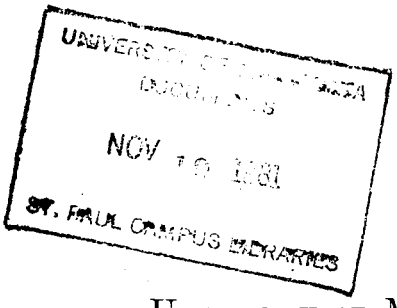

UNIVERSITY OF MINNESOTA.

Agricultural Experiment Station.

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MARCH, 1892.

DEHORNING EXPERIMENT.

CREAM RAISING BY COLD DEEP SETTING.

EXPERIMENTS IN CHEESE MAKING—INCORPORATING CREAM INTO CHEESE, ETC.

THE BABCOCK TEST AND CHURN.

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DEHORNING EXPERIMENT.

CLINTON D. SMITH AND T. L. HÆCKER.

Last summer it was decided by the Regents to place upon the station farm, a herd of good dairy cows, selected from natives, thorough-breds and their grades. In carrying out this purpose, some twenty-five cows were purchased during the month of October and shipped to the station. When they were let into the yard, it was noticed that the larger cows drove the smaller from feed and water, and often prevented their drinking unless protected by the attendant. It was apparent, that unless some means could be devised to prevent this, serious losses would occur, from irregular feeding and drinking and by premature births.

It was decided that the quickest and most effectual remedy was dehorning. This is, by many, considered a questionable practice, because of the pain inflicted during the operation. In order that the immediate effects might be studied, a comparison was made of the daily yield of milk and per cent of fat, before and after dehorning. These results were compared with the record of a number of cows, not dehorned but which saw the operation and smelled the blood.

The cows, Franc, Roxy, Sully, Gran, Clara and Crossy were over five years old and Patsey, Rossie and Bettie, over four years; these were dehorned on the ninth of November, 1891. They were fastened in a stanchion, the head drawn forward by means of a halter and small tackle blocks, until the neck was extended to its full length, so that the horns were sufficiently far from the stanchion to permit the free use of the narrow bladed butcher's saw, which we used.

The time occupied was about five seconds per horn; as soon as the horns were removed, pieces of cotton cloth smeared with pine tar were placed upon the wounds. Care was taken to saw the horns inside of the outer edge of the skin, removing with the horn a narrow strip of hair.

During the operation the cows gave every indication of intense suffering; but, upon being released no sign of pain was visible. The wounds healed rapidly without any other application than the tar.

Table I. is taken from the regular herd record, showing the pounds of milk given by each cow for the three milkings before they were dehorned, the per cent fat and total fat.

TABLE I.

	First Milking.			Second Milking.			Third Milking.		
	Lbs. milk.	Per cent fat.	Total fat.	Lbs. milk.	Per cent fat.	Total fat.	Lbs. milk.	Per cent fat.	Total fat.
Betty...	11.5	4.3	.494	11.	3.8	.418	11.5	4.1	.471
Clara...	9.5	4.6	.437	9.	3.7	.333	7.1	4.	.284
Crossy.	6.5	4.7	.305	6.5	4.9	.318	6.5	4.4	.286
Franc..	13.5	3.9	.526	13.5	4.	.540	15.	3.6	.540
Gran....	10.	3.8	.380	9.25	3.4	.314	9.5	4.3	.408
Patsey	10.5	3.5	.387	11.	3.6	.396	11.25	4.	.450
Rossie..	10.9	4.2	.457	10.	3.3	.330	10.9	3.7	.403
Roxy...	13.9	4.1	.569	12.75	3.5	.446	13.5	3.9	.526
Sully....	21.	4.5	.945	20.	4.3	.860	20.75	4.	.830
	107.3		4.5	103.		3.955	106.		4.298

Total milk yield for three milkings, 316.3.
Total pounds of fat for three milkings, 12.753.

Table II shows the pounds of milk given by each cow during the three milkings immediately following dehorning, with per cent of fat and total fat.

TABLE II.

	First Milking.			Second Milking.			Third Milking.		
	Lbs. milk.	Per cent fat.	Lbs. fat.	Lbs. milk.	Per cent fat.	Lbs. fat.	Lbs. milk.	Per cent fat.	Lbs. fat.
Betty...	10.6	2.9	.307	11.5	4.3	.495	9.25	4.6	.426
Clara...	12.25	7.	.857	9.	5.5	.495	9.25	4.7	.435
Crossy.	5.5	5.5	.302	6.	6.1	.366	6.5	5.9	.383
Franc..	12.75	3.4	.433	13.	3.9	.507	13.5	4.3	.580
Gran....	9.5	2.7	.256	7.5	3.8	.285	8.5	4.7	.400
Patsey.	10.	4.	.400	10.5	3.1	.325	10.5	3.8	.399
Rossie..	9.	3.2	.288	9.75	3.8	.370	9.25	3.7	.342
Roxy...	11.	4.6	.506	11.	4.8	.528	11.75	4.3	.505
Sully....	19.	3.1	.589	19.75	4.	.790	20.	3.6	.720
	97.6		3.938	98.		4.161	98.5		4.190

Total pounds of milk for the three milkings, 294.1.
Total pounds of fat for the three milkings, 12.289.

Table III shows the pounds of milk given by the six cows not dehorned, covering the same period as Table I, with per cent fat and total fat.

TABLE III.

	First Milking.			Second Milking.			Third Milking.		
	Lbs. milk.	Per cent fat.	Lbs. fat.	Lbs. milk.	Per cent fat.	Lbs. fat.	Lbs. milk.	Per cent fat.	Lbs. fat.
Gertie....	7.7	5.	.385	7.75	4.7	.364	8.	4.8	.384
Houston	15.5	5.1	.790	12.75	4.8	.612	13.25	4.9	.649
Maria....	13.	4.7	.611	13.5	4.7	.634	12.5	4.6	.575
Pottie....	12.75	5.	.637	12.25	4.	.490	12.1	4.5	.545
Pride.....	6.4	6.9	.441	5.5	5.6	.308	5.75	5 3	.305
Tricksey	13.25	5.1	.676	12.25	4.9	.600	12.25	5.5	.674
	68.6		3.540	64.		3.008	63.85		3.132

Total pounds of milk for the three milkings, 196.45.
Total pounds of fat for the three milkings, 9.68.

Table IV shows the pounds of milk given by the six cows not dehorned, covering the same period as Table II, the per cent fat and total fat.

TABLE IV.

	First Milking.			Second Milking.			Third Milking.		
	Lbs. milk.	Per cent fat	Lbs. fat.	Lbs. milk.	Per cent fat.	Lbs. fat.	Lbs. milk.	Per cent fat.	Lbs. fat.
Gertie....	7.	3.9	.273	8.25	6.	.495	7.5	4.9	.367
Houston	11.5	3.5	.402	15.5	5.2	.806	13.	5.3	.689
Maria....	12	4.3	.516	13.5	4.8	.648	13.	4.6	.598
Pottie....	11.5	3.8	.437	12.75	4.3	.548	12.5	4.2	.525
Pride.....	6.	4.8	.288	5.75	5.4	.301	5.5	5.8	.319
Tricksey	11.5	3.7	.425	12.	4.3	.516	11.5	4.8	.552
	59.5		2.341	67.75		3.314	63.		3.050

Total pounds of milk for the three milkings, 190.25.
Total pounds of fat for the three milkings, 8.605.

In Table V. the first period has reference to the time covered by the three milkings immediately prior to dehorning and the second period, to the three milkings after dehorning.

TABLE V.

SUMMARY.

	Nine cows dehorned.	Six cows not dehorned.
Milk yield first period	316.3	196.45
Milk yield second period	294.1	190.25
Shrinkage of milk during second period	22.2	6.2
Per cent of shrinkage in milk	7.	3.
Yield of fat in lbs. first period	12.753	9.68
Yield of fat in lbs. second period	12.289	8.60
Shrinkage in lbs., fat	.464	1.08
Per cent of shrinkage in fat	3.	11.

By comparing the yield of milk of the cows dehorned with that of the cows not dehorned, it will be observed that the former gave 22.2 lbs less, during the three milkings after being dehorned, the latter losing 6.2 lbs. The dehorned cows shrinking seven per cent, while the others lost three per cent.

Comparing the total fat products of these two groups of cows for the same periods, we find a much greater discrepancy, the dehorned cows showing a shrinkage of only three per cent, while the six cows not dehorned lost eleven per cent. It would appear from these observations that while the operation of dehorning may cause a slight, temporary variation in the flow of milk and fat content, the normal flow and per cent of fat is quickly recovered, and, that cows only seeing the operation and smelling the blood show a greater shrinkage in fat than do the ones dehorned.

A DOUBLE MONSTROSITY OF A CALF TRACEABLE TO INJURY OF ITS MOTHER.

PROF. OLAF SCHWARZKOPF.

Early in October, 1890, David Porter, in charge of the cattle-barn of the Minnesota Agricultural Experiment Station, called me to see a Holstein-Friesian cow which was hit by the horns of another cow, a noted fighter, while passing into the stables. I found the cow very nervous and excited; on the right flank behind the last rib and about one foot below the loins was a small bruise, about as large as a fifty cent piece. As the cow was with calf I auscultated the uterus, but could find nothing abnormal. I instructed the man to keep the cow in a quiet place and to watch her as she might possibly abort, however, she soon seemed all right and nothing further was thought of the case.

On January 28, 1891, the cow dropped a calf; as it did not have any passages within two days the cattle-man gave it a dose of castor oil, which had no effect. He then reported it to me and also stated that the calf seemed to be crippled. In looking at the calf I observed at once that it had a curved spine and further examination revealed that there was no rectal opening.

I had the calf sent over to the veterinary hospital and on February 2, 1891, examined it. An incision was made where the natural opening should be, but after perforating the skin, no rectum was found but a direct entrance into the abdomen. The intestines that lodged in the pelvic cavity apparently were the colon or coecum. I tried hard to find the rectum but did not succeed. On February 3, the calf which was greatly emaciated, died. The post mortem examination showed the following:

On opening the abdomen an irregular situs of the intestines was first to be noticed; in removing the intestines I found the rectum near the liver, ending in a blind sack, curved and possessing a kind of nodule, resembling somewhat a

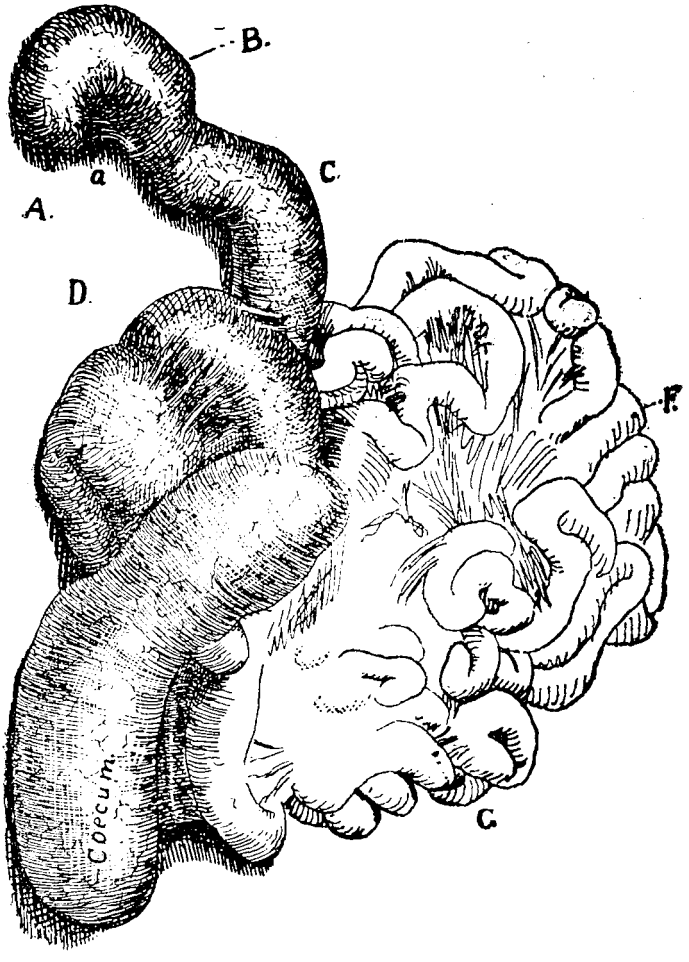

FIG. I.

A, Blind end of rectum; a, cicatrix; B, C, D, colon; F, ileum; G, jejunum.

cicatrix. After the removal of the intestines the the curve of the spine to the left was very apparent and the left kidney was very small and situated on top of the right kidney. The other organs were normal. The calf, certainly, could not have lived.

The practical conclusion that must be drawn from this case is that the abnormalities which the calf presented, were produced by external injuries. Critics may object and say that

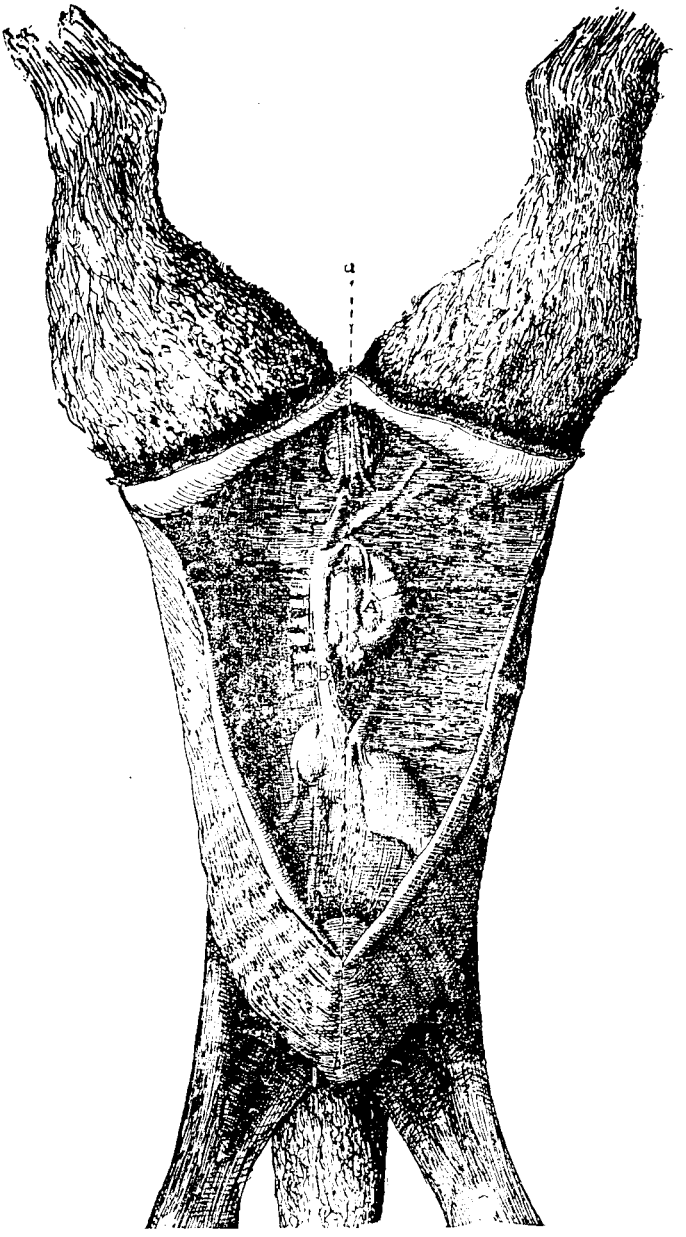

FIG. II.
A, right and left kidney in one place; B, posterior aorta; C, urinary bladder; a———b, straight line showing aberration of spine.

the skin and the membranes of the uterus are so thick that a cow's horn cannot touch the fœtus. This may be true as a rule, but by anyone that had examined this case, together with its history, no other conclusion could possibly be reached than to ascribe the cause of the abnormalities of the calf to the blow which its mother received four months previous to the birth.

I am not at all blindly devoted to dehorning cattle, on the contrary, being a lover of pure types and natural forms, I have always maintained that it is a violence of the laws of ethics and aesthetics to disfigure a beautiful Jersey cow by dehorning. But the principles of ethics are often out of place in the cow stable and barn-yard and I confess that I am now convinced, that it is a righteous and humane act to take horns off—at least of those cows that cannot keep peace with their fellow creatures.

CREAM RAISING BY COLD DEEP SETTING.

THE RAPIDITY OF THE PROCESS AND ITS RELATION TO THE TEMPERATURE OF THE SURROUNDING WATER.

HARRY SNYDER.

When milk is creamed by the cold deep setting system with the temperature of the tank water reduced to 39°-44° Ft. the efficiency of the creaming process is well known, but the changes that take place especially during the first part of the creaming process are not so well known. When the milk is set in the tank these questions are naturally suggested: How long before any change takes place; in which section of the can (top, middle or bottom) does the first change, in either temperature or fat content, occur; throughout the entire process what relationship exists between the rate of creaming of the different sections and the temperatures; and at the time of skimming how do the different sections compare as to the percentages of fat remaining in them?

In studying these questions the first difficulty that presents itself is the method of taking the sample from the can while the creaming process is going on without introducing a serious factor of error in disturbing the natural process.

Various methods of sampling were studied. Small glass siphons were at first made use of, but this method of sampling removed too much milk from the can, since a quantity of milk at least equal to the capacity of the siphons must first be removed before taking a sample. The method that gave the best results, and the one used in this experiment, is as follows: Two holes were bored in a block of wood and perforated corks fitted into these holes; through these perforations of the corks, glass tubes were passed, reaching to

the bottom and middle sections of the can. The block of wood rested on the top of the can and at the top end of each glass tube a piece of rubber, three inches in length was attached, furnished with a pinch cock which prevented the milk in the tubes from flowing back and causing unnecessary currents; the samples were taken by attaching a large pipette to the rubber at the end of the glass tubes opening the pinch cock and applying suction. A small measured portion equivalent to the capacity of the tubes was first removed before sampling. During the first trials another can of the same milk was set under precisely the same conditions and sampled only at the beginning and at the close of the trial periods, the object being to determine the effect of the slight currents caused by taking the samples in the way described. The figures given in the following tables are the averages of duplicate analyses. The temperature of the water in the various trials is somewhat higher than that required for the very best results, but inasmuch as many of the springs of the state which are used for this purpose are about the temperatures indicated, and some much higher, these temperatures were adopted so as to conform to about the normal conditions of many of the creameries of the state. The section designated as top was taken three inches from the surface, usually just below the cream line, but occasionally not, as the high per centages of fat in the results indicate.

In the following tables I, II, III and IV the changes that take place from period to period, under the conditions named may be studied:

TABLE I.

Milk divided into two equal portions set at 90° in water at 40°; 5% Fat in the original milk.

CAN I.				CAN II.			
Section of can.	Time from setting.	Per cent. fats.	Temp. of sections.	Section of can.	Time from setting.	Per cent. fats.	Temp. of sections.
Top	15 minutes	5.00	78 deg.	Top	15 minutes	5.00	72 deg.
Middle	do	5.00	72 "	Middle	do	5.00	69 "
Bottom	do	4.80	57 "	Bottom	do	4.95	56 "
Top	30 minutes	4.60	60 "	Top	30 minutes	4.95	60 "
Middle	do	4.45	57 "	Middle	do	4.90	57 "
Bottom	do	3.40	50 "	Bottom	do	3.60	49 "
Top	1 hour	4.00	54 "	Top	1 hour	3.40	54 "
Middle	do	3.85	52 "	Middle	do	3.20	52 "
Bottom	do	1.30	46 "	Bottom	do	1.95	46 "
Top	2 hours	3.30	52 "	Top	2 hours	3.60	50 "
Middle	do	2.10	46 "	Middle	do	3.00	47 "
Bottom	do	0.75	42 "	Bottom	do	1.05	42 "
Top	4 hours	1.45	46 "	Top	4 hours	1.55	45 "
Middle	do	1.35	45 "	Middle	do	1.35	45 "
Bottom	do	0.75	42 "	Bottom	do	0.65	41 "
Top	5½ hours	1.40	45 "	Top	5½ hours	1.20	45 "
Middle	do	1.00	44 "	Middle	do	1.10	45 "
Bottom	do	0.35	42 "	Bottom	do	0.55	43
Top	36 hours	0.40	44 "	Top	36 hours	0.50	44 "
Middle	do	0.30	44 "	Middle	do	0.45	44 "
Bottom	do	0.20	44 "	Bottom	do	0.20	44 "

Average of all sections, .30 fat. Fat in the skim milk, .35%.

Average for 36 hours, 38% fat. Fat in skim milk, 35%.

In Can B the middle layer was taken 1½ inches higher than in can A.

TABLE II.

CAN III. Set at 84° in water at 47°. 4.30 per cent. fat in original setting. Temperature at close, 47°.

SECTION OF CAN.	TIME FROM SETTING.	PER CENT. FATS.	NOTES.
Top	1 hour	4.1	At the same time a duplicate can was set, and the fat in the skim milk was .30% at the close of 24 hours.
Middle	"	4.	
Bottom	"	2.05	
Top	2 hours	2.45	
Middle	"	1.65	
Bottom	"	.9	
Top	3 hours	2.05	
Middle	"	1.45	
Bottom	"	.65	
Top	4 hours	——	
Middle	"	1.2	
Bottom	"	.60	
Top	5 hours	1.45	
Middle	"	1.00	
Bottom	"	.3	
Top	8 hours	——	
Middle	"	.55	
Bottom	"	.35	
Top	11 hours	.50	
Middle	"	.30	
Bottom	"	.20	

The average of all sections at the 11-hour period was .33% fat. The per cent of fat in the skim milk was .30% at the close of 24 hours.

CAN IV. Set at 92° in water at 47°. 4.2 per cent. fat in original setting. Temperature at close, 46°.

SECTION OF CAN.	TIME FROM SETTING.	PER CENT. FATS.	NOTES
Middle	20 minutes	4.6	
Bottom	do	3.7	
Middle	40 minutes	3.60	
Bottom	do	1.50	
Middle	1 hour	3.40	
Bottom	do	.70	
Middle	1⅓ hours	3.50	
Bottom	do	.60	
Middle	1⅔ hours	2.05	
Bottom	do	.50	
Middle	2 hours	1.00	
Bottom	do	.50	
Middle	3½ hours	.90	
Bottom	do	.30	
Middle	5 hours	.5	
Bottom	do	.3	
Middle	6 hours	.45	
Bottom	do	.3	
Middle	7 hours	.40	
Bottom	do	.25	
Middle	8 hours	.40	
Bottom	do	.18	
Top	10 hours	.40	
Middle	do	.30	
Bottom	do	.15	

Average of sections at close, .28% fat.

The points to be noted in these tables are as follows:

1. The first and most marked action affecting the composition and temperature takes place in the bottom layer, and within fifteen minutes this layer will show a less per cent of fat; the temperature of the middle section is affected more slowly and suffers a less loss of fat.

2. The top section, when the action is very rapid, may at the first hour period, contain more fat than in the original milk, but as the period increases it, too, grows poorer.

3. In each of the corresponding periods, the top layer is always richer in fat than the middle layer, the middle layer is richer than the bottom, and the bottom layer is always the poorest. During the first five or six hours the same relationship exists as to temperatures. The middle section has an intermediate temperature between the bottom and top sections, which are respectively the lowest and highest.

4. At the time of skimming the same relationship of the different sections as to fat exists. This emphasizes the

TABLE III.

CAN V. Set at 82° in water at 48°. 4.05 per cent. fat in original milk.				CAN VI. Set at 90° in water at 43°.			
SECTION OF CAN.	TIME FROM SETTING.	PER CENT. FATS.	NOTES.	SECTION OF CAN.	TIME FROM SETTING.	PER CENT. FATS.	TEMP OF SECT'NS IN CAN.
Top	15 minutes	3.9		Top	at starting	3.70	90 deg.
Middle	do	3.9		Middle	do	3.65	90 "
Bottom	do	3.65		Bottom	do	3.65	90 "
Top	45 minutes	3.15		Top	1 hour	5.40	58 "
Middle	do	3.00		Middle	do	3.30	54 "
Bottom	do	1.20		Bottom	do	1.00	52 "
Top	2¼ hours	2.05		Top	2 hours	4.00	55 "
Middle	do	1.05		Middle	do	1.25	52 "
Bottom	do	1.00		Bottom	do	.50	48 "
Top	4½ hours	.65		Top	3 hours	1.80	52 "
Middle	do	.55		Middle	do	.75	51 "
Bottom	do	.50		Bottom	do	.45	46 "
Top	6¼ hours	.65		Top	5 hours	.75	47 "
Middle	do	.45		Middle	do	.45	46 "
Bottom	do	.40		Bottom	do	.30	45 "
Top	8¼ hours	.50		Top	7 hours	.45	46 "
Middle	do	.40		Middle	do	.45	46 "
Bottom	do	.20		Bottom	do	.30	45 "
Top	10¼ hours	.40		Top	10 hours	.45	44 "
Middle	do	.30		Middle	do	.40	44 "
Bottom	do	.20		Bottom	do	.25	44 "
Top	24 hours	.40		Top	13 hours	.45	.....
Middle	do	.30		Middle	do	.40	.....
Bottom	do	.15		Bottom	do	.25	.....
Average of all sections at the close of 10¼ hour period, .30; 24-hour period, .28.				Average of all sections at the end of 10-hour period, .37 fat; at the end of 13-hour period, .37 fat.			

fact that samples of skim milk for analysis must be well mixed in order to obtain a sample that will represent the average composition, and at no time can a portion be withdrawn from any section and the fat in the whole skim milk calculated from the sample so taken.

TABLE IV.

CAN A. Set at 93° in water at 47°. 5.00 per cent fat in original setting. Temperature at close, 46°.				CAN B. Set at 90° in Water at 47°. 4.15 per cent. fat in original setting. Temperature at close, 46°.			
SECTION OF CAN.	TIME FROM SETTING.	PER CENT. FATS.	NOTES.	SECTION OF CAN.	TIME FROM SETTING.	PER CENT. FATS.	NOTES
Top	20 minutes	5.00		Top	15 minutes	4.15	
Middle	do	5.00		Middle	do	4.10	
Bottom	do	3.60		Bottom	do	3.95	
Top	40 minutes	2.55		Top	30 minutes	3.75	
Middle	do	2.25		Middle	do	3.50	
Bottom	do	2.00		Bottom	do	3.45	
Top	1 hour	(6.50)		Top	45 minutes	4.20	
Middle	do	2.20		Middle	do	4.10	
Bottom	do	1.60		Bottom	do	2.15	
Top	1⅓ hours	(7.50)		Top	1 hour	4.3	
Middle	do	2.10		Middle	do	4.05	
Bottom	do	1.50		Bottom	do	1.00	
Top	1⅔ hours	(10.60)		Top	1¼ hours	5.5	
Middle	do	2.00		Middle	do	3.8	
Bottom	do	1.40		Bottom	do	.8	
Top	2 hours	(10.00)		Top	1¾ hours	6.5	
Middle	do	2.00		Middle	do	2.65	
Bottom	do	1.10		Bottom	do	.45	
Top	2½ hours	1.90		Top	2¼ hours	9.5	
Middle	do	1.60		Middle	do	1.3	
Bottom	do	1.10		Bottom	do	.40	
Top	3¼ hours	1.60		Top	2¾ hours	4.55	
Middle	do	1.50		Middle	do	1.3	
Bottom	do	.70		Bottom	do	.40	
Top	4½ hours	1.50		Top	3¾ hours	.75	
Middle	do	1.30		Middle	do	.7	
Bottom	do	.60		Bottom	do	.4	
Top	6 hours	1.10		Top	4¾ hours	.5	
Middle	do	1.00		Middle	do	.48	
Bottom	do	.45		Bottom	do	.40	
Top	7½ hours	1.10		Top	5¾ hours	.50	
Middle	do	.60		Middle	do	.40	
Bottom	do	.30		Bottom	do	.30	
Top	9½ hours	.90		Top	7¾ hours	(Lost.)	
Middle	do	.60		Middle	do	.30	
Bottom	do	.20		Bottom	do	.15	
Top	11½ hours	.50		Top	9¾ hours	.40	
Middle	do	.30		Middle	do	.30	
Bottom	do	.20		Bottom	do	.15	
			The duplicate of this can sampled at the close of the 12½-hour period: Top .50, Mid. .25, Bot. .15. Average .30.				The duplicate of this can sampled at the close of the 9¾ hour period showed: Top .30, Mid. .30, Bot. .15. Average .25
12½ hrs.—top .50 do —mid. .30 do —bot. .20			Average .33.	Average of Sections at Close of 9¾ hours, .28 per cent.			

5. The temperature of the water at the time of setting is of far greater importance than the temperature of the milk. A reduction of 10° in the temperature of the milk does not appreciably affect the result, while a difference of

less than half of this amount in the temperature of the tank water seriously effects the creaming. When the temperature of the tank water is reduced to 40°, about 5 hours time is required for the different sections to attain a constant temperature and it is to be observed that during this period the most of the fat is brought to the surface and that during all of this period there is a constant relation between the fall in temperature and fat, the most rapid change in each section being observed when the temperature of that section reaches the temperature of the surrounding water. What the cause of this close relationship is, no satisfactory explanation has yet been given, simply the fact is known and the dairyman must conform to these temperatures in order to obtain the most beneficial results.

Since this is the season of the year when ice can be stored so abundantly and at little expense every dairyman is urged to lay in a supply. A running spring with a temperature not higher than 48° will do effectual work, but with temperature from 50° to 60° the creaming of milk by this process is attended with serious losses of fat in the skim milk. By the use of ice at least eight pounds of butter can be made where less than seven pounds are produced without it. When milk is set at temperatures as indicated in previous tables the usual practice is to skim at the end of eleven hours in order to use the pails and creamer for the next milking; this is a practice entirely safe with this system of creaming, under proper conditions. The average length of time required for the practical completion of the creaming of the above samples was only nine and three-quarter hours. A similar study of milks that cream less perfectly and under less favorable conditions was made in order to obtain data as to the length of time necessary for the completion of the creaming.

HOW LONG BEFORE SKIMMING CAN SAFELY BE DONE.

In the following table is an example of a can of milk set at 90° in a tank of water at 60°, which is a very unfavorable condition for creaming, the results show how slow and imperfect the action when compared with a lower and more favorable temperature and also how the rising of the fat practically ceases at about the eleven hour period.

TABLE V. CAN 7.

Section of Can.	Time From Setting.	Per Ct. of Fat.	Section of Can.	Time From Setting.	Per Ct. of Fat.
Top	at setting		Top	6¼ hours	3.00
Middle	do	4.45	Middle	do	2.70
Bottom	do		Bottom	do	2.25
Top	15 minutes	4.48	Top	7½ hours	2.78
Middle	do	4.5	Middle	do	2.65
Bottom	do	4.48	Bottom	do	2.20
Top	30 minutes	4.5	Top	8¼ hours	2.70
Middle	do	4.4	Middle	do	2.45
Bottom	do	4.45	Bottom	do	1.60
Top	45 minutes	lost	Top	9¼ hours	2.70
Middle	do	4.45	Middle	do	2.45
Bottom	do	4.42	Bottom	do	1.55
Top	1 hour	—	Top	10¼ hours	2.50
Middle	do	4.5	Middle	do	2.45
Bottom	do	3.92	Bottom	do	1.40
Top	1¼ hours	—	Top	11¼ hours	2.60
Middle	do	4.25	Middle	do	2.40
Bottom	do	4.05	Bottom	do	1.40
Middle	1¾ hours	4.25	Top	13¼ hours	2.55
Bottom	do	3.50	Middle	do	2.40
Top	2¼ hours	5.20	Bottom	do	1.40
Middle	do	3.90	Top	15¼ hours	2.45
Bottom	do	—	Middle	do	2.30
Top	3¼ hours	3.75	Bottom	do	1.20
Middle	do	3.20			
Bottom	do	2.65			
Top	4¼ hours	3.55			
Middle	do	3.00			
Bottom	do	2.30			
Top	5¼ hours	3.00			
Middle	do	2.95			
Bottom	do	2.18			

With this milk and temperature it will be noted that there was but little change after the 10¼-hour period.

In the following tables are examples of milk creamed at higher temperatures; the results are given simply to show the effect of prolonged setting in such cases. They are not given to show the incompleteness of the creaming by this process, but simply to determine if any benefit can be derived by a prolonged setting when the temperature of the water in the tank is above 49° or 50° at the time of setting.

TABLE VI.

Can VIII. Milk set at 70° in water at 52°.				Can IX. Milk set at 86°. Water 49°. 3.80% Fat at setting.			
Section of Can.	Time from Setting.	Per Cent. Fat.		Section of Can.	Time from Setting	Per Cent. Fat.	
All sections at start.....		4.30		Top.....	20 minutes	3.95	
Top.....	1½ hours	4.40		Middle.....	"	3.80	
Middle.....	"	4.20		Bottom...	"	2.10	
Bottom.....	"	2.25		Top.....	1 hour	3.75	
Top.....	3½ hours	2.40		Middle.....	"	3.45	
Middle.....	"	2.20		Bottom...	"	——	
Bottom.....	"	.45		Top.....	2 hours	3.55	
Top.....	7½ hours	1.80		Middle.....	"	2.95	
Middle.....	"	1.35	Average	Bottom...	"	1.75	
Bottom.....	"	.30	1.15	Top.....	3½ hours	2.45	
Top.....	24 hours	1.65		Middle.....	"	1.80	
Middle.....	"	1.35		Bottom...	"	1.60	
Bottom.....	"	.20	Average	Top.....	5½ hours	1.80	
			.85	Middle.....	"	1.30	
				Bottom...	"	.85	
				Top.....	9½ hours	1.25	Average
				Middle.....	"	1.00	.85
				Bottom...	"	.30	
				Top.....	24 hours	1.00	
				Middle.....	"	.80	
				Bottom...	"	.20	Average .66

In these tables the same points are to be noted as when the temperature of the water ranged from 40° to 47° F., except that the action is slower and the creaming far less perfect. At the end of 8¾ hours the average per cent of fat in the skim milk, due to the high temperature of creaming was 1.24 per cent., at the end of 25 hours it was 1.05 per cent.

The average of the eight trials when set at 47° showed that the creaming was practically completed before the end of the twelve hour period and that the skimming could then safely be done.

TABLE VII.

Can X. Milk set at 86° in water at 54°. 4.15% fat in original milk.				Can XI. Milk set at 84° in water at 54°. 4.25% fat in original milk.			
Section of can.	Time from setting.	Per cent. fat.	NOTES.	Section of can.	Time from setting.	Per cent fat.	
Top	½ hour	4.35		Top	1 hour	3.60	
Middle	do	4.20		Middle	do	3.45	
Bottom	do	3.55		Bottom	do	3.30	
Top	1 hour	3.50		Top	3 hours	3.50	
Middle	do	3.45		Middle	do	3.30	
Bottom	do	3.15		Bottom	do	2.15	
Top	2 hours	3.50		Top	5 hours	2.90	
Middle	do	3.15		Middle	do	2.85	
Bottom	do	1.60		Bottom	do	1.55	
Top	4 hours	——		Top	7 hours	2.35	Average
Middle	do	2.45		Middle	do	1.80	1.65
Bottom	do	1.40		Bottom	do	.80	
Top	6 hours	2.80		Top	27 hours	2.20	Average
Middle	do	2.20		Middle	do	1.50	1.35
Bottom	do	.60		Bottom	do	.35	
Top	8 hours	2.00					
Middle	do	1.80					
Bottom	do	.60					
Top	10 hours	1.80	Average				
Middle	do	1.60	1.30				
Bottom	do	.50					
Top	27 hours	1.55	Average				
Middle	do	1.45	1.13				
Bottom	do	.40					

In this setting no 9 or 10 hour period was taken so the results are not strictly comparable as to the closing period.

The average of 12 trials when set in water at temperatures varying from 50° to 60° F., showed that the creaming was practically completed within the same time. Although a slight gain resulted from a prolonged setting, in no case was this equal to the loss sustained for the want of a lower temperature at the beginning. A prolonged setting cannot make up for a low temperature at the time of setting.

EXPERIMENTS IN CHEESE MAKING.

HARRY SNYDER.

1. CHEESE MADE FROM NORMAL MILK RICH AND POOR IN FAT.

In cheese making, a great diversity of opinion exists as to losses of fat in working with different grades of milk. It has been claimed that when cheese is made from milk rich in fat that a large per cent of the total fat is lost in the whey, and that when the per cent of fat in the milk reaches a cer-

TABLE I.

Milk with percentages of fat ranging from 3.5 to 4.0 inclusive.

DATE.	Per cent fat in milk	Per cent fat in whey	Lbs. of Milk.	Lbs. of green cheese.
Jan. 20...	3.5	0.4	305	28.0
" 26...	3.6	0.3	"	30.
" 20...	3.7	0.4	"	27.
" 29...	3.7	0.4	"	29.
" 30...	3.7	0.3	"	29.
Feb. 3...	3.8	0.4	"	30.0
Jan. 12...	3.8	0.4	"	33.0
" 28...	3.8	0.5	"	29.0
" 23...	3.8	0.4	"	30.
" 30...	3.8	0.4	"	34.0
" 28...	3.9	0.3	"	30.
" 29...	3.9	0.3	"	29.0
" 27...	3.9	0.4	"	35.0
" 9...	3.9	0.4	"	32.0
Feb. 16...	4.0	0.4	"	——
Jan. 12...	4.0	0.4	"	34.0
" 22...	4.0	0.3	"	——
" 20...	4.0	0.4	300	30.0
" 22...	4.0	0.4	305	31.0
" 20...	4.0	0.4	300	30.0
" 12...	4.0	0.4	305	34.0
" 12...	4.0	0.4	"	34.0
" 11...	4.0	0.4	"	34.0
" 13...	4.0	0.4	"	34.
" 14...	4.0	0.3	"	33.0
" 13...	4.0	0.4	"	34.0
" 12...	4.0	0.4	"	32.0
" 18...	4.0	0.45	"	33.0
No. Trials 28.	3.85	0.38	304.7	31.46

TABLE II.

Milk with percentages of fat ranging from 4.1 to 4.4 inclusive.

DATE.	Per cent fat in milk	Per cent fat in whey	Lbs. of milk.	Lbs. of green cheese.
Jan. 19...	4.1	0.5	305	32.0
" 15...	4.1	0.3	"	31.0
Feb. 2...	4.2	0.3	"	31.0
Jan. 21...	4.2	0.4	"	32.
" 16...	4.2	0.4	"	31.0
" 14...	4.2	0.4	"	31.
" 18...	4.2	0.45	"	33.0
" 11...	4.2	0.4	"	34.0
" 14...	4.2	0.3	"	32.0
" 15...	4.2	0.3	"	32.0
" 9...	4.2	0.3	"	31.0
" 8...	4.2	0.4	"	34.0
" 15...	4.3	0.3	"	34.0
" 14...	4.3	0.3	"	34.0
" 14...	4.3	0.3	"	-35
" 15...	4.3	0.3	"	-32.0
" 9...	4.3	0.4	"	33.0
" 19...	4.3	0.4	"	32.0
" 15...	4.3	0.3	"	34.0
" 30...	4.3	0.4	"	-31
" 19...	4.3	0.4	"	32
Feb. 1...	4.4	0.3	"	35.0
Jan. 27...	4.4	0.4	"	
" 14...	4.4	0.3	"	35.0
" 23...	4.4	0.3	"	35.0
" 18...	4.4	0.4	"	34.0
" 18...	4.4	0.4	"	34.0
" 14...	4.4	0.3	"	35.0
" 16...	4.4	0.4	"	33.0
" 13...	4.4	0.4	"	33.0
" 11...	4.4	0.4	"	35.0
No. Trials 31.	4.29	0.36	305.0	32.8

tain point all the fat above that point is lost in the whey, and no more can be retained in the cheese. It is also claimed that only a small and definite per cent of fat can be utilized in cheese making. In order to obtain some knowledge upon this question, based upon actual experiments, the following work has been carried out. The cheese was made under the direction of Mr. Phillips, instructor in cheese making in the Dairy School of the University of Minnesota. In the following tables will be found grades of milk ranging from 3.5 to 5.4 per cent fat, classified in four groups together with the per cent of fat lost in whey in each case:

TABLE III.

Milk with percentages of fat ranging from 4.5 to 5.0.

DATE.	Per cent fat in milk	Per cent fat in whey	Lbs. of milk.	Lbs. of green cheese.
Jan. 13...	4.5	0.4	305	34.0
" 13...	4.5	0.4	"	34.0
" 9...	4.6	0.4	"	33.0
" 13...	4.6	0.4	"	36.0
" 11...	4.6	0.4	"	36.0
" 21...	4.6	0.4	300	32.0
" 21...	4.6	0.4	"	32.0
" 13...	4.6	0.4	305	36.0
" 11...	4.6	0.4	"	36.0
" 16...	4.6	0.4	"	33.0
" 12...	4.6	0.4	"	34.0
" 15...	4.7	0.3	"	34.0
" 25...	4.8	0.4	"	35.0
" 25...	4.8	0.4	"	——
No. Trials 14.	4.62	.39	304.3	34.2

TABLE IV.

Milk with percentages of fat ranging from 5.0 to 5.5.

DATE.	Per cent fat in milk	Per cent fat in whey	Lbs. of milk.	Lbs. of green cheese.
Jan. 23...	5.0	0.3	3 05	-36
" 23...	5.0	0.3	"	36.0
" 23...	5.0	0.3	"	-34
" 22...	5.4	0.4	"	-36
No. Trials 4.	5.10	0.32	305.0	35.5

GENERAL AVERAGES OF ALL THE GROUPS.

No. of Trials.	Milk with fat ranging from	Per cent. of fat in milk.	Per cent. of fat in whey.	Pounds of milk.	Pounds of green cheese.	Pounds of milk to make 1lb green cheese.
28	3.50-4.00	3.85	.38	304.7	31.46	9.68
31	4.10-4.40	4.29	.36	305.	32.80	9.30
14	4.50-4.90	4.62	.39	304.3	34.2	8.90
4	5.00- ——	5.05	.32	305	35.5	8.56

In these experiments, in which the cheese was made under the same conditions, the losses of fat in the whey are practically the same, whether the original milk was rich or poor in fat; and normal milks rich in fats were made into cheese without any greater percentage loss of fats in the whey, than poorer milk. It is also noted that where the milk was rich in fat it required a less number of pounds to make a pound of cheese.

INCORPORATION OF CREAM INTO CHEESE.

Inasmuch as the results of the previous experiment indicate that rich milk can be made into cheese with no greater loss of fat in the whey than poor milk, the question arises, can cream be incorporated into cheese?

This naturally resolves itself into two parts: first, can it be done; second, will it be a financial success. In this bulletin the first question alone will be discussed. In the following tables will be found in a condensed form the result of a number of experiments bearing on this question. The milk was divided into two portions, to one of which cream was added:

TABLE I.

DATE, January,	18	19	19	20	20	22	22
	Milk with cream added.	Milk with cream added.	Normal Milk.	Milk with cream added.	Normal Milk.	Milk with cream added.	Normal Milk.
Per cent of fat in milk	6.00	6.00	4.00	6.00	4.00	5.40	2.80
Pounds of milk in vat	300	300	300	300	300	300	300
Rennett test for ripeness	55	60	60	60	60	35	40
Temperature set	90	88	88	90	90	87	87
Amount of rennet used, ozs	1¼	1¼	¾	1½	¾	1.	¾
Minutes in curdling	12	25	25	14	14	8	13
Time required in raising to 120°, minutes	30	30	30	35	36	20	20
Hot iron test when dipped	⅛ in.	⅛ in.	⅛ in.	⅛ in.	⅛ in.	⅛ in.	⅛ in.
Per cent fat in whey	.40	.40	.40	.40	.40	.40	.40
Hot iron test when ground	½ in.	¾ in.	¾ in.	¾ in.	¾ in.	½ in.	½ in.
Weight of green cheese	38½	39½	32	36	30	36	28
Weight of milk per pound of cheese	7.79	5.79	9.39	8.33	10.00	8.33	10 71
Weight of whey	246	248	257	250	255	250	261

TABLE II.

Date	Kind of milk	Pounds of fat in Milk	Pounds of fat in Whey	Losses at Press. In liquids, lbs fat	Losses at Press. In solids, lbs. fat	Total lbs fat lost	Total lbs. fat recovered in cheese	No. lbs fat added in cream	No. lbs. fat added to cheese from cream	No. lbs. fat lost from cream
January 18...	creamed	18.00	.984	.072	.640	1.696	16.304	6	.....	.....
" 19...	creamed	18.00	.992	.060	.44	1.492	16.508	6	5.814	.186
" 19...	normal	12.00	1.028	.0779	.20	1.3059	10.694	0	.....	.....
" 20...	creamed	18.00	1.00	.0972	.656	1.753	16.247	6	5.73	.27
" 20...	normal	12.00	1.02	.0675	.40	1.48	10.52	0	.....	.....
" 22...	creamed	16.00	1.00	.0770	.24	1.317	14.883	7.8	7.655	.145
" 22...	normal	8.40	1.044	.0783	.05	1.172	7.228	0	.....	.....

EXPLANATION OF TABLES.—The column headed "total pounds of fat lost," includes the fat lost in the whey and at the press, both in liquids and solids; the total pounds of fat recovered is found by subtracting the total losses from the total pounds of fat in the milk. The number of pounds of fat added to the cheese from the cream is found by subtracting from the total fats in the creamed milks that of the normal milks of the same day, inasmuch as the milk was divided into two portions, to one of which cream was added and to the other it was not. The column headed "fat lost from cream," is the difference between the number of pounds of fat added to the milk as cream, and the number of pounds of fat added to the cheese from the cream.

From these tables it will be observed that by the addition of cream to milk so that the mixture contained about six per cent. fat no greater loss of fat occurred in the whey; a greater loss did result from the pressing of the creamed milks, this however, amounted to only a small per cent. of the fat added. Whether this loss will be more than balanced by the increase in the price received for this cheese yet remains to be seen.

In working with creamed milk the greatest losses are at the press, the solid material which resembles butter in appearance has a varied composition. In the column given as losses at the press, both the solids and the whey were analyzed separately, the solid matter ranges from 60 to 80 per cent. fat. The following is an example of this material, from a creamed milk, obtained at the press:

Water	13.53 per cent.
Fat	83.16 per cent.
Casein	1. per cent.
Ash and Salt	2.3 per cent.

To what extent cream can be incorporated into cheese without increasing the per cent. of loss in the whey depends largely upon the manipulation. The cheese made from creamed milk testing 7.6 per cent. fat, left in the whey .7 per cent. fat, indicating that the point in which cream can be added under the conditions in which these were made, without sustaining more than normal losses in the whey, lies somewheres between 6 and 7.6 per cent. of fat for the mixture. In each case it will be observed, where cream is added, that the weight of the green cheese obtained always exceeded that made from the same normal milk by more than the weight of the fat added to the cream.

In reviewing the tables in both of these articles on experiments in cheese making, it must be remembered that the per cent of fat left in the whey is, in a great measure, a test of the capabilities of the cheese maker and his apparatus. Daily work in the cheese factory of the dairy school shows this statement to be true among experienced makers. In working with rich milks every factoryman is urged to follow each step of his work with the test, to learn where the losses occur, then study what the causes are rather than attribute

any unusual losses to the high per cent of fat in the milk.

In these experiments an extended preliminary study was found necessary, to get all of the complicated factors under control, so that the conditions, processes and manipulations would be the same in all the different tests. All other known conditions therefore being the same, the variations in the results must be due to the variations in the per cent of fat in the milk, and the results recorded in the tables are therefore strictly comparable as to the loss of fat in the whey and at the press.

This report of the work is a summary of the results only. Complete analyses were made of the milk, whey, drippings and losses at the press both liquid and solid and determinations made of the protein compounds, sugar, ash, lactic acid, and fat in each by-product, but as these are necessarily technical in character a discussion of them is not given in this bulletin.

The whole question of the loss of fat in cheese making is one that requires careful consideration, for upon its right solution depends to a large extent the success of the factory. If it can not be demonstrated that, with normal milk, rich in fat, intelligent cheese makers can so incorporate the fat in the cheese as to leave as small a per cent of fat in the whey as with poorer milk, many patrons, owning herds of cows giving rich milk must advocate partial skimming at least. These experiments, however, seem to show that with rich milk the loss of fat in the whey is relatively less than where poor milk is used. The per cent of fat in the whey remains about constant, a little less than .4 per cent without regard to the quality of the original milk, hence the proportional loss in the whey is less with the richer milk both because there is more fat in the original milk and because there is a less proportional amount of whey. For example, in table I of the second article in the case of the 300 pounds of milk testing 2.8 per cent fat there was 261 pounds of whey, in the same weight of milk testing 5.4 per cent fat there was but 250 pounds of whey. The per cent of fat in the whey in each case was .4 per cent. The absolute loss of fat in the whey from the poor milk was 1.044 pounds while with the

rich milk it was but one pound. The absolute amount of fat in the poor milk was 8.4 pounds, while in the rich milk it was 16.2 pounds, hence the per cent of loss of the total fat of the whole milk was, in the whey of the poor milk 12.4 per cent, of the rich milk 6.25 per cent. This is one example taken from many. In the prosecution of this experiment ninety cheeses were made and the results in every case bear out the truth of the statement that the loss of fat in the whey is both relatively and absolutely larger with poor than with rich normal milk.

At the press, however, there are greater losses with the richer milk, occuring mainly in the solids of the drippings. The drippings were treated as follows: The total drippings from each cheese was caught in a stone jar and filtered through a weighed filter with slight pressure. The solids adhering to the sides of the jar were washed into the filter with portions of the filtrate. The solids and filtered whey were then weighed and analysed separately and gravimatrically. Attempts were made to dissolve this butter-like material with hot water and with chemicals but without success. In the case of the example last quoted the losses at the press from the cheese made from poor milk were .078 pounds in the liquids and .05 pounds in the solids, while with the 5.4 per cent milk, although the losses in the liquid were practically the same as with the poor milk, the loss in the solids was .24 pounds fat. Taking therefore the total fat lost in whey and drippings and dividing it by the total fat in the original milk we find that the per cent of total loss in the case of the poorer milk was 13 per cent while with the 5.4 per cent milk it was but 8.14 per cent.

The history of cheese making shows that the making of skim cheese however profitable temporarily to the individual maker is disastrous to the cheese trade of the state or section that makes the article. Any advice therefore that looks towards skimming at all should be listened to with caution. The results of these experiments tend strongly to show that, as far as the retention of the fat in the cheese is concerned there seems to be no legitimate excuse for the practice.

THE BABCOCK TEST AND CHURN.

CLINTON D. SMITH AND T. L. HÆCKER.

SUMMARY OF RESULTS.

This experiment was undertaken as a preliminary study of the question, how nearly the butter fat as indicated by the Babcock test in the whole milk of an individual cow can be accounted for in the butter, butter milk and skim milk. In the following table in which the results are tabulated, the first column contains the name of the cows under experiment; the second, the sum of the butter fat given by the cow in seven milkings as determined by the Babcock test; the third, the amount of butter fat in the butter churned from these seven milkings; the fourth, the amount of butter fat in the skim milk; fifth, the butter fat in the butter milk; sixth, the fat in the samples of the whole milk taken for analysis; seventh, the sum of the butter fat in the butter, skim milk, butter milk and samples; eighth the discrepancy between the indicated amount of butter fat in the whole milk and the amount accounted for in the products; it is marked plus when the amount found in the products exceeds the amount indicated in whole milk and minus when the latter is less than the former.

SUMMARY.

	POUNDS OF BUTTER-FAT IN						
	Whole milk.	Butter	Skim milk.	Butter milk.	Samples.	Totals.	Discrepancy.
Beckley.....	**4.731**	4.7000	.0621	.00865	.0567	**4.8274**	**+.0964**
Bess.....	**3.1562**	2.9729	.0702	.0119	.0343	**3.0893**	**—.0669**
Bess.....	**3.1427**	3.0518	.0708	.0107	.0264	**3.1597**	**+.0170**
Houston....	**5.352**	5.2635	.0719	.0064	.0568	**5.3986**	**+.0466**
Houston....	**5.0517**	4.7812	.0663	.0184	.0524	**4.9183**	**—.1334**
Maria.....	**4.6517**	4.6518	.0654	.0096	.0527	**4.7795**	**+.1278**
Olive.....	**4.302**	4.078	.0844	.0651	.0393	**4.2668**	**—.0352**
Olive.....	**4.459**	4.2903	.0783	.023	.042	**4.4336**	**—.0254**
Sully.....	**5.502**	5.218	.0981	.049	.043	**5.4081**	**—.0939**
Sw. Briar..	**5.3619**	5.337	.0739	.0189	.052	**5.4818**	**+.1199**
Sw. Briar..	**5.5001**	5.046	.0831	.0123	.0521	**5.1935**	**—.3066**
Topsy.....	**3.0654**	2.925	.0623	.0168	.0361	**3.0402**	**—.0252**
Topsy.....	**3.1867**	2.9959	.0662	.046	.0361	**3.1482**	**—.0424**

1. The bottles used in the analysis of the skim milk were graduated to one-tenth of one per cent only, but a variation of that amount in the reading would account for some of the discrepancies recorded above. As the milk was all separated by a hand centrifuge and repeated tests showed that no greater proportion of fat could be found in any of the skim milk, the column headed "butter fat in skimmilk" represents the total weight of skimmilk multiplied by the factor .001.

2. The scales on which the milk and butter were weighed are graduated to a tenth of a pound. Very much closer readings are desirable if not necessary in weighing the butter especially, as a variation of a tenth of a pound in the weight of that product would in many of the cases throw the discrepancy to the other side of the line.

3. The difficulty of taking a sample of butter for analysis that accurately represents the whole amount may account for still other of the discrepancies. Since the butter must be analyzed in any event whether the test or the churn is taken as the final arbiter in the comparison of different cows or different breeds, this factor is alike the misfortune of both methods.

4. If perceptible mechanical losses had occurred in the progress of these experiments, the sum of the fat found in the butter, skimmilk, buttermilk and samples would in every case have been less than the amount indicated in the whole milk, but the table shows that such is not the case.

5. Since the per cent of fat in the skimmilk remains about constant the total fat lost in the skimmilk is greater in the case of cows giving the larger quantity of milk. It is also relatively largest in the case of cows giving the milk poorest in fats.

6. The more exhaustive churnability of the cream as shown by the per cent of fat in the buttermilk was not in these experiments a characteristic of any one breed of cows: but here also the cow having a given amount of fat distributed through the least amount of milk, had of course the least amount of cream and buttermilk and therefore, the per cent of fat in the buttermilk remaining the same, the least absolute loss of fat therein.

7. To prevent waste of fat in the buttermilk, the cream from each cow had to be treated differently, in a manner peculiar to that cow, hence the churn is a test of the skill of the buttermaker as well as of the value of the cow.

8. In the analysis of acid skimmilk and buttermilk unless due allowance is made for the lactic acid and matters other than fat soluble in ether the usual gravimetric method is no more accurate than the Babcock test.

DETAILS OF THE EXPERIMENTS.

The cows selected for these tests were all fresh in milk. Beckley and Maria are grade Jerseys; Houston a cross-bred Guernsey-Jersey; Olive a grade Guernsey; Sweet Briar a registered Guernsey; Rose a grade Shorthorn; Bess a registered Holstein; Topsy a grade Holstein and Sully a native.

Each mess as soon as drawn from the cow was weighed and a sample weighing on the average 2 2-7 ounces taken for analysis. Seven of these samplss thus make one pound of milk and as they were thrown away their fat content is added to that of the butter, skimmilk and buttermilk as part of the fat in the whole milk not otherwise accounted for.

The milk was run through a hand centrifuge immediately after weighing, care being taken to wash all the cream from the bowl by liberal additions of skimmilk at the completion of the separation of each mess of each cow. The cream was then cooled and kept until seven milkings had accumulated when it was ripened and churned. Both the skimmilk and buttermilk were tested with the Babcock test; below is given in tabular form the detailed history of the experiment. The first column in the various tables shows the date of the milking, the second the weight of the milk, the third the per cent of fat in the milk as shown by the test, the fourth the product of the weight of milk multiplied by the per cent of fat or in other words the total fat in that milking, the fifth gives the weight of the skimmilk. As the experiment was performed in December the number in the first column designates the day of that month when the respective milkings were made.

Beckley.

Date	Whole milk, lbs.	Per cent fat	Total fat, lbs.	Skim milk, lbs.
26 p.m	12.5	6.	.75	9.4
27 a.m	13.	5.5	.715	10.8
27 p.m	11.	5.6	.616	8.3
28 a.m	11.5	5.9	.6785	8.4
28 p.m	11.	5.7	.627	7.
29 a.m	13.5	5.4	.729	10.
29 p.m	11.	5.6	.616	8.2
	83.5		4.731	62.1

Temperature of cream, 64°; time churning, 15 minutes; temperature when churned, 66°; when washed, 59°; when worked, 59°; buttermilk, 17.3 lbs.; per cent fat, .05; worked butter, 5.35 lbs; per cent fat, 87.85.

Butter fat in whole milk		4.731
" " butter	4.7000	
" " skim milk	.0621	
" " buttermilk	.0086	
" " samples	.0567	
Discrepancy		.0964
	4.8274	4.8274

Bess.

Date	Whole milk, lbs.	Per cent fat	Total fat, lbs.	Skim milk, lbs.
23 a.m	13	3.8	.494	9.4
23 p.m	13	3.7	.481	10.75
24 a.m	13.5	4.1	.5535	10.
24 p.m	13.	2.	.26	10.9
25 a.m	13	3.5	.455	9.6
25 p.m	12.75	3.6	.459	9.65
26 a.m	13.75	3.3	.4537	9.85
	92.		3.1562	70.15

Temperature of cream when churned, 64°; after churning 65°; when washed, 54°; when worked 56°; buttermilk 23.8 lbs.. per cent fat .05; worked butter 3.4 lbs., per cent fat 87.44.

Butter fat in whole milk		3.1562
" " skimmilk	.0702..	
" " buttermilk	.0119..	
" " samples	.0343..	
" " butter	2.9729..	
Discrepancy	.0669..	
	3.1562	3.1562

Bess.

Date	Whole milk, lbs.	Per cent fat	Total fat, lbs.	Skim milk, lbs.
26 p.m	13	3.3	.429	9.7
27 a.m	14.75	3.1	.4572	9.65
27 p.m	15.	2.8	.42	11.4
28 a.m	15.	1.9	.285	10.6
28 p.m	12.25	3.2	.392	8.85
29 a.m	14.75	4.2	.6195	10.65
29 p.m	13.5	4.	.54	10.
	98.25		3.1427	70.85

Temperature of cream when churned, 62°; after churning 66°; when worked, 59°; time of churning 30 minutes; buttermilk 21.5 lbs.; per cent fat .05; butter 3.45 lbs.; per cent fat 88.46.

Butter fat in whole milk		3.1427
" " butter	3.0518	
" " skimmilk	.0708	
" " buttermilk	.0107	
" " samples	.0264	
Discrepancy		.017
	3.1597	3.1597

Houston

Date	Whole milk, lbs.	Per cent fat	Total fat, lbs.	Skim milk, lbs.
23 a.m	14	5.9	.826	10.6
23 p.m	12.5	6.4	.800	9.7
24 a.m	13.75	5.4	.7425	9.95
24 p.m	13.5	5.8	.783	11.1
25 a.m	14	5.8	.812	10.9
25 p.m	13	5.8	.754	9.9
26 a.m	13.5	4.7	.6345	9.8
	94.25		5.352	71.95

Temperature of cream when churned 64°; of butter when washed 55°; when worked 59°; buttermilk, 21.6 lbs.; per cent fat .03; butter 6.05; per cent fat 87.00.

Butter fat in whole milk		5.352
" " butter	5.2635	
" " skimmilk	.0719	
" " buttermilk	.0064	
" " samples	.0568	
Discrepancy		.0466
	5.3986	5.3986

Houston.

Date	Whole milk, lbs.	Per cent fat	Total fat, lbs.	Skim milk, lbs.
27 p.m	12.5	5.5	.6875	9.
28 a.m	14.75	6.	.885	10.95
28 p.m	12.25	5.8	.7105	8.15
29 a.m	14	5.3	.742	10.6
29 p.m	12	5.8	.696	8.7
30 a.m	13.75	4.6	.6325	9.75
30 p.m	12.25	5.7	.6982	9.15
	91.5		5.0517	66.3

Temperature of cream when churned, 63°; of butter when washed 55°; when worked 59°; time of churning 35 minutes; buttermilk 18.4 lbs.; per cent fat, .1; butter 5.6 lbs.; per cent fat 85.38.

Butter fat in whole milk			5.0517
"	"	butter	4.7812
"	"	skimmilk	.0663
"	"	buttermilk	.0184
"	"	samples	.0524
Discrepancy			.1334
			5.0517 5.0517

Maria.

Date	Whole milk, lbs.	Per cent fat	Total fat, lbs.	Skim milk, lbs.
27 p.m	12.5	5.3	.6625	9.1
28 a.m	13.25	4.7	.6227	9.55
28 p.m	12.	5.4	.648	8.5
29 a.m	13.75	5.4	.7425	10.15
29 p.m	12.5	5.4	.675	9.1
30 a.m	13.5	4.9	.5615	10.
30 p.m	12.75	5.8	.7395	9.05
	90.25		4.6517	65.45

Temperature of cream when churned 64°; temperature of butter 66°; when washed 55°; when worked 58°; buttermilk 19.2 lbs.; .05% fat; time of churning 45 minutes; butter 5.3 lbs.; per cent fat, 87.77.

Butter fat in whole milk			4.6517
"	"	butter	4.6518
"	"	skimmilk	.0654
"	"	buttermilk	.0096
"	"	samples	.0527
Discrepancy			.1278
			4.7795 4.7795

Olive.

Date	Whole milk, lbs.	Per cent fat	Total fat, lbs.	Skim milk, lbs.
23 a.m	16.	4.2	.672	11.5
23 p.m	14.	4.5	.63	10.5
24 a.m	17.1	3.5	.5985	12.8
24 p.m	15.5	4.1	.6355	14.3
25 a.m	16.	3.8	.608	11.9
25 p.m	15.75	4.4	.693	11.75
26 a.m	15.5	3.	.465	11.7
	109.85		4.302	84.45

Temperature of cream when churned, 62°; time churning 40 minutes; temperature of butter 64°; when washed 56°; when worked 58°; buttermilk 21.7 lbs.; per cent fat .3; butter 4.65 lbs.; per cent fat 87.70.

Butter fat in whole milk			4.302
"	"	butter	4.078
"	"	skimmilk	.0844
"	"	buttermilk	.0651
"	"	samples	.0393
Discrepancy			.0352
			4.302 4.302

Olive.

Date	Whole milk, lbs.	Per cent fat	Total fat, lbs.	Skim milk, lbs.
26 p.m	14.75	4.2	.6195	10.95
27 a.m	16.	3.6	.576	12.
27 p.m	14.25	4.4	.627	9.85
28 a.m	15.5	3.8	.589	12.2
28 p.m	14.5	4.3	.6235	10.5
29 a.m	16.	4.4	.704	11.6
29 p.m	15.	4.8	.720	11.2
	106.		4.459	78.30

Temperature of cream 62°; time churning 30 minutes; temperature of butter, 65°; when washed 56°; when worked 60°; weight of worked butter, 4.85; buttermilk 23 lbs.; per cent of fat .1; per cent of fat in butter 88.46.

Butter fat in whole milk			4.459
"	"	butter	4.2903
"	"	skimmilk	.0783
"	"	buttermilk	.023
"	"	samples	.0420
Discrepancy			.0254
			4.459 4.459

Sully.

Date	Whole milk, lbs.	Per cent fat	Total fat, lbs.	Skim milk, lbs.
23 a.m	20.5	4.8	.984	15.1
23 p.m	18.	4.	.72	12.6
24 a.m	20.	4.	.80	14.9
24 p.m	17.25	4.6	.7935	13.05
25 a.m	19.5	4.5	.8775	15.5
25 p.m	17.5	4.	.70	12.3
26 a.m	19.	3.3	.627	14.7
	131.75		5.502	98.15

Temperature of cream when churned, 62°; time of churning 45 minutes; temperature of butter 64°; when washed, 60°; when worked 62°; buttermilk with water added to secure separation from buttermilk 49 lbs.; per cent of fat in same, .1; worked butter, 5.85 lbs.; per cent fat, 89.20.

Butter fat in whole milk.....5.502
" " butter.....5.218
" " skimmilk... .0981
" " buttermilk .049
" " samples..... .043
Discrepancy..... .0939

5.502 5.502

Sweet Briar.

Date	Whole milk, lbs.	Per cent fat	Total fat, lbs.	Skim milk. lbs.
23 a.m	16.25	5.	.8125	12.85
23 p.m	15.5	5.5	.8525	11.4
24 a.m	15.25	4.7	.7167	11.45
24 p.m	16.75	5.2	.871	13.15
25 a.m	17.25	4.6	.7935	12.65
25 p.m	16.25	5.1	.8287	10.65
26 a.m	15.25	4.1	.6252	10.95
	112.50		5.5001	83.1

Temperature of cream 64°; time of churning 33 minutes; temperature of butter 65°; when washed 55°; when worked, 58°; buttermilk 24.6 lbs.; per cent fat .05; butter 5.8 lbs.; per cent fat 87.

Butter fat in whole milk.....5.5001
" " butter 5.046
" " skimmilk... .0831
" " buttermilk .0123
" " samples..... .0521
Discrepancy..... .3066

5.5001 5.5001

Sweet Briar.

Date	Whole milk, lbs.	Per cent fat	Total fat, lbs.	Skim milk. lbs.
26 p.m	15.25	5.4	.8235	11.75
27 a.m	14.75	4.9	.7227	9.75
27 p.m	14.5	5.	.725	10.80
28 a.m	15.	5.9	.885	10.10
28 p.m	14.5	5.6	.812	10.50
29 a.m	14.5	4.6	.667	10.80
29 p.m	14.25	5.1	.7267	10.25
	102.75		5.3619	73.95

Temperature of cream, 63°; time churning 16 minutes; butter temperature 65°; when washed 62°; when worked 63°; buttermilk 18.9 lbs.; per cent fat .1; butter 5 lbs.; per cent fat 88.95.

Butter fat in whole milk.....5.4818
" " butter.....5.337
" " skimmilk... .0739
" " buttermilk .0189
" " samples..... .0520
Discrepancy.....

5.4818

Topsy.

Date	Whole milk, lbs.	Per cent fat	Total fat, lbs.	Skim milk, lbs.
23 a.m.	13.	3.9	.507	9.6
23 p.m.	11.5	3.9	.4485	8.4
24 a.m.	13.5	3.7	.4995	10.1
24 p.m.	12.5	4.	.50	9.8
25 a.m.	13.25	4.	.53	9.95
25 p.m.	12.1	3.5	.4235	8.9
26 a.m.	13.25	2.1	.2782	9.45
	89.1		3.1867	66.2

Temperature of cream, 62°; time churning, 27 minutes; butter 66°, when washed, 59°, when worked, 63°; buttermilk 23 lbs.; per cent fat, .2; butter, 3.5 lbs.; per cent fat, 86.84.

Butter fat in whole milk.....3.1867
" " butter.....2.996
" " skimmilk... .0662
" " buttermilk, .046
" " samples..... .0361
Discrepancy..... .0424

3.1867 3.1867

Topsy.

Date	Whole milk, lbs.	Per cent fat	Total fat, lbs.	Skim milk. lbs.
26 p.m	13.25	3.8	.5035	10.25
27 a.m	12.75	3.7	.4717	9.35
27 p.m	11.5	2.9	3.335	8.2
28 a.m	12.5	3.1	.3875	8.7
28 p.m	12.	4.3	.516	9.
29 a.m	12.25	3.2	.392	8.75
29 p.m	11.25	4.1	.4612	8.05
	85.5		3.0654	62.3

Temperature of cream 64°; time churning 30 minutes; butter, temperature 67°; when washed 58°; when worked 62°; buttermilk 16.8 lbs.; per cent fat .1; butter 3.25 lbs.; per cent fat 90.

Butter fat in whole milk.....			3.0654
" "	butter.....	2.925	
" "	skimmilk ..	.0623	
" "	buttermilk	.0168	
" "	samples	.0361	
Discrepancy.....		.0252	
		3.0654	3.0654