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FEEDING MILK COWS.

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TEXAS AGRICULTURAL EXPERIMENT STATION.

Four Feeding Experiments with Milk Cows.

J. H. CONNELL, M. SC.
JAS. CLAYTON.

The farmer, the dairyman, or the professional stock feeder, is usually limited to the choice of one or two grains or of one or more kinds of forage stuffs, and from these he must decide which is best suited to his purposes, basing his decision on the market price, the cost of handling and on the more important question, of intrinsic value to him. The farmer or dairyman usually owns hay and often wishes to buy a grain that will produce milk or beef freely when combined with it. He then considers the market prices, which are always variable.

The farmer or professional feeder may be able to secure one kind of grain or one kind of forage at a very cheap rate, and must choose something to feed with it as a companion food. In any case we must recognize the fact the value we expect to find in a grain or hay will depend largely on the nature and value of the other food selected to go with it.

In planning this series of feeding experiments to produce milk and butter, we hoped to answer some of the most important questions presenting themselves to all who feed milk cows. We have attempted to so plan the experiments that the results would be of practical value to everyone in the State feeding milk cows. We tried to decide what grains were best suited to accompany certain forage stuffs or hays, and what forage stuff is the best companion food for some of the most popular grains.

A portion of the experiments was devoted to a test of one grain against another grain, planned in such a manner that the value of one pound of a certain grain will be shown in pounds (or a fraction of a pound) of the other. These are considered the most valuable and conclusive results of this series of experiments, since it gives a more practical understanding of the relative values of the grains or forage stuffs compared than can be obtained in any other manner. By this method

of comparison we rid ourselves of the question of market prices, which changes the face value of most experiments with every change of season.

The most important questions answered by these four experiments are here mentioned:

How much cotton seed hulls is equal to one pound Alfalfa hay? Ans. 1.58 pounds when combined with 3 pounds cotton seed meal and 5 pounds cornmeal. (See page 502. Experiment No. 2.

How much cotton seed hulls is equal to 1 pound choice prairie hay? Ans. 1.45 pounds when combined with 3 pounds cotton seed meal and 5 pounds cornmeal. (See page 502. Experiment No. 2.

How much choice prairie hay is equal to 1 pound Alfalfa? Ans. 1.12 pounds when combined with 3 pounds cotton seed meal and 5 pounds corn meal. (See page 502. Experiment No. 2.

Does the addition of silage to a ration of common hay cheapen the ration? Ans. It does. (See pages 510 and 515. Experiments 3 and 4.

Having cotton seed meal, what single forage should be fed with it to produce largest flow of milk? (Forage tested—cotton seed hulls, alfalfa hay, silage, and prairie hay.) **Ans. Cotton seed hulls.** (See pages 510 and 515. Experiments 3 and 4.

Having common prairie hay, what single grain is the best to feed with it to produce largest flow of milk? (Grains tested were cotton seed and cotton seed meal.) **Ans. Cotton seed.** (See page 510 and 515. Experiment 3.

Having cotton seed hulls, what single grain is the best to feed with it to produce largest flow of milk? (Grains tested, cornmeal and cotton seed meal.) **Ans. Cotton seed meal.** (See pages 510 and 515. Experiments 3 and 4.)

EXPERIMENT NO. 1—TEST OF FORAGE STUFFS.

(Fed ad libitum ration of grain and forage.)

The first object of this experiment was to test the merits of the several most important forage stuffs used in this State in feeding milk stock—cotton seed hulls, alfalfa hay, common prairie hay, and corn silage. To do this most accurately it was thought best to feed as grain with each of the "hays" a mixture in equal parts of corn meal and cotton seed meal. It was further determined to feed all of the food as liberally as the cows demanded. In selecting cows for this test, eight grade cows were taken, four grade Jerseys and four grade Holsteins, and divided into four groups, and for convenience numbered 1, 2, 3, and 4; each group containing one Jersey and one Holstein grade. They were fed 28 days (January 26 to February 22). In this the grain feed given the eight cows was uniform; consisting of cotton seed meal and corn meal mixed in equal parts. The different groups were fed the following different kinds of forage:

Group No. 1, Alfalfa, at	$16 00 per ton.
Group No. 2, Cotton seed hulls at	6 00 per ton.
Group No. 3, Silage at $4.00 and Common hay	10 00 per ton.
Group No. 4, Common hay at	10 00 per ton.

The feed was given twice daily in limited quantities for the first period of seven days, and then gradually increased until the cows were given all they would consume.

The first table shows amount of feed given in limited quantities for the first seven days (January 26 to February 1, unchanged) with the total amount of milk and butter produced in these seven days and net receipts from sale of same, also weight of cows on February 1. In making all calculations an average price* was taken, based on the different commodities in this locality.

The following tables show what each group was fed daily and the milk and butter produced. Each table gives a complete record of this experiment for one period of seven days.

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* Corn meal (corn and cob meal) is valued at $14 per ton, and cotton seed meal at $20 per ton; cotton seed (boiled) at $10 per ton.

In making estimates of profits the milk is valued at 20 cents per gallon, butter at 25 cents per pound.

Table No. 1—Frst Period, Preliminary Feeding.

Jan. 26, to Feb. 1, inclusive. (All feed limited; same amount of grain fed all groups.)

	Number of cow.	Weight of cow, Feb. 1.	Grain feed, half each cotton seed meal and corn meal.	Alfalfa eaten—pounds.	Cotton seed hulls eaten—pounds.	Silage eaten—pounds.	Common hay eaten—pounds.	Total amount of feed eaten—pounds.	Total milk produced, seven days—pounds.	Total am't butter produced, seven days—pounds.	Average daily grain eaten—pounds.	Average daily forage eaten—pounds.	Average daily milk produced—pounds.	Average daily butter produced—pounds.	Average daily cost of feed—cents.	Value of whole milk produced per day—cents.	Value of butter produced per day—cents.	Profit daily from sale of whole milk—cents.	Av. val. milk and butter produced daily by groups—cts.
Group No. 1.	1	630	56	33	.....	.....	.....	89	142	6.1	8	4.7	20.2	.8	10.5	50.7	22.0	40.1	
	382	970	56	33	.....	.....	.....	89	120	6.0	8	4.7	17.1	.8	10.5	42.8	21.5	32.2	34.2
Group No. 2.	316	740	56	.....	41.5	.....	.....	97.5	122	6.4	8	5.9	17.4	.9	8.1	43.5	23.0	35.3	
	60	880	56	.....	41.5	.....	.....	97.5	129	5.1	8	5.9	18.4	.7	8.1	46.0	18.2	37.8	32.7
Group No. 3.	191	680	56	.....	.....	49	25.5	130.5	118	5.5	8	10.6	16.8	.7	10	42.1	17.5	32.1	
	278	830	56	.....	.....	49	25.5	130.5	123	6.3	8	10.6	17.5	.9	10	43.9	22.7	33.9	31.3
Group No. 5.	166	780	56	.....	.....	.....	51	107	120	7.0	8	7.2	17.1	1.0	10.4	42.8	25.2	32.4	
	319	770	56	.....	.....	.....	51	107	131	5.7	8	7.2	18.7	.8	10.4	46.7	20.2	36.3	33.7

Table No. 2—Second Period.

Feb. 2 to Feb. 8, inclusive. (Grain mixture and forage fed ad libitum.)

	Number of cow.	Grain feed, half each cotton seed meal and corn meal.	Alfalfa eaten—pounds.	Cotton seed hulls eaten—pounds.	Silage eaten—pounds.	Common hay eaten—pounds.	Total amount of feed eaten—pounds.	Total amount milk produced—pounds.	Total amount butter produced—pounds.	Average daily grain eaten—pounds.	Average daily forage eaten—pounds.	Average daily milk produced—pounds.	Average daily butter produced—pounds.	Average daily cost of feed—cts.	Value of whole milk produced per day—cents.	Value of butter produced per day—cents.	Profit daily per cow from sale of whole milk—cents.	Ave. value milk and butter produced daily by groups—cents.
Group No. 1.....	182	102	48	.....	.....	.....	150	175	9.2	14.5	6.8	25	1.3	17.8	62.5	33.0	44.6	
	382	104.5	63.5	.....	.....	.....	178	129	5.5	14.9	9	18.4	.8	19.9	46.0	19.7	26.1	40.3
Group No. 2.....	316	101	.....	74	.....	.....	175	117	5.2	14.4	10.5	16.7	.7	15.4	41.7	18.5	26.3	
	60	97	.....	86	.....	.....	183	138	5.5	13.8	12.2	19.7	.8	15.4	49.2	19.5	33.8	31.9
Group No. 3.....	191	96	.....	.....	74.5	44	214.5	132	5.1	13.7	16.9	18.8	.7	16.8	47.1	18.2	30.2	
	278	91	.....	.....	71.7	43.5	206.5	134	6.4	13	16.4	19.1	.9	16.2	47.8	23.0	31.6	34.0
Group No. 4.....	166	98	.....	.....	.....	77.7	175.7	129	7.2	14	11.1	18.4	1	17.4	46.0	26.0	28.6	
	319	100	.....	.....	.....	73.5	173.5	144	5.4	14.2	10.5	20.5	.8	17.3	51.4	19.2	34.0	35.6

Table No. 3—Third Period.

Feb. 9 to Feb. 15, inclusive. (Grain mixture and forage fed ad libitum.)

	Number of cow.	Weight of cow, Feb. 15.	Grain feed, half each cotton seed meal and corn meal.	Alfalfa eaten—pounds.	Cotton seed hulls eaten—pounds.	Silage eaten—pounds.	Common hay eaten—pounds.	Total amount of feed eaten—pounds.	Total amount milk produced—pounds.	Total amount butter produced—pounds.	Average daily grain eaten—pounds.	Average daily forage eaten—pounds.	Average daily milk produced—pounds.	Average daily butter produced—pounds.	Average daily cost of feed—cents.	Value of whole milk produced per day—cents.	Value of butter produced per day—cents.	Average daily gain from sale of whole milk—cents.	Average value milk and butter produced daily by groups—cts.
Group No. 1.	182	850	98.5	34.5	.....	.....	.....	132.7	172	5.6	14	4.8	24.5	.8	15.8	61.4	20.2	45.5	
	382	1000	142.5	44.7	.....	.....	.....	187.5	159	7.1	20.3	6.3	22.7	1	22.4	56.7	25.2	34.3	40
Group No. 2.	316	760	116.5	.....	42	.....	.....	158.5	112	5	16.6	6	16	.7	15.9	40	17.7	24	
	60	930	138	.....	62.5	.....	.....	200.4	140	5.4	19.1	8.9	20	.8	18.9	50	19.2		31.7
Group No. 3.	191	740	137.5	.....	.....	40	21.7	199.4	142	8.5	19.6	8.8	20.2	1	19.3	50.7	26.7	31	
	278	880	140	.....	.....	59.7	24.5	224.4	152	7.6	20	12	21.7	1	20.4	54.2	27.7	31.3	
																		33.8	39.7
Group No. 4.	166	800	158.5	.....	.....	.....	55	213.4	141	7.7	22.6	7.8	20.1	1.1	23.6	50.3	27.7	27.1	
	319	820	150	.....	.....	.....	54.5	204.5	165	7.1	21.4	7.7	23.5	1	22	58.9	25.5	38.8	40.6

Table No. 4—Fourth Period.

Feb. 16 to Feb. 22, inclusive. (Grain mixture and forage fed ad libitum.)

	Number of cow.	Weight of cow, Feb. 22.	Grain feed, half each cotton seed meal and corn meal.	Alfalfa eaten—pounds.	Cotton seed hulls eaten—pounds.	Silage eaten—pounds.	Common hay eaten—pounds.	Total amount feed eaten—pounds.	Total amount milk produced—pounds.	Total amount butter produced—pounds.	Average daily grain eaten—pounds.	Average daily forage eaten—pounds.	Average daily milk produced—pounds.	Average daily butter produced—pounds.	Average daily cost of feed—cents.	Value of whole milk produced per day—cents.	Value of butter produced per day—cents.	Gain daily from sale of whole milk—cents.	Average value milk and butter produced daily by groups—cts.
Group No. 1.	182	845	152.5	41	.....	.....	.....	193	169	9.4	21.7	5.8	27	1.3	23.1	67.5	32.5	44.4	
	382	980	181.5	39	.....	.....	.....	220.5	160	6.5	25.9	5.5	27.8	.9	26.4	57	22.5	30.6	45.6
Group No. 2.	316	750	102	.....	66.5	.....	.....	168.5	114	5.6	14.5	9.5	16.2	.8	15.2	40.5	20	25.3	
	60	905	128	.....	71.5	.....	.....	199.5	136	6.2	18.2	10.2	19.4	.9	18.5	48.5	23.5	30	33.1
Group No. 3.	191	720	154.5	.....	.....	37.5	15.7	207.7	142	6.0	22	7.6	20.2	.8	27.5	50.5	20	23	
	278	870	163.5	.....	.....	58.4	25.4	247	165	8.9	23.3	11.9	23.5	1.2	23.3	58.7	30	35.4	39.8
Group No. 4.	166	800	158	.....	.....	.....	41.5	199.5	144	8.1	22.5	5.9	20.5	1.1	22.1	51.2	27.5	39.1	
	319	800	140	.....	.....	.....	39.4	179.4	176	7.4	20	5.6	25.1	1	19.8	62.7	25	42.9	41.6

When the second, third, and fourth "periods" of this feeding test were compared with the first period, the following prominent facts are found worthy of mention. The feed consumed by the cows in this was 590 pounds more during the second period, 634½ pounds more during the third, and 763 pounds more during the fourth period than was given them during the first period, the amount consumed in the last period being nearly double that given them in the first. So gradual was the increase made in the feed demanded by the cows (which consisted chiefly of the grain given them, as there was practically no increase in the forage) that only three of the cows had slight attacks of indigestion, which were relieved without treatment. The other five had no trouble of any kind that could be traced to the food they consumed. The gain in the weight of the cows is sufficient proof of the healthfulness of the cows at the end of the test. The eight cows were weighed February 1st, 15th, and 22nd. Their total gain February 15th, was 500 pounds, and February 22nd, 390 pounds. The gain in butter and milk for the different periods, (based on the yield of the first period, was as follows: The gain for the second period was 93 pounds milk and 1.27 pounds butter. For the third period the gain was 188 pounds milk and 5.25 pounds butter, and for the fourth period the gain was 204 pounds milk and 10.16 butter.

As before stated, the money question was not considered in planning this experiment. However, it is interesting to note that the total value of the food consumed by the eight cows during this test for 28 days was $36.37, while the receipts from the sale of milk were $112.59, showing a net gain of $76.65 over the cost of the feed. It is but fair to suppose that in feeding so freely we fed somewhat wastefully from a profit and loss standpoint.

SUMMARY OF RESULTS.—EXPERIMENT NO. 1.

The following table shows comparison of groups and feeds, including the total amount of milk, and value of milk produced, total cost of feed eaten by each group, total amount of money earned by group, and the total gain or loss in the live weight of the cows:

GROUP NO. 1—MIXED GRAIN AND ALFALFA HAY.

893 pounds mixed grain	$7 59
337 pounds alfalfa	2 69
1230 pounds feed consumed: total cost	$10 28
1226 pounds milk produced; total value	30 65
Total net value	$20 37

1820 pounds total weight two cows beginning of test.
1845 pounds total weight two cows end of test, 28 days.
25 pounds total gain in flesh.

GROUP NO. 2—MIXED GRAIN AND COTTON SEED HULLS.

795 pounds mixed grain	$6 75
485 pounds cotton seed hulls	1 45
1280 pounds feed consumed; total cost	$8 20
1008 pounds milk produced; total value	25 21
Total net value	$17 01

1620 pounds weight two cows beginning of test.
1690 pounds weight two cows end of test, 28 days.
70 pounds gain in flesh.

GROUP NO. 3—MIXED GRAIN, COMMON HAY AND SILAGE.

895 pounds mixed grain	$7 60
440 pounds silage	87
226 pounds common hay	1 13
1560 pounds feed consumed; total cost	$9 60
1108 pounds milk produced; total value	27 70
Total net value	$18 10

1510 pounds total weight two cows beginning of test.
1620 pounds total weight cows end of test, 28 days.
110 pounds total gain in flesh.

GROUP NO. 4—MIXED GRAIN AND COMMON HAY.

916 pounds mixed grain	$7 79
443 pounds common hay	2 22
1359 pounds feed consumed; total cost	$10 01
1150 pounds milk produced; total value	28 75
Total net value	$18 74

1550 pounds total weight two cows beginning of test.
1620 pounds total weight two cows end of test, 28 days.
70 pounds total gain in flesh.

In studying the above statement, it will be first noticed that the group fed alfalfa hay and grain, produced the greatest flow of milk, followed next by common hay and grain. The smallest flow was produced on cotton seed hulls and grain ration.

We notice incidentally that the greatest clear profit was derived from the alfalfa hay and grain, followed next by the group fed common hay and grain. Because of the probable waste in feeding these cows, it is not fair to stress the items of profit appearing in the above statements.

Though all of the groups made a gain in live weight, there was no important gain, except in the case of group 3, fed silage, hay and grain. These made an average gain of nearly two pounds each per day. Had profits in feeding been a prominent point in this experiment, this live weight gain would be entered in all the groups as a credit, increasing clear profits in each case.

The group fed alfalfa hay and grain cost more for their 28 day's keep than any other two cows in this test. The cheapest ration fed consisted of cotton seed hulls and mixed grain, group 3.

When silage was added to the common hay ration (group 5), as compared with No. 4, we note that less grain and hay were consumed, and the cost of total ration cheapened. The flow of milk was apparently decreased because of the small amount of dry matter eaten.

EXPERIMENT NO. 2—FORAGE TEST.

The chief end in view in planning this experiment was to so arrange the feeding that a fair trial of alfalfa, cotton seed hulls, silage, and ordinary prairie hay would be had. To secure this trial, a fixed grain ration was prepared for all the groups, consisting of 3 pounds cotton seed meal and 5 pounds corn meal daily for each cow in the test. All the forage was given them that their appetites called for. This experiment began on February 23, 1894, and continued 21 days until March 15. For convenience of study, we have divided this time into periods of seven days each.

It will be seen by reference to the numbers of cows appearing on the next page, the same individuals were used in this experiment as were reported on in "Experiment 1," found in the preceding pages. The cows were not only the same, but were similarly grouped.

The same care was exercised in taking note of milk and butter weights, live weight of cows, waste in feed, and all essential details as was true of the former experiment. All calculations are based on the same prices of food stuffs and products as in Experiment No. 1.

The following tables show what each group was fed daily, and the milk and butter produced. Each table gives a complete record of this experiment for one period of seven days.

Table No. 5—Feeding Experiment No. 2, First Period.

Feb. 23 to March 1, inclusive. (The same grain fed to all; forage ad libitum.)

	Number of cow.	Weight of cow, March 1.	Cotton seed meal eaten—pounds.	Corn meal chops eaten—pounds.	Alfalfa eaten—pounds.	Cotton seed hulls eaten—pounds.	Corn silage eaten—pounds.	Choice prairie hay eaten—pounds.	Total amount feed eaten—pounds.	Total amount milk produced—pounds.	Total amount butter produced—pounds.	Average daily grain eaten—pounds.	Average daily forage eaten—pounds.	Average daily milk produced—pounds.	Average daily butter produced—pounds.	Average daily cost of feed—cents.	Value of whole milk produced per day—cents.	Value of butter produced per day—cents.	Daily profit from sale of whole milk—cents.	Ave. value milk and butter produced daily by groups—cents.
Group No. 1.	182	840	21	35	68.6	.....	.....	.....	103.6	166	8.82	8	9.8	23.4	1.26	14.3	58.5	31.5	44.2	
	382	990	21	35	70.8	.....	.....	.....	126.8	134	6.79	8	10.1	19.1	.97	14.6	47.8	24.2	33.2	40.4
Group No. 2.	60	900	21	35	.....	100.8	.....	.....	156.8	122	5.82	8	14.4	17.5	.86	10.8	43.7	21.5	32.9	
	316	800	21	35	.....	101.5	.....	.....	157.5	111	5.46	8	14.5	16	.78	10.8	40	19.5	29.2	31.1
Group No. 3.	278	880	20.5	34.8	.....	.....	42	39.7	137	129	5.11	7.9	11.7	18.4	.73	10.5	46	18.2	35.5	
	191	740	21	35	.....	.....	42	46.7	144.7	108	4.34	8	12.7	15.4	.62	11	38.5	15.5	27.5	29.5
Group No. 4.	319	810	21	35	.....	.....	.....	78.8	134.8	139	6.37	8	11.2	20	.91	12.1	50	22.7	37.9	
	166	820	21	35	.....	.....	.....	85.9	141.9	118	6.30	8	12.3	17	.90	12.6	42	22.5	29.4	34.3

Table No. 6—Feeding Experiment No. 2, Second Period.

March 2 to March 8 inclusive. (The same grain fed to all; forage ab libitum.)

	Number of cow.	Weight of cow, March 8.	Cotton seed meal eaten—pounds.	Corn meal chops eaten—pounds.	Alfalfa eaten—pounds.	Cotton seed hulls eaten—pounds.	Corn silage eaten—pounds.	Choice prairie hay eaten—pounds.	Total amount feed eaten—pounds.	Total amount milk produced—pounds.	Total amount butter produced—pounds.	Ave. daily grain eaten—pounds.	Average daily forage eaten—pounds.	Average daily milk produced—pounds.	Average daily butter produced—pounds.	Average daily cost of feed—cents.	Value of whole milk produced per day—cents.	Value of butter produced per day—cents.	Daily profit from sale of whole milk—cents.	Ave. value milk and butter produced daily by groups—cents.
Group No. 1.	182	870	21	35	92	.....	.....	.....	148	160	8.47	8	13.1	22.9	1.21	17	57.2	30.2	40.2	
	382	1020	21	35	90.8	.....	.....	.....	146.8	126	6.23	8	13	18	.89	16.9	45	22.2	28.1	38.6
Group No. 2.	60	940	21	35	.....	142.5	.....	.....	198.5	133	5.82	8	20.3	19	.85	12.6	47.5	21.2	34.9	
	316	800	21	35	.....	125.5	.....	.....	181.5	116	5.74	8	17.9	16.6	.82	11.9	41.5	20.5	29.6	32.6
Group No. 3.	278	850	20.8	34.7	.....	.....	42	31.2	128.7	106	4.83	7.9	10.5	15.1	.69	9.8	37.8	17.2	28	
	191	740	21	35	.....	.....	42	52.2	150.2	106	5.11	8	13.5	15.1	.73	11.45	37.8	18.2	26.4	27.7
Group No. 4.	319	820	21	35	.....	.....	.....	80.5	136.5	138	6.79	8	11.5	19.7	.97	12.2	49.3	24.2	37.1	
	166	820	21	35	.....	.....	.....	84.5	140.5	122	6.44	8	12.1	17.4	.92	12.5	43.5	23	31	36.6

Table No. 7—Feeding Experiment No. 2, Third Period.

March 9 to March 15 inclusive. (The same grain fed to all; forage ad libitum.)

	Number of cow.	Weight of cow, March 15.	Cotton seed meal eaten—pounds.	Corn meal chops eaten—pounds.	Alfalfa eaten—pounds.	Cotton seed hulls eaten—pounds.	Corn silage eaten—pounds.	Choice prairie hay eaten—pounds.	Total amount feed eaten—pounds.	Total amount milk given—pounds.	Total amount butter produced—pounds.	Ave. daily grain eaten—pounds.	Average daily forage eaten—pounds.	Average daily milk produced—pounds.	Average daily butter produced—pounds.	Average daily cost of feed—cents.	Value of whole milk produced per day—cents.	Value of butter produced per day—cents.	Daily profit from sale of whole milk—cents.	Ave. value milk and butter produced daily by groups—cents.
Group 1	182	840	21	35	116	... ...	.....	... ...	172	160	8. 26	8	16. 5	22. 9	1. 18	19.3	57. 2	29. 5	37. 9	
No. 1.	382	1000	21	35	110	... ...	.....	... ...	166	128	5. 88	8	15. 7	18. 3	. 84	19.06	45. 7	21	26. 6	38. 3
Group 2	60	940	21	35	.....	146	.....	... ...	202	136	6. 23	8	21	19. 4	. 89	12.8	48. 5	22. 2	35. 7	
No. 2.	316	800	21	35	.....	120.7	.....	... ...	176.7	118	6. 51	8	17. 2	16. 9	. 93	11.6	42. 2	23. 2	30. 6	34
Group 3	278	860	21	35	.....	... ...	42	53	151	118	7. 07	8	13. 6	16. 9	1. 01	11.5	42. 2	25. 2	30. 7	
No. 3.	191	750	21	35	.....	... ...	42	62	160	113	5. 39	8	15	16. 1	. 77	12.2	40. 2	19. 2	28	31. 7
Group 4	319	810	21	35	.....	... ...	.....	104	160	134	5. 89	8	15	19. 1	. 87	14	47. 7	21. 9	33. 7	
No. 4.	166	820	21	35	.....	... ...	.....	104.5	160.5	129	6. 37	8	15	18. 4	. 91	14	46	22. 7	32	34. 5

SUMMARY OF RESULTS—EXPERIMENT NO. 2.

The following table shows comparison of groups and feeds, including the total amount of milk, and value of milk produced, total cost of feed eaten by each group, total amount of money earned by group, and the total gain or loss in the live weight of the cows.

GROUP NO. 1—MIXED GRAIN AND ALFALFA HAY.

126 pounds cotton seed meal	$1 26
210 pounds corn meal	1 68
548 pounds alfalfa	3 83
884 pounds feed consumed—total cost	$6 77
874 pounds milk produced—total value	21 85
Total net value	$14 08

1830 pounds total weight two cows beginning of test.
1840 pounds total weight of two cows end of test, 21 days.
10 pounds total gain in flesh.

GROUP NO. 2—MIXED GRAIN AND COTTON SEED HULLS.

126 pounds cotton seed meal	$1 26
210 pounds corn meal	1 68
737 pounds cotton seed hulls	2 21
1073 pounds feed consumed—total cost	$5 15
736 pounds milk produced—total value	18 40
Total net value	$13 25

1700 pounds total weight two cows beginning of test.
1740 pounds total weight two cows end of test, 21 days.
40 pounds total gain in flesh.

GROUP NO. 3. MIXED GRAIN, CHOICE PRAIRIE HAY AND SILAGE.

125 pounds cotton seed meal	$1 25
209 pounds corn meal	1 67
252 pounds silage	50
285 pounds choice hay	1 42
882 pounds feed consumed; total cost	$4 84
680 pounds milk produced; total value	17 00
Total net value	$12 16

1620 pounds total weight two cows beginning of test.
1610 pounds total weight two cows end of test, 21 days.
10 pounds total loss in flesh.

GROUP NO. 4—MIXED GRAIN AND CHOICE PRAIRIE HAY.

126 pounds cotton seed meal	$1 26
210 pounds corn meal	1 68
538 pounds choice hay	2 69
874 pounds feed consumed	$5 63
780 pounds milk produced; total value	19 50
Total net value	$13 87

1630 pounds total weight two cows beginning of test.
1630 pounds total weight two cows end of test, 21 days.
— pounds total loss or gain in flesh.

RESULTS COMPARED.

The greatest flow of milk was from group No. 1, fed mixed grain and alfalfa hay. In flow of milk group No. 4 was second.

There was but little change in the live weight of the cows during this test. Group 2 gained 40 pounds in the 21 days, showing again the fattening tendency of hulls when fed to milk cows.

The most expensive ration was that in which alfalfa was used. The cheapest ration was that in which silage and choice hay appeared. The greatest clear profit was realized from the lot fed grain and alfalfa hay. It is interesting to note that the silage cheapened the ration, as is shown in group 3, but gave the lowest yield of milk, evidently because the group ate such a small quantity of food that it was impossible to keep up the flow of milk reported upon in Experiment No. 1. (See page 501.)

Since all these groups ate the same amount of the same grain, and were given all the forage demanded by their appetites, it is thought that the difference in the yield of milk will show the variation in the values of the several forage stuffs used in combination with the cornmeal and cotton seed meal. Such values, when obtained, will only be absolute when considering such fodders in connection with this particular grain ration.

When the cotton seed hull ration (group No. 2) produces 736 pounds of milk, the ration having alfalfa (group No. 1) shows 874 pounds, or a product in proportion of 1 (hulls) to 1.18 (alfalfa.) But since fewer pounds alfalfa were required to produce this ratio, we should multiply the 1.18 by 737 (pounds hulls) and divide by 548 (pounds alfalfa) to learn the equivalent of 1 pound of alfalfa in pounds of hulls. If these calculations are made as indicated, the result shows 1 pound alfalfa to be equal to 1.58 pounds cotton seed hulls. No notice is here taken of the 40 pounds gain in live weight in the group fed hulls.

In like manner we may compare alfalfa (of group 1) with choice hay, as fed to group 4. Here the values are more nearly the same. One pound alfalfa is equal to 1.12 pounds choice prairie hay. They are of practically the same value when combined with this grain feed (consisting of three pounds cotton seed meal and 5 pounds cornmeal each per day.)

In the same way we may compare the cotton seed hulls with hay by comparing the yield of milk from the two different groups and the amount of forage consumed in each case as above. In this case we see that 1 pound of choice hay produced as much milk as 1.45 pounds hulls.

EXPERIMENT NO. 3.

This experiment continued 28 days (January 26 to February 22). It was conducted at the same time as was Experiment No. 1, but was not a duplicate of it. This was intended to prove the worth of some of the most common food stuffs in the production of milk and butter. To test (1) cotton seed meal against corn meal, (2) cotton seed meal against cotton seed, (3) compare cotton seed hulls, alfalfa, and common hay with each other. To accomplish this, we fed one group cotton seed meal and another corn meal (both were given the same forage—cotton seed hulls). A group was fed cotton seed to compare with another fed cotton seed

meal (both groups were given the same forage—common hay); cotton seed meal was fed to three groups which were fed different hays, namely, cotton seed hulls, alfalfa, and common hay. So in the comparison of these we hoped to find the relative value of these important forage stuffs. The feeds given the different groups, with their values, were as follows:

Group No. 1. Cotton seed meal, $20 per ton; cotton seed hulls $6 per ton.
Group No. 2. Corn meal, $14 per ton; cotton seed hulls, $6 per ton.
Group No. 3. Cotton seed meal, $20 per ton; alfalfa, $16 per ton.
Group No. 4. Cotton seed meal, $20 per ton; common hay, $10 per ton.
Group No. 5. Cotton seed (boiled), $10 per ton; common hay, $10 per ton.

For these tests fifteen grade Jersey cows were selected and divided into five groups with three cows in each group, Nos. 1, 2, 3, 4, and 5. The selection of the cows and placing them in their respective places required the most careful study of the individual animals and a comparison of the several groups with each other.

The details of this test were managed the same as in Experiment No. 1. The cows of each group were fed all their appetites demanded, and for this reason much of the feed was probably wasted, when looked at from an economic standpoint. It is, therefore, unfair to say the profits shown are maximum profits; on the contrary, a much greater gain would have been realized had less grain been fed some of the groups.

The following tables show what each group was fed daily and the milk and butter produced. Each table gives a complete record of this experiment for a period of seven days:

Table No. 8—Experiment No. 3, First Period.

Jan. 26 to Feb. 1, inclusive. (Same grain fed to all groups; forage and grain ad libitum.)

	Number of cow.	Weight of cow, Feb. 1.	Cotton seed meal eaten—pounds.	Cotton seed (boiled) eaten—lbs.	Corn meal eaten—pounds.	Alfalfa eaten—pounds.	Common hay eaten—pounds.	Cotton seed hulls eaten—pounds.	Total amount feed eaten—pounds.	Total amount milk produced—pounds.	Total amount butter produced—pounds.	Average daily grain eaten—pounds.	Average daily forage eaten—pounds.	Average daily milk produced—pounds.	Average daily butter produced—pounds.	Average daily cost of feed—cents.	Value of whole milk produced—cents.	Value of butter produced per day—cents.	Gain daily per cow from sale of whole milk—cents.	Ave. value milk and butter produced daily by groups—cents.
Group No. 1.	169	645	56	...	...	.....	.....	43.7	99.2	130	7.7	8	6.2	18.5	1.0	9.8	46.4	27.5	36.3	
	356	510	54.5	...	...	.....	.....	46.5	101	102	7.2	7.3	6.6	14.5	1.0	9.7	36.4	25.5	26.6	
	70	655	56.2	...	...	.....	.....	45.5	102	97	1.3	8	6.5	13.8	.9	10	34.6	22.7	24.6	32.1
Group No. 2.	97	750	.....	...	70	.....	.....	45.5	115.5	106	6.3	10	6.5	15.1	.9	8.9	37.7	22.5	28.8	
	282	620	.....	...	70	.....	.....	45.5	115.5	77	4.5	10	6.5	11	.6	8.9	27.5	14.0	18.5	
	297	870	.....	...	70	.....	.....	46.5	116.5	104	6.7	10	6.5	14.8	.9	8.9	37.1	24.0	28.1	27.1
Group No. 3.	439	605	56	...	...	35	.....	.....	91	79	4.1	8	5.5	11.2	.5	12	28.2	14.7	16.2	
	354	460	56	...	...	32.5	.....	.....	88.5	105	6.9	8	4.6	15	.9	11.7	37.5	24.5	25.7	
	184	720	56	...	...	36	.....	.....	92	102	7.4	8	5.1	14.5	1.0	12.1	36.4	24.5	24.3	27.6
Group No. 4.	364	480	56	...	...	.....	55	.....	111	78	4.8	8	7.8	11.1	.6	11.9	27.8	14.2	15.8	
	283	730	48	...	...	.....	53	.....	101	85	6	6.8	7.5	12.1	.8	10.6	30.1	21.2	19.4	
	276	820	56	...	...	.....	55	.....	111	82	4.1	8	7.8	11.7	.5	11.9	29.2	14.5	17.3	22.8
Group No. 5.	274	810	.....	69	...	.....	55	.....	124	92	4.9	9.8	7.8	12.8	.7	8.8	32.1	17.5	23.2	
	360	415	.....	72	...	.....	55	.....	127	103	7.1	10.2	7.8	14.7	1.0	9.1	36.7	25.5	17.6	
	82	820	.....	75	...	.....	55	.....	130	78	5.8	10.7	17.8	11.1	.8	9.3	27.8	40.7	18.5	30

Table No. 9—Experiment No. 3, Second Period.

Feb. 2 to Feb. 8 inclusive. (Same grain fed all groups; forage and grain ad libitum.)

	Number of cow.	Cotton seed meal eaten—pounds.	Cotton seed (boiled) eaten—pounds.	Corn meal eaten—pounds.	Alfalfa eaten—pounds.	Common hay eaten—pounds.	Cotton seed hulls eaten—pounds.	Total amount feed eaten—pounds.	Total amount milk produced—pounds.	Total amount butter produced—pounds.	Average daily grain eaten—pounds.	Average daily of forage eaten—pounds.	Average daily of milk produced—pounds.	Average daily of butter produced—pounds.	Average daily cost of feed—cents.	Value of whole milk produced per day—cents.	Value of butter produced per day—cents.	Gains daily from sale of whole milk—cents.	Ave. value milk and butter produced daily by groups—cents.
Group No. 1	210	47	.....	.....	.....	.....	44	91	102	6.4	6.7	6.2	14.5	.9	8.5	36.4	23.3	27.8	
	356	65	.....	.....	.....	.....	48.5	113.5	102	6.1	9.2	6.9	14.5	.8	11.3	36.4	21.8	25	
	134	47.2	.....	.....	.....	.....	61	108.2	100	5.5	6.7	8.7	14.2	.7	9.3	35.7	19.5	26.3	28.8
Group No. 2	97	.....	.....	76	.....	.....	69.5	145.5	99	6	10.8	9.9	14.1	.8	10.5	35.2	21.5	24.7	
	282	.....	.....	75.5	.....	.....	51.5	127	70	4.4	10.7	7.3	10	.6	9.7	25.0	15.7	15.3	
	277	.....	.....	75	.....	.....	68.2	143.2	100	5.4	10.7	9.7	14.5	.7	10.9	46.2	15.5	35.3	26.5
Group No. 3	439	68	.....	.....	23	.....	.....	91	91	8.6	9.7	3.2	11.5	1.2	12.3	28.9	30.7	16.8	
	354	68	.....	.....	19.7	.....	.....	87.7	111	6.3	9.7	2.8	15.8	.9	11.9	39.6	81.7	27.6	
	184	67.2	.....	.....	25.7	.....	.....	93	102	7.2	9.6	3.6	14.5	1.0	12.5	36.4	25.5	23.8	30.4
Group No. 4	364	66	.....	.....	.....	55.7	.....	121.7	82	4.8	9.4	7.9	11.7	.6	13.4	29.2	17.5	15.8	
	283	57.7	.....	.....	.....	51	.....	108.7	108	7.1	8.2	7.2	15.4	1.0	11.8	38.5	25.2	26.6	
	276	54.7	.....	.....	.....	58.5	.....	103.2	82	5	7.8	8.3	11.7	.7	11.9	29.2	17.7	17.2	26.1
Group No. 5	274	.....	87	.....	.....	54	.....	141	95	6.6	12.4	7.7	13.5	.9	9	33.8	23.5	23.8	
	360	.....	87	.....	.....	51	.....	138	108	6.1	12.4	7.2	15.4	.8	9.5	38.5	22.7	28.7	
	82	.....	85	.....	.....	58	.....	143	87	6.6	12.1	8.2	12.4	.9	10.2	31.0	23.7	20.7	28.8

Table No. 10—Experiment No. 3, Third Period.

Feb. 9 to Feb. 15, inclusive. (Same grain fed to all groups; forage and grain ad libitum.)

	Number of cow.	Weight of cow, Feb. 15.	Cotton seed meal eaten—pounds.	Cotton seed (boiled) eaten—pounds.	Corn meal eaten—pounds.	Alfalfa eaten—pounds.	Common hay eaten—pounds.	Cotton seed hulls eaten—pounds.	Total amount feed eaten—pounds.	Total amount milk produced—pounds.	Total amount butter produced—pounds.	Average daily grain eaten—pounds.	Average daily forage eaten—pounds.	Average daily milk produced—pounds.	Average daily butter produced—pounds.	Average daily cost of feed—cents.	Value of whole milk produced per day—cents.	Value of butter produced per day—cents.	Gain daily from sale of whole milk—cents.	Ave. value milk and butter produced daily by groups—cents.
Grp. No. 1	210	580	40.2	.....	.....	.....	.....	35.5	75.7	86	5.3	5.7	5	10.8	.7	7.2	27.1	19	19.8	
	356	390	51.7	.....	.....	.....	.....	41.2	93	96	5.7	7.3	5.8	13.7	.8	9.1	34.2	20.6	25.1	
	134	690	47.5	.....	.....	.....	.....	65.2	112.7	105	5.8	6.7	9.3	15	.8	9.5	37.5	20.6	27.9	26.6
Grp. No. 2	97	820	.....	.....	102	.....	.....	76	178	98	5.6	14.5	10.8	14	.8	13.4	35	20	21.5	
	282	640	.....	.....	101.5	.....	.....	45.2	146.7	72	4.4	14.5	6.4	10.4	.6	12	25.7	16	13.6	
	277	900	.....	.....	96	.....	.....	65.7	161.7	110	6.2	13.7	9.3	14.2	.8	12.5	35.7	22	23.1	25.7
Grp. No. 3	439	620	74.5	.....	.....	20.2	.....	.....	94.7	80	4.4	10.6	2.8	11.4	.6	12.8	28.5	15.2	15.6	
	354	490	76	.....	.....	20.5	.....	.....	96.5	98	5.5	10.8	2.9	14	.7	13.1	35	19.7	21.8	
	184	700	76	.....	.....	32	.....	.....	108	93	4.5	10.8	4.5	13.2	.6	14.4	33.2	16.5	17.7	26.4
Grp. No. 4	364	510	75	.....	.....	.....	46.5	.....	121.5	84	4.6	10.7	6.6	12	.6	14	30	16.5	15.9	
	283	710	55.5	.....	.....	.....	66.7	.....	122.2	79	3.8	7.9	9.5	11.2	.5	12.7	28.2	13.7	15.4	
	276	780	60.5	.....	.....	.....	62.7	.....	123.2	78	3.5	8.6	8.9	11.1	.5	13.1	27.8	12.5	14.7	21.4
Grp. No. 5	274	800	.....	.....	85.5	.....	30	.....	115.5	85	4.7	12.2	4.2	12.1	.6	6.4	30.3	16.7	13.9	
	360	460	.....	.....	81.5	.....	23.7	.....	105.2	108	6.7	11.6	3.3	15.4	.9	7.5	38.5	24	30.9	
	82	820	.....	.....	90.2	.....	39	.....	129.2	72	5.6	12.8	5.5	10.2	.8	7.2	25.7	20.2	18.4	25.8

Table No. 11—Experiment No. 3, Fourth Period.

Feb. 16 to Feb. 22 inclusive. (Same grain fed all groups; forage and grain ad libitum.)

	Number of cow.	Weight of cow, Feb. 22.	Cotton seed meal eaten—pounds.	Cotton seed (boiled) eaten—pounds.	Corn meal eaten—pounds.	Alfalfa eaten—pounds.	Common hay eaten—pounds.	Cotton seed hulls eaten—pounds.	Total amount feed eaten—pounds.	Total amount milk produced—pounds.	Total amount butter produced—pounds.	Average daily of grain eaten—pounds.	Average daily of forage eaten—pounds.	Average daily of milk produced—pounds.	Average daily of butter produced—pounds.	Average daily cost of feed—cents.	Value of whole milk produced per day—cents.	Value of butter produced per day—cents.	Gain daily from sale of whole milk—cents.	Ave. value milk and butter produced daily by groups—cents.
Grp. No. 1	210	620	63	.....	.....	.....	.....	62.5	125.5	86	4.4	9	8.9	12.2	6.3	11.6	30.7	15.9	19.1	
	356	500	67.5	.....	.....	.....	.....	56.2	123.7	93	6.2	9.6	8	13.2	8.9	12	33.2	22.2	21.2	
	134	650	62.5	.....	.....	.....	.....	63.7	126.2	103	5.6	8.9	9.1	14.7	8	11.6	36.7	20	25.1	26.4
Grp. No. 2	97	790	.....	.....	134.2	.....	.....	62.7	197	101	6.5	19.8	8.9	14.4	9.3	16.5	36	23.3	20.5	
	282	620	.....	.....	136	.....	.....	33	169	75	4.4	19.4	4.7	10.7	6.3	14.9	26.8	15.7	11.9	
	277	870	.....	.....	130.7	.....	.....	60.7	191.5	100	6.1	18.6	8.6	14.2	8.7	15.6	35.7	21.8	20.1	26.5
Grp. No. 3	439	590	87.7	.....	.....	25.2	.....	.....	113	72	4.3	11.1	3.6	10.2	6.1	13.9	25.7	15.4	11.8	
	354	470	76.5	.....	.....	30.7	.....	.....	107.2	93	6.6	10.9	4.3	13.2	9.1	14.4	33.2	23.8	18.8	
	184	690	97	.....	.....	32.2	.....	.....	129.2	108	7.2	13.8	4.6	15.7	10.3	17.4	31.8	25.8	14.4	25.9
Grp. No. 4	364	490	83.5	.....	.....	.....	49.7	.....	133.5	81	4.3	11.9	7.1	11.5	6.2	14.4	28.9	15.6	14.4	
	283	710	59.5	.....	.....	.....	88.2	.....	147.7	100	6.2	8.5	11	11	8.9	13	25	22	11.9	
	276	800	75.2	.....	.....	.....	69.7	.....	145	83	4.4	10.7	9.9	11.8	6.4	15.6	29.6	16	13.9	22.8
Grp. No. 5	274	740	.....	50	.....	.....	28.7	.....	78.7	76	5.6	7.1	4.1	10.8	8	5.6	27.1	20.1	21.4	
	360	440	.....	79	.....	.....	22.5	.....	101.5	77	5.1	11.2	2.2	11.1	7.3	6.7	27.9	18.3	16.1	
	82	790	.....	79.5	.....	.....	36.2	.....	115.7	72	6	11.3	5.1	10.2	8.5	8.2	25.7	21.4	17.1	23.4

SUMMARY OF RESULTS—EXPERIMENT NO. 3.

The following statement shows by periods the total amount and cost of feed consumed; the total amount and value of milk produced; net gain in money for each period; the live weights of the cows at the beginning and end of test:

GROUP NO. 1—COTTON SEED MEAL AND COTTON SEED HULLS.

658	pounds cotton seed meal	$6 58
612	pounds cotton seed hulls	1 83
1270	pounds feed consumed; total cost	$8 41
1202	pounds milk produced; total value	30 45
	Total net value	$22 96
1955	pounds total weight three cows beginning of test.	
1770	pounds total weight three cows at end of test, 28 days.	
185	pounds total loss in flesh.	

GROUP NO. 2—CORN MEAL AND COTTON SEED HULLS.

1126	pounds corn meal	$7 88
670	pounds cotton seed hulls	2 01
1796	pounds feed consumed	$9 89
1112	pounds milk produced; total value	27 80
	Total net value	$17 91
2240	pounds total weigh three cows beginning of test.	
2280	pounds total weight three cows end of test, 28 days.	
40	pounds total gain in flesh.	

GROUP NO. 3—COTTON SEED MEAL AND ALFALFA.

859	pounds cotton seed meal	$8 59
331	pounds alfalfa	2 64
1190	pounds feed consumed; total value	$11 23
1134	pounds milk produced; total value	28 35
	Total net value	$17 12
1985	pounds total weight three cows beginning of test.	
1650	pounds total weight three cows end of test, 28 days.	
335	pounds total loss in flesh.	

GROUP NO. 4—COTTON SEED MEAL AND COMMON HAY.

747	pounds cotton seed meal	$7 47
712	pounds common hay	3 56
1459	pounds feed consumed; total cost	$11 03
1022	pounds milk produced; total value	25 55
	Total net value	$14 52
2030	pounds total weight three cows beginning of test.	
2010	pounds total weight three cows end of test, 28 days.	
20	pounds total loss in flesh.	

GROUP NO. 5—COTTON SEED (BOILED) AND COMMON HAY.

940	pounds cotton seed (boiled)	$4 70
509	pounds common hay	2 54
1449	pounds feed comsumed; total cost	$7 24
1053	pounds milk produced; total value	26 31
	Total net value	$18 07
2045	pounds total weight three cows beginning of test.	
1970	pounds total weight three cows end of test, 28 days.	
75	pounds total loss in flesh.	

RESULTS COMPARED.

The greatest flow of milk obtained in this experiment was from Group No. 1, fed cotton seed meal and hulls.

The greatest loss in live weight is noticed in the group fed cotton seed meal and alfalfa. The only gain in live weight of any group occurred in No. 2, which was fed corn meal and cotton seed hulls.

The greatest clear profit was derived from Group No. 5, fed cotton seed and common hay; followed next by Group No. 1, fed cotton seed meal and cotton seed hulls. The poorest returns were from cotton seed meal and common hay.

The cheapest ration used in the experiment was cotton seed and common hay, fed Group No. 5.

The dearest ration was cotton seed meal and alfalfa hay, fed Group No. 3.

When the first two groups are compared (in which hulls was the forage) we see that a 90 pound greater flow of milk was gotten when cotton seed meal was fed than when corn meal was used combined with hulls. The cotton seed meal ration also cost less—another advantage in its favor.

In comparing the groups fed common hay (Group No. 4, cotton seed meal, and Group No. 5, cotton seed), we see that when they were fed all that they would eat of both grains, the cows fed the cotton seed produced 31 pounds more milk. The seed cost less than the cotton seed meal, and the cows ate less hay when fed seed than when the meal was fed. The seed ration also cost less at the market rate used. Therefore, if prairie hay is to be fed milk cows, and we expect to feed but one kind of grain with it, cotton seed is far better than cotton seed meal.

Groups 1, 3, and 4 were all fed cotton seed meal as grain ration, and to each group a different forage was given—hulls, prairie hay, or alfalfa. In studying the results, we note that of these three groups, No. 1 (fed cotton seed hulls) gave the most milk, while Group No. 3 (alfalfa) came next; Group No. 4, which is common hay, came last. It is interesting to note how much more cotton seed meal (and common hay) was eaten by Group 4 than by the cows fed the meal and hulls. If cotton seed meal is to be fed as the sole grain ration, and a single forage stuff is wanted as companion food, we would select hulls for the purpose (all prices as quoted). Or if these are not available, choose alfalfa before common hay.

These conclusions are fully confirmed by a careful study of Experiment 4, which is reported upon fully in the following pages.

EXPERIMENT NO. 4.

The cows used in this experiment were the same as those reported on in No. 3, just preceding. The only difference in the method of feeding consisted in limiting the amount of forage to each group. The maximum limit for cotton seed hulls was fixed at 10 pounds per day, alfalfa 6 pounds per day, choice prairie hay 10 pounds per day. In many cases these amounts were not eaten.

Five groups were fed as in Experiment No. 3, with feeds assigned as follows:

Group No. 1, cotton seed meal and cotton seed hulls.
Group No. 2, corn meal and cotton seed hulls.
Group No. 3, cotton seed meal and alfalfa hay.
Group No. 4, cotton seed meal and choice prairie hay.
Group No. 5, cotton seed (boiled) and choice prairie hay.

It will be noticed that of the above groups three were fed cotton seed meal, but each group was given a different forage—alfalfa, hulls, or prairie hay—to show which of these hays would produce the most milk, when combined with cotton seed meal as the sole grain ration. It will also be noticed that two groups were given prairie hay, but each group was fed different grains—cotton seed or cotton seed meal—to show which grain produced the greatest flow of milk when fed, as a comparison to prairie hay. In the same manner cotton seed hulls was fed as forage to two groups, and each group was fed different grains, to test the value of corn meal and cotton seed meal when fed in conjunction with hulls. The experiment continued 21 days.

The following tables show what each group was fed daily and the milk and butter produced. Each table gives a complete record of this experiment for one period of seven days.

Table No. 12—Experiment No. 4, First Period.

Feb. 23 to March 1, inclusive. (Forage test, with different grain.)

	Number of cow.	Weight of cow, March 1.	Cotton seed meal eaten—pounds.	Corn meal eaten—pounds.	Boiled cotton seed (dry) eaten—pounds.	Alfalfa eaten—pounds.	Cotton seed hulls eaten—pounds.	Common hay eaten—pounds.	Total amount feed eaten—pounds.	Total am't milk produced—lbs.	Total amount butter produced—pounds.	Average daily grain eaten—pounds.	Average daily forage eaten—pounds.	Average daily milk produced—pounds.	Average daily butter produced—pounds.	Average daily cost of feed—cents.	Value of whole milk produced per day—cents.	Value of butter produced per day—cents.	Daily profit from sale of whole milk—cents.	Ave. value milk and butter produced daily by groups—cents.
Group No. 1	134	730	62.1	...	...	.....	.....	65.8	.....	127.9	104	5.6	8.8	9.4	14.8	.8	9	37	20.1	25.3	
	210	620	63.5	...	...	.....	.....	61	.....	124.5	86	5.1	9.0	8.7	12.3	.7	8.9	30.7	18.5	19	
	356	545	68.1	...	...	.....	.....	63.2	.....	131.3	96	6.2	9.7	9	13.7	.8	12.4	34.2	22.2	21.8	27.1
Group No. 2	277	880	.....	122.7	.....	.....	46	.....	168.7	102	6.0	17.5	6.5	14.6	.8	14.2	36.5	21.7	22.3	
	282	640	.....	145	.....	.....	21.2	.....	166.2	70	4.5	20.7	3	10	.6	15.4	25	16.2	9.6	
	97	820	.....	140.5	.....	.....	40.6	.....	181.1	93	4.7	20	5.8	13.3	.6	15.8	33.2	17	17.4	24.9
Group No. 3	439	640	79	...	...	22.8	.....	.....	101.8	71	3.7	11.3	3.2	10.1	.5	13.9	25.2	13.2	11.3	
	354	470	77.3	...	...	24.5	.....	.....	101.8	85	4.3	11.0	3.5	12.1	.6	13.8	30.2	15.5	16.4	
	184	720	72	...	...	36	.....	.....	108	108	7.4	10.3	5.1	15.4	1.0	14.4	38.5	26.5	24.1	24.8
Group No. 4	364	500	70	...	...	.....	.....	35.7	105.7	80	4.4	10	5.1	11.4	.6	12.5	28.5	16	16	
	283	700	49.7	...	...	.....	.....	55.3	105	100	6.0	7.1	7.9	14.3	.8	11.0	35.7	21.7	24.6	
	276	790	43.8	...	...	.....	.....	58.7	102.5	72	3.7	6.2	8.4	10.3	.5	10.4	25.7	13.7	15.2	23.5
Group No. 5	274	790	.....	16	44.3	.....	.....	35.8	96.1	77	4.3	8.6	5.1	11	.6	7.3	27.5	15.5	20.2	
	360	460	.....	...	85.6	.....	.....	17.9	103.5	73	5.1	12.2	2.5	10.4	.7	7.4	26	18.2	19.6	
	82	820	.....	...	80.4	.....	.....	28.6	109	75	5.7	11.5	4.1	10.7	.8	7.8	26.7	20.5	18.9	22.4

Table No. 13—Experiment No. 4, Second Period.

March 2 to March 8 inclusive. (Forage test with different grains.)

	Number of cow.	Weight of cow.	Cotton seed meal eaten—pounds.	Corn meal eaten—pounds.	Boiled cotton seed eaten—pounds.	Alfalfa eaten—pounds.	Cotton seed hulls eaten—pounds.	Common hay eaten—pounds.	Total amount of feed eaten—pounds.	Total amount of milk produced—pounds.	Total amount of butter produced—pounds.	Average daily grain eaten—pounds.	Average daily forage eaten—pounds.	Average daily milk produced—pounds.	Average daily butter produced—pounds.	Average daily cost of feed—cents.	Value of whole milk per day—cents.	Value of butter produced per day—cents.	Daily profit from sale of whole milk—cents.	Ave. value milk and butter produced daily by groups—cents.
Group No. 1	134	730	65.5	.....	.....	.....	69	.....	134.5	104	6.2	9.3	9.8	14.8	.8	12.3	37	22 2	24.7	
	210	570	30.5	.....	.....	.....	51.2	.....	81.7	79	4.6	4.3	7.3	11.3	.6	6.5	28.2	16.5	21.6	
	356	530	63.5	.....	.....	.....	63.5	.....	12.7	95	6.1	9.0	9.0	13.6	.8	11.8	34	22	22.2	26.6
Group No. 2	277	900	.....	143	.....	.....	42.5	.....	185.5	109	6.1	20.4	6.0	15.6	.8	16.1	39	22	22.9	
	282	660	.....	144	.....	.....	22.8	.....	166.8	66	4.9	20.6	3.2	9.4	.7	14.4	23.5	17.5	9.1	
	97	750	.....	130	.....	.....	30.2	.....	160.2	97	5.6	18.6	4.3	13.9	.8	14.3	34.7	20.2	20.4	26.1
Group No. 3	439	620	58.5	.....	.....	23.8	.....	.....	82.3	68	5.1	8.3	3.4	9.7	.7	11.1	24.2	18.2	13.1	
	354	480	68.5	.....	.....	30.7	.....	.....	99.2	89	6.5	9.8	4.4	12.7	.9	12.3	31.7	23.5	19.1	
	184	710	70	.....	.....	40.5	.....	.....	110.5	94	6.7	10	5.8	13.4	.9	14.6	33.5	24	18.9	25.8
Group No. 4	364	500	70	.....	.....	.....	.....	43.2	113.2	82	4	10	6.1	11.7	.5	13.0	29.2	14.5	16.1	
	283	700	60.7	.....	.....	.....	.....	61.5	122.1	91	5.2	8.6	8.8	13	.7	13.0	32.5	18.7	19.4	
	276	790	48.5	.....	.....	.....	.....	58	106.5	76	4.2	6.9	8.3	10.9	.6	11.2	27.2	15	16	22.8
Group No. 5	374	790	.....	26	41.5	.....	.....	30.5	98	76	4.4	9.6	4.3	10.9	.6	7.8	27.2	15.7	19.4	
	362	440	.....	.....	73	.....	.....	13.8	86.8	70	6.7	10.4	1.9	10	.9	6.2	25	24	18.8	
	82	790	.....	.....	54	.....	.....	26.8	80.8	76	5.3	7.7	3.8	10.9	.7	5.7	27.2	19	21.4	23

Table No. 14—Experiment No. 4, Third Period.

March 9 to March 15 inclusive. (Forage test, with different grain.)

	Number of cow.	Weight of cow, March 15.	Cotton seed meal eaten—pounds.	Corn meal consumed—pounds.	Boiled cotton seed eaten—pounds.	Alfalfa eaten—pounds.	Cotton seed hulls eaten—pounds.	Common hay eaten—pounds.	Total amount of feed eaten—pounds.	Total am't milk produced—lbs.	Total amount of butter produced—pounds.	Average daily grain eaten—pounds.	Average daily forage eaten—pounds.	Average daily milk produced—pounds.	Average daily butter produced—pounds.	Average daily cost of feed—cents.	Value of whole milk produced per day—cents.	Value of butter produced per day—cents.	Daily profit from sale of whole milk—cents.	Ave. value milk and butter produced daily by groups—cents.
Group No. 1	134	690	45	... ...	.....	.....	49	.....	94	103	6.3	6.4	7	14.7	.9	8.5	36.7	22.5	28.2	
	210	590	29	... ...	.....	.....	33	.....	88	68	3.4	7.8	4.7	9.7	.4	8.1	24.2	12.2	16.1	
	356	540	70	... ...	.....	.....	70	.....	140	107	5.3	10	10	15.3	.7	13	38.2	19.2	25.2	25.6
Group No. 2	277	910	.....	140.5	.....	.....	28.5	.....	169	99	6.0	20.0	4.0	14.1	.8	15.3	35.2	21.5	19.9	
	282	660	.....	140	.....	.....	27	.....	167	57	3.3	20	3.8	8.1	.4	15.1	20.2	12	5.1	
	97	790	.....	126.5	.....	.....	40	.....	166.5	92	5.6	18	5.7	13.1	.8	14.3	32.7	20.2	18.4	23.6
Group No. 3	439	610	48.5	... ...	.....	32.5	.....	.....	81	56	2.8	6.9	4.6	8	.4	10.5	20	10	9.5	
	354	480	70	... ...	.....	36.5	.....	.....	106.5	83	5.2	10	5.2	11.8	.7	14.1	29.5	18.7	15.4	
	184	700	70	... ...	.....	42	.....	.....	112	102	6.7	10	6	14.5	.9	14.8	36.2	24.2	21.4	23.1
Group No. 4	364	520	70	... ...	.....	.....	.....	58.5	128.5	80	5.0	10	8.3	11.4	.7	14.2	28.5	18	14.3	
	283	720	70	... ...	.....	.....	.....	68	138.5	101	6.4	10	9.7	14.4	.9	14.8	36	23	21.2	
	276	780	59	... ...	.....	.....	.....	62	121	78	4.5	8.4	8.8	11.1	.6	12.9	27.8	16.2	14.9	24.9
Group No. 5	274	770	.....	12	49	.....	.....	33.3	94.5	69	4.8	8.7	4.8	9.8	.6	7.1	24.5	17.2	17.4	
	360	430	.....	... ...	62.7	.....	.....	22.2	84.9	65	5.2	8.9	3.1	9.3	.7	6	23.2	18.7	17.1	
	82	810	.....	... ...	54.2	.....	.....	32.2	86.4	62	3.9	7.7	4.6	8.8	.5	6.2	22.1	14	15.9	19.7

SUMMARY OF RESULTS—EXPERIMENT NO. 4.

GROUP NO. 1—COTTON SEED MEAL AND COTTON SEED HULLS.

497 pounds cotton seed meal	$4 97
526 pounds cotton seed hulls	1 57
1023 pounds feed consumed; total cost	$6 54
842 pounds milk produced; total value	21 05
Total net value	$14 51

1890 pounds total weight three cows beginning of test.
1820 pounds total weight three cows end of test, 21 days.
70 pounds total loss in flesh.

GROUP NO. 2—CORNMEAL AND COTTON SEED HULLS.

1232 pounds cornmeal	$8 62
298 pounds cottonseed hulls	89
1528 pounds feed consumed; total cost	$9 51
783 pounds milk produced, total value	19 57
Total net value	$10 06

2240 pounds total weight three cows beginning of test.
2360 pounds total weight three cows end of test, 21 days.
60 pounds total gain in flesh.

GROUP NO. 3—COTTON SEED MEAL AND ALFALFA HAY.

634 pounds cotton seed meal	$6 34
289 pounds alfalfa	2 31
923 pounds feed consumed; total cost	$8 64
756 pounds milk produced; total value	18 90
Total net value	$10 26

1830 pounds total weight three cows beginning of test.
1890 pounds total weight three cows end of test, 21 days.
60 pounds total gain in flesh.

GROUP NO. 4—COTTON SEED MEAL AND COMMON HAY.

541 pounds cotton seed meal	$5 41
500 pounds common hay	2 50
1041 pounds feed consumed; total cost	$7 91
760 pounds milk produced; total value	19 00
Total net value	$11 09

1990 pounds total weight three cows beginning of test.
2020 pounds total weight three cows end of test, 21 days.
30 pounds total gain in flesh.

GROUP NO. 5—COTTON SEED (boiled) AND COMMON HAY.

545 pounds cotton seed (boiled)	$2 72
241 pounds common hay	1 20
795 pounds feed consumed; total cost	$3 92
643 pounds milk produced; total value	16 07
Total net value	$12 05

2070 pounds total weight three cows beginning of test.
1910 pounds total weight three cows end of test, 21 days.
160 pounds total loss in flesh.

RESULTS COMPARED.

In all of the groups fed cotton seed meal (1, 3, and 4) we see that the largest flow of milk comes from group 1, to which cotton seed hulls was fed as forage. This ration also cost less than either of those containing common hay or alfalfa. This result was obtained in Experiment No. 3, in testing the value of these three forage stuffs when combined with cotton seed meal as grain. (See page —.)

Groups 1 and 2 were both fed cotton seed hulls, and No. 1 was given cotton seed meal as a grain, while No. 2 was fed corn meal to determine which of these single grains formed the best companion food for hulls. The cotton seed meal group (No. 1) gave more milk and cost much less.

Groups 4 and 5 were given common hay, and cotton seed was tested against cotton seed meal. A study of the figures shows that cotton seed meal in this case produced more milk than did the cotton seed, but the cost of the meal ration was so much more than in the ration where cotton seed was used that the net profit is much in favor of the cotton seed when cost is calculated at the prices stated.

SUGGESTIONS.

Some general conclusions and opinions based on the feeding trials found in the preceding pages may not be out of place just here. Of course, we do not recommend for general use all of the rations used in these tests. In fact, before feeding we had good reason to suppose that some of the feeds given would show poor results. From the results of these experiments and from much practical experience in feeding large milk herds a variety of foods, we are fully justified in recommending the use of the following rations for Southern milk cows:

No. 1. 9 pounds Cotton Seed, 2 pounds Corn Meal, 13 pounds Prairie Hay.

No. 2. 5 pounds Cotton Seed, 4 pounds Cotton Seed Meal, 15 pounds Prairie Hay.

No. 3. 5 pounds Corn Meal, 3 pounds Cotton Seed Meal, 14 pounds Alfalfa Hay.

No. 4. 6 pounds Cotton Seed Meal, 15 pounds Corn Silage, 12 pounds Alfalfa Hay.

No. 5. 6 pounds Cotton Seed Meal, 6 pounds Wheat Bran, 10 pounds Cotton Seed Hulls.

No. 6. 10 pounds Wheat Bran, 4 pounds Corn Meal, 12 pounds Prairie Hay.

No. 7. 10 pounds Cotton Seed, 20 pounds Corn Silage, 10 pounds Prairie Hay.

No. 8. 6 pounds Cotton Seed Meal, 20 pounds Corn Silage, 10 pounds Prairie Hay.

No. 9. 6 pounds Cotton Seed Meal, 30 pounds Silage, 6 pounds Alfalfa Hay.

No. 11. 10 pounds Cotton Seed Meal, 15 pounds Prairie Hay.

No. 12. 10 pounds Cotton Seed Meal, 15 pounds Cotton Seed Hulls.

No. 13. 12 pounds Wheat Bran, 15 pounds Sorghum Hay.

No. 14. 8 pounds Corn Meal, 18 pounds Alfalfa.

The number of these suggestions might be increased if space permitted.

Although milk cows will often do well for an indefinite time on cotton seed or cotton seed meal as the sole grain, yet we think best to add a second grain in either case, such as corn meal or wheat bran.

As much as 16.3 pounds of grain (equal parts of corn meal and cotton seed meal) were fed per cow for 21 days to Group 4 in Experiment No. 1, without injury.

We do not advise the combination of cotton seed meal with prarie hay alone for milk cows, although there are some conditions under which it should be fed.

Cotton seed hulls when combined with corn meal do not produce a large milk flow, but increase the live weight rapidly.

Cotton seed hulls should not be fed continuously as sole forage to milk cattle.

Corn silage always cheapens the cost of the forage ration, but in the experiments here reported on too little food was eaten by the groups fed silage to permit a good flow of milk. The cows in these groups were "off their feed" the greater part of the test.

NOTE.

The feeding, milking, and immediate care of the cows was placed under the charge of Mr. James Clayton and Mr. J. W. Carson. The actual feeding was done by members of the graduating class of 1894, and by Mayes and Hutson (of second class), assisted by Students Rowe, Spears and Ahrenbeck.

The tables presented in this report were compiled from the daily records by Mr. Clayton.

The experiments were planned by the Director, and the manner of conducting them was indicated by him.