Nineteenth and Twentieth Annual Report.
Twenty-First Annual Report.