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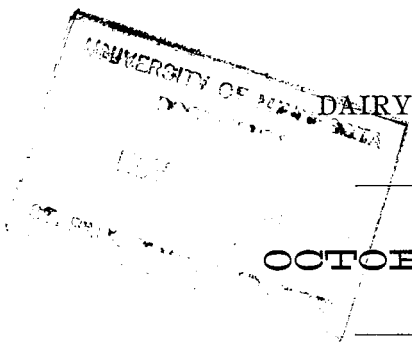

DAIRY DIVISION.

OCTOBER, 1894.

DAIRY HERD RECORD FOR 1893.
COST OF BUTTER PRODUCTION IN WINTER.
COMPARING PRAIRIE HAY WITH TIMOTHY.—REARING DAIRY CALVES.—CO-OPERATIVE CREAMERIES.
EXPERIMENTS IN SWEET CURD CHEESE WORK.

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University of Minnesota.

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DAIRY HERD RECORD FOR 1893.

T. L. HÆCKER.

The unprecedented shrinkage in the price of wheat dur- the past few years, the heavy draft which it makes on the fertility of the soil and the uncertainty of the crop, has awakened in the minds of the people of the northwest a greater interest in dairying. Dairy husbandry covers a large field, embracing the kind of animal best adapted for dairying, selection, breeding, rearing and training of the young stock, their management, and the feeding value of the different grasses, grains and by-products of the mills, the best method of creaming milk, ripening and churning cream, and working, packing and marketing butter, and the manufacture of various kinds of cheese best adapted to our conditions, the organization of co-operative dairy associations, building, equipment and operation of creameries and cheese factories, with many other questions which bear upon this industry. The call for information has been so great and the lines of inquiry so varied that it was difficult to decide in which direction investigation should begin and if more has been undertaken than could be done well it is because of the great need; however, much of this work may be considered as simply preliminary.

One of the most important factors in dairying is the cost of butter production and to ascertain this the annual yield of milk and butter fat of each cow in the University Farm herd and cost of feed for each was the chief object of this record. No special effort was made to select an economical ration; the cows were fed bran, barley, corn, linseed meal, ensilage, roots and hay as had been the practice theretofore.

During the winter season the rations were adjusted to the appetite and power of assimilation of the cow, giving as much grain as each would eat regardless of size. During the summer enough grain was given to maintain a normal flow of milk. From the 1st of January to the 25th of February each cow received daily from twenty-four to forty pounds of ensilage, from three to five pounds of mixed hay, mostly timothy, six to ten pounds of wheat bran, and one to two pounds of linseed meal. From the 25th of February to the 7th of March each received from twenty-four to thirty pounds of ensilage, six to eight pounds of bran, five to six pounds of barley, one and a half to two pounds of linseed meal and three to five pounds of hay. During the remainder of March there was a reduction of two pounds of bran and a decrease in the amount of ensilage to about half of that fed in January. The ensilage was made from the two varieties of corn, "Pride of the North" and "White Dent," and was richer in ears than is usually the case. Toward spring much of it was of inferior quality owing to mould, and from this cause several of the cows were thrown off their feed and suffered a material shrinkage in milk and fat. During April they were fed from six to twelve pounds of old millet hay, which caused stomach disorders in several of the cows and proved fatal in one case, post mortem examination revealing impaction of the third stomach with millet seed. The cows were turned out to pasture the 17th of May, when the grain feed was gradually reduced and by the 1st of June it ranged from four to eight pounds of the mixture—bran, barley and linseed meal.

The feeding stuffs used have been found by analysis to contain the following per cent. of dry matter:

Hay, timothy	89.75	Ensilage	26.15
Hay, millet	92.35	Bran	89.60
Hay, prairie	89.15	Linseed meal	89.89
Barley meal	88.22	Squashes	14.72
Corn meal	89.27	Mangels	10.00

The average price per ton for the feed was found from statistics furnished by prominent farmers residing in different portions of the state and is believed to be a fair average valuation for the whole state:

	Per Ton.	Per lb. cents		Per Ton.	Per lb. cents.
Hay, timothy	$ 5.60	.28	Corn meal....	$14.00	.7
Hay, prairie..	3.20	.16	Linseed meal	26.00	1.30
Hay, millet.....	5.60	.28	Ensilage.....	2.00	.10
Hay, oat.....	4.80	.24	Bran.....	11.00	.55
Barley meal....	14.00	.70	Mangels.....	2.00	.10
Oats.....	18.00	.90	Squashes.....	2.00	.10

Pasture, the season, $3.50.

The Grain Ration for each cow consisted of one part linseed meal, two parts barley, two parts corn meal and

TABLE VII.—Age of Cows and Date of Calving Prior to and During Experiment.

	Age.	Date of calving 1892.	Date of calving 1893.
Annie	6	July 10	August 4
Beckley	8	November 12	*July 10
Bess	9		February 15
Bettie	8	November 2	*September 1
Clara	7	June 13	*May 27
Dido	10		March 1
Dora	11	March 27	March 9
Fancy	7	March 21	May 6
Gertie	4	November 10	September 26
Houston	9	October 27	November 5
Jennie	5		November 27
Nora	3	November 20	*August 15
Olive	9	October 24	
Patsy	6	November 30	
Pride	10	February 15	May 22
Reddie	9	July 25	November 28
Rose	10		April 7
Rossy	5	April 16	*May 15
Roxy	8	October 16	*Aug. 10
Sully	9	October 16	*July 5
Sweet Briar	9	November 11	October 28
Topsy	7		February 22
Tricksey	9	October 21	December 14

*Aborted.

three parts wheat bran, or in cases where either barley or corn was omitted the other was increased pound for pound.

During the winter the cows were confined at night and a portion of the day in a basement, fastened with the Smith revolving stanchion which gives them more freedom than does the old rigid stanchion. Nearly all the cows are dehorned which made it possible to turn them a portion of each day into a large enclosed basement adjoining the stable, for water and exercise. During warm winter days they were occasionally turned into a yard.

In Table VII is given a list of the cows, approximate age, date of calving prior to and during the experiment and the number of days they were in milk during the year. It will be seen that a number of cows aborted; whether this increased or diminished the yield of milk and butter fat for the year is not known. It is apparent however that it had an injurious effect on a few that are somewhat inclined to lay on flesh, such as Beckley, Clara, Rossie and Sully. Bettie and her daughter Nora, with Roxy show but little, if any such disposition, or suffer an abnormal shrinkage in the flow of milk. The general plan was to have all cows calve in the fall. In some cases this was not carried out for various reasons. The cows were not all selected especially for the dairy as they were also to be used for illustrating purposes in the class room, where it is necessary to have fair representatives of the various types. Dido and Fancy do not belong to the dairy herd. The former is a full blood shorthorn of a milking family. Fancy is a full blood Polled-Angus but was transferred to the dairy for a year's trial, for the reason that in conformation she had some points which indicated fair dairy qualities. Rose and Sully are grade shorthorns. Rose is rather spare and angular while Sully belongs to the medium fleshy type. Most of the cows selected for the dairy were spare, deep in body, well developed spine and rump, sharp withers, steep at the crops, thin, rather long neck and face. At the time they were selected no information was solicited from or given by the owners, but each cow was selected because of the individuality she showed as a milk and butter giver. Neither was the Bab-

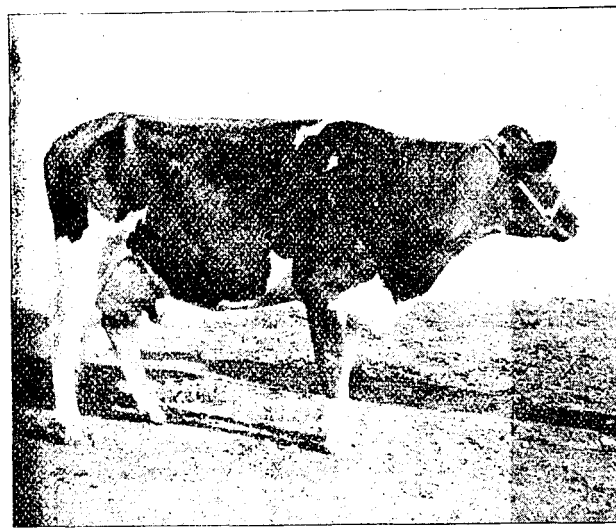
cock test resorted to except in case of Tricksey, and after three years' trial and severe pruning none of the cows so selected have, as yet, been culled out.

TABLE VIII.—Total Individual Yields of Milk and Fat.

Name.	Breed.	Days in Milk.	Lbs. of Milk.	Lbs. of Butter Fat.
Annie	Jersey	334	5,013.90	312.70
Beckley	Grade Jersey	365	4,948.30	300.98
Bess	Holstein Fresian	331	10,087.00	374.09
Bettie	Guernsey	365	4,957.90	267.67
Clara	Grade Jersey	365	4,952.80	241.92
Dido	Shorthorn	343	5,562.60	216.43
Dora	Jersey	346	6,515.90	353.86
Fancy	Polled Angus	363	5,992.00	261.71
Gertie	Grade Jersey	339	5,106.20	260.28
Houston	Jersey-Guernsey	320	6,976.10	366.98
Jennie	Grade Holstein	334	6,008.40	226.99
Nora	Jersey-Guernsey	365	4,526.00	225.46
Olive	Grade Guernsey	357	6,093.10	284.40
Patsy	Grade Jersey	365	6,284.20	293.09
Pride	Jersey	301	6,090.20	303.05
Reddie	Grade Guernsey	349	5,183.50	274.57
Rose	Grade Shorthorn.	266	7,337.70	296.38
Rossie	Grade Jersey	365	6,784.70	278.23
Roxy	Grade Jersey	365	7,546.30	358.42
Sully	Grade Shorthorn	365	7,066.00	318.01
Sweet Briar	Guernsey	336	7,094.30	357.62
Topsy	Grade Holstein	331	10,287.20	407.92
Tricksey	Guernsey	326	6,964.60	340.71
Average		343	6,407.78	300.93

In Table VIII. is given the names of the cows, the breed to which they belong, days in milk, the pounds of milk and fat produced. It was the aim not to resort to any estimates in this work when it was possible to get actual results.

Each milking was therefore weighed and recorded and a sample taken and tested by the Babcock test for per cent. of fat. In yield the grade Holstein-Friesian, Topsy, leads with



TOPSY.

10,287.2 lbs. of milk and 407.92 lbs. of fat. Bess, the full blood Holstein-Friesian follows with a record of 10,087 lbs. of milk and 374.09 lbs. of fat. The smallest yield of milk 4,526 lbs. was from the three year old heifer Nora. The smallest yield in butter fat was from the shorthorn Dido, 216 lbs. The only farrow cow in the herd was Fancy, the Polled-Angus and this fact should be borne in mind in comparing the amount and cost of her dairy product with others in the trial. Topsy carried a calf only a short time during the latter part of the year's work. Beckley, Clara, Rossie and Sully aborted quite early and were not bred until late in the autumn or early winter. The annual average yield of milk was 6407.78 pounds and average of fat 300.93 pounds including the two beef cows Fancy and Dido.

TABLE IX.—Weight of Cows, Average for Months and Year 1893.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Aver'ge
Annie	774	770	775	787	804	874	888	826	834	846	854	.....	821
Beckley	945	943	950	973	968	1011	921	899	908	926	926	936	942
Bess	1215	1138	1058	1007	1006	1076	1159	1122	1147	1186	1201	1210	1127
Bettie	775	776	761	779	795	831	832	840	796	818	810	813	802
Clara	875	889	908	926	942	906	923	916	913	919	893	902	909
Dido	1267	1277	1225	1286	1174	1263	1273	1245	1225	1237	1232	1237	1245
Dora	907	898	894	853	809	843	838	839	836	853	854	883	859
Fancy	*1233	*1251	*1273	*1269	1313	1301	1301	1240	1221	1234	1224	1219	1256
Gertie	832	821	851	856	857	898	911	951	973	865	871	878	880
Houston	920	928	909	896	900	927	953	954	952	1004	924	900	931
Jennie	915	926	963	994	977	1023	1040	1057	1074	1125	1119	1031	1020
Nora	783	801	806	814	839	869	889	861	819	827	828	846	832
Olive	752	731	766	735	758	789	801	810	820	863	918	915	805
Patsy	827	807	796	795	803	911	927	902	901	935	931	934	872
Pride	758	781	697	705	736	780	783	770	773	773	773	771	758
Reddy	994	968	981	956	974	1029	1051	1036	1074	1107	1141	1018	1027
Rose	1212	1251	1272	1135	1017	1122	1148	1110	1079	1071	1081	1135	1136
Rossie	838	820	864	862	996	931	940	942	941	942	946	898	903
Roxy	975	921	921	942	931	1004	1035	971	971	973	968	972	965
Sully	1268	1272	1291	1307	1299	1321	1186	1130	1121	1138	1148	1141	1219
Sweet Briar	956	926	915	927	941	1001	1025	1060	1059	1118	1031	1040	1000
Topsy	1249	1266	1086	1020	991	1070	1078	1107	1054	1129	1101	1060	1101
Tricksey	902	912	890	911	935	951	951	967	984	1004	1038	1095	962

The figures marked thus (*) are for 1894.

TABLE X.—Milk Record, Monthly and Total for Each Cow.

NAME.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Annie	386.8	347.0	399.1	360.1	329.7	285.3	25.8	688.9	654.6	545.4	575.3	466.1	5,013.9
Beckley	528.3	488.0	470.5	454.3	476.5	499.1	286.7	404.2	410.7	378.1	296.7	255.2	4,948.3
Bess	225.9	455.2	1,431.8	1,114.5	1,087.6	1,172.8	1,066.7	977.5	948.7	833.0	584.0	189.2	10,087.0
Bettie	579.8	451.8	488.5	440.0	430.5	438.8	414.6	415.1	338.7	352.4	317.1	290.6	4,957 9
Clara	371.2	334.4	373.5	330.1	282.3	499.7	567.4	558.7	453.1	472.1	385.6	324.7	4,952.8
Dido	*189.1	*10.6	720.7	610.6	535.6	687.1	715.1	497.1	464.2	465.7	440.2	326.6	5,562.6
Dora	*266.8	*69.8	695.0	848.9	765.5	767.4	712.9	601.0	557.7	458.0	415.7	357.2	6,515.9
Fancy	*337.2	*254.7	303.5	*271.8	725.1	891.9	559.1	616.0	550.5	485.8	431.8	365.6	5,992.0
Gertie	584.3	492.0	505.1	428.2	439.8	437.2	310.1	33.0	.....	662.6	615.6	598.3	5,106.2
Houston	807.7	668.9	708.3	592.2	617.1	693.8	608.0	485.2	255.3	.....	705.6	834.0	6,976.1
Jennie	546.1	489.8	604.6	552.6	617.0	676.7	513.1	471.8	383.3	125.7	37.7	990.0	6,008.4
Nora	422 8	347.4	366.4	328.6	368.3	388.0	344.2	351.2	384.5	417.2	415.8	391.6	4,526.0
Olive	771.3	623.3	647.4	500.7	519.6	598.1	571.5	527.2	461.5	398.5	327.4	146.6	6,093.1
Patsy	862.8	659.9	621.7	501.2	541.1	653.9	541.3	481.7	406.1	426.5	344.5	243.5	6,284.2
Pride	467.2	448.9	127.1	.....	243.2	915.8	851.3	748.6	634.8	606.6	555.6	491.1	6,090.2
Reddie	537.5	381.1	409.7	351.3	421.7	542.7	463.6	401.2	328.1	286.0	127.7	932.9	5,183.5
Rose	.....	.....	.....	709.0	1,069.4	1,067.2	968.8	849 1	755.4	649.0	605.3	664.5	7,337.7
Rossie	498.7	479.1	525.0	467.4	502.9	713.1	690.7	656.1	608.4	593.6	561.3	488.4	6,784.7
Roxy	854.0	652.1	682.4	608.5	646.6	788.7	577.7	451.7	577.0	639.2	565.3	503.1	7,546.3
Sully	561.4	517.9	552.6	520.7	518.4	398.6	502.8	711 4	713.8	696.5	713.4	658.5	7,066.0
Sweet Briar	826.5	686.2	649.7	613.2	653.5	765.8	689.4	562.2	437.6	57.2	594.1	558.9	7,094.3
Topsy	175.3	132.0	1,407.6	1,184.2	1,064.8	1,121.0	1,067.2	936.0	850.4	756.7	761.4	830.6	10,287.2
Tricksey	806.9	669.0	727.0	625.7	660.4	766.7	699.3	583.8	492.7	317.2	72.5	442.7	6,964.6

The figures marked thus (*) are for the year 1894.

For the dairy herd proper, the average annual milk yield was 6,467.80 pounds, and butter fat 306.83 pounds.

The cows were weighed every Monday morning after milking and feeding and before they were allowed to drink. Little change took place in the weight of the cows during the year. Sweet Briar gained 84 pounds and Jennie gained 116. Nora and Gertie made some growth during the year. The scales afford but little assistance in our efforts to convey to the reader a proper conception of the size of the cow. A small cow compactly built and carrying considerable flesh may weigh as much or more than one with a large frame, lean and loosely built.

In the last annual report of this station it appears that there were ten cows in the herd weighing over one thousand pounds; of these three do not appear in this year's record, having been culled out. In table X. are eight cows weighing over a thousand pounds each and three of these will be discarded for want of merit.

TABLE XI.—Per Cent Fat—Average per Month and Year.

NAME.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average
Annie	7.06	7.00	6.70	6.89	7.17	6.85	7.50	4.72	5.59	5.91	6.16	6.26	6.48
Beckley	6.45	6.42	6.16	6.39	6.52	6.17	6.26	5.59	5.58	5.80	5.88	6.37	6.13
Bess	4.66	4.58	3.82	3.85	3.72	3.43	3.56	3.65	3.78	3.48	3.56	3.92	3.83
Bettie	4.87	4.87	5.00	5.49	5.56	5.18	5.41	5.63	5.41	5.66	5.55	6.26	5.41
Clara	5.32	5.05	4.87	5.30	5.63	4.59	4.49	4.57	4.64	4.51	4.42	4.96	4.86
Dido	*4.43	*4.10	3.65	4.12	4.20	3.79	3.86	3.89	4.26	3.83	3.84	3.85	3.99
Dora	*6.97	*7.16	4.77	4.92	5.48	5.21	4.97	5.27	5.22	5.87	6.11	6.65	5.72
Fancy	*4.93	*5.07	4.26	4.47	4.00	3.72	4.14	4.36	4.66	4.52	4.35	4.70	4.43
Gertie	5.42	5.20	4.78	5.03	5.07	4.94	5.75	6.00	.....	4.90	4.90	4.99	5.18
Houston	5.41	5.32	5.15	5.12	5.08	5.00	5.42	5.51	5.37	.....	4.76	5.31	5.22
Jennie	3.71	3.44	3.19	3.44	3.63	3.45	4.19	4.35	4.57	4.49	3.29	3.78	3.79
Nora	4.95	5.20	4.92	5.39	5.23	4.88	5.33	5.15	4.87	4.72	4.51	4.88	5.00
Olive	4.55	4.48	4.64	4.77	4.54	4.44	4.57	4.59	4.84	4.91	5.26	5.84	4.79
Patsy	4.49	4.23	4.39	4.73	4.82	4.65	4.71	4.84	4.91	4.70	4.68	5.36	4.71
Pride	5.78	5.51	6.40	.....	4.17	4.58	4.56	4.86	4.96	5.00	5.23	5.46	4.71
Reddie	5.63	5.94	5.73	5.59	5.08	4.70	5.15	5.36	5.59	5.80	.....	4.92	5.41
Rose	.....	.....	.....	3.85	3.73	3.90	4.10	4.16	4.46	4.29	4.36	4.82	4.19
Rossie	4.23	4.02	4.13	4.38	4.39	4.03	4.07	4.01	4.17	3.88	3.69	4.16	4.10
Roxy	4.65	4.71	4.60	4.74	4.88	4.68	5.00	5.28	4.85	4.45	4.52	4.89	4.77
Sully	4.65	4.43	4.35	4.70	4.89	4.87	5.00	4.23	4.59	4.20	3.88	4.51	4.53
Sweet Briar	5.03	4.97	5.14	4.98	5.15	5.15	4.98	5.24	5.55	.....	4.54	5.15	5.08
Topsy	5.00	4.10	3.83	3.93	4.00	4.15	3.96	4.03	4.13	4.31	3.68	3.85	4.08
Tricksey	4.68	4.85	4.76	4.77	4.69	4.47	4.58	4.79	5.26	5.60	.....	4.27	4.79

The figures marked thus (*) are for the year 1894.

TABLE XII.—Total Butter Fat for each Cow for each Month and for the Year.

NAME.	Jan.	Feb.	March.	April	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	For Year
Annie	27.13	24.01	26.80	25.11	23.49	19.77	2.11	31.25	36.21	35.28	31.98	29.56	312.70
Beckley	34.23	29.00	28.98	29.14	30.33	30.68	18.01	22.74	22.47	22.02	17.21	16.17	300.98
Bess	9.78	20.61	54.37	42.93	39.66	40.16	37.99	35.72	35.89	29.01	20.49	7.48	374.09
Bettie	28.04	22.12	24.59	24.31	23.98	23.57	23.14	23.20	18.54	20.15	17.54	18.49	267.67
Clara	19.70	16.96	18.31	17.80	17.02	23.16	25.62	25.79	22.85	21.51	16.89	16.31	241.92
Dido	*8.19	*.44	25.88	25.32	20.22	25.65	23.79	19.45	20.20	17.97	16.55	12.77	216.43
Dora	*18.63	*5.01	32.05	41.77	42.47	40.61	35.45	32.13	29.30	27.16	25.30	23.98	353.86
Fancy	*16.83	*13.04	*13.19	*12.30	30.06	33.06	31.56	27.49	25.84	22.13	18.71	17.50	261.71
Gertie	31.57	25.59	24.30	21.65	22.53	21.74	18.49	1.99	.....	32.48	29.96	29.98	260.28
Houston	44.98	36.58	36.49	30.52	31.41	35.22	33.28	26.72	14.99	.....	32.67	44.12	366.98
Jennie	20.19	16.73	19.35	19.21	22 78	23.34	22 66	20.75	17.74	5.66	1.15	37.43	226.99
Nora	20.85	17.74	18.23	17.00	19.37	19.19	18.60	18.00	18.92	19.77	18.58	19.23	225.46
Olive	34.15	28.05	30.48	23.98	23.57	25.88	26.31	24.45	22.01	19.81	17.08	8.63	284.40
Patsy	38.35	27.71	27.14	23.75	26.69	30.88	25.23	23.65	20.22	20.25	15.98	13.24	293.09
Pride	26.23	23.84	8.31	.....	10.22	42.18	38.96	35.82	31.09	30.64	28.86	26.90	303.05
Reddie	29.63	22.30	22.65	19.58	21.61	25.69	24.00	21.70	18.44	16.42	6.69	45.86	274.57
Rose	.....	.....	.....	27.25	39.79	43.63	39.74	36.05	33.61	27.66	26.00	22.65	296.38
Rossie	21.38	19.49	21.52	21.11	22.25	28.78	28.07	26.26	25.41	23.02	20.71	20.26	278.23
Roxy	40.03	30.64	31.23	28.88	31.42	37.17	29.12	23.86	27.89	28.68	25.10	24.40	358.42
Sully	26.13	23.91	23.96	24.67	24.79	19.70	25.73	29.87	32.75	29.17	27.61	29.72	318.01
Sweet Briar	41.25	34.15	33.23	30.22	33.78	37.01	34.41	30.14	25.00	2.83	26.73	28.87	357.62
Topsy	8.32	4.82	53.71	47.30	42.35	45.72	42.14	37.78	35.23	29.84	28.65	32.06	407.92
Tricksey	37.48	32.08	34.24	29.98	30.90	33.88	32 25	28.03	26.10	27.78	3.84	24.15	340.71

The figures marked thus (*) are for the year 1894.

Table XII. gives the yield of milk of each cow in pounds, each month in the year, and shows a remarkable persistency in the flow of milk, though this feature cannot be taken into account with Beckley, Bettie, Clara, Nora, Rossie, Roxy and Sully, as they aborted during the trial, and also Fancy, as she was not in calf during the year, which doubtless caused her to give a larger yield than she would have done under normal conditions.

Annie left the herd in Nov. 1893, so her record for Nov. and Dec. 1892 is given to complete the year. Dido and Dora calved in March and to complete the year's record for them it is carried over into 1894, the requisite length of time. The same would have been done with Rose had she been in milk during that period; she goes dry about three months of the year. Fancy's record commences with May, 1893 and ends May 1st, 1894. The amount of milk given by a cow or the cost of milk alone gives but little data of practical value for the reason that there is such a marked difference in the quality of the milk from different cows.

By comparing tables X. and XI. it will be seen that the milk from the cows giving a large flow contains a small percentage of fat while the milk from those giving a small quantity is relatively rich in fat. Annie's milk contained the largest percentage of fat up to August when she calved and the quality of the milk dropped nearly two per cent. The next in quality is Beckley with an average of 6.13 per cent. fat. The average per cent. for the Jerseys and their grades is 5.3; for the Holstein Friesian and grades it is 3.9, the Guernseys and grades average 5 per cent, and the shorthorns and grade shorthorns 4.2 per cent. There seems to be a general tendency for the milk to get richer as the period of lactation advances, yet there are so many variations that it is exceedingly difficult to account for them all. During the first half of June there was a marked decrease in the per cent. fat, while for the remainder of the month the increase was equally as marked. So far there is no indication that feed produces any great change in the quality of milk. Succulent feed slightly increases the volume of milk and consequently decreases the per cent. fat, while a change to dry feed decreases the flow

which results in an increased per cent. fat. The daily variation in the quality of milk is greater than the daily variation in quantity, but taking longer periods, such as a month or more, the variation appears to be reversed.

The herd as a whole is composed of cows light in weight, the two most marked exceptions being Dido and Fancy, which are heaviest, though not as large as Bess and Topsey. Next in size and weight are Sully and Rose, the grade shorthorns. If we exclude the two beef cows, Dido and Fancy, (which do not belong to the dairy herd proper) the average weight is 947 pounds.

As will be seen by Table XIII. all the feed consumed by each cow, and time in pasture during the year, is charged to her account. This seems to be the proper thing to do, for a cow must be maintained during the time when she goes dry be it long or short. If she is a good dairy cow the period will be comparatively short. Sully, the grade shorthorn, consumed the most feed, which cost $43.98; Bess follows next with $43.52; then Topsy $42.56; Sweet Briar $42.34; Houston $41.22 and Roxy $41.01. All the others were under $40 and over $32 with an average for the herd of $37.82. The amount of milk and cost per 100 pounds is a matter of little moment on account of the wide variation in the per cent. of fat and other solids contained in different milks. The grade Holstein, Topsy, produced the largest amount of butter fat for the year; she also produced it at the least cost, 10.4 cents per pound. Judging from her conformation, her quality individually, the richness of her milk and the fact that many of the cows in the neighborhood, where she was bred, have an infusion of Jersey, it is suspected that she has some Jersey blood in her veins. The fact that the full blood cows Dora and Annie came from the same herd and that other cows in the herd are grade Jerseys, and that it is not known which cow was her dam, makes her blood lines a matter of uncertainty. It is known, however, that her sire was a Holstein-Friesian.

TABLE XIII.—Feed Consumed by Each Cow.

NAME.	Bran.	Barley.	Corn.	Linseed Meal.	Roots.	Ensilage.	Hay.	Pasture. (Days.)
Annie	1938.87	952.68	254.75	482.36	1718.40	3561.00	1960.50	130.50
Beckley	1806.64	874.77	345.90	450.93	1870.00	4702.00	1962.00	130.50
Bess	2002.53	1156.32	351.59	551.85	1780.00	3644.00	2329.00	130.50
Bettie	1528.67	800.05	252.78	384.28	1780.00	3920.00	1688.50	130.50
Clara	1569.21	831.41	258.94	396.53	1745.00	4060.00	1740.00	123.50
Dido	1331.38	796.89	265.02	341.65	1745.00	3662.00	1824.00	130.50
Dora	1729.92	894.58	434.27	446.23	1780.00	3046.00	2050.00	130.50
Fancy	1560.69	886.18	602.37	426.92	1780.00	1506.00	2569.00	135.50
Gertie	1496.09	739 29	349.19	382.75	1800.00	3916.00	1649.50	130.50
Houston	2064.09	840.40	306.81	546.86	1640.00	4180.00	2150.00	130.50
Jennie	1824.74	988.87	321.36	467.32	2517.00	3630.00	1749.50	130.50
Nora	1558.70	815.31	268.04	393.24	1780.00	3906.00	1688.50	130.50
Olive	1651.48	912.69	288.82	359.50	1870.00	2470.00	2259.60	130.50
Patsy	1615.87	741.35	231.78	402.48	1780.00	3336.00	1970.50	130.50
*Pride	1446.17	968.74	691.56	441.93	1835.00	1918.00	2039.00	130.50
Reddie	1646.59	816.89	331.42	420.39	1780.00	4094.00	1725.40	130.50
Rose	1755.64	753.24	482.83	449.02	1780.00	1768.00	2191.00	130.50
Rossie	1544.19	777.62	312.25	390.85	1870.00	3138.00	1644.50	130.50
Roxy	1979.65	898.98	383.77	499.87	1870.00	3564.00	2266.40	130.50
Sully	2113.10	1083.59	346.78	525.55	1780.00	5272.00	1998.00	130.50
Sweet Briar	2088.28	816.43	390.84	553.54	1870.00	3940.00	2334.00	130.50
Topsy	1965.71	1123,50	360 77	542.34	1780.00	3344.00	2266.00	130.50
Tricksey	1985.59	720.73	403.14	520.25	1860.00	3450.00	2612.00	130.50

*Pride, during June and July received 68 pounds of oats, value of oats is included in cost.

Hay consists of Timothy, Oat and Millet; and prairie hay for Dido, Dora and Fancy half the time during the months of Feb., March and April.

TABLE XIV.—Cost of Feed and Dairy Products,

NAME.	Weight of cow	Cost of feed	Lbs. of milk	Cost of 100 pounds milk	Pounds of butter fat	Cost of 1 lb. of butter fat.	Pounds of butter	Cost of 1 pound butter.	Pounds of butter per 100 pounds live weight
				cents		cents		cents	
Annie	821	$39.10	5013.90	77.9	312.70	12.4	379.03	10.3	46.17
Beckley	942	39.24	4949.30	79.3	300.98	13.1	364.82	10.8	38.73
Bess	1127	43.52	10087.00	43.1	374.09	11 6	453.40	09.6	40.24
Bettie	802	34.04	4957.90	68.7	267.67	12.7	324.40	10.5	40.45
Clara	909	34.79	4952.80	70.2	241.92	14.4	293.20	11.8	32.25
Dido	1302	32.13	5562.60	57.8	216.43	14.8	262.30	12.2	20.14
Dora	877	37.58	6515.90	57.7	353.86	10.6	428.90	08.8	48.91
Fancy	1259	37.07	5992.00	61.9	261.71	14.2	317.20	11.7	25.24
Gertie	880	34.07	5106.20	66.7	260.28	13.1	315.50	10.8	35.85
Houston	931	41.22	6976.10	59.1	366.98	11.2	444.80	09.3	47.78
Jennie	1020	39.19	6008.40	65.2	226.99	17.3	275.10	14.2	26.97
Nora	832	34.52	4526.00	76.3	225.46	15.3	273.30	12.6	32.87
Olive	805	35.69	6093.10	58.6	284.40	12.5	344.70	10.4	42.82
Patsy	872	34.44	6284.20	54.8	293.09	11.7	355.10	09.7	40.72
Pride	758	38.26	6090.20	62.8	303.05	12.6	367.30	10.4	48.46
Reddie	1027	36.27	5183.50	70.0	274.57	13.2	332.80	10.9	32.40
Rose	1136	36.73	7337.70	50.1	296.38	12.4	359.20	10.2	31.62
Rossie	903	33.72	6784.70	49.7	278.23	12.1	337.20	10.0	37.34
Roxy	965	41.01	7546.30	54.3	358.42	11.4	434.40	09.4	45.02
Sully	1219	43.98	7600.00	62.2	318.01	13.8	385.50	11 4	31.62
Sweet Briar	1000	42.34	7094.30	59.7	357 62	11.8	433.50	09.8	43.35
Topsy	1101	42.56	10287.20	41.4	407.92	10.4	494.40	08.6	44.90
Tricksey	962	40.71	6964.60	58.5	340.71	11.9	412.98	09.8	42.92
Total	22448	872.18	147378.91	1406.6	6921.47	294.7	8362.7	243.3	
Average	976	37.82	6407.78	61.1	300.93	12.8	364.6	10.6	38.12
Averages without Dido and Fancy	947	38.23	6467.80	61.2	306.93	12.7	371.9	10.4	39.59

Dora gave 353.86 lbs. of fat costing 10.6 cents per lb., she was, however, at a disadvantage as she carried a calf six months of the test while Topsy was in calf only a short time during the year. Eleven of the cows average 344.04 lbs. butter fat and the herd with Dido and Fancy average 300.93, while the dairy herd proper averages 306.83 lbs. In examining further, table XIV. it will be seen that there are excellent cows among all the breeds represented in the Station herd; it also appears that among the best can be found large cows as well as small ones; large in this sense does not mean heavy in weight but has reference to size only.

The average cost of 100 lbs. of milk was 61.2 cents. The average cost of a pound of butter fat for the herd was 12.8 cents. If all the cows in the herd that are spare and will not lay on flesh under heavy feeding are placed in one group and those that carry a superfluous amount of flesh in another group, we find the cows that give the largest returns for food consumed, in the first lot and in every instance, those that give a smaller return, in the other lot. The spare cows average 337.1 lbs. of butter fat at a cost of 11.6 cents per lb. while the cows that are inclined to put on flesh average 267.8 lbs. of fat at a cost of 13.8 cents per lb. It should be stated in justice to Beckley and Sully, that under normal conditions one or possibly both would be classed in the spare group. At the time of dropping their calves the placenta was removed from these two by artificial means, while in the other cases nature was allowed to take its course. These two shrunk materially in their milk and were out of condition a couple of weeks.

In Table XIV. is given also the number of pounds of butter and its cost per pound assuming that each .825 of a bl. of fat in the milk will make a pound of butter allowing for losses in skim and butter milk. The average amount of butter per cow for the entire herd for the year was 364.6 lbs. Taking out the two beef cows the average for the remainder of the herd was 371.9 lbs. being a trifle over one pound of butter per day for each cow. The average cost for feed per day for each cow was 10.4 cents. In examining Table IX. it should be borne in mind that the cows were charged a uniform price for pasture as it was impossible to ascertain how much grass each cow consumed, consequently the cost of butter fat for the summer may not be absolutely correct, though the errors, if any, are slight.

Further investigation will be made on this subject with a view of arriving at some definite conclusions as to the type of cow best adapted for the dairy.

TABLE XV.—Cost of One Pound of Butter Fat by Months.

NAME.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Annie	.130	.124	.131	.145	.145	.103	.100	.112	.097	.135	.119	.124
Beckley	.124	.136	.173	.143	.129	.076	.105	.121	.118	.124	.180	.184
Bess	.223	.066	.103	.115	.100	.062	.062	.096	.088	.128	.195	.406
Bettie	.122	.135	.143	.149	.142	.086	.082	.118	.139	.135	.155	.116
Clara	.172	.176	.222	.204	.184	.086	.074	.106	.098	.125	.184	.183
Dido	.257	.182	.192	.143	.156	.078	.079	.141	.108	.150	.184	.234
Dora	.170	.365	.074	.100	.091	.060	.066	.099	.093	.120	.140	.143
Fancy	.187	.263	.307	.316	.086	.068	.074	.110	.103	.143	.170	.170
Gertie	.097	.116	.167	.168	.140	.092	.086	.131	.....	.100	.114	.132
Houston	.090	.107	.122	.141	.126	.060	.063	.113	.116	.....	.092	.090
Jennie	.169	.178	.227	.217	.172	.107	.103	.155	.154	.525	.261	.100
Nora	.164	.168	.193	.214	.176	.107	.102	.152	.138	.134	.164	.158
Olive	.099	.120	.122	.179	.152	.080	.072	.112	.117	.134	.181	.251
Patsy	.089	.108	.140	.155	.129	.066	.075	.116	.111	.135	.167	.214
Pride	.120	.230	.251	.....	.079	.060	.071	.100	.099	.114	.142	.129
Reddie	.133	.141	.194	.185	.157	.080	.079	.113	.122	.166	.205	.081
Rose	.....	.....	.....	.088	.079	.041	.059	.084	.081	.115	.147	.175
Rosie	.120	.153	.164	.172	.156	.070	.067	.093	.089	.120	.153	.147
Roxy	.100	.103	.142	.149	.126	.070	.065	.132	.095	.112	.154	.161
Sully	.160	.170	.212	.200	.160	.110	.110	.106	.083	.112	.145	.133
Sweet Briar	.130	.115	.134	.143	.117	.070	.068	.105	.104	.085	.146	.137
Topsy	.304	.137	.089	.100	.094	.050	.055	.091	.089	.124	.139	.124
Tricksey	.114	.123	.130	.144	.128	.071	.072	.113	.100	.054	.117	.....
Average	.149	.151	.165	.162	.132	.076	.078	.114	.106	.140	.159	.164

COST OF BUTTER PRODUCTION IN WINTER.

T. L. HÆCKER.

The object of this experiment was to ascertain with greater accuracy, the cost of butter fat for the winter months when all the conditions are more under control than during the summer. Each cow was charged with all the feed consumed and credited with her yield of milk and fat. It was found impossible to make the trial the same length for each cow for the reason that they were not all at the same time in a condition which would make it fair, so each cow was placed on trial at a time when it was thought she would do herself justice.

A careful record was kept of the amount of feed taken by each cow, and a chemical analysis made of all the feed stuffs used. The cost of the feed was calculated upon the same basis as it was in the yearly feed record. Each milking was weighed and tested by the Babcock test, so the results are actual, no estimates being resorted to in any part of the work. The average weight was ascertained by weighing each cow every Monday morning after feeding and before watering, dividing this sum by the number of weeks each cow was in the trial.

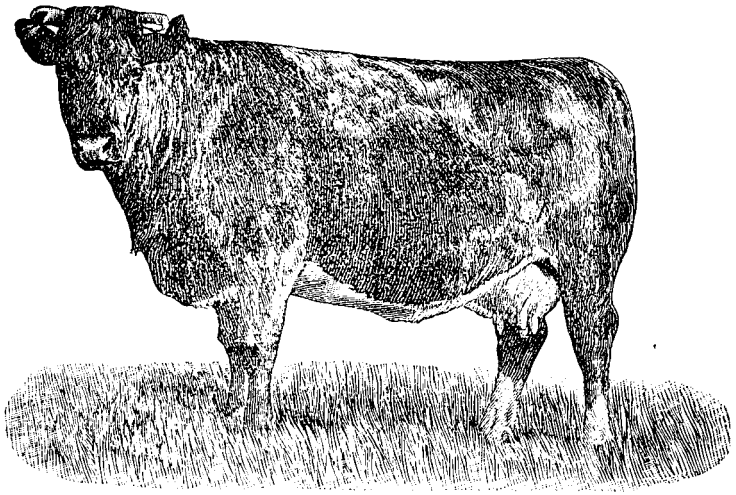
To explain the headings below the columns in Table XVI. it may be well to state that the first gives the names of the cows in the trial, the second, average weight of each cow; third, the number of days each cow was in the trial; fourth the total pounds of dry matter eaten; fifth, the average number of pounds of dry matter taken per day; sixth, the number of pounds of dry matter taken daily per one thousand pounds of live weight; seventh, pounds of butter fat produced during the trial; eighth, butter fat produced per day; ninth, pounds of dry matter required for each pound of butter fat; tenth, cost of a pound of butter fat; eleventh,

TABLE XVI.—Summary of Results Obtained.

NAME.	Avge. Weight	Days on Trial	Dry Matter in Food	Dry Matter per Day	Dry Matter per 1000 lbs. live Weight	Total Butter Fat	Butter Fat per Day	Dry Matter for 1 lb. Butter Fat	Cost of 1 lb. of Butter Fat	Butter Fat per Day per 1000 lbs. live weight
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cents.	
Annie	787	152	3095.53	20.37	25.80	142.78	.939	21.68	12.8	1.193
Beckley	941	121	2864.41	23.67	25.15	143.37	.944	25.08	14.3	1.000
Bess	1134	154	3772.88	24.60	22.04	177.19	1.150	21.29	12.3	1.014
Bettie	787	181	3323.37	18.36	23.33	136.75	.756	24.30	13.8	.960
Clara	902	181	3455.82	19.09	21.16	111.26	.614	31.05	17.8	.680
Dido	1277	184	3452.24	18.76	14.61	106.88	.579	32.36	18.2	.453
Dora	874	142	2771.59	19.52	22.33	150.26	1.058	18.44	11.1	1.211
Fancy	1232	151	2863.97	18.97	15.41	88.21	.584	32.47	18.1	.474
Gertie	849	181	3565.21	19.70	23.20	165.55	.915	21.53	12.3	1.078
Houston	911	151	3884.53	25.73	28.24	192.69	1.276	20.16	10.8	1.401
Jennie	966	151	3222.39	21.34	22.09	112.91	.747	28.58	16.6	.773
Nora	815	181	3339.05	19.00	23.31	112.15	.620	29.77	17.2	.761
Olive	854	181	3647.05	20.15	23.59	153.55	.848	23.75	13.4	.993
Patsy	849	181	3411.08	18.85	22.20	153.18	.846	22.27	12.6	.996
Pride	771	151	2890.74	19.14	24.82	136.47	.904	21.18	12.6	1.172
Reddie	1004	182	3823.92	21.10	21.02	156.44	.859	24.44	13.8	.857
Rose	1106	112	2213.99	19.76	17.87	103.56	.924	21.37	12.9	.835
Rossie	1054	181	3196.09	17.66	16.75	127.23	.703	25.12	14.6	.667
Roxy	950	181	4043.03	22.34	23.52	184.56	1.197	21.91	12.4	1.260
Sully	1237	181	4469.19	24.69	19.96	154.45	.853	28.94	16.4	.689
Sweet Briar	966	181	4483.09	24.77	25.65	194.45	1.074	23.06	12.8	1.112
Topsy	1108	174	4005.00	23.17	20.91	199.88	1.148	20.04	12.0	1.036
Tricksey	924	138	3373.37	24.45	26.46	161.56	1.170	20.88	11.4	1.266

pounds of butter fat produced daily per thousand pounds of live weight. Every cow in the herd was in the trial, and by referring to Table VIII. the breeding of each cow may be seen. In noticing the average weight of the cows it should be borne in mind that the weight of a cow does not convey a correct idea of her size. Neither Dido nor Fancy are as large as their weight would indicate. The same is true of Beckley, Clara and Rossie, while Topsy, Jenny. Bess and Bettie are larger than one would suppose, judging from their weight. The variation in amount of dry matter consumed per day by different cows is much larger than is generally supposed. In order to make comparison, the feed consumed is figured on a basis of one thousand pounds live weight. Houston consumed an average of 28.24 pounds per day, Dido took only 14.61 pounds per day, Fancy following next with 15.41 pounds. Not only are these two cows light feeders, but it also appears from the foregoing table, that they gave a small return for the feed consumed. Fancy gave only one pound of butter fat for every 32.47 pounds of dry matter eaten, Dido required 32.36 pounds for each pound of butter fat, while the smaller cows, Houston and Dora, required only 20.18 and 18.44 pounds respectively, and the large framed cow, Topsey, required only 20 04 of dry matter for a pound of butter fat. From this, it seems the line cannot be drawn between good and poor cows on their size, neither can it be drawn on breeds; for example, take the two shorthorns, Dido and Rose, the former requiring 32.36 pounds of dry matter for a pound of butter fat, to 21.37 pounds for Rose. The grade Holstein, Jennie, takes 28.58, while the grade Holstein, Topsy, is charged only 20.04. The Jersey, Beckley, takes 25.08 and the Jersey, Dora, takes only 18.44.

It is evident then that some cows produce butter fat much cheaper than others, the variation being so great that under certain conditions one class will produce it at a profit and another at a loss. If the cows are divided into four groups based on conformation, assigning the beefy cows to the first those with less tendency to plumpness to the second, the spare, cows lacking depth to the third and the spare cows with deep bodies to the fourth, results follow which seem to be of vital importance to every dairyman.



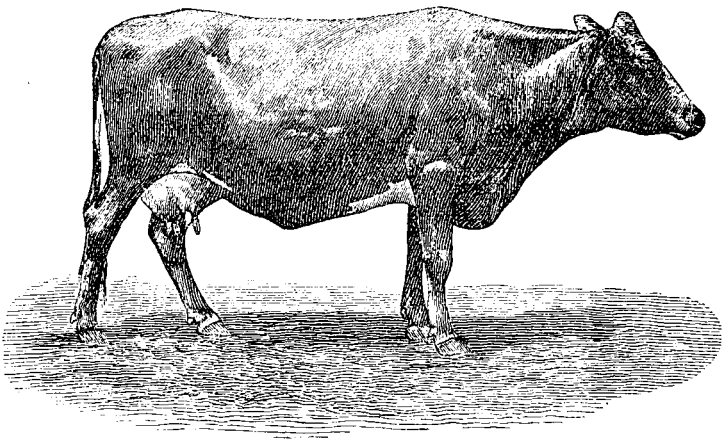
DIDO.

TABLE XVII. GROUP I.—Beef Type. Blocky and Plump.

Cow.	Weight.	Breed.	Lbs. Dry Matter per day per 1000 lbs. live weight	Lbs. dry matter for 1lb. of butter fat	Lbs. butter fat from 100 lbs. of dry matter	Cost of 1lb of butter fat
						cents.
Fancy	1256	Polled Angus	15.41	32.47	3 08	18.1
Dido	1245	Shorthorn	14.61	32.36	3.09	18.2
Sully	1219	Shorthorn	19.96	28.94	3.45	16.4
Average	1240		16.66	31.25	3.20	17.5

To illustrate the general conformation of the cows in this group a picture of the Shorthorn cow Dido is given. The engraving was made from a photograph taken before the experiment began, and is an excellent likeness of the cow. She is large and blocky in outline, being level from base of horns to setting on of tail, deep well rounded thigh coming well down to hock, brisket low and running well forward, neck short and heavy at the shoulders, broad across the shoulders, full crops, ribs well sprung and body deep in the middle. She is in every way a very fine animal. She ate 18.76 pounds of dry matter per day, required

32.36 pounds of dry matter for each pound of butter fat, making the cost of butter fat 18.2 cents. Fancy is smaller in frame but carries more flesh. She is level on upper and lower lines, making her deeper in the flank and chest than Dido. She is closely ribbed, ribs well sprung making her level across the back, crops full, very heavy shouldered, broad across the withers and remarkably broad between the elbows indicating enormous lung capacity. She required 32.47 pounds dry matter for a pound of butter fat, making the butter fat cost 18.1 cents per pound. Sully is less inclined to lay on flesh than either of the others. She has less breadth of withers, crops quite low, deep and low in the middle and heavy thigh. She required 28.94 pounds dry matter for a pound of butter fat, making it cost 16.4 cents per pound. The cost of butter fat from group I. was 17.5 cents per pound.

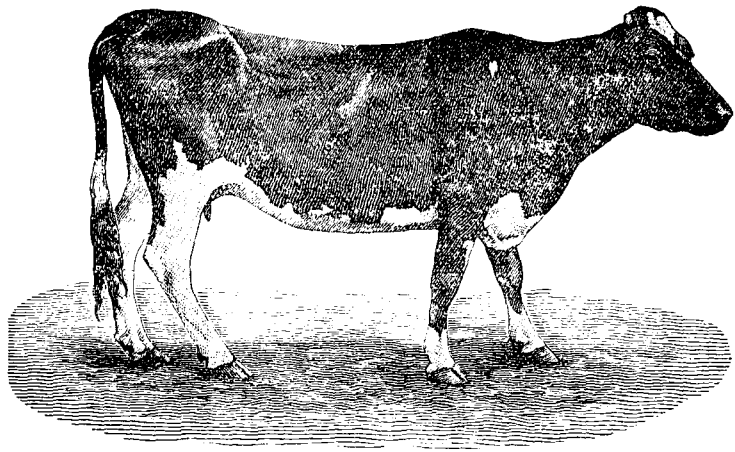


BECKLEY.

TABLE XVIII. Group II.—Cows Having Less Tendency to Lay on Flesh.

Cow.	Weight.	Breed.	Lbs. Dry Matter per day per 1000 lbs. live weight.....	Lbs. Dry Matter for 1lb. of butter fat.....	Lbs. butter Fat from 100 lbs of Dry Matter.	Cost of 1lb. of butter fat.....
						cents
Beckley	942	Gr. Jersey	25.15	25.08	3.98	14.3
Clara	909	" "	21.16	31.05	3.22	17.8
Reddie	1027	" Guernsey	21.02	24.44	4.09	13.8
Rossie	903	" Jersey	16.75	25.12	3.98	14.6
Average	945		21.02	26.42	3.82	15.1

This group would ordinarily be classed as fair dairy cows, but upon close inspection they show a well defined tendancy to growing flesh. Their hips (hooks), chines and withers are not as sharp as is the case with those in the two groups following. Their necks are rather short and a trifle heavy, thighs and crops too full. Rossie, a first-cross Jersey, carries the most flesh. Beckley, a high grade Jersey, follows next, both are more than ordinarily deep in body; Reddy and Clara are not as deep, and show less tendency to lay on flesh. The cows in Group II. consumed on an average 20.37 pounds dry matter per day, and required 26.42 pounds of dry matter for a pound of butter fat, costing 15.1 cents per pound.

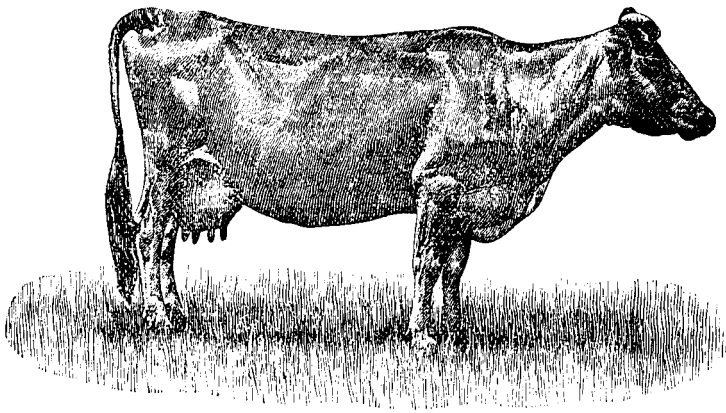


BETTIE.

TABLE XIX. Group III.—Cows Spare and Angular in Form, but Lacking Depth.

Cow	Weight	Breed	Lbs. dry matter per day per 1000 lbs. live weight	Lbs. of dry matter for 1 lb of butter fat	Lbs. of butter fat from 100 lbs. of dry matter	Cost of 1 lb. of butter fat
Jennie	1020	Gr. Holstein	22.09	28.58	3.49	16.6
Bettie	802	Guernsey	23.33	24.30	4.12	13.8
Olive	805	Gr. Guernsey	23.59	23.75	4.21	13.4
Average	875		23.00	25.54	3.94	14.6

The cows in this group are spare and angular, but lack in depth through the flank and middle. This is especially the case with Jennie, that has a restless, roving disposition always seeming to look for something better, while Olive and Bettie are more contented. Bettie is a fair representative of the cows in Group III.; they are not inferior dairy cows, their record for the year 1893 was 944 pounds of butter. They are the lightest feeders in the herd and require 25.54 pounds dry matter for a pound of fat, the butter fat costing 14.6 cents.



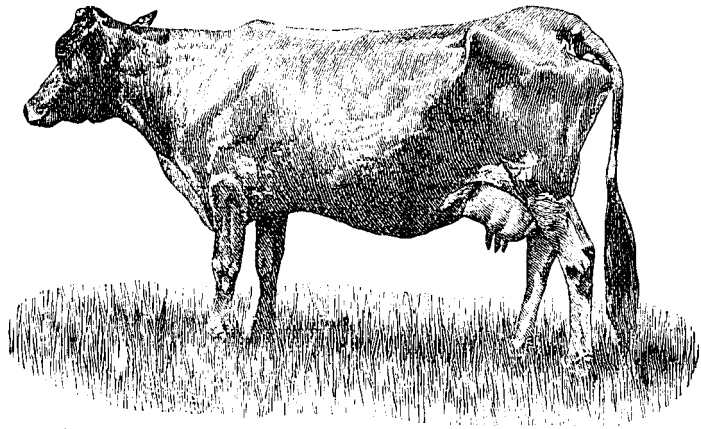
HOUSTON.

TABLE XX. Group IV.—Cows Spare and Angular with Deep Bodies.

Name of cows	Breed	Lbs. dry matter per day per 1000 lbs. live weights	Lbs. dry matter per 1 lb butter fat	Lbs. of butter fat from 100 lbs. of dry matter	Cost of 1 lb. of butter fat
					cents
Annie	Jersey	25.80	21.68	4.61	12.8
Bess	Holstein	22.04	21.29	4.69	12.3
Dora	Jersey	22.33	18.44	5.42	11.1
Gertie	Gr.- "	23.20	21.53	4.64	12.3
Houston	JerseyGuernsey	28.24	20.16	4.96	10.8
Patsy	Gr.-Jersey	22.20	22.27	4.49	12.6
Pride	Jersey	24.82	21.18	4.72	12.6
Rose	Shorthorn	17.87	21.37	4.67	12.9
Roxy	Gr.-Jersey	23.52	21.91	4.56	12.4
Sweet Briar	Guernsey	25.65	23.06	4.33	12.8
Topsy	Holstein	20.91	20.04	4.99	12.0
Tricksey	Guernsey	26.46	20.88	4.78	11.4
Average		23.58	21.15	4.73	12.1

The cows in group IV. embrace all in the herd not in the preceding groups except the heifer Nora, that is not classified for the reason that she made some growth during the year. It requires feed to make growth, consequently she is an exception to the conditions common to the other members of the herd. To give a better idea of the conformation of the cows in these groups, than can be done by words alone, the illustrations are given. Houston, a cross-bred Jersey-Guernsey consumed more feed per day and produced butter fat at less cost than any other cow in this trial. It is there-

fore proper that she should be selected as one of the representatives of the type of cow that gives best return for food consumed. The illustration is from a photograph taken after the close of the experiment. She is, and has been, in good health all the time she has been in the herd. Her appetite is clearly shown by the fact that she ate 28.24 pounds of dry matter daily during the test; the standard being 24 pounds. That she made good use of it—possibly the best that could be—is evident from the cost of butter fat, 10.8 cents per



DORA.

pound. Dora follows next in productive capacity, making a pound of butter fat for 11.1 cents, and returning a pound of fat for every 18.44 pounds of dry matter consumed. The average number of pounds of dry matter eaten per day by the group is 23.58; average pounds of dry matter for a pound of fat 21.15; cost of a pound of fat 12 1 cents. The cows in group IV deviating the most from the type as represented by Houston and Dora, are Rose, Annie and Sweet Brier, deviation being in the order named. In examining the cost of butter fat in this group it will be seen that Rose produces it for 12.9 cents and Annie and Sweet Brier each for 12.8 cents per pound.

TABLE XXI.—Averages of the Four Groups.

Group	Dry matter eaten per day....	Dry matter per 1000 lbs. of live weight	Dry matter per lb. of butter fat	Butter fat for 100 lbs. of dry matter	Cost of a lb. of butter fat....
I	20.81	16.66	31.25	3.20	17.5
II	20.37	21.02	26.42	3.78	15.1
III	19.95	23.00	25.54	3.91	14.6
IV	21.86	23.58	21.15	4.72	12.1

It appears from the foregoing table that group I.. the heavy beefy cows, consumed 20.81 pounds of dry matter per day and required 31.25 pounds dry matter for a pound of butter fat; that group II., the cows having an angular form, but a tendency to lay on flesh, consumed 20.37 pounds dry matter per day and required less to make a pound of butter fat than the first group; while group III., the spare cows lacking somewhat in depth of body, consumed 19.95 lbs. food daily, and required less dry matter for a pound of fat than groups I. and II., and that group IV., the spare, deep bodied cows, consumed the most feed per day and made the best use of it. The cost of butter fat as indicated in the last column, seems to depend more upon the type of cow than the breed, there being less variation in cost of production between cows of a certain type than between cows of the same breed. The cost of one hundred pounds of dry matter was 57 cents; estimating the price of a pound of butter fat at 25 cents the cows in group I. returned a net profit of 23 cents for each hundred pounds of dry matter consumed; group II., 37 cents; group III., 41 cents and group IV., 61 cents. Referring to table XXI., it will be seen that the first group consumed, on an average, 20.81 pounds dry matter per day, returning 4.7 cents profit; the cows in group II, ate 20.37 pounds dry matter and gave 7.5 cents profit; group III. ate 19.95 pounds each and returned 8.1 cents, while group IV. ate 21.86 pounds each per day at a profit of 13.3 cents, or nearly three times as great a net profit as the blocky cows in group I.

SUMMARY.

The record of the dairy herd for the year 1893 seems to warrant the following conclusions:

First. The average annual cost of keeping a dairy cow is thirty-eight dollars.

Second. A herd of cows bred on dairy lines, well fed and carefully handled, will produce on an average six thousand four hundred pounds of milk per year at a cost of sixty-two cents per hundred pounds and twelve and a half cents a pound for butter fat.

Third. A herd of good dairy cows well fed and carefully handled will produce on an average three hundred pounds of butter fat each per year, which is equivalent to three hundred and sixty-five pounds of butter per cow.

Fourth. The average cost of a pound of butter will be ten and a half cents.

Fifth. Taking the entire herd the average cost of a pound of butter fat during the winter months is thirteen and nine-tenths cents.

Sixth. The productive capacity of a cow depends more upon type and conformation than upon size or breed. Those of the beef type produced butter fat at a cost of seventeen and a half cents per pound; those carrying a medium amount of flesh produced butter fat at a cost of fifteen and one-tenth cents per pound; the spare cows lacking in depth of body produced butter fat at a cost of fourteen and six tenths cents per pound and the spare cows having deep bodies produced butter fat at a cost of twelve and one tenth cents per pound.

COMPARING PRAIRIE HAY WITH TIMOTHY HAY.

T. L. HÆCKER.

In a state like Minnesota where so large a portion is composed of open prairie still covered with the virgin grasses, the question of their food value is one of no little moment, especially in all that section north and west of the Twin Cities. For that section the, almost, universal roughage-feed for horses, cattle and sheep is the upland prairie hay.

The term employed to designate this hay is rather ambiguous; prairie hay consists of many varieties of grasses, depending, to a certain extent, upon composition of soil and degree of moisture. But if practical investigation into the value of the native grasses, for the production of milk and growing of young stock, be deferred until these grasses are all divided and classified and the relative proportion of each contained in a given quantity of hay, is computed, there will be little use for the facts after they are obtained. For feeding purposes, prairie grasses can be divided into three classes, the upland, the dry bottom land and the swale or marsh grasses. Of these the upland prairie is the most common and for this reason it was selected for an experiment in milk production in comparison with timothy hay.

Character of Hay Fed.—The prairie hay secured was fine in blade, of good quality, apparently early cut and not exposed to rain before stacking. It was almost free from swale grass and tall blue joint. The timothy hay was medium fine, rather short, cut early and properly cured, had a fine flavor, good color and was first grade in every respect.

The intention was to carry this experiment from the first of February to the first of May, covering the period, March and April, when it is most difficult to get satisfactory results in a feeding experiment with dairy cows. But it was not until about the middle of February that the cows adjusted them-

selves to the rations selected. There was no difficulty experienced in feeding prairie hay but it required careful training to induce all of them to eat the timothy clean.

The mixed grain ration consisted of 98 pounds bran, 44 pounds ground barley, 44 pounds ground corn and 26 pounds linseed meal.

Sixteen cows were selected for the experiment and were divided into four groups, and the time into four periods. The daily feeding program was as follows:

Lot 1—Periods I and III, Grain 14 lbs., Prairie hay 14 lbs.
Lot 1—Periods II and IV, Grain 14 lbs., Timothy hay 14 lbs.
Lot 2—Periods I and III, Grain 14 lbs., Timothy hay 14 lbs.
Lot 2—Periods II and IV, Grain 14 lbs, Prairie hay 14 lbs.
Lot 3—Periods I and III, Grain 12 lbs., Ensilage 10 lbs., Prairie hay 11 lbs.
Lot 3—Periods II and IV, Grain 12 lbs., Ensilage 10 lbs., Timothy hay 11 lbs.
Lot 4—Periods I and III, Grain 12 lbs., Ensilage 10 lbs., Timothy hay 11 lbs.
Lot 4—Periods II and IV, Grain 12 lbs., Ensilage 10 lbs., Prairie hay 11 lbs.

CONDUCT OF THE EXPERIMENT.

The feeding preliminary to the experiment, began the 22nd day of January, continuing to the 12th of February, when the experiment proper commenced and it was closed the evening of the 29th of April. It was divided into four periods of fourteen days each with seven days intervening between periods for preliminary feeding. During the first and third periods the cows in Lot 1 were fed on grain and prairie hay; Lot 2, on grain and timothy hay; Lot 3, grain, ensilage and prairie hay and Lot 4, grain, ensilage and timothy hay. During the second and fourth periods, the cows in Lot 1, were fed grain and timothy hay; Lot 2, grain and prairie hay; Lot 3, grain, ensilage and timothy hay and Lot 4, grain, ensilage and prairie hay. The cows were fed twice and watered once a day, and weighed every Monday morning after feeding and before watering. The feed was weighed each day and in a few instances when feed was left it was weighed back, giving due credit to the cow leaving it.

In the preliminary feeding between the first and second periods, Daisy, in Lot 1 went off her feed and did not recover in time to enter the trial in the second period. She was therefore dropped from the experiment. Betty also at one

time refused to eat the full amount of timothy hay, but it was so near the close of the second period that no perceptible change took place in her yield of milk and butter fat. During the third and fourth periods she was in excellent condition and gained, both in milk and in butter fat, though during the last week of the experiment she refused to eat all the timothy. Fancy was offered the hay left by Bettie but she refused to take it. In the third period, when changing from prairie to timothy, Clara in Lot 2, failed to eat the required amount of timothy and, showing abnormal loss in both milk and fat, was taken out of the experiment. Beckley, in Lot 3, ate all the feed given but showed by her appearance and performance that she was not in normal condition, which subsequent developements confirmed. During the first period, Jenny in Lot 4, refused to eat a full ration of timothy, and throughout the experiment, showed that the ration was a trifle too large when on timothy hay. She seemed to like the wild hay much better, increasing both in yield of milk and fat when on prairie hay. Because of the break in the first period and other peculiarities noted, she was taken out of the trial, which left three cows in each lot. All of them were fed to their full capacity for so long a period except Sweet Brier and possibly, Topsy; the former would have taken a few pounds more and the latter might have taken half as much.

Every milking of each cow was weighed and tested for per cent fat, as has been our invariable practice since the establishment of the dairy herd in the autumn of 1891.

The daily grain ration was as follows:

Lots 1 and 2	Lots 3 and 4
Bran 6.17 lbs.	Bran 5.29 lbs.
Barley 3.08 lbs.	Barley 2.64 lbs.
Corn 3.08 lbs.	Corn 2.64 lbs.
Linseed Meal 1.65 lbs.	Linseed Meal 1.41 lbs.

Samples of Grain, Hay and Ensilage.—Samples of the grain were taken in Mason pint jars and sealed. The samples of ensilage were taken by the chemist, and both prairie and

timothy hay were sampled every day and a composite sample of each was analyzed.

All the work in connection with the experiment was done by students attending the School of Agriculture. Messrs. Walter Field and A. J. Glover had charge of the feeding; W. C. Currie, R. W. Clark and James McGrath did the milking; Archie L. Haecker tested the milk with the Babcock test and Ernest W. Major kept the record and computed the yield of milk and fat. The milk was weighed and sampled by the milkers. All the work was done with that zeal and earnest fidelity which can only be secured through those who take a deep interest in obtaining accurate results in an experiment of this kind.

Since the ration fed to Lot 1 and Lot 2 differed from that fed to Lot 3 and Lot 4, the results obtained from the first two groups will be considered separate from that of the last two.

TABLE XXII.—Cows, Weights, Date of Calving and Date of Service.

Name	Age	Breed	Wt.	Date of calving	Served
Bettie	9	Guernsey	846	Aug., 1893	Dec. 30, 1893
Daisy	2½	Grade Guernsey	.....	.....	April 10, 1894
Gertie	5	Grade Jersey	874	Sept. 26, 1893	Nov. 15, 1894
Fancy	8	Polled Angus	1246	Mar., 1893	.....
Houston	10	Jersey-Guernsey	867	Nov. 5, 1893	Jany. 9, 1894
Roxy	9	Gr. Jersey	936	Aug. 10, 1893	Nov. 10, 1893
Clara	8	" "	.....	May 27, 1893	.....
Sully	10	" Shorthorn	1173	July 5, 1893	Nov. 19, 1893
Beckley	9	" Jersey	.....	July 10, 1893	Nov. 13, 1893
Mollie	2½	" Shorthorn	950	.....	Dec. 27, 1893
Pride	11	Jersey	748	May 2, 1893	Nov. 30, 1893
Nora	4	" -Guernsey	827	Aug. 15, 1893	Nov. 26, 1893
Jenny	6	Gr. Holstien	.....	Nov. 27, 1893	Jan. 17, 1894
Sweet Brier	10	Guernsey	1025	Oct. 28, 1893	Jan. 30, 1894
Rossie	6	Gr. Jersey	916	May 15, 1893	Dec. 15, 1893
Topsy	8	" Holstien	1030	Nov. 9, 1893	Dec. 28, 1893

The weight of the cows is the average of the weight of each on the 5th and 12th of February at the beginning of the experiment.

The composition of the bran, barley, corn, ensilage, timothy and prairie hay and percentage digestible of bran, barley and corn was obtained by analyses and experiments made by Prof. Harry Snyder. The co-efficients employed in calculating the amount digestible in timothy and prairie hay were taken from the Massachusetts State Experiment

TABLE XXIII.—Composition of Feed Stuffs Used.

	Percentage composition.						Lbs. digestible.			
	Water	Ash	Protein	Carbo hydrates	Fiber	Fat	Protien	Carbo hydrates	Fiber	Fat
Bran	10.40	5.95	15.38	52.87	10.25	5.05	11.55	34.89	3.38	3.63
Barley	11.78	.....	11.57	65.63	6.00	2.70	9.42	56.82	2.92	1.89
Corn	11.72	.....	11.25	69.40	2.28	3.88	10.11	65.16	1.11	3.01
Linseed meal	9.20	5.70	32.90	35.40	8.90	7.90	27.00	32.00	2.00	7.10
Timothy hay	12.32	4.58	6.53	44.57	28.83	3.17	3.17	28.97	16.14	1.81
Prairie hay	10.85	6.28	5.91	47.81	26.32	2.83	2.36	27.73	13.16	1.42
Ensilage	72.00	1.41	2.42	17.19	6.00	1,06	1.10	13.00	2.00	.70

Station Annual Report for 1893; using the co-efficient from "hay of mixed grasses low in nitrogen," for the prairie hay. For ensilage and linseed meal those used in the Annual Report of the Wisconsin Experiment Station for 1892 were employed.

FEED CONSUMED AND MILK AND BUTTER FAT PRODUCED BY LOTS 1 and 2.

The following tables give the amount of grain and hay eaten and pounds of milk and butter fat produced by each cow in Lots 1 and 2 during the four periods:

TABLE XXIV. Lot 1.

	Period I. Feb. 12—25.				Period II. Mch. 5—18.			
	Grain	Prairie hay	Milk	Fat	Grain	Timothy	Milk	Fat
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Bettie	196	194	117.8	7.52	196	140	124.0	7.72
Fancy	196	196	129.4	6.50	196	196	138.2	5.89
Gertie	196	195	223.6	11.67	196	196	213.8	10.33
Total	588	585	470.8	25.69	588	532	476.0	23.94

	Period III. Mch. 26—April 8.				Period IV. April 16—29.			
	Grain	Prairie hay	Milk	Fat	Grain	Timothy	Milk	Fat
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Bettie	196	196	129.9	8.61	196	181.5	133.5	9.11
Fancy	196	196	137.1	6.02	196	196	120.9	5.53
Gertie	196	196	214.1	10.70	196	182.5	207.8	10.64
Total	588	588	481.1	25.33	588	560	462.2	25.28

It will be observed that Bettie gained in Period II. 6.2 pounds of milk and .2 of a pound fat over that given by her during Period I. During Period III. she gained 5.9 pounds of milk and .89 of a pound of fat over Period II, and during Period IV. 3.6 pounds of milk and .5 of a pound of fat over Period III. In Period II. Fancy gained, while on timothy, 8.8 pounds of milk and lost .61 of a pound of fat as compared with Period I., while in Period III. on prairie hay she lost 1.1 pounds of milk and gained .13 of a pound of fat, and in Period IV, on timothy she lost 16.2 pounds of milk and .49 of a pound of fat. Gertie lost in yield of fat during both periods when fed on timothy, and regained a trifle when on praire hay in Period III.

TABLE XXV. Lot 2.

	Period I. Feb. 12—25.				Period II. Mch. 15—18.			
	Grain	Timothy	Milk	Fat	Grain	Prairie hay	Milk	Fat
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Houston	196	193	281.0	15.15	196	196	312.6	14.66
Roxy	196	196	213.9	10.38	196	196	221.4	11.04
Sully	196	196	238.2	11.25	196	996	257.8	11.06
	588	585	733.1	36.78	588	588	791.8	36.76

	Period III. Mch. 26—Apr. 8.				Period. IV. Apr. 16—29.			
	Grain	Timothy	Milk	Fat	Grain	Prairie hay	Milk	Fat
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Houston	196	196	299.3	14.83	196	196	295 4	15.02
Roxy	196	196	209.9	10.86	196	196	209.3	11.51
Sully	196	196	242.3	11.16	196	196	259.7	12.05
Total	588	588	764.4	36.85	538	588	764.4	38.58

In the above table is given the amount of grain and hay eaten and milk and fat produced by each cow during the four periods, and also the total pounds of feed eaten and milk and butter fat produced by Lot 2 during the four periods. During the first three periods there was scarcely any variation in the total amount of butter fat produced by the three cows. During the fourth period while the cows received prairie hay they gained 1.76 pounds fat.

With one exception Lot 2 ate all the feed given during the four periods, Houston on a single occasion refused to eat all the hay. The hay left was weighed and deducted, making the amount of hay consumed 193 pounds, being 3 pounds less than that eaten by the other cows in the group.

Comparing the yields of milk and butter fat during the first period with that of the fourth it will be seen that the cows gained both in yield of milk and of fat during the trial, showing that the cows were in excellent working condition and responded well to the care bestowed in feeding and milking.

SUMMARY OF RESULTS WITH LOTS 1 AND 2.

By adding the total amount of milk yielded by Lot 1 during Periods I. and III. and Lot 2 during Periods II. and IV. we find the number of pounds of milk and butter fat yielded when feeding prairie hay. The total amount of milk and butter fat produced by Lot 1. during Periods II. and IV., and by Lot 2 during Periods I. and III. gives the number of pounds of milk and fat yielded when feeding on timothy hay.

The following table gives the total quantity of grain, timothy hay and prairie hay eaten and milk and butter fat produced by Lots 1 and 2 during each of the four periods:

TABLE XXVI. Comparing Prairie Hay With Timothy for Milk and Butter Fat.

Timothy Hay.						Prairie Hay.					
		Grain	Timothy hay	Milk	Fat			Grain	Prairie hay	Milk	Fat
Lot	Period					Lot	Period				
1	II	588	532	476.0	23.94	1	I	588	585	470.8	25.69
1	IV	588	560	462.2	25.28	1	III	588	588	481.1	25.33
2	I	588	585	733.1	36.78	2	II	588	588	791.8	36.76
2	III	588	588	751.5	36.85	2	IV	588	588	764.4	38.58
		2352	2265	2422.8	122.85			2352	2349	2508.1	126.36

During the four periods the cows when fed on prairie hay consumed as much grain as they did when fed on timothy. Eliminating this common factor we have the following result:

2,265 pounds of *timothy hay* with grain produced 2,422.8 pounds of milk containing 122.85 pounds of fat.

2,349 pounds of *prairie hay* with a similar amount of grain produced 2,508.1 pounds of milk containing 126.36 pounds of fat.

During the periods when prairie hay was fed, the cows in Lots 1 and 2 produced 85.3 pounds more milk and 3.51 pounds more butter fat than they did during the periods when timothy hay was fed.

Applying the standard of values for the two kinds of hay adopted on page 39 of this report, being $5.60 per ton for timothy and $3.20 for prairie hay, it is found that the cost of the daily ration fed to Lot 1, during Periods I and III and to Lot 2, during Periods II and IV, when fed on grain and prairie hay, was 12.1 cents, and the cost of the daily ration fed to Lot 1 during Periods II and IV and to Lot 2 during Periods I and III, when fed on timothy hay, was 13.8 cents. During the 28 days when the cows were fed on grain and timothy hay they consumed $23.18 worth of feed and produced 2,422.8 pounds of milk and 122.85 pounds of butter fat; the milk costing 95 cents per hundred pounds and the butter fat 18.8 cents per pound.

During the 28 days when fed on grain and prairie hay, they consumed $20.33 worth of feed and produced 2,508.1 pounds of milk and 126.36 pounds of butter fat; the milk costing 81 cents per hundred pounds and the butter fat 16 cents per pound, being a difference of 14 cents per hundred pounds of milk and 2.8 cents per pound of butter fat, in favor of prairie hay.

FEED CONSUMED AND MILK AND BUTTER FAT PRODUCED BY LOTS 3 AND 4.

Twelve cows were in the experiment proper. Six, as we have seen, were fed a fundamental grain ration of 14 pounds each daily with 14 pounds of timothy or prairie hay, three receiving prairie hay and three timothy in alternation during the four periods. The other six were divided into two groups designated as Lot 3 and Lot 4, and received a fundamental ration of 12 lbs. of grain and ten pounds of ensilage with

11 lbs. of timothy or prairie hay, the hay being fed in alternation during the four periods the same as with Lots 1 and 2, mentioned above. While there is a slight variation in the amount of milk and fat produced by each cow during the four periods, the amount produced by each group shows remarkable uniformity and persistency in yield. Pride during the first period in February gave 210.7 lbs. of milk and 11.44 lbs. of butter fat and during the fourth period she gave 215.1 lbs. milk and 11.80 lbs. of fat showing that she gained both in flow of milk and in yield of fat during the experiment. By examining the records of the other cows in the group it will be seen that there was a gradual increase in the yield of butter fat as the experiment progressed. During the first period the three cows yielded 26.67 lbs. of fat while during the fourth period they produced 29.48 lbs. a gain of 2.81 lbs. fat. During Periods I and III when the cows were fed on grain, ensilage and prairie hay the yield of milk was 1,081.9 lbs. and butter fat 55.53 lbs; and during Periods II and IV when timothy was substituted they gave 1,123.1 lbs. of milk and 57.54 lbs. butter fat, being an excess of 41.2 lbs. of milk and 2.01 lbs. of fat when timothy hay was fed.

Results in feeding experiments with dairy cows are at best a mystery. There are so many things, other than feed, that will cause a change in the flow of milk and its fat content that it is very difficult to account, always, for such changes. With all the close attention and care that was bestowed upon the cows during the trial we failed to find the cause of the steady increase in yield of fat by Nora. Neither can it be explained why Molly should gain 23 pounds in milk in the second period when on timothy and not gain, but give less, in the fourth period when on timothy. In the second period she gave 180.9 pounds of milk, containing 7.57 pounds of fat, while in the fourth, 148.2 pounds contained 8.08 pounds of fat, a marked increase in the per cent of fat without any apparent cause.

The following tables give the number of pounds of grain, ensilage and hay eaten and the amount of milk and butter fat produced by each cow in Lots 3 and 4 during the four periods:

TABLE XXVII. Lot 3.

	Period I. Feby. 12—25.					Period II. March 5—18.				
	Grain	Ensilage	Prairie hay	Milk	Fat	Grain	Ensilage	Timothy	Milk	Fat
	lbs.	lbs.	lbs.			lbs.	lbs.	lbs.		
Mollie	168	140	152	157.6	7.39	168	140	154	180.9	7.57
Nora	165	140	148	150 1	7.84	168	140	154	166.3	8.30
Pride	168	140	154	210.7	11.44	168	140	154	246.1	12.19
Total	501	420	454	518.4	26.67	504	420	462	593.3	28.06
	Period III. Mch. 26—Apr. 8.					Period IV. Apr. 16—29.				
	Grain	Ensilage	Prairie hay	Milk	Fat	Grain	Ensilage	Timothy	Milk	Fat
	lbs.	lbs.	lbs.			lbs.	lbs.	lbs.		
Mollie	168	140	154	152.7	7.23	168	140	154	148.2	8.08
Nora	168	140	154	169.9	9.22	168	140	154	166 5	9.60
Pride	168	140	154	240.9	12.41	168	140	154	215.1	11.80
Total	504	420	462	563.5	28.86	504	420	462	529.8	29.48

TABLE XXVIII. LOT 4.

	Period I. Feb. 12—25.					Period II. Mch. 5—18.				
	Grain	Ensilage	Timothy	Milk	Fat	Grain	Ensilage	Prairie hay	Milk	Fat
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbr.	lbs.	lbs.	lbs.
Rossie	168	140	149	213.9	9.20	168	140	154	226.1	9.10
Sweet Briar	168	140	154	194.6	10.76	168	140	154	197.6	10.00
Topsy	168	140	151	306.5	12.82	168	140	154	325.9	13.02
Total	504	420	454	715.0	32.78	504	420	462	749.6	32.12
	Period III. Mch. 26—Apr. 8.					Period. IV. Apr. 16—29.				
	Grain	Ensilage	Timothy	Milk	Fat	Grain	Ensilage	Prairie hay	Milk	Fat
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Rossie	168	140	154	232-5	9.61	168	140	154	245.8	10.14
Sweet Briar	168	140	154	197.0	10.06	168	140	154	218.8	11.06
Topsy	168	140	154	279.7	11.32	168	140	154	290.2	11.89
Total	504	420	262	709.2	30.99	504	420	462	754.8	33.09

During period I Rossie in Lot 4 refused 5 lbs. of timothy, and Topsy refused 3 lbs of timothy which were weighed back. During the other periods all the grain, ensilage and hay offered was eaten. In yield of milk Rossie gained gradually during the experiment giving 213.9 lbs. in the first period and 245.8 in the fourth. In fat she lost .1 lb. in the second, gained .51 of a pound in the third and .53 of a pound in the fourth. Sweet Brier gave almost exactly the same amount of milk during the first three periods and in the fourth, on prairie hay, gained 21.8 lbs. Her variation in yield of butter fat was slight; losing .76 of a pound in the second period and gaining 1 lb. in the fourth, both on prairie hay. Topsy gained in milk and fat in the second while on prairie hay, lost in milk and fat, while in the third on timothy and gained in both milk and fat during the fourth on prairie hay. Comparing the yield of milk and fat during the first period with that of the fourth it will be seen that the lot gained both in milk and fat during the experiment giving 39.8 lbs. more milk and .31 of a pound more fat the last period than the first.

SUMMARY OF RESULTS WITH LOTS 3 AND 4.

Adding the yield of milk and butter fat of Lot 3 during Periods I and III with that of Lot 4 during Periods II and IV we find the number of pounds of milk and butter fat produced while fed on prairie hay. And adding the total amount of milk and fat produced by Lot 3 during Periods II. and IV., and by Lot 4 during Periods I. and III. gives the amount of milk and butter fat yielded by the cows when fed on timothy hay.

The following table gives the amount of grain, ensilage, timothy and prairie hay eaten and milk and butter fat produced by Lots 3 and 4, during each of the four periods:

TABLE XXIX--Comparing Prairie Hay with Timothy for Milk and Butter Fat.

Prairie Hay.

		Grain	Ensilage	Hay	Milk	Fat
Lot 3	Period I	501	420	454	518.4	26.67
" 3	" III	504	420	462	563.5	28.86
" 4	" II	504	420	462	749.6	32.12
" 4	" IV	504	420	462	754.8	33.09
		2013	1680	1840	2586.3	120.74

Timothy Hay.

		Grain	Ensilage	Hay	Milk	Fat
Lot 3	Period II	504	420	462	593.3	28.06
" 3	" IV	504	420	462	529.8	29.48
" 4	" I	504	420	454	715.0	32.78
" 4	" III	504	420	462	709.2	30.99
		2016	1680	1840	2547.3	121.31

The amount of grain, ensilage and hay eaten by the cows in Lots 3 and 4 was practically the same We have therefore the following result:

The cows fed on *prairie hay*, grain and ensilage produced during the experiment 2,586.3 lbs. of milk containing 120.74 lbs. of butter fat.

The cows fed on *timothy hay*, grain and ensilage produced 2,547.3 lbs. of milk containing 121.31 lbs. of butter fat. The difference being 39 lbs. of milk in favor of *prairie hay* and 5.7 of a pound of butter fat in favor of *timothy*.

During the periods when prairie hay was fed the cows in Lots 3 and 4 produced 39 lbs. more milk and .57 of a pound less butter fat than they did during the periods when timothy hay was fed.

Applying the standard of values for the two kinds of hay used in the first part of this report, being $5.60 per ton for timothy and $3.20 for prairie hay, the cost of the daily ration fed to Lot 3 during Periods I. and III. and to Lot 4 during Periods II. and IV. when fed on grain, ensilage and prairie hay was 11.1 cents. And the cost of the daily ration fed to Lot 3 during Periods II. and IV. and to Lot 4 during Periods I. and III. when fed on timothy hay was 12.4 cents.

During the 28 days when the cows were fed on grain, ensilage and prairie hay they consumed $18.64 worth of feed and produced 2,586.3 lbs. of milk and 120.74 lbs. of butter fat; the milk costing 72 cents per hundrek pounds and the butter fat 15.4 cent per pound.

During the periods when they were fed on grain, ensilage and timothy hay they consumed $20.83 worth of feed and produced 2,547.3 lbs. of milk and 121.31 lbs. of butter fat; the milk costing 81.7 cents per hundred lbs. and the butter fat 17.1 cents per pound, being a difference of 9.7 cents per hundred pounds of milk and 1.7 cents per pound of butter fat in favor of the ration when prairie hay was fed.

Taking the results of the four lots of cows we find that when timothy was fed the average cost of a hundred pounds of milk was 88.3 cents and the average cost of a pound of butter fat was 17.9 cents, and during the periods when prairie hay was fed the average cost of a hundred pounds of milk was 76.5 cents, and the cost of pound of butter fat was 15.7 cents, being 11.8 cents less per hundred pounds of milk and 2.2 cents less per pound of butter fat when prairie hay was fed.

GENERAL SUMMARY.

As the results of two experiments conducted with twelve cows comparing the nutritive value of timothy and prairie hay for milk and butter fat production we have the following testimony:

First: As between early cut and well cured timothy hay and fine well cured upland prairie hay, cows prefered the prairie hay.

Second: Prairie hay was at least equal to timothy for the production of milk and butter fat.

Third: At the present price of the two kinds of hay, milk was produced at thirteen per cent. less cost, and butter fat at twelve per cent. less cost when prairie hay was fed.

Fourth: With dairy cows fresh in milk in the fall or early winter, comfortably housed, well and regularly fed and milked, there will be little if any shrinkage in the flow of milk and yield of butter fat during the winter months.

DIGESTIBLE NUTRIENTS IN THE RATIONS.

In planning this experiment no note was taken as to the amount of the different nutrients contained in the rations selected. The kind and quantity of feed stuff was made up from a dairyman's standpoint and the amount of protein and carbohydrates and the nutritive ratio of the four rations used was not calculated until several months after the experiments closed. The remarkable results obtained in this experiment in regard to the uniform and persistent flow of milk and yield of butter fat during so long a trial, makes the nutritive ratio of the rations and the amount of protein, carbohydrates and fat they contained a matter of considerable interest.

The experiment commenced on the 12th of February and closed with the 29th day of April, being a period of 77 days. During the first period of the experiment commencing the 12th and closing the 25th of February the twelve cows gave 2,8628.2 lbs. of milk and 139.74 lbs. .butter fat and during the last period commencing the 16th of April and ending with the 29th of April they gave 2,922.6 lbs. of milk and 142.37 lbs. of butter fat being 60.4 lbs. more of milk and 2.63 lbs. more butter fat than they gave the first period.

In the following table is given the the dry organic matter and the digestable nutrients in the rations fed to lots 1 and 2; to lot 1 during periods I. and III. and to lot 2 during periods II. and IV.

TABLE XXX.—Digestible Nutrients in Ration when Grain and Prairie Hay were Fed.

Kind of Feed	Lbs of Feed	Dry Organic Matter	DIGESTIBLE			Digestible Nutrients Lbs	Nutritive ratio
			Protein	Carbohydrates	Fat		
Bran	6.17	5.53	.71	2.36	.22	3.29	
Barley	3.08	2.72	.29	1.84	.06	2.19	
Corn	3.08	2.72	.31	2.04	.09	2.44	
Linseed Meal	1.65	1.56	.45	.52	.12	1.09	
Prairie Hay	14.00	12.48	.33	5.72	.20	6.25	
Total	27.98	24.95	2.09	12.48	.69	15.26	1:6.7

The six cows in lots 1 and 2, during the periods when prairie hay was fed took 24.95 lbs. of dry matter containing

2.09 lbs. protein, 12.48 lbs. carbohydrates and .69 lbs. of fat making 15.26 lbs. digestible nutrients daily; during which periods they ate 2,563.68 lbs. of digestible dry matter. By referring to table XXVI. it will be seen that the cows in lot 1, periods I. and III. and lot 2, periods II. and IV. gave 2,508.1 lbs. of milk containing 126.36 lbs. of butter fat, which is equivalent to 97.83 lbs. of milk containing 4.92 lbs. of butter fat for every 100 lbs. of digestible nutrients.

In the following table is given the dry organic matter and the digestible nutrients in the rations fed to lots 1 and 2; to lot 1 during periods II. and IV. and to lot 2 during periods I. and III.

TABLE XXXI—Digestible Nutrients in Ration when Grain and Timothy Hay were Fed.

Kind of Feed	Lbs of Feed	Dry Organic Matter	DIGESTIBLE			Digestible Nutrients	Nutritive ratio
			Protein	Carbohydrates	Fat		
Bran	6.17	5.53	.71	2.36	.22	3.29	
Barley	3.08	2.72	.29	1.84	.06	2.19	
Corn	3.08	2 72	.31	2.04	.09	2.44	
Linseed Meal	1.65	1.50	.45	.52	.12	1.09	
Timothy Hay	14.00	12.28	.44	6.32	.25	7.01	
		24.75	2.20	13 08	.74	16.02	1:6.7

The six cows in lots 1 and 2 while on timothy hay ate 24.75 lbs. dry matter per day during the four periods containing 2.2 lb. protein, 13.08 lbs. carbohydrates, .74 of pound of fat. The total digestible nutrients taken by each cow per day was 16.02 lbs. Deducting the amount refused makes a total for the six cows during the two periods of 2,649.36 lbs. By referring to table XXVI. it will be seen that the cows in lots 1 and 2 while on timothy hay yielded 2,422.8 lbs. of milk and 122.85 lbs. of butter fat, which is equivalent to 91.50 lbs. of milk containing 4.63 lbs. of butter fat for every 100 lbs. digestible nutrients.

Summing the results of the two lots during the four periods we have the following:

	Milk produced per 100 lbs. of digestible matter	Fat produced per 100 lbs. of digestible matter
	Lbs.	Lbs.
With Grain and Prairie Hay	97.83	4.92
With Grain and Timothy Hay	91.50	4.63
In favor of Prairie Hay	6.33	.29
Per cent	6.9	6.2

Lots 3 and 4 were fed ensilage in addition to hay and grain. The results obtained by the cows in these lots are therefor considered seperately. The rations fed to lot 3 during periods I. and III. and to lot 4 during periods II. and IV. is given in the following table:

TABLE XXXII—Digestible Nutrients in Ration when Grain Ensilage and Prairie Hay were Fed.

Feed	Lbs Feed	Lbs Dry Matter	DIGESTIBLE			Total Digestible dry matter	Nutritive ratio
			Protein	Carbohydrates	Fat		
Bran	5.29	4.74	.61	2.02	.19	2.82	
Barley	2.64	2.33	.25	1.58	.05	1.88	
Corn	2.64	2.33	.27	1.75	.08	2.10	
Linseed Meal	1.41	1.28	.38	.45	.10	.93	
Prairie Hay	11.00	9.81	.26	4.50	.14	4.90	
Ensilage	10.00	2.80	.11	1.32	.07	1.50	
	32.98	23.29	1.88	11.62	.63	14.13	1:6.8

The six cows in lots 3 and 4 during the periods when prairie hay was fed received 23.29 lbs. of dry matter daily containing 1.88 lbs. protein, 11.62 lbs. carbohydrates and .63 of a pound of fat, making 14.13 lbs. digestible nutrients. During the four periods when on prairie hay they ate 2,373.-84 lbs. digestible dry matter, and produced 2,586.3 lbs. of milk containing 120.74 lbs. of butter fat which is equivalent to 108.95 lbs. of milk and 5.08 lbs. butter fat for every 100 lbs. digestible dry matter taken.

The ration fed to lots 3 and 4 during periods when timothy was fed, is given in the following table:

TABLE XXXIII.—Digestible Nutrients in Ration when Grain, Ensilage and Timothy Hay were Fed.

	Lbs Feed	Lbs Dry Matter	DIGESTIBLE			Total Digestible dry matter	Nutritive ratio
			Protein	Carbohydrates	Fat		
Bran	5.29	4.74	.61	2.02	.19	2.82	
Barley	2.64	2.33	.25	1.58	.05	1.88	
Corn	2.64	2.33	.27	1.75	.08	2.10	
Linseed Meal	1.41	1.28	.38	.45	.10	.93	
Timothy Hay	11.00	9.64	.35	4.96	.20	5.51	
Ensilage	10.00	2.80	.11	1.32	.07	1.50	
	32.98	23.12	1.97	12.08	.69	14.14	1:6.9

The six cows in lots 3 and 4 during the periods when timothy hay was fed received 23.12 lbs. of dry matter daily containing 1.97 lbs. protein, 12.08 lbs. of carbohydrates and .69 of a pound of fat making 14.74 pounds of digestible nutrients. During the periods when fed on timothy hay they ate 2,476.32 lbs. digestible nutrients and produced 2,547.3 lbs. of milk containing 121.31 lbs. of butter fat which is equivalent to 102.86 lbs. of milk containing 4.89 lbs. of butter fat for every 100 lbs. of digestible dry matter eaten.

Comparing the results obtained when the two groups were fed on prairie hay with that when fed on timothy hay we have the following:

	Milk produced per 100 lbs. digestible dry matter	Butter fat produced per 100 lbs. digestible dry matter
	Lbs	Lbs
With grain, ensilage and prairie hay	108.95	5,08
With grain, ensilage and timothy hay	102.86	4.89
In favor of Prairie Hay	6.09	.19
Per cent	5.9	3.9

While the results obtained with the two different groups of cows are not comparable for the reason that the last two groups received ensilage in addition to grain and hay, yet it is interesting to note that the cows receiving ensilage produced 11.24 pounds more milk and .21 of a pound more fat from 100 pounds digestible dry matter than was given by the cows in lots one and two, fed on grain and hay; also that the cows receiving ensilage had a ration having a nutrition ratio of 1:6.9, while groups one and two were fed on a ration having a nutrition ratio of 1:67.

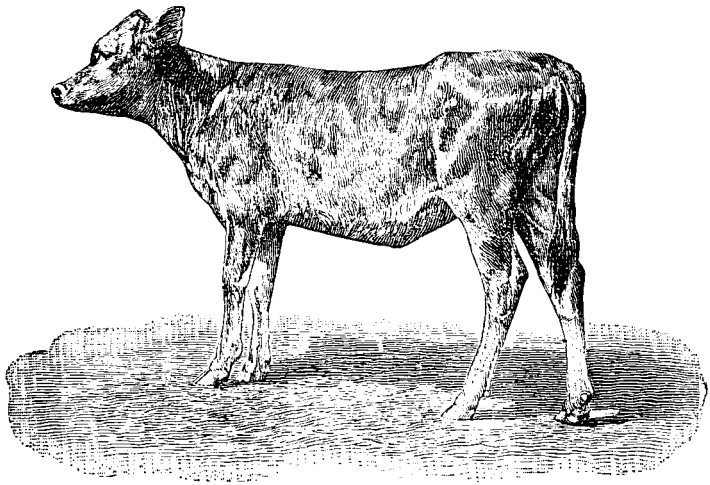
The fact that the cows in this trial maintained a uniform flow of milk and slightly increased the yield of fat during the progress of the experiment suggests that a ration of 1:69 gives satisfactory results.

RAISING DAIRY BRED CALVES.

T. L. HÆCKER.

Minnesota is destined to become one of the greatest dairy states in the Union, and since the dairy industry can be developed only in proportion to the increase of the number of cows, the rearing of calves for the dairy is a matter of vital importance. In all that vast territory north and west of the twin cities, there are but few localities within a radius of four miles where there are enough cows to warrant the organization of a co-operative creamery or cheese factory association. In such an extent of country where there is a demand for cows in nearly every neighborhood, the attempt to supply this demand by purchase is out of the question and our only remedy is to breed and rear the calves and in this way the demand for dairy stock can be gradually supplied. It is therefore to the interest of farmers of Minnesota to breed their cows to dairy sires and rear the heifer calves. The importance of having stock intended for the dairy produced by dairy sires is forcibly illustrated in another part of this bulletin, where it is shown by actual experiment with twenty-three cows, on a years' trial, that the dairy bred cows produced on an average 337 pounds of butter fat at a cost of 11.6 cents per pound, while the cows having a tendency to convert feed into beef on practically the same ration gave, on an average, only 267 pounds of butter fat, costing 13.8 cents per pound. There are now and then good dairy animals produced by sires belonging to beef or general-purpose breeds, but they are exceptional cases. The great majority of the offspring will be a failure in the dairy.

The calves reared in this trial were all of the dairy type and with three exceptions converted all of their feed into growth. The object of the experiment was to compare



No. 6. YOUNG HOUSTON.

the cost of raising calves on whole milk and on skim milk supplemented with a feed of flax seed meal—ground flax, and to note the thriftiness of the calves raised on the two kinds of feed. This experiment was undertaken after fifteen years' experience in raising dairy calves as a business and therefore not without certain settled convictions as to the best methods of procedure.

The calf was allowed to suckle the dam once and in some instances twice. It was then taken from the dam and one feeding period allowed to pass without offering the calf any milk. The object in doing this was to get the calf to drink readily without the finger. During the first week the calf was fed twice a day as much of the dam's milk as was considered sufficient to keep it in a thrifty condition. To insure uniform feeding the milk was weighed as soon as drawn from the cow and given to the calf at once. During the second week the feed was half whole milk from the dam and half fresh separator skim milk. The third week, if in a thrifty condition, it received separator skim milk with a table-spoonful of ground flax. If a little delicate it received one-third whole and two-thirds skim milk. The ration of skim milk and ground flax seed was gradually increased according to the growth of the calf.

Nine calves were in the trial, one was fed on whole milk during a period of 61 days while eight were changed to skim milk as indicated above.

TABLE XXXVI.—Record of Calf No. 1.

Period of Four Weeks.	FEED. Milk				Cost for period	Weight	Gain in weight	Average daily gain	Cost of 1 lb. gain
	Lbs.				$	Lbs.	Lbs.	Lbs.	Cts.
First	364				3.64	115	30	1.07	12.15
Second	504				5.04	190	75	2.68	6.71
*Third	520				5.20	245	55	1.96	10.20
Total	1388				13.88	245	160		
Average								1.96	9.69

*Last period only three weeks and five days.

The time is divided into periods of four weeks each. During the first, second and third week of the first period the calf received 12 pounds of milk daily and during the fourth week it received 16 pounds of milk each day. During four weeks it took 364 pounds of whole milk and gained thirty pounds in growth, being an average daily gain in weight of 1.07 pounds; each pound of gain costing 12.15 cents, estimating milk at $1 per 100 pounds. During the first week of the second period it received sixteen pounds of milk daily, during the second and third week eighteen pounds, and during the fourth week twenty pounds. During the four weeks it received 504 pounds of milk and gained 75 pounds, being an average daily gain of 2.68 pounds, at a cost of 6.71 cents per pound. During the third period which covered only twenty-six days, it received twenty pounds of milk daily, gained 55 pounds at a cost of 10.2 cents per pound; the average daily gain being 1.96 pounds.

The total amount of whole milk taken was 1,388 pounds, total gain 160 pounds and the average cost per pound gain was 9.69 cents. The calf consumed $13.88 worth of milk and was then sold for veal bringing $7.20, being a loss of $6.68.

During a year's trial, in which every cow in the station herd was included, it was found that the average cost for producing a hundred pounds of milk was 61 cents. Applying this cost to the amount of milk taken by the calf instead of the value of a hundred pounds of milk, we find that the calf took $9.79 worth of milk leaving a net loss of $2.40.

TABLE XXXVII. Record of Calf No. 2.

Period of four weeks	Feed					Cost for period	Weight	Gain in weight	Average daily gain	Cost of 1 lb. gain
	Milk	Skim milk	Flax meal	Oats	Hay					
	lbs.	lbs.	lbs.	lbs.	lbs.	$	lbs.	lbs.	lbs.	cents
First	88	310	1.96			1.40	103	43	1.53	3.27
Second		462	4.41			.81	127	24	.86	3.36
Third		504	8.26	21	42	1.27	160	33	1.18	3.84
Total	88	1276	14.63	21	42	3.48	160	100		
Averaga									1.19	3.49

Calf No. 2 was a full blood Jersey. During the first two days it received 10 pounds whole milk daily. During the other five days it received 8 pounds whole milk and 4 pounds skim milk. During the first two days of the second week it received 4 pounds of whole milk and 8 pounds of skim milk daily and during the balance of the week it received 4 pounds whole milk and 10 pounds skim milk. During the second and third weeks it received 16 pounds of skim milk per day and 1 pound of flax seed meal per week. It gained 43 pounds in weight during the period, being an average daily gain of 1.53 pounds at a cost of 3.27 cents per pound of gain. During the second period it received 462 pounds of skim milk, 4.41 pounds of flax seed meal, gained 24 pounds in weight being an average daily gain of .86 of a pound at a cost of 3.36 cents per pound of gain. During the third period it received 504 pounds of skim milk, 8.26 pounds of flax seed meal, gaining 1.18 pounds per day at a cost 3.84 cents per pound. The total gain during the three periods was 100 pounds, being an average daily gain of 1.19 pounds. The total cost for feed during the 84 days was $3.49.

TABLE XXXVIII.—Record of Calf No. 3.

Period of four weeks.	Feed.				Cost for period	Weight	Gain in weight	Average daily gain	Cost of 1 lb. gain
	Milk.	Skim milk.	Flax seed.	Oats.					
	lbs.	lbs.	lbs.	lbs.		lbs.	lbs.	lbs.	cents
First	126	182	.98		1.49	.95	40	1.43	3.72
Second		462	5.53	1.40	.85	127	32	1.14	2.66
Third		462	6.72	4.62	.90	163	36	1.18	2.51
Fourth		448	7.70	7.28	.90	207	44	1.57	2.04
Fifth		448	5.88	11.90	.93	234	27	.96	3.46
Total	126	2002	26.81	25.20	5.07	234	179		
Average								1.28	2.88

Calf No. 3 was a cross bred Jersey-shorthorn. It was changed gradually from whole milk to skim milk. During the first week it received eight pounds whole milk per day, during the second six pounds whole milk and six pounds skim milk, during the third week four pounds whole milk and eight pounds skim milk, and during the fourth week it received twelve pounds skim milk per day. The gain in weight during the first period of four weeks was 48 pounds, being an average gain of 1.43 pounds per day at a cost of 3.72 cents per pound. During the first two weeks of the second period it received sixteen pounds of skim milk daily and from .17 to .20 of a pound of flax seed and during the third week it received daily sixteen pounds skim milk and .20 of a pound of flax seed meal, and during the fourth week eighteen pounds skim milk and .2 pounds flax seed meal. During the second period it received 462 pounds skim milk, 5.53 pounds flax seed and 1.4 pounds of whole oats, gaining during the four weeks 32 pounds, at a cost of 2.04 cents per pound. During the third period the milk was gradually increased to 18 pounds and the flax meal to .25 of a pound, aggregating during the period 462 pounds skim milk, 6.72 pounds ground flax and 4.62 pounds oats, the calf averaging a daily gain of 1.28 pounds at a cost of 2.51 cents per pound. During the fourth period it received 448 pounds of milk, 7.70 pounds flax meal and 7.28 pounds oats, making a gain of 44 pounds

at a cost of 2.04 cents per pound. During the fifth period the ground flax was decreased to 5.88 pounds and the oats increased to 11.9 pounds and it gained only 27 pounds at a cost of 3.46 cents per pound. During this period it had an attack of scours brought about possibly by feeding too much flax meal. This calf made good growth and laied on some flesh. With a single exception it made a greater average gain than the other calves fed on skim milk, and the cost of growth was only 2.88 cents per pound.

TABLE XXXIX—Record of Calf No. 4.

Period of Four Weeks.	FEED.				Cost for Period	Weight	Gain in Weight	Average daily gain	Cost of 1 lb. gain
	Milk	Skim milk	Flax Seed meal	Oats					
	Lbs.	Lbs.	Lbs.	Lbs.	$	Lbs.	Lbs.	Lbs.	Cts.
First	84	252	2.17		1.20	105	33	1.18	3.63
Second		462	5.88	2.45	.87	127	22	.78	3.98
Third		462	7.00	5.11	.91	157	30	1.07	3.04
Fourth		448	7.98	8.54	.95	189	32	1.14	2.97
Fifth		448	4.20	12.25	.89	205	16	.57	5.58
Total	84	2072	27.23	28.35	4.82	205	133		
Average								.95	3.84

Calf No. 4 was a grade Guernsey. During the first week it received 8 pounds of whole milk daily, during the second week 4 pounds of whole milk and 8 pounds of skim milk, during the third week 12 pounds skim milk and during the fourth week 16 pounds, aggregating during the first period 84 pounds whole and 252 pounds skim milk, and 2.17 pounds ground flax, and it gained 33 pounds in weight at a cost of 3.68 cents per pound. During the second period it received 462 pounds of skim milk, 5.88 pounds ground flax and gained 22 pounds, costing 3.98 cents per pound of gain. During the third period with the same amount of skim milk and a slight increase in the meal it gained 30 pounds at a cost of 3 cents per pound while during the fourth period it gained only 16 pounds at a cost of a trifle over 5.5 cents per pound of gain. The calf during the second and fifth periods

had an attack of scours which accounts for the small gain made. The cost of growth during the twenty weeks was 25 cents less than calf No. 3, but the cost per pound of growth was about one cent more.

TABLE XL. Record of Calf No. 5.

Period of Four Weeks.	Feed.				Cost for period	Weight	Gain in weight	Average daily gain	Cost of 1 lb. gain
	Milk	Skim milk	Flax seed	Oats					
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
First	112	252	2.17	.....	1.48	115	30	1.07	4.94
Second	.....	462	5.88	2.45	.87	144	29	1.03	3.02
Third	.....	462	7.00	5.11	.90	165	21	.75	4.33
Fourth	.....	448	7.98	8.54	.95	203	38	1.36	2.49
Fifth	.....	448	4.20	12.25	.89	235	32	1.14	2.79
Total	112	2072	27.23	28.35	5.10	235	150	.....	.....
Average	.....	.....	.....	.....	.....	.....	.....	1.07	3-51

Calf No. 5 was a grade Holstein and was fed the same as No. 3 with the exception that it received 12 pounds of whole milk the first week. It made moderate growth during the twenty weeks of the trial except a few days during the third period when digestion was impaired by feeding the milk at too low a temperature. The calf was fat when it was dropped and continued to lay on flesh during the experiment. It was heavy in shoulders and full in thighs.

TABLE XLI---Record of Calf No. 6.

Period of Four Weeks.	FEED.				Cost for period	Weight	Gain in Weight	Average daily gain	Cost of 1 lb. gain
	Milk	Skim milk	Flax Seed meal	Oats					
	Lbs.	Lbs.	Lbs.	Lbs.	$	Lbs.	Lbs.	Lbs.	Cts.
First	182	168	.98	.....	2.10	110	45	1.60	4.79
Second	.....	448	5.53	.....	.81	145	35	1.25	2.31
Third	.....	476	6.72	4.62	.92	160	15	.54	6.08
Fourth	.....	462	7.70	6.30	.94	196	36	1.29	2.61
Fifth	.....	448	7.84	11.20	.96	231	35	1.25	2.74
Sixth	.....	448	1.96	14.70	.85	257	26	.93	3.26
Total	182	2450	30.73	36.82	6.58	257	192	.....	.....
Average	.....	.....	.....	.....	.....	.....	.....	1.14	3.47

Calf No. 6 was a cross-bred Jersey-Guernsey. It was a model in form from a dairy standpoint, being spare; deep through the middle and flank, light in the fore quarters and unusually large in hind quarters. To show the condition of the calf at the close of the experiment and its conformation, an illustration is given at the head of this article Its dam is Houston, see page 61 of this bulletin. The calf made rapid growth during the experiment except in the third period when its was checked by taking too much skim milk during the second week. During the first, it received 10 pounds whole milk, during the second week 12 pounds and during the third 4 pounds whole milk and 8 pounds skim milk. During the remainder of the trial it received 16 pounds skim milk daily except in the first and second week of the third period when it received 18 pounds daily which proved a little too much. It received ground flax and oats the same as did the other calves in the trial. During the six periods the feed cost on an average $1.10 for a period being a trifle over 25 cents per week. It gained on an average 1.14 pounds per day at a cost of 3.47 cents per pound of growth.

TABLE XLII.—Record of Calf No 7.

Period of Four Weeks	Feed					Cost of period	Weight	Grain in weight	Average daily gain	Cost of 1 lb. gain
	Milk	Skim milk	Flax seed	Bran	Oats					
	lbs.	lbs.	lbs.	lbs.	lbs.	$	lbs.	lbs.	lbs.	lbs.
First	154	196	1.68	....	.....	1.87	131	49	1.75	3.82
Second	112	280	.....	.....	.....	1.54	197	66	2.34	2.35
Third	.....	490	.....	.....	.....	.78	250	53	1.89	1.48
Fourth	.....	546	.....	10.5	.....	.96	330	80	2.86	1.20
Fifth	.....	560	.....	14	.....	1.01	390	60	2.14	1.68
Sixth	.....	560	.....	.....	14	1.16	420	30	1.07	3.87
Total	266	2632	1.68	24.5	14	$7.32	420	338	.....	.....
Average	.....	.....	.....	.....	.....	.....	.....	.....	2.01	2.40

Calf No. 7 was a full blood Holestein-Friesian, it was large and in good condition when it was dropped. was a

hearty feeder and showed strong digestive powers. During the first week it received 12 pounds of milk daily, during the second 10 pounds of whole milk and 4 pounds of skim milk, and during the third and fourth 12 pounds of skim milk and some flax meal. During the period of four weeks it gained 49 pounds, being an average daily gain of 1¾ pounds at a cost of 3.82 cents per pound. During the second period it received 4 pounds whole milk and 10 pounds skim milk daily and gained 66 pounds, being an average daily gain of 2.34 pounds at a cost of 2.35 per pound. During this period it gained in flesh and to prevent this in the third period no whole milk was given. It made an average gain of 1.89 pounds per day at an average cost of a trifle less than 1.5 cents per day. The fourth period it received 546 pounds of skim milk and 10.5 pounds of bran and an equal amount of corn meal gaining 80 pounds at a cost of 1.2 cents per pound. The average gain during the six periods was a trifle over 2 pounds per day at an average cost of 2.4 cent per pound.

TABLE XLIII.—Record of Calf No. 8.

Period of Four Weeks	Feed					Cost for period	Weight	Gain in weight	Average daily gain	Cost of 1 lb. gain
	Milk	Skim milk	Flax meal	Bran	Corn meal					
	lbs.	lbs.	lbs.	lbs.	lbs.	$	lbs	lbs.	lbs.	cents
First	98	238	.84			1.36	100	40	1.41	3.44
Second		350	4.13			.64	127	27	.96	2.37
Third		350				.53	154	27	.96	1.96
Fourth		504				.81	195	41	1.46	1.98
Fifth		560		14	14	1.02	240	45	1.61	2.26
Sixth		560		10.5	10.5	.97	270	30	1.07	3.23
Total	98	2562	4.97	24.5	24.5	5.33	270	210		
Average									1.25	2.54

Calf No. 8 was a full blood Jersey. During the first week it received 10 pounds of whole milk daily, but not being weighed this week is not included in the above record. During the second week, which is the first week it was in

the experiment, it received 8 pounds of whole milk and 4 pounds of skim milk with the usual amount of flax seed meal. It made rapid growth and laid on some flesh. During the second period it received 350 pounds of skim milk and 4.13 pounds of ground flax. It still continued to lay on flesh so the ground flax was discontinued in the third and fourth periods. It made excellent growth during the eighth week gaining 68 pounds at an average cost of 1.97 cents per pound. The average daily gain during the trial was 1¼ pounds per day at a trifle over 2.5 cents per pound.

TABLE XLIV.—Record of Calf No. 9.

Period of Four Weeks	Feed					Cost for period	Weight	Gain in weight	Average daily gain	Cost of 1 lb. gain
	Milk	Skim milk	Oats	Hay	Bran					
	lbs.	lbs.	lbs.	lbs.	lbs.	$	lbs.	lbs.	lbs.	lbs.
First	98	182				1.30	120	48	1.71	2.71
Second		504				.76	150	30	1.07	2.53
Third		504	28			1.01	190	40	1.41	2.56
Fourth		564	21	14	3.5	1.00	220	30	1.07	3.34
Fifth		182		98	38.5	1.14	240	20	.71	5.73
Sixth				168	56	1.34	265	25	.89	5.37
Total	98	1876	49	280	98.0	6.55	265	193		
Average									1.14	3.71

Calf No. 9 was out of grade shorthorn cow by a Jersey sire. In conformation it resembled the sire, and showed little, if any, tendency to lay on flesh. During the first period it received 98 pounds of whole milk, 182 pounds of skim milk and 1.68 pounds of ground flax and gained 1.71 pounds per day at a cost of 2.71 per pound. During the fifth and sixth periods it received in addition to the feed stuffs recorded in the table, 50 pounds of corn meal and 44 pounds of linseed meal which is included in the cost for feed. The calf made satisfactory growth except in the last two periods, when the skim milk was gradually withdrawn. During the time when no skim milk was fed the average cost of a pound of gain was 5.5 cents. The

cost of a pound of growth when whole milk was fed was 9.69 cents, while the average cost of a pound of growth of the calves fed on skim milk and ground flax was 3.23 cents.

The following table gives a general summary of results:

TABLE XLV.—Summary.

	Days in trial	Cost	Weight	Gain in weight	Average daily gain	Cost of 1 lb. gain
		$	lbs.	lbs.	lbs.	cents
Calf No. 1	61	13.88	245	160	1.90	9.69
" " 2	84	3.48	160	100	1.19	3.49
" " 3	140	5.07	234	179	1.28	2.88
" " 4	140	4.82	205	133	.95	3.84
" " 5	140	5.10	235	150	1.07	3.51
" " 6	168	6.58	257	192	1.14	3.47
" " 7	168	7.32	420	338	2.01	2.40
" " 8	168	5.33	270	210	1.25	2.54
" " 9	168	6.55	265	193	1.14	3.71
Average for calves fed on skim milk					1.25	3.23

The flax seed meal was analyzed with following results:

Water 6.11 per cent; dry matter 93.89 per cent. Composition of dry matter:

Ash.....4.03	Ether extract.....40.56
Crude Proetin....23.12	Crude Fiber..... 8.02
Nitrogen free ex.....24.27	

While the experiment was fairly satisfactory as to the general growth of the calves, the details in feeding were not as carefully carried out as the importance of the word required. It is therefore being repeated with a view of obtaining more accurate data, though it can hardly be expected that our efforts will result in growing a finer lot of calves.

CO-OPERATIVE CREAMERIES.

T. L. HÆCKER.

The great interest that has been awakened in the minds of farmers of Minnesota on the subject of diversified farming brings so many letters making inquiry as to best methods of organizing co-operative creamery associations that it is found impracticable to answer them all in detail by letter. It is therefore thought best to offer such suggestions and give such information as will place this industry on a firm basis. That intelligent dairying is a profitable business needs no argument; demonstrated results are more convincing than words; the results in Freeborn and Steele counties have settled this question for all time so far as our state is concerned. It should, however, be remembered that there are creameries and cheese factories idle in Minnesota, which is also conclusive proof that such enterprises are not always a success, and that the causes of such failures should be considered. After a thorough canvass of the state it was found that about half of the vacant factories are in localities where there are not a sufficient number of cows; others failed because they were owned by individuals who did not pay enough for cream to make it an object for the farmers to patronize them. As a rule the gathered cream plan, where old methods of setting milk were used, did not give satisfactory returns to farmers; but whenever separator creameries have been established on the co-operative plan, in localities where there are a sufficient number of cows within a radius of four miles, they have in every instance secured highly satisfactory results. Therefore when considering the advisability of starting a creamery in any locality, the first thing to do is to ascertain if the required number of cows can be secured within a radius of four or five miles, which is about as far as milk can profitably be hauled. If less than four hundred cows are secured we would advise that the project be dropped, as it is difficult to make it a success with less.

ORGANIZATION.

If the required number of cows can be pledged within the limits prescribed the next thing is the organization. In this matter as in most all other enterprises it is well to follow the course pursued by the successful creameries. One of the chief agencies of success in the Freeborn county creameries is their method of organization. They do their own oganizing and have nothing whatever to do with agents who are going through the country offering to work up a creamery company in any neighborhood, soliciting the stock and getting out the articles of incorporation, building the creamery and equipping it and turning it over to an association of farmers at a given price. This of course seems like a very nice way, as it relieves the members of the creamery association of all the preliminary work in the organization of the creamery, but it is expensive as outside parties can not do it so cheaply and effectively as it can be done by the farmers living in the neighborhood. In the long run it is not to the interest of supply houses to do this part of the work, for in every case where these ready built and equipped creameries have been turned over to the farmers they soon discovered that they paid from $500 to $2,000 more for the plant than it was worth, which creates dissatisfaction with the house they dealt with and it loses their trade.

HOW TO RAISE THE MONEY.

The old plan of providing funds for building creameries was for each patron to take one or more shares of stock, paying the cash for them. In many communities it has been found difficult to raise the money under this plan, as many desirable patrons were unable to raise the amount of cash required to build and equip a creamery.

To overcome this difficulty let each patron of the proposed creamery sign an agreement drawn after the form given below marked "Organization Agreement," signing his name, and the number of cows he will agree to furnish milk from, to the creamery.

You will notice this agreement provides for borrowing the amount of money necessary to build the creamery, and

that each person signing the agreement, agrees to be responsible for the payment of the sum borrowed. There is hardly a community in the state in which some one cannot be found who would be willing to loan $2,000, more or less, to an association of twenty-five, or fifty, or more, farmers, each one of whom agrees to be personally responsible for the loan.

When the required number of patrons and cows have been secured, call a meeting of the patrons and perfect the organization by adopting and signing articles of agreement. We give below articles af agreement and by laws, which are in use by the Freeborn county creameries, and have been found to be very satisfactory. Of course such changes could be made in these as might be desired. It will be noticed that article two of the by laws, provides that five cents on each one hundred pounds of milk received at the creamery shall be retained to form a sinking fund, to be used to pay off the money borrowed. And, that article four of the agreement authorizes the Board of Directors to borrow the sum required, the loan to be paid back out of the sinking fund as fast as it is accumulated.

This plan enables the creamery association to start without the individual patrons being required to raise the cash, and at the same time it gives the creamery the ready cash to buy their lumber, materials and machinery, so as to obtain the benefit of the lowest cash prices.

The five cents per hundred pounds that is deducted from the amount of milk taken to the creamery is not felt by the patrons, as even after this is taken out they will get more out of their milk than they have been getting by making it into butter themselves, so that the creamery is gradually paying for itself, without expense to the patrons.

Under this plan, a creamery that is receiving milk from five hundred cows should be getting ten thousand pounds of milk a day, if five cents per hundred of this went into the sinking fund, it would be five dollars a day; so that it would require from a year to a year and a half to pay off the loan, and have the creamery clear under this plan, on a creamery receiving the amount of milk stated above.

The following agreement of organization, articles of association and by laws are used by the Freeborn county creameries:

ORGANIZATION AGREEMENT.

We, the undersigned citizens of .....county, state of Minnesota, do hereby agree to form ourselves into an Association to be known by the name of the .....Association, and we agree to borrow the sum of ..... dollars, or less, to put up a building and equip it with the necessary machinery, and jointly, to become personally responsible for the sum borrowed including interest. The money to be raised in the manner agreed upon by the Association. We also agree to furnish the milk from the number of cows opposite our names.

NAME. COWS.

ARTICLES OF AGREEMENT OF THE.....ASSOCIATION.

We, whoss names are hereunto subscribed, and whose residences are within the county of ..... in the state of Minnesota, do hereby associate ourselves together as a co-operative association under the laws of the state of Minnesota, and have adopted the following constitution, viz:—

ARTICLE I.

The name of the Association shall be the ..... Assoeiation and its place of business shall be at or near Section ..... in the Town of ..... in said..... county.

ARTICLE II.

The object of this Association shall be the manufacture of butter or cheese or both from whole milk, at actual cost.

ARTICLE III.

The officers of this Association shall be a President, Vice-President, Secretary, Treasurer and three Trustees, who shall be elected annually at the regular annual meeting of the Association to be held on the first Monday of January of each year and their term of office shall be one year and until their successor shall have been duly elected and qualified.

ARTICLE IV.

The duties of the respective officers shall be as follows:—The President shall preside at all meetings of the Association, sign all drafts and pay over to the Treasurer all moneys which shall have come into his possession by virtue of his official position, taking the treasurer's receipts therefor.

He shall have power to call special meetings of the Association whenever in his judgment the business of the Association shall require it.

The Vice President shall perform the duties of the President when he is absent or otherwise unable to attend to them.

The Secretary shall keep a record of all the meetings of the Association, and make and sign all orders upon the Treasurer.

The Treasurer shall receive and receipt for all moneys belonging to the Association and pay out the same only upon orders which shall be signed by the Secretary; he shall give bonds in such amount as the Association shall provide.

The President, Vice President, Secretary and Treasurer and three Trustees shall constitute a Board of Directors, whose duties shall be to audit and allow all just claims against the Association. They shall compute the amount of milk receipts, the amount of product sold and the moneys received therefor, and, after deducting from the total receipts the percentage herein provided for as a sinking fund and also the running expenses, on the 20th day of each month, divide the remaining receipts of the preceding month among the members and patrons of the Association, proportionally to the amount of whole milk or fat furnished by each. Provided, however, that in case of the withdrawal of any member from this Association before the moneys herein provided to be borrowed shall have been paid in full, principal and interest, all product from milk furnished by such withdrawing members then on hand, and any moneys received from such product then in the possession of the Association shall be retained until all such moneys so borrowed shall have been fully repaid, and thereafter said moneys, or any remainder thereof after applying the just share of such withdrawing members therefrom to the repayment of any balance of such indebtedness not paid from the sinking fund, shall be paid over to him or his assigns.

The Board of Directors shall cause the Secretary to make, in writing a report to the annual meeting to the Association, setting forth in detail the gross amount of milk receipts, the net amount of receipts from product sold and all other receipts, the amount paid out for running expenses, the sums, if any, paid out for milk, and all other matters pertaining to the business of the Association. A like statement, containing the gross amount of milk receipts, the net receipts from product sold and all running expenses of the creamery shall be made and posted conspicuously in the creamery building at the time of the division of the prior month's receipts as aforesaid.

The Board of Directors shall borrow a sum of money not exceeding .... Thousand Dollars, to be used by them in the erection, completion and furnishing of the creamery building and for no other purpose. Said members of said board may borrow said money on their individual responsibility, and in case they shall do so, then the sinking fund herein provided for shall by them be applied in payment of such borrowed moneys as the same fall due in the same manner as though said moneys had been borrowed by the Association. Said members of the board in

such case shall be held to be the creditors of the Association to the amount of such moneys unpaid, and the several members of said Association shall be personally responsible, jointly and severally, for the same. Provided, however, that prior to any legal assertion of such individual responsibility, the entire sinking fund then accrued and on hand shall be applied upon such indebtedness: And, provided further, that said members so borrowing said moneys may if they so elect, demand and receive any part or all of the moneys received from product sold, then in the possession of the Association, upon such indebtedness before enforcing such personal responsibility. In which case only that part of such indebtedness remaining after applying thereon all sums so received shall be recovered or demanded from the members of the Association.

ARTICLE V.

The several members shall furnish all the milk from all the cows subscribed by each, all milk to be sound, fresh, unadulterated, pure and unskimmed, and patrons of the Association not members, may by agreement with the Board of Trustees furnish such amounts of milk as may be agreed upon. The Association shall receive all such milk so furnished, manufacture the same into butter, cheese or both and sell and receive all moneys from the product; and from the moneys so received deduct such a percentage thereof, or such a number of cents per one hundred pounds of milk as shall have been agreed upon by the Association in the by-laws or otherwise, and also deduct the running expenses of the creamery, the remainder thereof to be distributed as provided in Article IV. hereof.

ARTICLE VI.

Each member shall be entitled to one vote only at any meeting of the Association. New members may be admitted as provided in the By-laws. Members shall be permitted to withdraw only as provided in the By-laws.

ARTICLE VII.

The first officers and Board of Trustees shall be as follows: ..... President; .....Vice President; ..... Secretary; .....Treasurer; .... Trustees.

ARTICLE VIII.

The constitution may be amended at any annual meeting, or at any special meeting called for that purpose, provided that two-thirds of all members present vote in favor of such change; and provided further, that at least one month's notice of such proposed amendment shall have been given in such manner as may be provided in the By-laws, or otherwise by the Associations.

NAMES.

BY-LAWS OF THE.....ASSOCIATION.

I.

The Treasurer shall give bonds in the sum of.....dollars the bond to be approved by the Board of Directors.

II.

Five cents on each one hundred pounds of milk received at the creamery shall be reserved to form a sinking fund.

III.

No milk shall be received or business of any kind transacted at the creamery on Sundays.

IV.

During the interval between the twentieth day of May and the twentieth day of September of each season all milk shall be delivered at the creamery as early at least as nine o'clock a.m.; during the remaining portion of the season as early as ten o'clock a.m.

V.

All milk delivered shall be sweet and in good condition; if any be found otherwise, the operator may condemn the same, and in such case he shall notify the President thereof. The operator shall test the milk of each member and patron at least three times a week.

VI.

Any member or patron of the Association found skimming, watering or in any manner adulterating his milk offered at the creamery shall forfeit to the Association as follows: For the first offense ten dollars; for the second offense, twenty-five dollars; for the third offense he or she shall forfeit all interest in the Association and also all claims for milk theretofore delivered to the Association. But no such forfeiture shall be adjudged without first affording to the member or patron charged with having so skimmed, watered or adulterated his milk, full opportunity to defend himself from such charge. Any member sending to the creamery any bloody or unhealthy milk, or any milk from any cow within four days after calving, shall, if convicted of having so done knowingly, forfeit as prescribed above in this section.

VII.

Members and patrons furnishing whole milk may take from the separator or the tank at the creamery four-fifths of the quantity of milk (in

pounds or quantity) delivered at the creamery by them on that day. Any member taking therefrom more than such amount shall forfeit to the Association the sum of five dollars for each such taking.

VIII.

Withdrawals from the Association shall be allowed only as follows:— The member desiring to withdraw shall give at least one month's notice of his application therefor. Such application shall only be allowed on a vote of two-thirds of all members present and voting at any meeting for hearing at which such application shall have been noticed. Provided, however:— That any member living more than three miles by the nearest road from the creamery building, may make application to the Board of Directors, who in their discretion may grant permission to such member to withdraw from the Association.

IX.

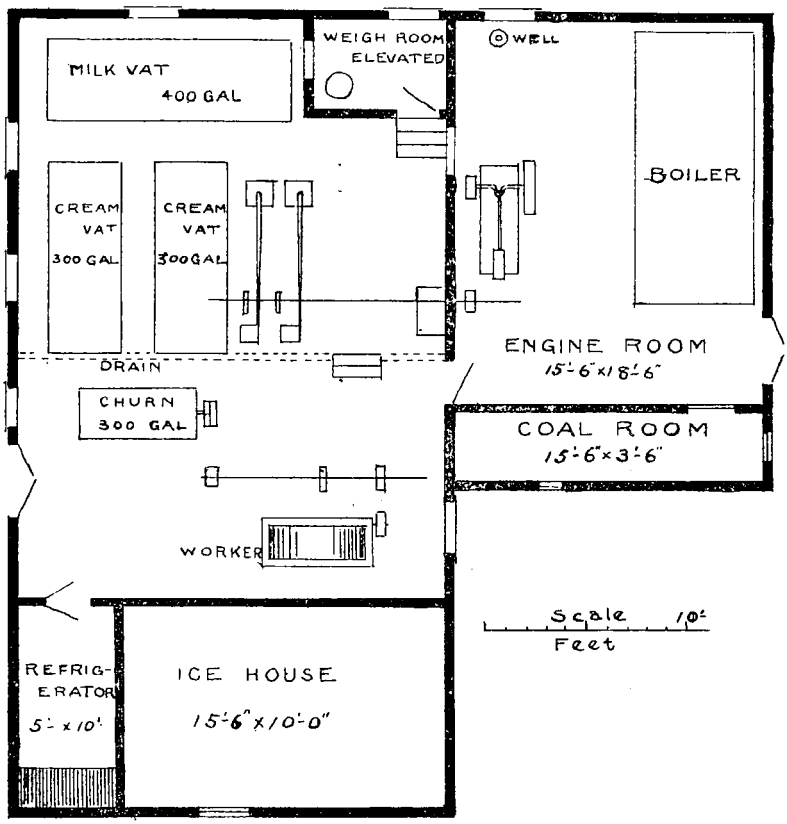
Any member refusing to deliver at the creamery the milk agreed to be there delivered, shall, without reasons satisfactory therefor to the Association, forfeit all interest in the product on hand.

X.

Notice of any proposed amendment to the Constitution shall be in writing or printing and shall be kept posted prominently in the creamery building and also on the walls of the delivery department for the reception of milk.

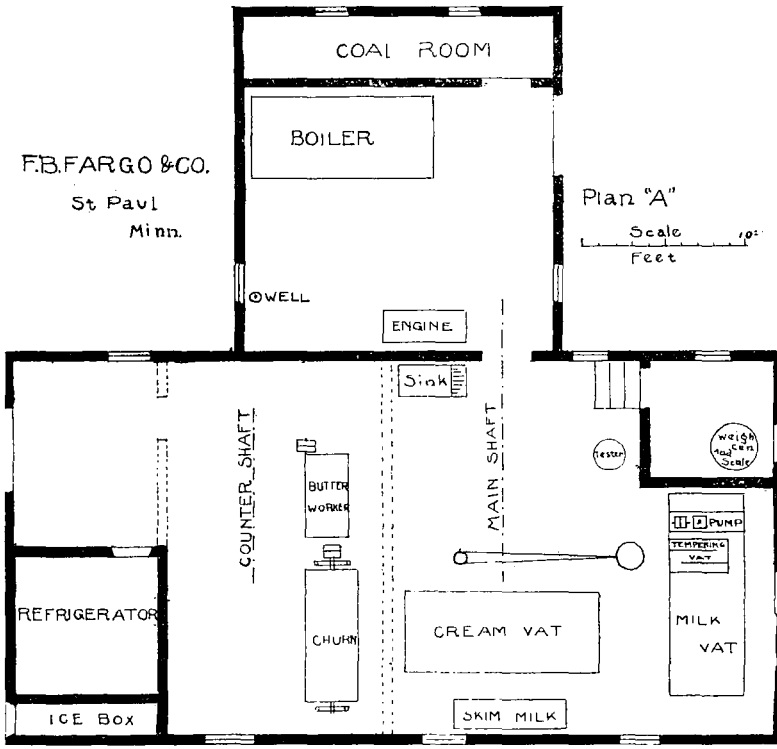
THE CREAMERY BUILDING

After the organization of a creamery association the universal inquiry is: "What kind of a building is it necessary to construct and can you furnish us plans for same?" In order that we may be able to intelligently answer these inquiries we requested the creamery supply houses in the state to furnish us with a plan of a model creamery building; in reply to this request two of the firms have kindly responded and the plans are given below.



GROUND PLAN OF CREAMERY
CREAMERY PACKAGE MFG. CO.
MANKATO MINN.

Plan No. 1, which is furnished by the Creamery Package Company, of Mankato, provides for a creamery 20x38 with an engine and boiler and coal room 16x22 and will cost from $600 to $800 according to location and if stone and lumber is brought to the creamery site by the members of the association. The equipments of the creamery will cost from $1500 to $2000 according to the number of separators.



Plan No. 2.

Plan No. 2 is furnished by F. B. Fargo & Co., of St Paul. The building is 44 feet long by 22 feet wide and 12 feet to the ceiling. Boiler, coal and engine room on side of building 20x 20 feet, equipped with separator capacity of 20,000 lbs. of milk daily, and all other machinery with capacity of 20,000 lbs. milk daily or butter capacity of 800 lbs. daily.

ESTIMATE OF COST.

Foundation (mason, brick and cement)	$ 60 00
Lumber (delivered on ground)	570 00
Hardware	35 00
Carpenter work	175 00
Grading for drive way (estimate level ground)	20 00
Painting	40 00
Machinery, including all steam and water pipe and fitting, and all belting as per usual lists of one separator outfit	1,500 00
Freight on same (estimate 100 miles)	50 00
Drayage (in town)	10 00
Machinest to set up all machines (estimate 10 days)	30 00
Brick, lime and cement to set boiler and engine in boiler room	115 00
Mason work to set boiler and engine	35 00
Extra labor handling boiler and engine	10 00
Iron roof for boiler room	20 00
Butter milk tank and drain	20 00
Waste water drain (estimate 10 rods)	10 00
Galvanized iron for ice box in refrigerator and ice box	20 00
Radiating steam pipe put in place sufficient to heat entire building	85 00
Incidental expenses	75 00
	$2,880 00

The above estimate does not include well, but it includes pump and pipe.

The farmers in the neighborhood of Geneva, Freeborn county have what they consider a model creamery. It has two good separators and is in every respect equipped with the best apparatus and cost $2,800 when ready for receiving milk. There will be many new creameries built the coming season and it is of great importance that farmers inform themselves as to the size and kind of building best adapted for their purpose as well as to what the necessary cost will be.

MANUFACTURE OF SWEET CURD CHEESE.

T. L. HÆCKER.

One of the objects of the Division of Dairy Husbandry is to develop new avenues for this industry. Noting the great demand in the larger cities in the state for some foreign brands of cheese at highly remunerative prices it was deemed of sufficient interest to offer instruction in the manufacture of a few of the most popular kinds at the Minnesota Dairy School. The plan received the hearty approval of the regents of the university and Hon. John Luchsinger of Monroe, Wis., was engaged to take charge of the manufacture of Emmenthaler, brick and Limburger, and J. H. Hecker of Neenah, Wis., to give instruction in the manufacture of Gouda and Edam cheese. During the entire work a careful record was kept of the amount of milk used, the per cent of fat and other solids contained in the milk and the amount of green cheese obtained. Some difficulty was experienced in securing the apparatus necessary for the work and also in properly curing the cheese. The Dairy Hall is not supplied with curing rooms where either the temperature or moisture is under control to the extent that is necessary for best results. Notwithstanding these unfavorable conditions the cheese manufactured under the supervision of the instructors were uniformly of good quality and received high commendation from those best qualified to pass upon their merits. The result obtained seem to warrant a continuation of the work and the publication of the process of their manufacture with tables showing the composition of the milk and whey, the loss of fat and other solids in the whey and the relation existing between the per cent fat in the milk and the yield of green cheese. The milk and whey of each make was examined by chemical analysis

and from the data thus obtained the recovery of solids in the cheese was calculated. No effort was made to ascertain the composition of the cured cheese by actual analysis for the reason that the want of sufficient space and accommodations in the curing room made it impracticable to keep each day's make separate. The process of dressing, also, in all but two instances, rendered it impossible to ascertain the exact amount of cured cheese obtained from a hundred pounds of milk. From the two exceptions noted it was found that the shrinkage which takes place during the process of curing is much greater than is generally supposed. In one case it was twenty-five and in another twenty-six per cent. The cheese from these two makes were salted in brine five days, at a temperature of 70 degrees Fahrenheit, and cured in a room held at a temperature of sixty degrees. The moisture in the air of the room ranged from 75 to 90 per cent of total saturation. These are as favorable conditions as can be reached ordinarily and the loss of weight may reasonably be expected to be as great as shown in these two trials.

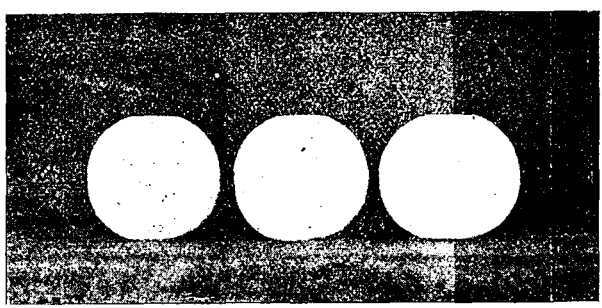


Fig. 1. Form of Edam Cheese.

The quality, size, form and general appearance of Edam cheese is a matter of considerable importance. Goods faultless in these respects will sell in our markets at top prices, while an article excellent in quality but undersized and defective in form will be shaded from two to three dollars per dozen. The term quality here, does not mean that the cheese must be made from milk containing a high percentage

of fat; but has reference to salt, flavor and texture. It is therefore of the utmost importance that the milk should be fresh, clean and pertectly sweet.

METHOD OF MANUFACTURING EDAM CHEESE.

Edam cheese is made from warm milk fresh from the cow, though sometimes it is made by mixing the evening's milk, after it is skimmed, with the morning's milk. If the evening's milk is used it must be set over night in ice water to hold in check the process of ripening. In the morning it is skimmed and warmed to 86 degrees Fahrenheit, and then the morning's milk is added. The mixed milk should be at a temperature of 86 degrees Fahrenheit, when the rennet is put in. If whole milk is used it is generally raised to 90 degrees before adding the rennet. In winter it is set at a little higher temperature. When the milk is warmed to the temperature desired, color is added at the rate of one or one and a half ounces of color to one thousand pounds of milk. We used from one and a half to two ounces of Hansen's cheese color to a thousand pounds, but this gave too high a color in the opinion of some who use and handle the best grade of imported Edam. Color should be thoroughly incorporated with the milk before rennet is added. It is not possible to state the exact amount of rennet that should be used as it varies in strength, but enough should be taken so the milk will commence to coagulate in five to seven minutes and should be ready for the knife in from fifteen to twenty minutes. We used from eight to ten ounces of Hansen's rennet extract per thousand pounds of milk. Dilute the rennet with about five times its volume of tepid water and in pouring it into the milk, pass over the whole length of the vat so that the rennet will not all be put in one end. Stir the milk with a large inverted dipper by moving it slowly through the milk the whole length of the vat so as not to give the milk a tide motion. Stir about one minute, then set the dipper on the surface of the milk a moment to check the agitation, then cover the vat until the curd is ready to

cut. To ascertain this insert the index finger into the milk at an angle of 45 degrees, with the thumb slightly break the curd laying over it, gently raise the finger and if the curd breaks clean leaving but few or no flakes it is ready to cut. A little practice will soon teach one when the curd cuts to best advantage. It should not be so firm that it will cut hard, neither should it be cut when it is too soft, as this occasions great loss of solids in the whey, yet the general tendency of the curd should be towards softness. The American curd knife is recommended as its use occasions less loss of fat and other solids. First cut with the horizontal knife lengthwise with the vat, then follow with the vertical knife as soon as the whey begins to appear between the layers of curd. Cut lengthwise of the vat with the vertical knife, then cut cross wise and lengthwise until the curd is cut into pieces the size of wheat kernels. The particles of curd adhering to the sides and bottom of the vat are now carefully rubbed loose.

After cutting, the curd should be allowed to settle a few moments ; stir gently for five minutes then apply heat, gradually raising the temperature to 98, though sometimes when the curd has not been cut finely or uniformly it is necessary to raise it to 102 deg. Fahrenheit. The curd is sufficiently cooked when it is firm and elastic, when the larger particles of curd are not soft and contain no free whey inside. It is difficult to give a full description of all the conditions bearing upon this part of the work; there should, however, be no unnecessary delay in getting the curd under pressure as the ripening process at this stage of the work is very rapid. When the curd is sufficiently firm it is allowed to settle, when the whey is drawn off until the upper surface of the curd begins to appear.

FILLING THE EDAM MOLDS.

Before the molds are filled they should be put in warm water so the curd will not be cooled during the process of filling. As soon as the whey is drawn fill the molds at once by taking a double handful of curd and pressing gently but firmly into the mold; as the filling progresses pour the whey out of the mold. Care should be taken to put the same

quantity into each mold to make the cheese perfectly spherical and of uniform size when pressed.

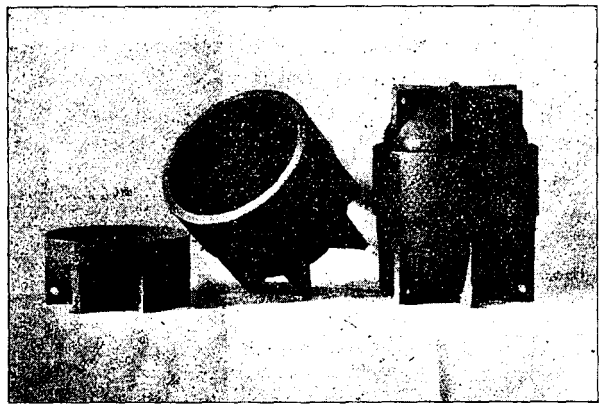


Fig. 2. Edam Molds.

The molds used at this Station are of cast iron, the pattern being made from an imported cheese of proper form. Figure 1 gives an illustration of some of the cheese made in these molds. The photograph was taken before they were dressed, so it gives the form of the cheese when first taken from the mold. They have a flattened surface on each end so they will set on the shelf without rolling. When the molds are filled, put under gentle, continued pressure for a sufficient length of time to make the cheese firm enough to retain its form while it is being dressed, which may require from fifteen to sixty minutes, according to condition of curd. When they are ready to dress set the molds containing the cheese into a vat of sweet whey or water at a temperature between 120 and 130 degrees Fahrenheit. Let stand for a minute before moving from the mold. Then take the cheese out place it in the warm water for one or two minutes then wrap a linen cloth around it, folding the edges carefully over on each side forming small pleats at regular intervals; put a linen cap on each end, replace in mold and put under pressure. The cloths and caps must be thoroughly soaked in the warm whey or water before applying to the cheese and care should be exercised that no part of the cheese remains un-

covered and that in returning it to the mold the bandage does not get displaced. If from any cause the curd seems to be tainted, washing in water at a temperature of 100 degrees Fahrenheit, before putting it in the mold will assist in freeing it from taint. Edam cheese does not require as much pressure as cheddar, 60 to 120 pounds will under ordinary conditions be sufficient. They should remain under pressure from six to twelve hours though no harm will be done if they are not taken out until the day following.

SALTING AND CURING.

When the cheese is taken from the press the molds are set in water at a temperature of 120 degrees Fahrenheit and allowed to stand for a few minutes. The cheese is then taken out and the bandage carefully removed, using care not to tear off any of the rind. The cheese is now ready for salting and for this, two methods may be employed, dry or wet salting. In dry salting it is necessary to have six salting molds to every press mold, these are made of wood, are quite similar in form to the press molds but require no cover. The inner surface of the salting mold is completely covered with a coating of salt, the cheese is then placed in the mold with a little sprinkling of salt on the upper part exposed to the air. This is repeated for five or six days turning them each day so they will settle into the proper shape.

If iron molds of the Minnesota Dairy School pattern are used, wet salting will be preferable, the cheese will have the proper form when taken out of the press, thus requiring less labor. In wet salting the cheese is placed in a tank of brine as strong as it can be made, a little salt is sprinkled on the upper end exposed to the air. The cheese should be turned each day and left in the brine five to eight days. The temperature of the brine may range from 60 to 70 degrees. Surface salting makes it exceedingly difficult to obtain uniformity, some day's make will take salt more readily than others, owing to the variation in the percentage of moisture in the curd. It is therefore especially important that the milk worked is fresh and that the cutting and cooking be as uniform as possible. When the cheese is sufficiently salted it is taken out of the brine and placed on a board to drain, for

twenty-four hours. It is then washed in warm water wiped dry and placed on the shelf for curing, leaving a little space between the cheese. Always set the cheese on the flattened end, turn and rub with the hand each day the first month, twice a week the second month and once a week the third month. The curing room should be cool and moist, the temperature should be held between 55 and 65 degrees, and there should be no sudden changes even within the temperatures given. Fresh air is also of prime importance though strong currents should not be allowed to come in contact with the cheese as it will cause cracking. If the air in a curing room becomes foul the cheese will become slimy or pasty and injurious fungi will soon develop. It the room is too damp bluish-yellow or red spots will appear which injure the quality of the goods and in extreme cases render it worthless.

PREPARING EDAM CHEESE FOR MARKET.

When the cheese is two or three months old it is prepared for market by turning it in a lathe until it is smooth and round, then colored with analine. The dye is made by dissolving a little analine or carmine in alcohol or ammonia. Take a two or three gallon jar, fill two-thirds full of water and add enough of the coloring matter to secure the desired shade. In this bath put the cheese for a minute or two then place on a shelf to dry and when dry give a light coating of boiled linseed oil. When in the coloring bath the cheese can be conveniently graded; the solid cheese will drop to the bottom, these are good keepers and belong to the best grade; those more open and of poorer quality will barely sink, while the ones that float are inferior goods. Cheese for export are wrapped with tinfoil in much the same way as in dressing; they are placed in boxes, each containing twelve cheese, in two layers of six each, the cheese being partitioned off with narrow boards.

The milk used in these experiments from Feb. 7th to the 15th was purchased from dealers and that used from the 19th of February to the 9th of May was from the station herd. That used during the latter period was not the mixed milk of the whole herd, but each make of cheese was from a

certain number, though not always the same cows, which accounts for the variation in the per cent of fat in the milk. The milk worked on the 7th of March, the 3rd, 5th and 7th of April and the 8th and 9th of May was two thirds whole and one-third skim milk. On and after the 10th of February fresh rennet extract was used, which will account for the change which took place as to the time of coagulation with the rennet test. The table is submitted simply to show the process of the make each day. There are a number of points which suggest further experiments and, if possible, more careful work. In Mann's acid test 50cc is the amount of milk used with one-tenth normal standard alkali. Comparing the figures in the fourth column with those in the fifth and taking those into account the temperature of the milk, it appears that the degree of acidity of the milk and the degree of the ripeness do not always run parallel. The degree of ripeness was ascertained by Monrad's modification of Harris' rennet test, as by this method more exact data can be obtained. It consists in diluting the rennet extract by putting 5cc (cubic centimeters) of rennet extract with a pipette into a flask measuring 5cc. then filling with cool water. Of this diluted rennet 5 cc. is added to 160 cc. of milk in a tin cup, at 86 degrees Fahr., the exact time elapsing between putting in the diluted rennet and when the milk commences to coagulate, indicates its degree of ripeness. In these experiments the aim was to have the milk in the vat commence to coagulate in seven minutes, excepting one vat on the 20th of February.

The morning's milk used the 3rd of April was tainted, so it was bailed occasionally for about an hour and a half and there being no improvement it was raised to a temperature of 158 degrees, then immediately cooled to 86 degrees, and some of Hansen's lactic ferment added, allowed to stand until evening, when the rennet test showed 20 sec., only 2 1-10 extract per 1,000 lbs. of milk was used; coagulation commenced in five minutes and it was ready for the knife in ten.

Comparing the time required until coagulation commences with that when ready for the knife the latter time will be found double the former. There in more regularity in

the figures indicating when coagulation commenced than in the time required for the curd to form sufficiently for cutting; this may be due to the fact that it is impossible to fix upon a uniform degree of firmness of the curd. By comparing the figures showing the amount of alkali required to neutralize the acidity in the milk with that required for the whey, it will be seen that the acidity in the whey was some 40 per cent less than in the milk.

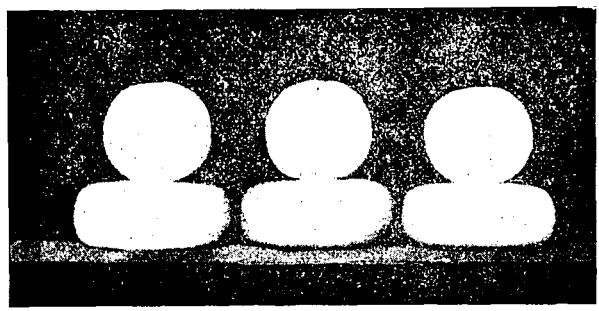


Fig. 3. Comparative Size of Edam and Gouda Cheese.

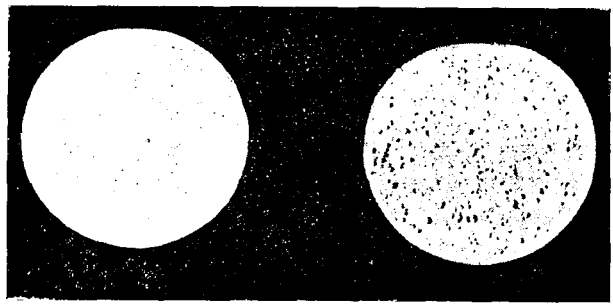


Fig. 4. Sectional view of Edam cheese made from good milk.

Fig. 5. Sectional view of Edam cheese made from tainted milk.

TABLE XLVI.—Processes and Principal Conditions in the Manufacture of Edam Cheese.

Date.	Lbs. of milk in vat.	Per cent fat in milk.	Amount of alkali necessary to neutralize acidity of milk.	Rennet test for ripeness.	Temp. of milk when test was taken.	Amount of extract used per 1000 pounds of milk.	Time required until coagulation begins.	Time required until ready for knife.	Temp. to which curd was heated.	Time required to cook the curd.	Amount of alkali necessary to neutralize acidity of whey.	Time from adding rennet to putting to press.	Weight of green cheese.	Lbs. of milk to 1 lb. of cheese.
1894			c.c.	secs.		ozs.	mins.	mins.		mins.	cc.	mins.		
Feb. 7	235.25	4.9	14	140	88°	15.6	7	16	94°	41	8.7	110	31	7.58
" 8	238.50	4.8	14	180	88°	8.9	7	20	95°	29	8.7	115	31.83	7.61
" 9	233.75	5.0	14.5	100	88°	11.6	6.5	18	100°	17	9.2	86	30.75	7.60
" 10	121	5.2	13	70	87°	11.0	5	17	96°	46	.....	92	16.87	7.17
" 14	156	4.7	13.5	85	88°	11.10	6	22	99°	64	.....	117	22	7.09
" 15	223.75	4.8	.....	70	89°	11.0	5	13	99°	65	8	90	31.12	7.12
" 19	115	4.9	13.5	60	94°	9.0	5	13	100°	34	8.3	79	16.12	7.13
" 20	50	5.1	.....	75	88°	3.0	15	35	101°	38	7.6	102	7.25	6.89
" 20	50	5.1	.....	75	88°	9.0	6.5	16	100°	43	7.6	84	7	7.14
" 28	83.5	4.7	12.4	85	88°	8.2	6	18	100°	48	7.6	91	11	7.60
Mch. 3	64	4.4	13	75	90°	8.9	7	13	100°	31	7.8	72	8.62	7.54
" 5	60	5.0	13	60	90°	7.1	7	15	100°	38	7.8	75	8.5	7.05
" 6	60	4	11.6	90	86°	10.6	7	15	96°	39	7.4	81	7.5	8.00
" 7	50	3	13	90	84°	10.6	6	14	96°	22	7.6	59	5.5	9.09
" 8	60	4.5	12.4	60	90°	7.1	6	13	100°	21	7.4	66	7.5	8.00
" 9	60	3.5	12.4	60	90°	7.1	5	10	100°	35	7.4	72	7	8.57
" 10	60	4.5	13.2	60	90°	7.1	6.5	13	100°	25	7.6	60	8.25	7.27
" 21	60	4.7	12.4	60	90°	7.1	6	15	102°	24	6.6	54	7.78	7.71
" 22	60	4.7	12	70	90°	8.4	6.5	14	100°	33	7	69	7.78	7.71
" 31	90	3.35	12.2	65	90°	7.7	6	12	96°	24	7	65	10.7	8.41
Apr. 3	90	.....	20	20	86°	2.1	5	10	96°	.....	.....	47	8.8	10.22
" 5	90	3.3	14	60	86°	7.1	7	14	86°	38	8	77	10.8	8.33
" 7	90	3-1	12.2	70	86°	8.3	6.5	12.6	96°	26	7	67	10.6	8.49
May 8	140	2.5	12.2	70	88°	8.3	6.5	14	98°	40	7.2	97	14.3	9.70
" 9	165	2.6	12.6	75	88°	8.8	7	15	98°	40	7.2	99	16.5	10.00

TABLE XLVII.—Analysis of Milk, Whey and Edam Cheese.

Date		Percentage composition		From 100 lbs. milk.		
		Solids	Fat	Lbs.	Solids	Fat
Feb. 7	Milk	13.65	4.9	100.00	13.65	4.90
	Whey	6.75	.41	86.82	5.86	36
	Gr. cheese	59.10	34.48	13.18	7.79	4.54
Feb. 8	Milk	13.82	4.8	100 00	13.82	4.80
	Whey	7.11	.57	86.88	6.18	.50
	Gr. cheese	58.24	32.81	13.12	7.64	4.30
Feb. 9	Milk	13.69	5.0	100.00	13.69	5.00
	Whey	6.93	.5	86.84	5.92	.43
	Gr. cheese	58.31	34.70	13.16	7.77	4.57
Feb. 10	Milk	14.17	5.2	100.00	14.17	5.20
	Whey	7.30	.79	86.06	6.28	.68
	Gr. cheese	56.61	32.42	13.94	7.89	4.52
Feb. 12	Milk	.....	.....	.....	.....	.....
	Whey	.....	.....	.....	.....	.....
	Gr. cheese	.....	.....	.....	.....	.....
Feb. 14	Milk	13.65	4.7	100.00	13.65	4.70
	Whey	7.20	.58	85.90	6.18	.50
	Gr. cheese	52.91	29.77	14.10	7.47	4.20
Feb. 15	Milk	14.02	4.8	100.00	14.02	4.80
	Whey	7 28	.54	86.09	6.27	.46
	Gr. cheese	55.75	31.17	13.91	7.75	4.34
Feb. 19	Milk	14.00	4 9	100.00	14.00	4.90
	Whey	7.00	.59	85.98	6.02	.51
	Gr. cheese	56.94	31.39	14.02	7.98	4.39
Feb. 20.	Milk	14.10	5.1	100.00	14.10	5.10
	Whey	7.15	.72	86.00	6.15	.62
	Gr. cheese	56.86	32.00	14.00	7.95	4.48
Feb. 20	Milk	14.10	5.1	100.00	14.10	5.10
	Whey	7.35	.82	85.50	6.28	.70
	Gr. cheese	53.93	30.34	14.50	7.82	4.40
Feb. 28	Milk	13.24	4.7	100.00	13.24	4.70
	Whey	6.95	.50	86.83	6.02	.43
	Gr. cheese	54.73	32.36	13.17	7.22	4.27
March 3	Milk	13.93	4.4	100.00	13.93	4.40
	Whey	7.24	.45	86.53	6.26	.39
	Gr. cheese	56.96	29.81	13.47	7.67	4.01
March 5	Milk	13,99	5.	100.00	13.99	5.00
	Whey	7.48	.58	85.83	6.42	.50
	Gr. cheese	53,41	31.76	14.17	7.57	4.50
March 6	Milk	12.78	4.	100.00	12.78	4.00
	Whey	7.31	.51	87.50	6.40	.45
	Gr. cheese	51.07	28 40	12.50	6.38	3.55
March 7	Milk	10.84	3.	100.00	10.84	3.00
	Whey	6.36	.34	89.00	5.66	.30
	Gr. cheese	47.09	24.55	11.00	5.18	2.70
March 8	Milk	13.13	4.5	100.00	13.13	4.50
	Whey	6.98	.52	87.50	6.11	.46
	Gr. cheese	56.27	32.40	12.50	7.02	4.04
March 9	Milk	12.28	3.5	100.00	12.28	3.50
	Whey	7.30	.70	88.33	6.45	.62
	Gr. cheese	50.00	24.71	11.67	5.83	2.88
March 10	Milk	12.30	4.5	100.00	12.30	4.50
	Whey	7.20	.73	86.25	6.21	.63
	Gr. cheese	44.24	28.12	13.75	6.09	3.87
March 21	Milk	13.59	4.7	100.00	13.59	4.70
	Whey	7.53	1.0	87.03	6.55	.87
	Gr. cheese	54.24	29.56	12.97	7.04	3.83
March 22	Milk	13.24	4.7	100.00	13.24	4.70
	Whey	7.44	.88	87.03	6.48	.77
	Gr. cheese	54.76	29.82	12.97	6.76	3.93

TABLE XLVIII.—Analysis of Milk, Whey and Edam Cheese.

Date		Percentage Composition. Solids	Water	Fat	Solids not fat	Ash	Protein	Lactose
March 31	Milk	12.30	87.70	3.35	8.95	.73	3.30	4.90
	Whey	7.04	92.96	.67	6.37	.42	.84	5.05
	Gr Cheese	51.31	48.69	23.21	28.10	3.02	21.49	3.83
Apr. 5	Milk	12.68	87.32	3.43	9.25	.70	3.57	4.91
	Whey	6.83	93.17	.44	6.39	.44	.96	5.05
	Gr Cheese	55.56	44.44	25.37	30.19	2.59	22.69	3.79
Apr. 7	Milk	12.32	87.68	3.15	9.17	.76	3.68	4.80
	Whey	6.87	93.13	.46	6.41	.36	.93	5.05
	Gr Cheese	53.20	46 80	23.30	29.90	3.68	24.24	2.92

Date		From 100 lbs. of Milk. Pounds	Solids	Water	Fat	Solids not fat	Ash	Protein	Lactose
March 31	Milk	100.00	12.30	87.70	3.35	8.95	.73	3.30	4.90
	Whey	88.11	6.10	81.91	.59	5.61	.37	.74	4.45
	Gr Cheese	11.89	6.20	5.79	2.76	3.34	.36	2.56	.45
April 5	Milk	100.00	12.68	87.32	3.43	9.25	.70	3.57	4.91
	Whey	88.00	6.01	81.99	.39	5.63	.39	.85	4.45
	Gr Cheese	12.00	6.67	5.33	3.04	3.62	.31	2.72	.46
April 7	Milk	100.00	12.32	87.68	3.15	9.17	.76	3.68	4.80
	Whey	88.22	6.06	82.16	.41	5.65	.32	.82	4.46
	Gr Cheese	11.78	6.26	5.52	2.74	3.52	.44	2.86	.34

METHOD OF MANUFACTURING GOUDA CHEESE.

For a number of years there have been numerous inquiries as to the best method of manufacturing cheese in the home dairy. The answers to these inquiries have uniformly been a lengthy description of the cheddar process, which is not at all adapted to home work. By this process a whole day is required, even when a single cheese is made. What the isolated farmer needs is a short process which requires a small outlay only, for apparatus. After a careful study of the methods employed in the manufacture of the numerous foreign brands, the Gouda has been selected as the one best adapted for the home dairy. First, the milk is worked warm, fresh from the cow; second, it requires less than two hours to do the work; third, the cheese can be cured in a cellar or in any damp, cool place; fourth, it is a good keeper; fifth, it is nutritious and palatable.

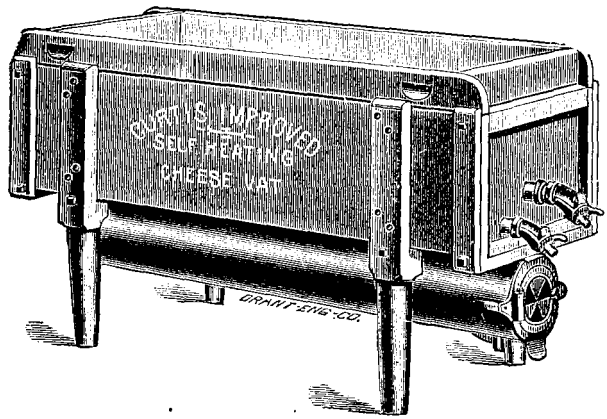


Fig. 6. Self Heating Cheese Vat.

Gouda cheese is largely manufactured in Southern Holland where climatic conditions are very different from those which exist in the northwest. We are subject to greater and more sudden changes in temperature and a drier atmosphere. It is therefore evident that the control of temperature and moisture must be provided for. In Holland the cheese is similar in form to the American cheddar, except that the upper and lower edges are rounded. They ordinarily weigh from eight to sixteen pounds. The cheese made in

the Minnesota Dairy School and in these experiments weighed from seven to eight pounds and are better adapted for family use.

Gouda is a sweet curd cheese made from whole milk fresh from the cow, preferably before it cools below 88 degrees. To prevent cooling it is better to strain at once into a wooden vat lined with tin or copper which prevents rapid cooling; or into a small self heating vat. If color is used one dram to 150 pounds of milk will give about the proper shade. The temperature of the milk, when the rennet is added, should be from 88 to 90 degrees. Enough rennet should be used to make the curd ready for the knife in fifteen to twenty minutes. This will require from seven to twelve ounces of rennet to 1000 pounds of milk, according to the strength of the rennet. To ascertain when it is ready to cut insert the finger in the milk at an angle of 45 degrees until the thumb touches the milk, gently raise the finger and if the curd breaks clean across it leaving but few or no flakes, it is ready. A little practice will soon teach one when the curd cuts to best advantage. It should not become so firm that it will cut hard by gathering in front of the knife or swaying off to one side, as this causes uneven cutting. Neither should it be cut when it is too soft, as this occasions great loss of curd in the whey; yet the general tendency of the curd should be toward softness. To insure even cooking, cut fine—about the size of peas. Stir gently for about five minutes, then apply more heat until the curd reaches 102 to 104 degrees F.; this should require from 20 to 30 minutes. The curd should be stirred during the whole process, and when ready for the mold it should be quite firm and make a squeaky noise when chewed.

FILLING THE GOUDA MOLDS.

Now let the whey run off or dip it out, then fill the mold at once by taking a double handful of curd and pressing it gently but firmly into the mold. Care should be taken not to allow the curd to drain too much before it is put into the mold, as it will then be too dry to pack readily. When the mold is full take the cheese out, turn it and replace it in the

mold, put on cover and put it under press for an hour. The pressure should be light at first.

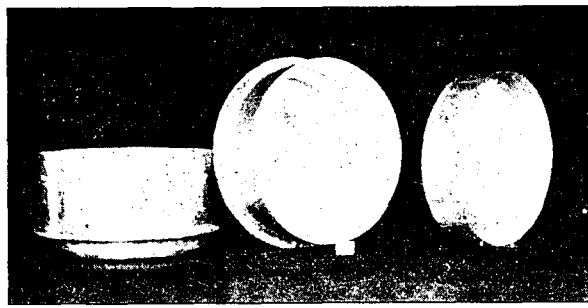


Fig. 7 Gouda Molds.

The press may be an oak stick four inches square, sixteen feet long, one end to rest under a slat nailed against the wall; place the cheese mold under the stick about three feet from the wall. On the other end suspend a pail or box containing cobble stones; during the first hour the pail should hang some two feet from the outer end of the stick. The cheese should then be taken out for dressing, which is done by taking a piece of cloth about six inches wide and long enough to go around the cheese. Dip cheese and cloth into whey or water at about 120 degrees Fahrenheit, wrap the cloth smoothly around the cheese, folding the edges carefully over the sides, put a linen cap on each side, replace in mold and again put it under the press; now move the vessel containing the stones or other weights toward the end of the stick, to increase the pressure. Leave it in press from eighteen to twenty-four hours at which time it will be ready for salting.

SALTING AND CURING GOUDA CHEESE.

This is done by rubbing the cheese all over with salt, once a day for six to ten days, according to temperature, moisture and desired keeping qualities. The cheese should be turned every day. Sometimes brine salting will bring better results. Make a brine as strong as possible, let the cheese float in it from five to eight days turning every day and sprinkling a little salt on top. When salted they should

be washed in warm water, wiped dry and placed on the shelf for curing. Be sure to rub and turn them at least once a day the first month, twice a week the second month, and once a week the third month. The curing room should be cool and rather damp. The temperature should not vary more than from 55 to 65 degrees.

If one has no vat for the milk, weigh it and put it fresh into a boiler or tub. When the milk is at the proper temperature add the rennet at the rate of three small tablets to 100 pounds of milk. Dissolve the tablets in a teacup of warm water (not hot), mix thoroughly in the milk by stirring carefully with an inverted dipper. Cut the curd very carefully with a wire broiler or toaster, such as is used in the kitchen. The wires should not be more than ¼ to ⅜ of an inch apart; pass the broiler through the curd slowly when it is quite soft. To cook the curd draw off about half the whey and warm to 100 degrees and pour into the vat, gently stir for ten or twelve minutes, then pour off the whey through a sieve or cloth strainer; quickly pour into the curd enough water, heated to 104 degrees, to cover it, stir gently until sufficiently cooked, which should take from fifteen to twenty minutes. If the curd seems to firm up too slowly, raise it to 105 or 106 degrees by adding more warm water. If you have no mold the cheese can be pressed in a sieve, steamer or four-quart measure. If you have no coarse linen use cotton cheese cloth or similar fabric. Scald the whey, and after cooling skim off the fat, which can be used for culinary purposes.

Only absolutely pure milk can be used in sweet curd work. If any cow is out of health, off her feed, feverish or excited, better throw her milk away or use it for making butter. If there is danger of the curd being tainted or gassy the whey should be let off at once and the curd cooked in water. When it has developed firmness the water should be drawn off and the curd thoroughly worked before putting into the mold.

TABLE No. XLIX.—Tabulated Statement of Process and Principal Conditions in the Manufacture of Gouda.

Date.	Lbs. of milk in vat	Per cent fat in milk	Amount of alkali necessary to neutralize acidity of Milk	Rennet test for ripeness	Temp. of milk when test was taken	Amt. extract used per 1000 lbs. milk.	Time required until coagulation begins	Time required until ready for knife	Temp. to which curd was heated	Time required to cook the curd	Amount of alkali necessary to neutralize acidity of whey	Time from adding rennet to putting to press	Weight of green cheese	Lbs. of milk to 1 lb. cheese
1894			c.c.	secs.			mins.	mins.		mins.	c.c	mins.		
Feb. 28	69	5.00	14.3	53	92°	.....	9.38	24	104°	77	10	128	8.5	8.1
March 12	100	4.50	12.4	70	90°	8.2	6	18	102°	45	7.4	76	12	8.33
" 13	100	4.20	12.6	60	90°	7.1	6	18	100°	44	7.4	77	14	7.14
" 14	100	4.90	13	60	90°	7.1	7	21	100°	39	7.2	80	14	7.14
" 15	100	5.00	13	60	90°	7.1	8	24	100°	39	7	85	14	7.14
" 16	100	.....	13	60	90°	7.1	6	18	102°	18	7.6	51	14	7.14
April 9	100	4.86	13	60	90°	7.1	6	18	98°	107	7	87	14.1	7.09
" 11	100	4.22	12.4	65	86°	7.7	6	19	98°	60	7	99	13.5	7.33
" 12	100	4.50	12.4	70	90°	8.5	6	18	98°	60	7.4	93	14.1	7.09

TABLE L.—Analyses of Milk, Whey and Gouda Cheese.

Date		Composition Solid	Fat	From 100 lbs. of milk Lbs.	Solids	Fat
Feb. 28	Milk	13.98	5.00	100.00	13.98	5.00
	Whey	7.16	.50	87.68	6.27	.44
	Green cheese	62.59	36.71	12.32	7.71	4.56
March 12	Milk	13.15	4.50	100	13.15	4.50
	Whey	7.03	.46	88	6.19	.40
	Green cheese	58.00	34.17	12	6.96	4.10
March 13	Milk	13.60	4.20	100	13.60	4.20
	Whey	7.23	.60	86	6.22	.52
	Green cheese	52.71	26.21	14	7.38	3.68
March 14	Milk	14.44	4.90	100	14.44	4.90
	Whey	7.20	.65	86	6.19	.56
	Green cheese	58.93	31.00	14	8.25	4.34
March 15	Milk	13.73	5.00	100	13.73	5.00
	Whey	7.27	.67	86	6.25	.58
	Green cheese	53.43	31.57	14	7.48	4.42

TABLE LI.—Amount of Solids Lost and Recovered in Making Gouda Cheese.

Date.	Per cent. solids in milk.	Pounds of green cheese from 100 lbs. milk.	Pounds of solids lost in whey from 100 lbs. milk.	Pounds of solids recovered in cheese from 100 lb. milk	Per cent. of solids in milk lost in whey.	Per cent. of solids in milk recovered in cheese.
March 13..	13.60	14.00	6.22	7.38	45.74	54.26
April 11.....	13.21	13.50	5.99	7.22	45.34	54.66
March 12..	13.15	12.00	6.19	6.96	47.07	52.93
April 12.....	13.69	14.10	6.16	7.53	45.00	55.00
April 9.....	13 80	14.10	6.19	7.61	44.86	55.14
March 14..	14.44	14.00	6.19	8.25	42.87	57.13
March 15..	13.73	14.00	6.25	7.48	45.52	54.48
Feb. 28.....	13.98	12.32	6.27	7.71	44.85	55.15

TABLE LII.—Amount of Fat Lost and Recovered in Making Gouda Cheese.

Date	Per cent fat in milk	Lbs. of gr. cheese from 100 lbs. of milk	Lbs. of fat lost in whey from 100 lbs. of milk	Lbs. of fat recovered in cheese from 100 lbs of milk	Per cent of fat in milk lost in whey	Per cent of fat in milk recovered in green cheese
March 13..	4.20	14.00	.52	3.68	12.38	87.62
April 11.....	4.22	13.50	.30	3.92	7.10	92.90
March 12..	4.50	12.00	.40	4.10	8.89	91.11
April 12.....	4.50	14.10	.51	3.99	11.33	88.67
April 9.....	4.86	14.10	.47	4.39	9.67	90.33
March 14..	4.90	14.00	.56	4.34	11.43	88.57
March 15..	5.00	14.00	.58	4.42	11.60	88.40
Feb. 28.....	5.00	12.32	.44	4.56	8.80	91.20

TABLE LIII.—Analyses of Milk, Whey and Gouda Cheese.

Percentage Compositian.

Date		Solids	Water	Fat	Solids not fat	Ash	Protein	Lactose
April 9	Milk	13.80	86.20	4.86	8.94	.71	3.35	4.85
	Whey	7.21	92.79	.55	6.66	.41	.94	5.15
	Gr Cheese	53.97	46.03	31.13	22.84	2.55	18.01	3.04
April 11	Milk	13.21	86.79	4.22	8.99	.75	3.40	4.88
	Whey	6.93	93.07	.35	6.58	.42	.92	5.15
	Gr Cheese	53.48	46.52	29.04	24.44	2.88	19.25	3.18
April 12	Milk	13.69	86.31	4.50	9.19	.78	3.54	4.90
	Whey	7.17	92.83	.59	6.58	.40	.90	5.15
	Gr Cheese	53.41	46.59	28.29	25.16	3.12	19.64	3.40

From 100 lbs. of Milk.

Date		Pounds	Solids	Water	Fat	Solids not fat	Ash	Protein	Lactose
April 9	Milk	100.00	13.80	86.20	4.86	8.94	71	3.35	4.85
	Whey	85.90	6.19	79.71	.47	5.72	.35	.81	4.42
	Gr Cheese	14.10	7.61	6.49	4.39	3.22	.36	2.54	.43
April 11	Milk	100.00	13.21	86.79	4.22	8.99	.75	3.40	4.88
	Whey	86.50	5.99	80.51	.30	5.69	.36	.80	4.45
	Gr Cheese	13.50	7.22	6.28	3.92	3.30	.39	2.60	.43
April 12	Milk	100.00	13.69	86.31	4.50	9.19	.78	3.54	4.90
	Whey	85.90	6.16	79 74	.51	5.65	.34	.77	4.42
	Gr Cheese	14.10	7.53	6.57	3.99	3.54	.44	2.77	.48

TABLE LIV.—Tabulated Statement of Process and Principal Conditions in the Manufacture of Emmenthaler (Swiss Cheese.)

Date.	Lbs. of milk in vat	Per cent of fat in milk	Amount of alkali necessary to neutralize acidity of milk	Rennet test for ripeness	Temp. of milk when test was taken	Amount of extract used per 1000 pounds of milk	Time required until coagulation begins	Time required until ready for breaking	Temp. to which curd was heated	Time required to cook the curd	Per cent fat in whey	Time from adding rennet to putting to press	Weight of green cheese	Lbs. of milk to 1 lb. of cheese	Lbs. of cured cheese
1894			cc.	secs.		ozs.	mins.	mins.		mins.		mins.			
Jan. 16	370.	4.1	.....	70	90°	5.30	11	31	120°	55	1.1	106	39.3	9.41	31.6
" 17	330.7	4.2	.....	75	88°	6.50	9	29	110°	45	.7	118	37.	8.93	.....
" 20	327.6	3.5	.....	40	88°	2.10	9	22	112°	75	.5	122	32.3	10.14	30.9
" 22	374.2	4.0	15.3	99	90°	5.98	13	32	115°	70	.8	150	38.5	9.71	28.7
" 23	355.3	4.2	14.5	105	90°	5.50	15	35	115°	42	.9	138	38.1	9.32	27.3
*Feb. 2	187.	4.6	.....	120	90°	8.54	11	30	119°	57	.3	248	24.6	7.55	20.
" 6	369.5	4.9	14.	90	92°	7.09	10	24	115°	56	.5	264	41.	9.01	34.3
Mch. 24	248.	4.5	12.8	60	90°	4.03	10	30	120°	66	.8	133	30.	8.27	.....
" 27	300.	4.5	12.4	70	90°	3.85	12	36	120°	58	.9	127	34.	8.82	.....
" 29	224.	4.4	12.2	60	90°	3.50	11	33	120°	59	1.3	109	25.	9.	.....

*Curd cut with American knife.

The foregoing table includes the cheese made under the direction of Hon. John Luchsinger during the session of the Dairy School in January, those made by J. H. Hecker in February and W. P. Simpson in March. All the cheese were made of whole milk, except the one made the 20th of January which consisted of two-thirds whole milk and one-third skim.

The milk used during January and February was purchased from a creamery in the southern portion of the state and from dealers in the city, being mixed evening's and morning's milk which had been subjected to low temperature in shipping; while that worked in March was morning's milk. The mixed milks required 14cc to 15.3cc to neutralize the acid, while the fresh morning's milk required 12.2 to 12.8. In comparing the alkali test with the rennet test it will be observed that on the days when the milk required from 14 to 15.3cc alkali to neutralize the acid, the rennet test required from 90 to 105 seconds before coagulation commenced, and in March when the milk required from 12.2 to 12.8cc alkali, coagulation commenced in from 60 to 70 seconds. The milk worked on the 20th of January commenced to coagulate in nine minutes with only two ounces of rennet to 1000 pounds of milk and was ready for breaking in twenty-two minutes. That used on the 23rd of January took 15 minutes before commencing to coagulate and it was not ready for breaking until after the expiration of 35 minutes. With ordinarily sweet milk the time from adding the rennet until the curd is ready to break is 31 minutes. The temperature to which the curd was raised ranged from 110 to 120 degrees. The curd of January 17th was cooked at 110 degrees, and although kept under exactly the same conditions as the other cheese made the same month, it was ready for the market early in May. It was sold to a grocer and retailed readily at 18 cents; as soon as it was sold he called at the Station and offered 15 cents for all on hand. The cheese made on the 23rd of January was ripe in six months, while none of the others appear to be ripe at the close of the seventh month.

The cheese made from whole milk and the curd reduced

by a curd breaker shrunk in the process of curing on an average, 24.6 per cent; while that cut with an American curd knife shrunk 18.7 per cent. When the curd breaker was used to reduce the curd, it required, on an average 10.3 pounds of milk for one pound of cured cheese and when a knife was used a pound of cured cheese was made from 9.3 pounds of milk. The average loss of fat in the whey was .83 of one per cent. when the breaker was used and .30 with the curd knife. With whole milk and using the breaker, the cheese shrunk in curing 26.1 per cent; using the knife the shrinkage was 9.3 per cent.

The whey from the Swiss cheese made on the 16th of January was raised to 150 degrees F., the butter fat skimmed and two pounds of butter were made of inferior quality. On the 17th of January the whey was run through a No. 3 Alpha Separator, a good sour milk starter was added and the cream churned the day following, giving a yield of 2.1 pounds of fair butter, the flavor being much better than that made the day previous. On the 22nd there was drawn from the Swiss curd 322 pounds of whey to which was added 6.7 pounds butter milk and 7.6 pounds of cream testing 25 per cent. fat. It was then condensed and made 33 pounds Primost of the finest quality, which sold for 12½ and 15 cents per pound. The milk from which the cheese was made on the 23rd was frozen but otherwise was in good condition. It required 14.5cc alkali to neutralize the acid but the rennet test showed 105 seconds when coagulation commenced. After seven months this was the best cheese in the lot but hardly ready for consumption.

On the 2nd of February the American curd knife was used to note the effect, if any, upon the curd, loss of fat, flavor and texture; fat in whey .3 of one per cent. After seven months the cheese was tried and found dry and almost closed, the Swiss holes were few, small and lacked that lively glossy appearance characteristic of good Emmenthaler; it also lacked the proper flavor.

From the cheese made on the 6th of February, 300 pounds of whey were taken and run through a hand separator obtaining 9.3 pounds of cream which was churned, yield-

ing 3 pounds of unsalted butter. When six months old the cheese was in fine condition but was far from being ripe. Those made the 24th, 27th and 29th are to all appearance in fine condition and promise good results though not mature at this writing.

The whey of the 24th was separated, giving 9 pounds of cream, which was cooled to 45 degrees F., and after two hours raised to 65 degrees F., and three pounds of fresh buttermilk added. The following day it was churned at 62 degrees F., washed and worked at 56 degrees, and 1.9 pounds of butter obtained, which scored: flavor 40, grain 30, color 14, salt 8; total 92. It was cut five points on flavor, June standard, flavor good but not quick; one on color, being a point too high and two points short on salt.

On the 29th of March 192 pounds of whey were drawn, testing 1.1 per cent. fat. It was run through a hand separator, cooled to 50 degrees, in a couple of hours was raised to 65 degrees, twenty per cent. starter was added and set in a Boyd vat. The following day it was churned at 62 degrees F., washed and worked. Weight of butter 2.3 pounds. Flavor 38, grain 28, color 15, salt 10; total 91.

Whey butter as usually made is a very low grade of goods, selling about on a par with the grade generally termed "packing stock, poor," which sells for 10 cents when extra dairy butter sells at 20 cents. By running the whey through a separator and ripening the cream with good lactic ferment, the quality of the butter can be improved 25 to 50 per cent.

TABLE LV.—Analyses of Milk, Whey and Swiss Cheese.

Percentage Composition.

Date.		Solids.	Water.	Fat.	Solids not fat.	Ash.	Protein	Lactose.
March 24...	Milk	13.35	86.65	4.51	8.84	.64	3.48	4.72
	Whey	7.13	92.87	1.01	6.12	.27	.90	4.97
	Gr. Cheese	58.57	41.43	29.93	28.60	3.34	22 13	2.90
March 27...	Milk	13.68	86.32	4.50	9.18	.63	3.63	4.90
	Whey	7.24	92.76	.83	6 41	.32	.92	5.10
	Gr. Cheese	64.09	35.91	33.21	30.85	3.06	24.82	3.32
March 29...	Milk	13.34	86.66	4.40	8.94	.80	3.32	4.87
	Whey	7.27	92.73	.88	6.39	.46	.86	5.07
	Gr. Cheese	61.64	38.40	32.40	29.44	3.48	22.88	3.24

From 100 lbs. of Milk.

Date.		Lbs.	Solids	Water	Fat	Solids not fat	Ash	Protein	Lactose
March 24	Milk	100.00	13.35	86.65	4.51	8.84	.64	3.48	4.72
	Whey	87.90	6.27	81.64	.89	5.38	.24	.79	4.37
	Gr. Cheese	12.10	7.08	5.01	3.62	3.46	.40	2.68	.35
March 27	Milk	100.00	13.68	86.32	4.50	9.18	.63	3.63	4.90
	Whey	88.67	6.42	82.26	.74	5.68	.28	.82	4.52
	Gr. Cheese	11.33	7.26	4.06	3.76	3.50	.35	2.81	.38
March 29	Milk	100.00	13.34	86.66	4.40	8.94	.80	3.32	4.87
	Whey	88.84	6.46	82.38	.78	5.67	.41	.77	4.51
	Gr. Cheese	11.16	6.88	4.28	3.62	3.27	.39	2.55	.36

TABLE LVI.—Analyses of Milk, Whey and Emmenthaler Cheese.

Date		% Composition		From 100 lbs. of milk		
		Solids	Fat	Lbs.	Solids	Fat
Jan. 22	Milk	12.23	4.	100.	12.23	4.00
	Whey	7.07	.93	89.71	6.34	.82
	Gr. cheese	57.22	30.78	10.29	5.89	3.18
Jan. 23	Milk	10.98	4.2	100.	10.98	4.20
	Whey	7.37	.80	89.28	6.58	.72
	Gr. cheese	41.02	32.49	10.72	4.40	3.48

TABLE LVII.—Amount of Fat Lost and Recovered in Making Emmenthaler Cheese.

Date.	Per cent fat in milk	Lbs. of greencheese from 100 lbs. of milk	Lbs. of fat lost in whey from 100 lbs. of milk	Lbs. of fat recovered in cheese from 100 lbs. of milk	Per cent of fat in milk lost in whey	Per cent of fat in milk recovered in cheese
Jan. 22.....	4.00	10.29	.82	3.18	20.50	79.50
Jan. 23.....	4.20	10.72	.72	3.48	17.14	82.86
Mch. 29.....	4.40	11.16	.78	3.62	17.73	82.27
Mch. 27.....	4.50	11.33	.74	3.76	16.44	83.56
Mch. 24.....	4.51	12.10	.89	3.62	19.73	80.27

TABLE LVIII.—Amount of Solids Lost and Recovered in Making Emmenthaler Cheese.

Date	Per cent solids in milk	Lbs. of green cheese from 100 lbs. of milk	Lbs. of solids lost in whey from 100 lbs. of milk	Lbs. of solids recovered in cheese from 100 lbs. of milk	Per cent of solids in milk lost in whey	Per cent of solids in milk recovered in cheese
Jan. 22.....	12.23	10.29	6.34	5.89	51.84	48.16
Jan. 23.....	10.98	10.72	6.58	4.40	59.93	40.07
Mch. 29.....	13.34	11.16	6.46	6.88	48.43	51.57
Mch. 27.....	13.68	11.33	6.42	7.26	46.93	53.07
Mch. 24.....	13.35	12.10	6.27	7.08	46.97	53.63