THE

MANUFACTURE OF CHEDDAR CHEESE.

By EDITH J. CANNON,

AND

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THE

MANUFACTURE OF CHEDDAR CHEESE.

As many roads may lead to the same place, so there are many ways by which it is possible to make good Cheddar cheese. The experiments, or rather observations, which were made at the Vallis Farm Cheese School of the Bath and West and Southern Counties Society last autumn were, however, confined for the time being to one system of manufacture only. Hence for their correct appreciation it is essential that this system should be clearly understood in all its details. To this end, the following description and explanation of that system has been written. We have first to deal with

THE EVENING'S MILK.—This is brought into the dairy and strained through fine muslin into the cheese-tub. The temperature of the milk when brought in varies from 91° to 87° F., and to prevent the cream rising it is necessary to gently stir the milk at intervals of 15 minutes during the first hour if the temperature of the milk or dairy is high, and at longer intervals as the milk cools. When the weather is warm, more frequent stirring is needed than when the weather is cool.

In the morning the evening's milk is skimmed, and the cream placed in the warmer with a portion of the evening's milk. This portion will vary with the time of year and the temperature of the evening's milk in the morning. In June, July, and August, about one-half will be necessary; in the spring and autumn, more than half may be necessary. This must be done before the morning's milk is strained into the tub containing the remainder of the evening's milk.

Then the quantity of milk in the tub and in the warmer should be noted, and also the temperature of each.

It is essential in cheese-making to know the quantity of milk that is being dealt with.

Without possessing this knowledge it is impossible to ascertain whether the cows are maintaining their yield, and paying for their keep; to judge whether the amount of cheese made is what it ought to be; to accurately estimate the quantity of rennet which should be used; and, generally, to conduct the many operations of cheese-making by a sure and not haphazard method. Therefore the necessity of having both the cheese-tub and warmer accurately gauged cannot be too strongly urged upon all cheese-makers.

While it is customary to find cheese-tubs with a gauge, it is seldom that the warmer has one. Yet to facilitate and ensure accuracy in cheese-making, it is advisable to have accurate gauges for both cheese-tub and warmer. The gauges should not be fixed to the tub, but made to suspend from the rim thereof, so that they can be easily removed and cleaned—or, better still, so graduated that they may be used in the centre of the tub. Those at present supplied with cheese-tubs are not graduated finely enough. They are only marked to show 5-gallon differences, whereas it would be easy to subdivide each of these divisions into 5, so as to gauge the exact number of gallons present. These marks might reach only half-way across the gauge. Greater care should also be taken to place the cheese-tub exactly horizontal; frequently there is a difference of two or more gallons in the reading of the gauge, according to its position on the tub.

HEATING EVENING'S MILK.—The first operation is to bring the whole of the milk to the correct temperature for renneting. This temperature is 84° F.

In order to estimate the temperature to which the portion of evening's milk in the warmer should be heated, it is necessary to first note the quantity of milk in the tub and its temperature. If the milk in the tub be exactly 84° F., then evidently it is only necessary to heat the portion of evening's milk in the warmer to 84° also. But if the milk be above 84°, then, in order to cool it down, the milk in the warmer must not be heated to 84°, and on the other hand it must be heated above 84° when the milk in the tub is below this temperature. The milk, however, must not be heated above 90° F., and hence it is that the quantity of evening's milk heated must depend upon the time of year, as this affects both the quantity and temperature of the milk in the tub. It is always advisable to have plenty of evening's milk in the warmer.

In order to show how to calculate the temperature to which the milk in the warmer should be raised, let us assume there are 60 gallons of milk in the tub at 83°, and 20 gallons in the warmer. Each gallon in the tub has to be raised 1 degree, which represents 60 degrees of heat, therefore the 20 gallons must be raised 3° above the temperature required so as to give these 60 degrees of heat up to the milk in the tub. The temperature required is 84°, to which add the 3° required, and we obtain 87° as the temperature to which the evening's milk must be heated.

On the other hand, if the 60 gallons were at 86° F., they would have to be lowered 2° each, or 120 degrees of heat, which is the same as lowering 20 gallons 6 degrees each. Hence the 20 gallons would be required at a temperature 6° below 84°, or at 78° F.

The rule may be stated thus. Multiply the number of gallons of milk in the tub by the number of degrees which they have to be raised or lowered, and divide the number so obtained by the gallons of milk in the warmer. The result shows the number of degrees above or below 84, to which the milk in the warmer must be brought.

Example.—There are 17 gallons of milk in warmer and 51 in tub at 82° F. The milk in the tub has therefore to be raised 2° F.

Multiply 51 × 2 = 102

Divide by 17) 102 (6
102

Add 6 to 84, and we obtain 90° as the temperature to which the 17 gallons have to be raised.

WHEY ADDED.—A certain quantity of whey, which has been reserved from the previous day's make, is now heated in the warmer to 84°, and added to the milk to ensure sufficient acidity. The quantity depends mainly upon the temperature to which the evening's milk has fallen during the night. If it remains above 70° F. in the morning, about 1 gallon of sour whey should be used; if under 70° but above 65°, from 2 to 3 gallons would be desirable. The quantity must, however, depend upon the judgment of the maker. In some instances, where the dairy is small and the milk remains at a high temperature all night, it is not necessary to add any whey. Should there have been any taint in the previous day's milk, it would be unwise to add any whey from that day's make. It will then be necessary to keep the heat in the evening's milk during the night, by covering the tub over with a cloth, not forgetting to stir so as to prevent the cream rising.

RENNETING.—The next operation is to add the necessary quantity of rennet. After adding the rennet the milk is thoroughly well stirred for 10 minutes. When the milk is very ripe—which will have been noticed if the cream tasted a little sour before being put into the warmer—a shorter period will be sufficient. The tub is then covered over, three laths being first laid across the top of it, and upon them a "wrapper" of sackcloth. This will maintain the heat in the milk and keep out dust.

MEASURING RENNET.—To use the proper quantity of rennet is one of the most important points in cheese-making. The quantity will depend upon the time of year, the composition of the milk, and the strength of the rennet. The first two can only be estimated from experience and by careful observations from day to day. The latter can be easily determined by the aid of a few instruments. It is impossible to lay too much stress upon the importance of using the correct quantity of rennet, and that this shall be pure and clean. If rennet be added in excess, a hard curd will be obtained; and when insufficient is used, a soft curd, causing white whey and a considerable loss of fat, ensues, unless the very greatest care is subsequently exercised.

A good Rennet Extract will cause 9000 times its own volume of milk to set in a firm curd in 45 minutes. Seeing then the remarkable strength of the Rennet Extract, it is most necessary to have a means of very accurately measuring out the quantity necessary.

Some cheese-makers use merely an old tea-cup, and wonder why they do not get the same results with their cheese day after day. Some use the ordinary medicine glass divided into tea-spoons, but this is not nearly accurate enough. At our suggestion, Messrs. Townson and Mercer, of 79, Bishopsgate Street, London, have made a two-ounce graduated glass cylinder-measure, having 200 divisions, each of which represents 100th part of an ounce.* With this measure it is easy to accurately measure out the necessary quantity of rennet, while to calculate what this quantity is will be very simple. Multiply the number of gallons of milk by 16, and divide by 9, the result will show the number of divisions of rennet necessary.

For example: 72 gallons of milk are in the tub, multiply this by 16, the result is 1152, which divided by 9 gives 128; and therefore 128 divisions of rennet will be required, in other words, 1·28 ounces.

This will be correct when the proportion of rennet to milk is 1 to 9000; if the proportion is to be 1 to 8800, then divide by 8·8, or if 1 to 9200, then divide by 9·2.

TESTING RENNET.—To test the strength of the rennet, proceed as follows. Take 6 oz. of milk, warm to 84° F., add 10

* It may be obtained direct from Messrs. Townson & Mercer, 79, Bishopsgate Street, London. Price about 3*s*. 6*d*., carriage paid.

divisions accurately of rennet; stir well for a second or two, and note carefully how many seconds elapse after adding the rennet before the milk sets firmly; the time will vary according to the strength of the rennet. To facilitate noting the exact time when the milk sets, a little bit of cork may be floated on the 6 oz. of milk; it will suddenly stop moving the instant the milk sets. The number of seconds which it takes to set the milk should be noted on the bottle or in a note-book.

In this way it is after a little experience easily possible to tell whether any new rennet bought is adulterated or of the same strength as the old, for if not, it will take longer for the 10 divisions of rennet to curdle the 6 oz. of milk.

CUTTING THE CURD.—The curd is ready to cut when it has attained a certain degree of firmness, which is judged by cheese-makers in various ways, some by pressure with the fingers on the top of the curd, others by the way in which the curd breaks over the finger, or, better still, over a clean glass thermometer. The curd should break with a clean fracture, and not fall away in little pieces on either side. When this consistency is obtained, the curd is "cut" with a breaker, great care being necessary to cut it evenly, thoroughly, and yet gently, so as to prevent any loss of fat. Subsequently the curd is allowed to settle until the whey has risen. The time which elapses before the whey rises and the curd is fit to break will vary nearly every day, and the whey is allowed to rise more thoroughly in autumn than in summer. When the whey rises quickly—one hour from the time of renneting—it indicates that a quite sufficient quantity of acid was present in the milk; but if the whey rises more rapidly, there was an excess of acidity; while, if it takes longer than 1 hour from time of renneting, then there was a lack of acidity, and the stirring during scald will have to be continued for a longer period than would otherwise be necessary.

BREAKING.—When the whey has properly risen, the "breaking" of the curd commences. The curd must be broken gently but evenly for half an hour, at the end of which time it should be in a uniform state of fine division, and in pieces about the size of peas.

After breaking, the curd is allowed to settle for 5 minutes. Sufficient whey is then put aside for the morrow's cheese.

FIRST SCALD.—A quantity of whey is now placed in the warmer, and heated to such a temperature that when it is again mixed with the portion in the tub the latter is raised to a temperature of 88° F. This is called the first scald. The quantity of whey heated varies from about 20 to 15 gallons, the temperature to which it is raised being 110° F.

The exact temperature required may be estimated by means of a similar calculation to that adopted with the evening's milk. Thus, if there are 60 gallons in tub and 15 in warmer, the temperature in tub is, say, 83°, hence 60 gallons have to be raised 5 degrees each, or 300 degrees of heat; the 15 gallons in the warmer must therefore be heated 20 degrees above the required 88°, or to 108° F.

While the whey is being warmed, the tub is washed round to the bottom with the hand, so as to separate any curd which may cling to the sides. The curd must be kept stirred while the whey is being heated. The hot whey having been added, the curd is well stirred for 15 minutes in it, and then allowed to pitch or settle for 5 minutes.

SECOND SCALD.—A fresh portion of whey is placed in the warmer, raised to 130°, and sufficient is gradually added to the tub to raise the contents to a temperature of 92° F. Later in the year the temperature of the second scald is raised to 94° F.

The curd is kept continually stirred in this scald until it has acquired a certain degree of firmness. This firmness is estimated by the sense of touch of the maker, some of the curd being pressed in the hand. Others use the hot-iron test. The curd should attain a condition which is technically termed "shotty." Ordinarily this condition is obtained after about 30 minutes' stirring, though sometimes it may take much longer. In fact, it cannot always be obtained, and the curd is then known as "sweet." When the curd is sufficiently hard, the contents of the tub are very rapidly stirred round into the condition of a whirlpool, so as to gather the curd into the centre. The curd is then allowed to settle for 15 minutes, but if "sweet," and not firm, it must remain for a longer period. Subsequently the whey is drawn off through a strainer into the whey leads. The curd is then "piled."

PILING CURD.—This operation consists in turning up the outer rim of curd, which lies on the bottom, and immediately around the side of the tub, and throwing it back on to the centre pile of curd, more especially around the edge, so as to build up a solid circular block of curd in the middle of the tub, the edge of which is about 6 inches from the side of the tub. The crumbs of curd in the strainer are placed on the top of the pile, and well pressed in with the hands. The curd is next cut with a knife into blocks about 6 to 8 inches square, this being about the height of the piled curd. The centre blocks having been turned over, the outer ones are placed upon them, the heap cut round with a knife, so as to remove all projecting edges, and the portions cut off placed on the top. All the crumbs are next carefully swilled down with whey from the sides of the tub and from around the pile, collected in the strainer, and then placed on the top of the pile. The piled curd is covered with thin cheese-cloths and wrappers, and the curd is allowed to drain, as a rule, until the whey drops from the tub. This will generally take from 20 to 30 minutes, or longer if the curd is "sweet." When the curd is too firm from an excess of acidity, it is sufficient to cover it when draining with thin cloths only.

RIPENING OF CURD.—The curd is next cut into six or eight blocks, one half taken to the "rack" in the "cooler," broken with the hands into small pieces, and tied up tightly in a cloth. The remaining half is treated in a similar manner, and the two bundles are then placed one on top of the other, and subjected to pressure by being covered with a tin pan reversed, on which are placed a cloth, a thick board, and a heavy weight. The weight varies from 56 lbs. to 84 lbs., according to the quantity of curd. The whole is wrapped round with cloths to keep the heat in the curd, and so promote its ripening. Should, however, the curd be "soft" from excess of acid, it is not advisable to wrap it up.

The curd is left thus for half-an-hour, during which time a certain amount of liquid drains away from it. When the curd is soft from excess of acid, from 10 to 15 minutes is sufficient.

FIRST CUTTING.—The curd is taken out of the cloth and cut with a knife vertically from N. to S. and E. to W. at distances of 1 inch, so as to produce oblong pieces of curd 1 inch square and about 4 inches in length. These are well mixed together, again tied up in the cloths, the bundles being reversed so that the upper one is placed underneath. The bundles having been treated as above described, are subjected to the same pressure for a further period of half-an-hour. Again some liquid drains away.

SECOND CUTTING.—The curd is taken out of the cloth, cut as before, then pressed down so as to lie at an angle of 45° with the cooler, and again cut across, so that each oblong piece becomes divided into three or more cubes of about 1 inch each in size. When the curd is very sweet it is cut into larger, about 2-inch cubes. The cubes are packed up as before and subjected to pressure for half-an-hour.

TURNING THE CURD.—The curd is then opened up, broken into lumps by being pressed against the rack, again tied up and subjected to the same pressure as before for half-an-hour.

This operation is repeated sometimes twice or thrice, at regular intervals of half-an-hour, except when the curd is slow to ripen, as frequently happens in the autumn. It may then be necessary to leave one hour between each turning.

The turning of the curd proceeds until it has attained the requisite degree of ripeness. The curd should then be dry and solid when cut, leathery, of good taste and smell, and sufficiently acid.

No part of the manufacture of Cheddar cheese requires more judgment, experience and natural aptitude than to determine when the curd has attained that condition in which it may be considered fit to grind.

GRINDING AND SALTING CURD.—It is then passed through the curd mill, spread on the cooler and salted. The quantity of salt used is 2½ lbs. to 112 lbs. of curd. The salt is thoroughly mixed with the curd, which is then placed in the vat, each portion as it is put in being pressed down carefully so as to pack the vat evenly.

PRESSING.—The vat is then put under the first press, pressure being applied very slowly and increased gradually until full pressure is applied. Here it is left over-night.

Next morning the cheese is removed from the first press, and dry cloths having been put on it, it is placed in the second press, under slightly greater pressure.

This operation is repeated for 3 days in succession, greater pressure being placed upon the cheese each day. At the end of 3½ days the cheese is bound, labelled, and taken to the cheese room.

Where many cheeses are made, it is advisable to have two cheese rooms for ripening the cheese. The temperature of the one to which the cheeses are first taken should be maintained as far as possible between 63° and 68° F. The second room may be cooler, with a temperature of 58° to 63° F. For three or four weeks after the cheeses are made, they must be turned every day; and subsequently they should be turned every few days until sold.

Such is a description of the method of making Cheddar cheese adopted at the School of the Bath and West and Southern Counties Society. But, in addition to a close attention to the details herein mentioned, it is essential to the production of a good cheese that the following conditions be observed.

Cleanliness.—First and foremost, it is necessary that the greatest care be taken in milking to prevent any contamination getting into the milk. And should the milk in the evening be brought into the dairy before the day's cheese has been vatted, the cheese-maker must wash her hands before touching any of the apparatus used for the evening's milk.

The apparatus and all utensils employed must be kept scrupulously clean by thorough washing and scalding, not the least trace of curd being left anywhere. Here we may mention that badly made, as also worn-out, utensils, cannot possibly be thoroughly cleansed, and must be rejected. The dairy itself must be kept clean and well ventilated, and nothing should be kept in it except what is absolutely required for the cheese-making. The floor must be well laid, and all cracks, open joints, &c., filled in with cement, and the drain should be an open one. Should any milk or whey be spilt on the floor, it must immediately be wiped up with a clean flannel or mop.

In addition to the minute attention to details which has been insisted on, it is essential that an ever-watchful intelligence should be possessed, and constant observation exercised, by every cheese-maker who aims at the rare result of producing, throughout a whole season, cheese of the best quality, at once rich, mild, and uniform in character.

Nothing short of the most exact attention to every detail herein set forth will ever secure the manufacture of cheese of this high quality.

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OBSERVATIONS

ON

CHEDDAR CHEESE-MAKING.

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ON

CHEDDAR CHEESE-MAKING.

Scope and Conditions of the Enquiry.

When I was appointed by the Council of the Bath and West and Southern Counties Society to make observations on the practice of Cheddar Cheese-making, as carried out at the Society's Cheese School, with the view, if possible, of throwing some light on the many problems which arise from time to time in a Cheese Dairy, my instructions were as follows:—

"To pay special attention to any circumstances connected with the practical work of the School which might, from time to time, be brought to my notice by the head teacher.

"To visit the School not less than once a week, and undertake, at my own laboratory, such bacteriological or other researches as might be found necessary in connection with the School.

"To provide a competent assistant to remain constantly at the School, making daily such analyses, doing such work, and keeping such records as might be considered desirable."

As this was the first official attempt to provide a scientific side to a practical Cheese School, it was regarded in the light of an experiment, to be carried on for a limited time, to deal with limited objects. It had, however, for its main object—

"(*a*) The formulating of a complete scheme of investigation of the science—of which it is not too much to say that at present very little is known—which underlies the existing practice of the best cheese-makers.

During the whole of the process of cheese-making chemical changes are constantly occurring which are very imperfectly understood; whilst the existence, development, and effect of various bacteria during the different stages of the process doubtless exercise a material influence on the cheese produced, and require to be carefully studied.

Amongst other subjects of inquiry it was desired that particular attention should be given to:—

"(*b*) Variations in quality of milk from cows feeding in different pastures.

"(*c*) Causes of defects in cheese-making from quality of milk, changes in temperature, &c.

"(*d*) Effect of temperature in ripening of cheese."

It was an essential condition that the practical teaching given at the School should not be in any way interfered with.

The Farm and Stock.

The Society's Cheese School was situated at Vallis Farm, about two miles from Frome, in a hilly part of the county of Somerset. The farm consists of about 320 acres, mostly in pasture, some of the fields being on the top of the hill, others lower down, and some in the valley. The soil is very varied, being partly clay, a good deal oolite, and a small portion mountain limestone.

The number of cows kept is fifty, and, as the fields are of very unequal size, and keep (grass) was scarce during the period of the observations, it was not possible for the cows to remain upon the same field for any length of time, though Mr. Armstrong, the tenant, willingly did all in his power to promote the object of the observations.

The cows were of somewhat varied character, being mainly cross-bred animals with both Longhorn and Shorthorn blood in them. The size of their udders was, in my opinion, small, and consequently the animals were not calculated to give a large yield of milk.

The pastures on which the cows were fed were six in number:—

The Leaze, 42 acres; Oxen Leaze, 22; Stevens, 14; Summer Leaze, 12; The Front, 10, and the Mead, 6 acres. The Oxen Leaze, Summer Leaze, and Mead, had been mown prior to the commencement of the observations. The other fields were not mown. In addition to the food which they obtained from the pastures, the younger animals, about one-third of herd, received from September 15th a mixture of 2 lbs. cotton-cake, and 2 lbs. linseed-cake each, per diem.

I. The Record of Observations.

My first duty was to draw up a scheme of observations which should leave no important operation in the manufacture of Cheddar cheese unrecorded. As each week new thoughts arose, the observations were found to be deficient in some respect or other, and each new thought necessitated the introduction of a new observation; thus it was not until the last month of the observations that the table of data could be made as complete as was found necessary.

In reproducing these tables it has been deemed desirable to give to all of them the form finally adopted, hence for the first months the records will be found incomplete. I believe that these tables, together with the tables of analyses, completely cover the whole process of Cheddar cheese-manufacture. Their chief drawback is that they are too minute for everyday use, and could not possibly be adopted except for the purpose of investigation. A condensed form of the tables might, however, with advantage, be kept in every cheese dairy, and would afford information that could not fail to be of the utmost advantage.

RECORD OF OBSERVATIONS MADE AT THE BATH A

1	2	3	4	5	6	7	8	9	10	1
	Relating to Evening's Milk.									
Day of Month.	Name of Field.	Weight of Milk.	At Night.				In Morning.			
			Time.	Temp. of Dairy.	Temp. of Milk.	Acidity.	Time.	Temp. of Dairy.	Temp. of Milk.	Acidi
		lbs.	P.M.				A.M.			
1–2	..	..	..	..	..	..	..	..	..	..
2–3	The Leaze . .	422	4.50	64	90	·20	6.30	64	68	·2
3–4	The Leaze . .	386	5.15	64	88	·21	6.35	64	67	·2
4–5	Oxen Leaze .	432	5.55	64	89	·22	6.53	62	68	·2
5–6	The Leaze . .	412	6.15	64	89	·21	6.45	62	68	·2
6–7	Oxen Leaze .	453	5.41	62	90	·21	6.53	64	67	·2
7–8	The Leaze . .	453	6.2	63	89	·21	6.45	63	68	·2
8–9	Oxen Leaze .	432	6.3	64	91	·20	7.23	63	68	·2
9–10	The Leaze . .	355	4.54	65	88	·21	7.8	64	67	·2
10–11	Oxen Leaze .	432	5.55	65	89	·21	6.32	65	68	·2
11–12	The Valley .	463	6.5	65	89	·21	6.50	64	70	·2
12–13	The Leaze . .	412	5.40	65	90	·21	6.45	65	69	·2
13–14	The Leaze . .	412	5.45	66	90	·24	7.10	66	70	·2
14–15	Oxen Leaze .	432	5.55	66	91	·23	6.31	66	70	[illegible]
15–16	The Valley .	401	5.55	64	89	·21	7.3	65	68	[illegible]
16–17	The Leaze . .	391	4.35	66	90	·24	7.15	65	67	[illegible]
17–18	Oxen Leaze .	412	5.50	65	89	·23	6.35	65	69	[illegible]
18–19	The Front . .	432	6.15	65	89	·22	6.45	64	69	[illegible]
19–20	Oxen Leaze .	401	5.50	63	87	·23	6.38	66	68	[illegible]
20–21	The Leaze . .	422	6.0	63	86	·25	7.5	62	67	[illegible]
21–22	The Front . .	381	6.0	64	89	·22	6.55	63	67	[illegible]
22–23	Oxen Leaze .	432	6.40	63	89	·24	6.45	64	68	[illegible]
23–24	The Front : .	350	5.18	62	84	·23	6.55	62	65	[illegible]
24–25	Summer Leaze.	381	6.20	63	89	·24	6.45	63	68	[illegible]
25–26	Summer Leaze .	371	6.10	63	87	·22	7.5	62	68	[illegible]
26–27	Summer Leaze.	381	5.48	63	89	·24	6.45	63	68	[illegible]
27–28	Summer Leaze.	391	5.35	63	89	·24	6.50	62	68	[illegible]
28–29	Summer Leaze.	371	5.46	62	89	·23	6.45	64	68	[illegible]
29–30	Summer Leaze.	381	5.50	62	88	·23	6.50	60	65	[illegible]
30–31	The Leaze . .	340	5.0	62	87	·22	6.50	61	64	[illegible]

EST OF ENGLAND SOCIETY'S CHEESE SCHOOL, AUGUST, 1891.

12	13	14	15	16	17	18	19	20	21	22	23
	MORNING'S MILK.			MILK HEATED.		STALE WHEY.		MIXED MILK, &c.			
										Rennet added.	
Name of Field.	Weight of Milk.	Acidity.	Total Weight of Milk.	Quantity.	Temp.	Quantity.	Acidity.	Acidity before Renneting.	Time of Renneting.	Vol.	Proportion.
	lbs.		lbs.	galls.		galls.			A.M.	ounces.	
tevens . .	..	..	970	..	84	..	..	..	7.21	1·78	8539
he Leaze .	587	·20	1009	22	83	4	·44	·23	7.20	1·82	8527
he Leaze .	551	·22	937	22	84	4	·43	·23	7.30	1·78	8180
he Leaze .	587	·24	1019	22	84	4	·47	·24	7.26	1·84	8608
he Mead .	525	·24	937	23	84	4½	·45	·24	7.25	1·71	8514
tevens . .	546	·23	999	24	84	4½	·46	·24	7.40	1·82	8527
he Leaze .	495	·24	948	22	87	4½	·45	·24	7.28	1·77	8316
he Leaze .	556	·21	988	20	89	4½	·42	·22	7.37	1·82	8440
tevens . .	561	·20	916	20	82	4½	43	·23	7.40	1·71	8327
he Front .	536	·21	968	24	82	4½	·44	·22	7.25	1·89	8000
he Front .	546	·22	1009	23	83	4½	·47	·23	7.25	1·82	8527
he Leaze .	504	·21	916	23	84	4½	·44	·23	7.25	1·64	8683
he Leaze .	548	..	960	21	82	4½	·46	·25	7.20	1·61	9242
he Leaze .	515	·23	947	21	82	4½	·49	·24	7.28	1·68	8726
he Front .	484	·24	885	24	82	4½	·50	·25	7.16	1·61	8545
he Leaze .	569	·26	960	21	82	4½	·48	·24	7.30	1·71	8655
he Leaze .	566	·24	978	22	84	4½	·47	·23	7.39	1·71	8888
						lbs.					
he Leaze .	474	·24	906	22	86	30	·47	·25	7.25	1·56	9025
he Mead .	557	·22	958	23	83	30	·46	·29	7.29	1·78	8471
he Leaze	505	·24	927	22	90	30	·46	·25	7.30	1·66	8674
he Leaze .	504	·22	885	21	86	30	·41	·26	7.30	1.64	8391
he Mead .	484	·21	916	22	87	30	·44	·25	7.45	1·66	8578
he Leaze .	546	·22	896	20	84	30	·46	·26	7.30	1·62	8592
he Leaze .	525	·23	906	22	84	30	·47	·25	7.22	1·66	8481
he Leaze .	546	·24	917	23	84	30	·48	·25	7.32	1·66	8578
he Leaze .	546	·25	927	..	80	30	·49	·24	7.28	1·70	8470
he Leaze .	556	·22	947	23	80	30	·47	·24	7.36	1·72	8558
he Leaze .	525	·24	896	22	84	30	·50	·25	7.25	1·62	8592
he Leaze .	484	·22	865	21	88	30	·49	·26	7.40	1·56	8614
tevens . .	515	·22	855	17	86	30	·49	·24	7.25	1·52	8736

RECORD OF OBSERVATIONS MADE AT THE BATH AND WE

	24	25	26	27	28	29	30	31	32	33	34	3
						Temp. of Scald.				Relating to Whey.		
Day of Month.	Time when Curd cut.	Acidity of Whey before Breaking.	Time of Breaking.	Acidity of Whey put aside.	Time Scalding commences.	1st.	2nd.	Time taken in Stirring.	Time in Scald.	Temp. when drawn.	Acidity.	Acid of drai ing fr pile Curd
	A.M.		A.M.		A.M.			min.	h. m.			
1–2	8.6	..	..	·15	9.25	88	92	..	1.45	90	·25	·3
2–3	8.6	·15	8.40	·17	9.37	88	92	..	1.46	89	·24	·3
3–4	8.18	·15	8.41	·16	9.36	88	92	..	1.54	89	·26	·4
4–5	8.12	·16	8.43	·17	9.43	88	92	..	1.54	89	·29	·3
5–6	8.12	·15	8.34	·16	9.31	88	92	..	1.54	89	·25	·3
6–7	8.37	·16	8.52	·16	9.47	88	92	..	1.53	89	·25	·3
7–8	8.15	·16	8.42	·17	9.35	88	92	..	1.52	89	·24	·3
8–9	8.24	·15	8.48	·21	9.40	88	92	..	1.50	90	·22	·2
9–10	8.27	·15	8.50	·16	9.58	88	92	..	1.29	90	·24	·3
10–11	8.12	·16	8.35	·16	9.31	88	92	..	1.45	90	·25	·3
11–12	8.10	·16	8.35	·17	9.30	88	92	..	1.52	89	·26	·3
12–13	8.12	·16	8.45	·17	9.37	88	92	..	1.55	89	·30	·4
13–14	8.7	·17	8.37	·18	9.35	88	92	..	1.40	90	·29	·3
14–15	8.15	·16	8.45	·18	9.40	88	92	..	1.40	90	·26	·3
15–16	8.3	·16	8.35	·17	9.25	88	92	..	1.40	89	·25	·3
16–17	8.15	·16	8.55	·18	9.45	88	92	..	1.55	89	·27	·3
17–18	8.25	·17	8.50	.18	9.34	88	92	..	1.40	89	·25	·3
18–19	8.10	·17	8.35	·17	9.25	88	92	..	1.40	90	·26	·3
19–20	8.15	·16	8.40	·17	9.37	88	93	..	1.50	90	·24	·3
20–21	8.15	·14	8.45	·15	9.40	88	94	..	1.50	91	·22	·3
21–22	8.15	·15	8.46	·16	9.40	88	94	..	1.55	91	·28	·3
22–23	8.30	·15	9.5	·16	9.53	88	94	..	1.47	90	·24	·3
23–24	8.18	·15	8.50	·17	9.40	88	94	..	2.0	90	·23	·4
24–25	8.10	·16	8.40	·17	9.34	88	94	..	1.56	90	·28	·4
25–26	8.18	·17	8.43	·17	9.32	88	94	..	1.28	91	·24	·3
26–27	8.15	·16	8.35	·17	9.27	88	94	30	1.30	91	·24	[illegible]
27–28	8.27	·17	8.43	·18	9.33	88	94	33	1.27	91	·26	[illegible]
28–29	8.13	·18	8.35	·18	9.25	88	94	42	1.35	91	·23	[illegible]
29–30	8.26	·17	8.57	·18	9.48	88	94	38	1.32	91	·22	[illegible]
30–31	8.12	·17	8.40	·17	9.30	88	94	52	1.50	91	·23	[illegible]

F ENGLAND SOCIETY'S CHEESE SCHOOL, AUGUST, 1891.—*Contd.*

36	37	38	39	40	41	42	43	44	45	46	47	48
			Acidity of Whey during Treatment of Curd.								Salt added.	
Time Curd emains piled.	Time Curd is taken from Tub.	Temp. of Curd when taken from Tub.	When taken to Cooler.	After 1st Cutting.	After 2nd Cutting.	After 1st Turning.	After 2nd Turning.	After 3rd Turning.	After 4th Turning.	Acidity of curd when Milled.	Weight.	Per centage.
min.											lbs. oz.	
..	..	..	..	..	·60	·83	·90	·97	..	..	2 4	..
..	..	..	·49	·67	·80	·89	·97	..	..	..	2 4	..
..	..	..	·49	·61	·79	·85	·91	1·00	..	..	2 2	2·07
..	..	..	·52	·67	·85	·87	·92	·98	..	..	2 5	2·16
..	..	..	·45	·56	·72	·74	·81	·91	..	..	2 2	2·10
..	..	..	·54	·69	·78	·79	·90	..	..	..	2 4	2·10
..	..	..	·42	·52	·58	·70	·78	·78	..	..	2 2	2·08
..	..	..	·49	·60	·73	·80	·88	·88	..	1·90	2 3	2·10
..	..	..	·46	·53	·74	·83	·83	·92	..	1·70	2 2	2·09
..	..	..	·49	·63	·73	·80	·86	·92	..	3·20	2 3	2·10
..	..	..	·52	·64	·81	·87	·88	..	..	2·95	2 5	2·10
..	..	..	·50	·63	·76	·83	·94	..	..	3·85	2 2	2·08
..	..	..	·50	·66	·82	·94	·94	..	..	4·70	2 3	2·10
..	..	..	·53	·67	·82	·84	·89	..	..	3·60	2 2	2·06
..	..	..	·49	·60	·75	·78	·90	..	..	3·70	2 0	2·00
..	..	..	·46	·57	·69	·74	·83	·91	..	3·80	2 3	2·13
..	..	..	·48	·65	·78	·90	..	..	..	3·50	2 4	2·06
..	..	..	·48	·63	·73	·80	·95	..	..	3·50	2 2	2·08
..	..	..	·43	·60	·77	·80	·90	·94	..	3·00	2 3	2·10
..	..	..	·47	·60	·73	·74	·77	·91	..	3·20	2 2	2·04
..	..	..	·46	·57	·69	·77	·77	1·04	..	2·90	2 1	2·06
..	..	..	·49	·67	·84	·85	·93	1·07	..	2·90	2 2	2·07
..	..	..	·50	·66	·76	·76	·93	1·05	..	2·80	2 1	2·09
..	..	..	·53	·72	·79	·90	..	..	..	3·20	2 3	2·06
..	..	..	·49	·65	·81	·89	..	..	..	3·10	2 3	2·06
30	..	..	·50	·67	·83	·93	..	..	..	3·50	2 4	2·10
23	..	..	·51	·67	·80	·91	..	..	..	3·60	2 5	2·24
34	..	..	·49	·63	·74	·92	..	..	..	..	2 3	2·04
30	..	..	·45	·63	·77	·84	..	..	..	3·50	2 2	2·07
30	..	..	·51	·65	·75	·90	..	..	..	3·40	2 2	2·14

RECORD OF OBSERVATIONS, AUGUST, 1891.—*Continued.*

	49	50	51	53	54	55	56		57		58		59	
	Relating to Curd.			Relating to Cheeses.										
							Temp. of Cheese Room.				Hygrometer Reading.			
Day of Month.	Temp. in Vat.	Weight when Vatted.	Time of Vatting.	Acidity of liquid from Press.	Weight taken to Cheese Room.	Loss in Press.	Morning.		Evening.		Morning.		Evening.	
							Min.	Max.	Min.	Max.	Dry.	Wet.	Dry.	Wet.
		lbs.	P.M.	per cent.	lbs.	lbs.								
1–2	78	..	5.50	..	98	..	..	..	..	..	..	..	..	..
2–3	73	..	5.30	1·06	104½	..	..	..	..	..	..	..	..	..
3–4	74	102½	6.15	1·08	98½	4	..	..	..	..	..	..	..	..
4–5	74	107	5.30	1·11	104	3	..	..	..	..	..	..	..	..
5–6	72	101	5.45	1·10	97	4	..	..	..	..	..	..	..	..
6–7	75	107	5.5	1·02	101	6	..	..	..	..	..	..	..	..
7–8	72	102	8.30	1·11	99	3	64	66	64	66	..	..	..	..
8–9	73	104	5.30	·92	100	4	62	67	63	67	..	..	..	..
9–10	74	101½	6.20	1·02	96	5½	62	67	62	67	..	..	..	..
10–11	75	104	5.55	1·02	98½	5½	63	67	63	66	..	..	..	..
11–12	75	110	4.30	1·01	105	5	64	66	63	70	..	..	..	..
12–13	76	102	4.10	1·12	99	3	64	68	64	68	..	..	..	..
13–14	77	104	4.10	1·10	98½	5½	65	68	65	69	..	..	..	..
14–15	75	103	4.20	1·00	98½	4½	66	70	67	69	..	..	..	..
15–16	76	100	4.30	1·01	95½	4½	64	69	65	69	..	..	..	..
16–17	73	102½	5.30	1·10	98	4½	65	69	66	68	..	..	..	..
17–18	78	109	3.15	1·05	104	5	63	66	63	66	..	..	..	..
18–19	78	102	3.30	1·08	96½	5½	63	66	64	67	..	..	..	..
19–20	74	104	4.50	1·10	99½	4½	60	66	60	64	..	..	..	..
20–21	74	104	5.30	1·09	98½	5½	60	63	60	65	..	..	..	..
21–22	72	100	5.40	1·15	95½	4½	62	64	60	64	..	..	..	..
22–23	72	102½	5.15	1·10	96½	6	61	63	60	65	..	..	..	..
23–24	74	98½	5.20	1·15	94	4½	62	63	62	65	..	..	..	..
24–25	74	106	3.35	1·15	101½	4½	61	62	61	63	..	..	..	..
25–26	77	106	3.15	1·03	100	6	60	62	..	..	..	..	..	..
26–27	76	107	3.0	1·08	101	6	60	65	61	69	63	61	64	62
27–28	77	103	2.50	1·15	99	4	60	64	60	65	61	60	64	61
28–29	74	107	3.20	1·07	101½	5½	60	63	60	64	61	59	64	62
29–30	74	102½	3.25	1·08	96	6½	58	64	59	64	62	59	65	61
30–31	75	99	3.15	1·08	94	5	60	65	61	65	62	60	63	61

RECORD OF ANALYSES—AUGUST.

August.	Composition of Mixed Milk.							Composition of Whey.			Composition of Curd.			
	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	Ash.
2–3	..	..	..	..	..	..	..	..	..	..	38·16	61·84	..	2·04
3–4	..	..	..	..	..	..	..	..	..	..	39·10	60·90	..	1·94
4–5	..	..	..	..	..	..	..	..	..	..	40·98	59·02	..	1·96
5–6	..	..	..	..	..	..	..	..	..	..	41·38	58·62	..	..
6–7	87·86	12·14	3·36	2·62	·38	5·00	·78	6·76	·33	·61	40·80	59·20	..	..
7–8	87·58	12·42	3·71	2·56	·39	..	..	6·76	..	·48	..	..	..	..
8–9	87·68	12·32	3·61	2·84	·36	4·71	·80	6·93	·30	·70	40·58	59·42	..	..
9–10	87·24	12·76	4·04	2·51	·36	..	..	7·04	·38	·58	40·80	59·20	..	2·05
10–11	87·68	12·32	3·53	2·69	·34	4·96	·80	6·81	·27	·59	41·40	58·60	..	2·05
11–12	87·32	12·68	3·95	2·71	·36	4·88	·78	6·92	·38	·61	41·05	58·95	..	..
12–13	..	..	..	..	..	..	..	6·89	·36	·68	41·95	58·05	..	1·90
13–14	87·82	12·18	3·61	2·69	·35	4·73	·80	6·84	·21	·62	42·00	58·00	..	2·05
14–15	87·66	12·34	3·67	2·67	·39	4·81	·80	6·83	·31	·59	40·85	59·15	..	2·05
15–16	87·10	12·90	4·17	2·57	·37	5·01	·78	7·03	·30	·67	40·95	59·05	..	2·05
16–17	87·62	12·38	3·72	2·68	·36	4·82	·80	6·99	·32	·62	40·90	59·10	..	2·05
17–18	87·28	12·72	4·09	2·76	·33	4·76	·78	7·01	·29	·59	40·80	59·20	..	2·05
18–19	87·40	12·60	3·86	2·93	·40	4·65	·76	6·96	·40	·60	40·95	59·05	..	2·15
19–20	87·42	12·58	3·89	2·96	·33	4·62	·78	7·02	·35	·46	41·45	58·55	28·05	..
20–21	87·46	12·54	3·79	2·90	·42	4·69	·74	7·01	·35	·65	41·00	59·00	27·90	2·10
21–22	87·20	12·80	3·93	2·81	·36	4·96	·74	7·05	·29	·59	40·50	59·50	..	..
22–23	87·44	12·56	3·91	2·75	·37	4·85	·68	6·99	·29	·59	41·45	58·55	29·83	2·05
23–24	87·46	12·54	3·85	2·77	·37	4·79	·76	6·99	·32	·63	40·75	59·25	28·80	2·10
24–25	87·02	12·98	4·20	2·84	·37	4·83	·74	7·02	·32	·60	41·10	58·90	28·31	2·05
25–26	87·24	12·76	4·00	2·58	·39	5·05	·74	6·95	·30	·59	40·85	59·15	..	2·15
26–27	87·24	12·76	3·94	2·91	·38	4·77	·76	7·08	·36	·62	40·70	59·30	..	2·05
27–28	87·38	12·62	3·82	2·85	·40	4·81	·74	6·74	·35	·58	41·05	58·95	..	2·10
28–29	87·16	12·84	4·10	2·88	·38	4·70	·78	6.78	·34	·60	..	..	..	..
29–30	87·00	13·00	4·08	2·94	·39	4·81	·78	7·06	·41	·61	42·05	57·95	..	2·20
30–31	87·14	12·86	4·00	2·87	·39	4·82	·78	7·02	·39	·57	41·10	58·90	..	2·10
Average	87·39	12·61	3·87	2·76	·37	4·84	·77	6·94	·33	·60	40·91	59·09	28·58	2·06

RECORD OF OBSERVATIONS MADE AT THE BATH AND WI

1	2	3	4	5	6	7	8	9		10	1
	Relating to Evening's Milk.										
			At Night.				In Morning.				
Day of Month.	Name of Field.	Weight of Milk.	Time.	Temp. of Dairy.	Temp. of Milk.	Acidity.	Time.	Temp. of Dairy.		Temp. of Milk.	Aci
		lbs.	P.M.				A.M.	min.	max.		
31–1	The Leaze . .	371	5.50	62	88	·24	6.55	..	62	66	[illegible]
1–2	Oxen Leaze .	371	5.36	61	88	·24	6.50	..	62	68	[illegible]
2–3	Front . . .	412	6.25	61	90	·23	7.0	..	58	69	[illegible]
3–4	Oxen Leaze .	391	6.40	61	90	·22	6.50	..	60	69	[illegible]
4–5	The Leaze . .	412	5.45	60	89	·22	6.55	60	62	70	[illegible]
5–6	Oxen Leaze .	412	6.35	60	89	·23	6.57	60	61	69	[illegible]
6–7	The Leaze . .	340	5.20	60	88	·22	7.15	60	62	67	[illegible]
7–8	The Leaze . .	453	7.45	61	86	·21	6.50	61	62	73	[illegible]
8–9	The Leaze . .	412	5.55	60	88	·21	7.2	59	64	77	[illegible]
9–10	Mixed Fields .	412	7.5	59	88	·21	7.0	62	65	74	[illegible]
10–11	Oxen Leaze .	412	6.55	61	88	·21	6.58	61	66	72	[illegible]
11–12	Leaze . . .	412	7.15	61	88	·22	6.57	61	66	73	[illegible]
12–13	Summer Leaze	422	6.40	63	94	·20	6.50	62	66	72	[illegible]
13–14	Mixed Fields .	350	5.10	63	92	·21	7.2	63	67	..	..
14–15	Mixed Fields .	381	6.20	62	88	·21	6.56	61	65	70	[illegible]
15–16	Mixed Fields .	381	5.55	62	89	·20	7.3	61	64	70	[illegible]
16–17	Mixed Fields .	401	5.50	61	90	·21	7.4	61	63	71	[illegible]
17–18	Oxen Leaze .	350	5.55	62	91	·20	7.10	61	63	74	[illegible]
18–19	Mixed Fields .	350	5.45	64	87	·20	7.2	64	66	70	[illegible]
19–20	Oxen Leaze .	371	5.55	63	90	·21	7.10	62	65	71	[illegible]
20–21	The Front . .	329	4.40	62	89	·20	7.8	60	63	..	[illegible]
21–22	Oxen Leaze .	360	5.50	60	88	·22	6.55	58	61	66	[illegible]
22–23	Oxen Leaze .	371	5.45	61	89	·21	7.5	58	61	71	[illegible]
23–24	Oxen Leaze .	360	5.48	60	90	·21	7.8	57	61	66	[illegible]
24–25	Oxen Leaze .	360	6.0	60	90	·20	7.2	59	62	69	[illegible]
25–26	The Front . .	329	6.12	61	90	·20	6.55	60	63	72	[illegible]
26–27	Oxen Leaze .	360	6.15	62	90	·21	7.0	59	62	69	[illegible]
27–28	The Front . .	278	4.55	62	87	·20	7.0	58	62	70	[illegible]
28–29	Oxen Leaze .	350	6.55	60	88	·20	7.8	59	61	68	[illegible]
29–30	Oxen Leaze .	310	5.50	61	89	·21	..	60	62	..	[illegible]

F ENGLAND SOCIETY'S CHEESE SCHOOL, SEPTEMBER, 1891.

12	13	14	15	16	17	18	19	20	21	22	23
MORNING'S MILK.				HEATING MILK.		STALE WHEY.		MIXED MILKS, &c.			
										Rennet added.	
Name of Field.	Weight of Milk.	Acidity.	Total Weight of Milk.	Quantity.	Temp.	Quantity added.	Acidity.	Acidity before Renneting.	Time of Renneting.	Vol.	Proportion.
	lbs.		lbs.	galls.		lbs.			A.M.	ounces.	
tevens . .	453	·23	824	18	87	30	·48	·24	7.24	1·48	8648
he Mead .	494	·23	865	18	82	30	·50	·25	7.23	1·44	9333
eaze . .	453	·23	865	21	86	30	·49	·24	7.32	1·44	9333
tevens . .	464	·21	855	18	84	30	·43	·23	7 32	1·42	9352
tevens . .	443	·21	855	18	84	30	·44	·22	7.35	1·42	9352
he Mead .	463	·22	875	19	84	30	·41	·22	7.48	1·44	9444
tevens . .	484	·21	824	14	84	30	·40	·27	7.27	1·40	9142
lixed Fields	402	·21	855	17	85	30	·42	·22	7.36	1·44	9222
he Leaze .	453	·21	865	27	86	30	·46	·21	7.35	1·44	9333
tevens . .	412	·22	824	20	84	30	·42	·21	7.34	1·38	9274
he Leaze .	463	·19	875	18	85	30	·41	·21	7.39	1·44	9444
he Leaze .	425	·19	835	17	94	30	·40	·19	7.38	1·39	9553
he Leaze .	453	·20	875	17	84	30	·43	·21	7.36	1·44	9444
he Leaze .	515	·19	865	none	..	none	..	·21	7.40	1·43	9398
tevens . .	432	·21	813	18	84	30	·40	·21	7.33	1·38	9159
he Leaze .	474	·22	855	18	84	none	..	·21	7.35	1·43	9286
he Leaze .	441	·21	844	18	84	none	..	·22	7.35	1·42	9239
he Leaze .	474	·23	824	none	..	none	..	·25	7.31	1·39	9208
lixed Fields	453	·24	803	17	76	10	·52	·23	7.26	1·36	9176
he Leaze .	442	·22	813	16	80	10	·45	·22	7.30	1·37	9226
tevens . .	454	·22	783	20	86	20	·47	·21	7.29	1·31	9282
he Leaze .	423	·21	783	17	86	20	·45	·22	7.36	1·35	9007
he Leaze .	391	·21	762	20	86	20	·44	·22	7.24	1·32	8969
he Leaze .	402	·23	762	15	86	20	·39	·23	7.42	1·31	9038
he Leaze .	433	·20	793	14	84	20	42	·22	7.32	1·33	9263
he Leaze .	381	·21	710	17	85	20	·42	·23	7.28	1·32	8363
he Leaze .	392	·22	752	16	85	25	·42	·24	7.37	1·26	9261
he Leaze .	442	·23	710	17	85	20	·45	·24	7.32	1·20	9200
he Leaze .	391	·21	741	17	84	20	·46	·22	7.38	1·24	9209
he Leaze .	390	..	700	..	..	40	·45	·23	6.37	1·22	8918

RECORD OF OBSERVATIONS MADE AT THE BATH AND W[

	24	25	26	27	28	29	30	31	32	33	34
						Temp. of Scald.				RELATING TO WH[	
Day of Month.	Time when Curd cut.	Acidity of Whey before Breaking.	Time of Breaking.	Acidity of Whey put aside.	Time Scalding commences.	1st.	2nd.	Time taken in Stirring.	Time in Scald.	Temp. when drawn.	Acidity.
	A.M.		A.M.		A.M.			min.	h. m.		
31–1	8.12	·16	8.40	·16	9.32	88	94	45	1.40	91	·24
1–2	8.9	·15	8.35	·16	9.30	88	95	60	1.55	92	·25
2–3	8.18	·16	8.40	·18	9.35	88	94	30	1.25	92	·24
3–4	8.17	·16	8.40	·15	9.35	88	94	52	1.50	91	·23
4–5	8.20	·15	8.45	·15	9.37	88	94	45	1.33	92	·19
5–6	8.35	·14	9.2	·15	9.50	89	94	60	1.45	91	·20
6–7	8.13	·13	8.33	·15	9.20	88	94	60	1.50	91	·21
7–8	8.23	·14	8.37	·14	9.32	88	94	50	1.38	91	·20
8–9	8.20	·14	8.40	·15	9.30	88	94	55	1.40	91	·21
9–10	8.18	·14	8.42	·16	9.34	88	94	39	1.32	92	·22
10–11	8.25	·14	8.50	·15	9.35	88	94	60	1.53	91	·23
11–12	8.25	·14	8.45	·15	9.35	88	94	42	1.32	92	·22
12–13	8.22	·15	8.30	·17	9.20	89	93	30	1.12	92	·25
13–14	8.25	·13	8.59	·14	9.50	89	93	65	1.55	91	·23
14–15	8.20	·15	8.40	·16	9.32	88	93	60	1.52	91	·26
15–16	8.35	·13	9.15	·14	10.5	88	94	65	2.1	91	·20
16–17	8.21	·14	8.42	·18	9.32	88	94	55	1.38	91	·27
17–18	8.17	·17	8.30	·19	9.25	88	94	25	1.15	92·5	·29
18–19	8.13	·15	8.40	·15	9.30	88	94	48	1.38	91·5	·19
19–20	8.17	·14	8.40	·16	9.28	88	94	60	1.48	91	·25
20–21	8.18	·14	8.45	·15	9.36	88	94	33	1.24	92	·23
21–22	8.13	·14	8.37	·14	9.28	88	94	60	1.50	91	·23
22–23	8.12	·14	8·40	·15	9.30	89	95	60	1.50	92	·23
23–24	8.28	·13	8.58	·15	9.45	88	94	62	1.52	91	·21
24–25	8.18	·14	8.45	·15	9.35	88	94	60	1.55	91·5	·24
25–26	8.18	·15	8.40	·16	9.30	89	95	62	1.55	91·5	·24
26–27	8.23	·16	8.50	·16	9.38	88	94	60	1.57	91	·26
27–28	8.20	·15	8.50	·16	9.37	89	94	60	1.43	91	·25
28–29	8.27	·15	8.55	·16	9.42	88	94	60	1.52	91	·23
29–30	7.22	·15	7.47	·16	8.30	88	96	60	1·30	94	·25

F ENGLAND SOCIETY'S CHEESE SCHOOL, SEPTEMBER, 1891—*contd.*

36	37	38	39	40	41	42	43	44	45	46	47		48
			Acidity of Whey during Treatment of Curd.								Salt Added.		
ime urd mains lled.	Time Curd is taken from Tub.	Temp. of Curd when taken from Tub.	When taken to Cooler.	After 1st Cutting.	After 2nd Cutting.	After 1st Turning.	After 2nd Turning.	After 3rd Turning.	After 4th Turning.	Acidity of Curd when Milled.	Weight.		Per centage.
nin.											lbs.	oz.	
15	..	..	·47	·63	·86	·89	..	..	..	3·40	2	1	2·11
33	..	..	·59	·69	·83	·95	..	..	..	3·40	2	2	2·12
18	..	..	·47	·66	·72	·93	·98	..	..	3·30	2	2	2·15
17	12.5	..	·49	·66	·74	·81	·97	..	..	3·90	2	1	2·10
30	12.4	92	·59	·67	·73	·87	1·02	..	..	3·30	2	1	2·21
30	12.30	91	·49	·67	·86	·98	1·05	..	..	3·50	2	2	2·18
35	12.5	90	·51	·66	·81	·94	·98	..	..	3·20	2	0	2·18
30	12.7	91	·49	·62	·75	·91	·97	..	..	3·40	2	1	2·22
30	12.5	..	·51	·65	·80	·90	·93	..	..	3·30	2	1	2·19
23	11.50	92	·53	·76	·85	·95	..	..	..	3·30	2	0	2·17
25	12.25	90	·60	·78	·88	..	..	..	..	3·20	2	2	2·27
28	11.55	91	·50	·59	·68	·76	·89	..	..	3·10	2	0	2·21
12	11.6	91	·48	·58	·67	·80	·84	·90	..	3·50	2	1	2·22
25	12.35	90	·47	·55	·64	·76	·86	·88	93 5th 1·06	3·50	2	0	2·22
12	12.5	89	·56	·71	·83	·94	1·10	..	..	3·60	1	14	2·06
60	1.35	88	·35	·42	·50	·72	·73	·82	·87	3·10	2	0	2·13
15	11.48	89	·61	·70	·80	·89	1·04	..	..	4·91	2	0	2·08
15	11.15	89	·61	·65	·81	·87	..	..	..	4·10	2	0	2·11
37	12.4	90	·47	·59	·71	·79	·87	·90	·98	3·20	1	12	1·93
20	11.55	91	·57	·70	·80	·90	1·05	..	..	3·40	2	0	2·10
15	11.40	93	·46	·50	·62	·72	·72	·83	·90	3·80	1	14	2·07
15	12.2	90	·52	·57	·73	·85	·87	·98	..	3·50	1	14	2·03
25	12.10	91	54	·60	·71	·78	·83	·94	..	3·50	1	13	2·04
30	12.34	91	·52	·59	·72	·79	·88	·92	..	3·50	1	13	2·09
40	12.35	92	·60	·68	·73	·88	·96	·99	..	4·20	1	14	2·15
24	12.10	91	·55	·60	·70	·85	·87	·95	..	3·70	1	12	2·13
17	12.20	91	·62	·68	·78	·85	·97	..	..	3·50	1	14	2·10
29	12.20	90	·52	·52	·71	·80	·88	1 01	..	4·40	1	12	2·07
35	12.30	92	·59	·66	·77	·84	·98	1·06	..	4·50	1	14	2·10
35	11.11	93	..	..	..	..	..	..	..	..	..		..

RECORD OF OBSERVATIONS, SEPTEMBER, 1891—*continued.*

	49	50	51	53	54	55	56		57		58		59	
	RELATING TO CURD.			RELATING TO CHEESES.										
							Temp. of Cheese Room.				Hygrometer Reading.			
Day of Month.	Temp. in Vat.	Weight when Vatted.	Time of Vatting.	Acidity of Liquid from Press.	Weight taken to Cheese Room.	Loss in Press.	Morning.		Evening.		Morning.		Evening.	
							Min.	Max.	Min.	Max.	Dry.	Wet.	Dry.	Wet.
		lbs.	P.M.	per cent.	lbs.	lbs.								
31–1	74	97½	3.5	1·04	92	5½	62	63	61	66	63	61	65	61
1–2	74	100	3.18	1·06	93½	6½	61	65	60	64	62	59	64	62
2–3	73	98½	3.32	1·08	93	5½	59	64	59	62	61	58	64	61
3–4	75	98	3.53	1·08	91	7	60	64	60	64	61	59	64	62
4–5	73	93	4.15	1·09	88	5	60	64	60	66	61	59	65	62
5–6	74	97½	4.20	1·21	93	4½	60	64	60	64	62	59	65	62
6–7	75	91½	4.0	1·14	87½	4	61	64	62	66	63	62	65	63
7–8	76	92½	3.55	1·08	88½	4	62	65	61	64	63	61	64	62
8–9	76	94	3.57	1·07	88½	5½	62	69	62	66	65	61	63	61
9–10	77	92	2.55	1·06	88½	3½	64	69	63	..	66	62	..	..
10–11	78	93½	2.58	·99	91	2½	65	70	65	71	66	62	71	68
11–12	76	90½	3.35	1·01	87½	3	65	71	64	69	71	68	68	65
12–13	75	92½	3.25	1·04	90	2½	67	72	66	72	68	65	72	69
13–14	72	90	7.48	1·05	88	2	68	73	66	71	68	66	66	61
14–15	75	91	3.50	1·21	89½	1½	61	66	65	70	67	61	65	62
15–16	71	93½	10.17	·91	90	2½	60	66	61	64	62	59	63	61
16–17	75	96	3.20	1·18	93½	2½	62	66	62	65	63	61	66	66
17–18	77	94½	1.25	1·05	92	2½	63	65	62	66	64	62	63	61
18–19	73	90½	7.55	1·04	87	3½	63	67	65	68	66	65	67	65
19–20	75	95	3.38	1·13	90	5	64	66	63	67	65	64	67	64
20–21	71	90½	5.5	1·16	87	3½	61	66	60	63	63	61	62	59
21–22	71	92½	5.10	1·11	88½	4	58	61	57	62	59	57	60	58
22–23	72	88½	5.15	1·10	84	3½	57	63	58	63	60	58	62	59
23–24	72	86½	6.15	1·16	82	4½	59	64	59	65	61	59	62	60
24–25	75	87	6.15	1·18	82½	4½	61	62	61	65	62	60	63	62
25–26	71	82	5.45	1·19	77	5	60	63	62	65	62	60	63	61
26–27	73	89	5.3	1·14	84	5	58	63	59	64	60	59	64	61
27–28	72	84½	5.48	1·14	79½	5	58	63	58	64	60	58	64	62
28–29	73	89	4.57	1·21	83	6	59	64	59	64	61	60	64	62
29–30	76	84	1.40	1·23	78½	5½	..	..	..	..	..	..	..	..

September.	Composition of Mixed Milk.							Composition of Whey.			Composition of Curd.			
	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	Ash.
31–1	86·86	13·14	4·24	2 95	·35	4·74	·76	7·04	·32	·61	41·80	58·20	..	1·80
1–2	86·90	13·10	4·34	2·89	·38	4·71	·78	7·01	·33	·61	40·60	59·40	..	..
2–3	87 00	13·00	4·22	2·88	·43	4·71	·76	7·03	·35	·62	40·25	59·75	..	2·35
3–4	87·04	12·96	4·18	2·62	·40	5·00	·76	7·00	·34	·64	40·80	59·20	..	2·20
4–5	87·20	12·80	4·09	2·83	·40	4·70	·78	6·99	·38	·53	40·20	59·80	..	2·40
5–6	86 94	13·06	4·31	2·94	·39	4·64	·78	7·07	·30	·63	40·90	59·10	..	2·25
6–7	87·04	12·96	4·20	3·02	·44	4·50	·80	7·05	·30	·62	40·00	60·00	..	2·25
7–8	87 28	12·72	4·00	2·89	·48	4·57	·78	7·03	·32	·63	40·50	59·50	..	1·75
8–9	87·06	12·94	4·13	2·83	·39	4·81	·78	7·05	·31	·63	41·25	58·75	..	2·00
9–10	87·04	12·96	4·22	3·06	·44	4·44	·80	7·05	·35	·64	41·00	59·00	..	1·95
10–11	87·18	12·82	4·09	2·96	·50	4·49	·78	6·95	·37	·62	40·95	59·05	..	2·05
11–12	87·22	12·78	4·03	3·04	·39	4·52	·80	6·97	·33	·63	40·35	59·65	..	2·00
12–13	87·20	12·80	4·07	2·95	·32	4·66	·80	7·14	·41	·61	41·80	58·20	..	2·00
13–14	87·40	12·60	3·85	..	..	..	·78	6·90	·32	·62	39·90	60·10	..	2·08
14–15	87·16	12·84	3·98	2·91	·38	4·79	·78	6·92	·37	·63	42·10	57·90	..	1·90
15–16	87·12	12·88	3·75	2·93	·45	4·99	·76	6·96	·33	·59	39·50	60·50	..	2·80
16–17	87·34	12·66	3·75	3·19	·44	4·52	·76	7·02	·29	·63	43·20	56·80	28·60	1·60
17–18	86·88	13·12	4·28	2·92	·42	4·72	·78	6·78	·26	·64	41·80	58·20	29·05	1·65
18–19	86·94	13·06	4·06	3·00	·34	4·88	·78	7·11	·41	·63	40·15	59·85	28·52	2·15
19–20	86·96	13 04	4·17	2·88	·35	4·86	·78	6·97	·31	·61	41·15	58·85	29·16	1·80
20–21	86·60	13·40	4·32	3·00	·36	4·92	·80	7·16	·39	·60	42·00	58·00	29·70	1·95
21–22	87·00	13·00	4·10	3·02	·42	4·68	·78	6·99	·30	·62	40·80	59·20	29·18	1·90
22–23	86·72	13·28	4·18	3·06	·41	4·85	·78	6·91	·33	·61	40·75	59·25	29·24	2·00
23–24	86·80	13·20	4·15	3·10	·44	4·75	·76	7·11	·30	·63	40·25	59·75	29·52	2·05
24–25	87·20	12·80	4·01	3·16	·38	4·45	·80	7·09	·31	·60	40·60	59·40	27·60	2·00
25–26	86·76	13·24	4·26	3·05	·44	4·71	·78	6·99	·31	·61	39·60	60·40	28·78	1·95
26–27	86·80	13·20	4·15	3·17	·47	4·65	·76	6·94	·35	·62	39·80	60·20	..	1·90
27–28	86·58	13·42	4·34	3·29	·46	4·55	·78	6·98	·30	·59	41·30	58·70	..	1·95
28–29	86·66	13·34	4·38	3·02	·37	4·81	·76	6·89	·42	·62	41·25	58·75	..	1·95
29–30	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Average	87·00	13·00	4·13	2·99	·41	4·69	·78	7·00	·34	·62	40·85	59·15	28·93	2·02

RECORD OF OBSERVATIONS MADE AT THE BATH AND WE

1	2	3	4	5	6	7	8	9		10
	Relating to Evening's Milk.									
			At Night.				In Morning.			
Day of Month.	Name of Field.	Weight of Milk.	Time.	Temp. of Dairy.	Temp. of Milk.	Acidity per Cent.	Time.	Temp. of Dairy.		Temp. of Milk.
		lbs.	P.M.				A.M.	min.	max.	
30–1	Oxen Leaze .	319	6.2	59	89	·21	7.5	60	61	68
1–2	Oxen Leaze .	329	6.10	59	89	·20	7.5	57	61	70
2–3	Oxen Leaze .	278	6.10	59	86	·21	6.45	57	59	68
3–4	Mixed Fields .	288	5.45	58	88	·21	7.8	55	60	69
4–5	Mixed Fields .	257	5.4	55	86	·21	7.6	56	59	71
5–6	Oxen Leaze .	309	6.8	56	87	·21	7.10	56	59	71
6–7	Oxen Leaze .	278	6.3	58	85	·21	..	56	59	66
7–8	Oxen Leaze .	278	6.35	57	86	·21	6.55	55	59	72
8–9	Oxen Leaze .	288	6.0	55	89	·21	6.56	57	59	69
9–10	Mixed Fields .	298	5.50	58	88	·21	7.0	58	60	69
10–11	Oxen Leaze .	278	5.55	59	87	·21	7.5	57	61	68
11–12	Oxen Leaze .	226	4.27	60	85	·20	7.3	56	61	65
12–13	Oxen Leaze .	246	5.45	60	86	·20	7.0	55	59	69
13–14	Oxen Leaze .	236	5.55	59	86	·20	7.15	56	59	70
14–15	Mixed Fields .	246	6.2	59	87	·21	7.2	56	58	65
15–16	Mixed Fields .	236	5.47	60	85	·20	7.3	56	58	64
16–17	Oxen Leaze .	247	5.40	58	87	·22	7.2	53	58	65
17–18	Oxen Leaze .	247	5.53	58	87	·21	7.7	54	58	63
18–19	Oxen Leaze .	226	4.55	57	84	·20	7.8	54	57	63
19–20	Oxen Leaze .	247	6.12	58	84	·20	7.15	54	57	64
20–21	Mixed Fields .	247	5.54	58	85	·20	7.26	54	57	70
21–22	Mixed Fields .	237	5.47	59	84	·20	7.30	55	58	63
22–23	Oxen Leaze .	247	6.5	59	85	·21	7.8	54	57	63
23–24	The Front . .	237	6.10	58	86	·20	7.0	53	58	63
24–25	The Front . .	206	6.35	58	85	·21	7.6	52	57	62
25–26	The Front . .	154	4.15	57	86	·20	7.15	52	55	59
26–27	The Front . .	216	5.50	61	87	·21	7.12	58	64	65
27–28	Oxen Leaze .	226	5.46	65	88	·20	7.25	58	65	66
28–29	The Front . .	206	5.50	66	87	·21	7.22	57	65	64
29–30	The Front . .	206	6.10	67	88	·20	7.25	58	67	70
30–31	Oxen Leaze .	196	6.0	68	88	·20	7.15	57	64	67

ENGLAND SOCIETY'S CHEESE SCHOOL, OCTOBER, 1891.

12	13	14	15	16	17	18	19	20	21	22	23
Morning's Milk.				Milk Heated.		Stale Whey.		Mixed Milks, &c.			
										Rennet added.	
ame of Field.	Weight of Milk.	Acidity.	Total Weight of Milk.	Quantity.	To Temp.	Quantity.	Acidity.	Acidity before Renneting.	Time of Renneting.	Vol.	Proportion.
	lbs.		lbs.	galls.		lbs.			A.M.	ounces.	
ne Leaze .	402	..	721	15	86	20	·46	·23	7.30	1·22	9190
ne Leaze .	330	·20	659	17	90	40	·44	·22	7.26	1·10	9309
ne Leaze .	370	·21	648	16	85	20	·45	·22	7.20	1·09	9247
ne Leaze .	381	·20	669	16	86	40	·40	·21	7.27	1·12	9285
ne Leaze .	402	·20	659	16	85	20	·42	·21	7.33	1·11	9225
ne Leaze .	350	·21	659	16	86	20	·40	·21	7.37	1·10	9309
ne Leaze .	350	..	628	13	87	20	·41	·21	7.34	1·08	9037
ne Leaze .	329	·20	607	16	89	20	·41	·21	7.32	1·04	9076
ne Leaze .	350	·20	638	15	84	20	·40	·21	7.34	1·08	9185
ne Leaze .	309	·22	607	14	84	20	·40	·22	7.35	1·02	9254
he Leaze .	299	·21	577	13	85	20	·42	·22	7.26	·98	9142
ne Leaze .	330	·20	556	14	85	20	·43	·22	7.22	·94	9191
he Leaze .	269	·20	515	15	90	20	·42	·21	7.23	·86	9302
he Leaze .	309	·21	545	17	90	20	·42	·21	7.22	·92	9217
ixed Fields	269	·21	515	13	88	20	·43	·23	7.23	·85	9411
ne Leaze .	289	·21	525	14	88	20	·41	·21	7.27	·86	9488
he Leaze .	309	·20	556	14	92	20	·41	·22	7.23	·94	9191
ne Leaze .	298	·21	545	12	90	20	·39	·21	7.32	·92	9217
he Leaze .	330	·20	556	12	90	20	·40	·21	7.39	·94	9191
ne Leaze .	278	·21	525	14	90	20	·40	·21	7.33	·88	9273
ne Leaze .	268	·21	515	15	90	20	·39	·22	7.32	·86	9302
ne Leaze .	267	·21	504	13	90	20	·40	·21	7.40	·84	9333
ne Leaze .	237	·20	484	15	90	20	·39	·22	7.56	·82	9170
ne Leaze .	216	·20	453	12	90	20	·39	·21	7.40	·78	9025
ne Leaze .	257	·21	463	13	90	20	·39	·21	7.44	·79	9113
ne Leaze .	288	·20	442	10	89	20	·38	·21	7.40	·74	9297
ne Leaze .	206	·20	422	12	90	20	·39	·21	7.58	·72	9111
ne Leaze .	175	·20	401	10	92	20	·40	·21	7.54	·67	9313
ne Leaze .	165	·21	371	15	90	20	·40	·21	7.42	·62	9290
ne Leaze .	165	·20	371	14	90	20	·41	·20	7.30	·62	9290
ne Leaze .	175	·21	371	14	91	20	·39	·21	7.28	·62	9290

RECORD OF OBSERVATIONS MADE AT THE BATH AND WES[T]

	24	25	26	27	28	29	30	31	32	33	34	35
						Temp. of Scald.				RELATING TO WHE[Y]		
Day of Month.	Time when Curd cut.	Acidity of Whey before breaking.	Time of breaking.	Acidity of Whey put aside.	Time Scalding commenced.	1st.	2nd.	Time taken in Stirring.	Time in Scald.	Temp. when drawn.	Acidity per Cent.	Aci[d] … drain… fr…
	A.M.		A.M.		A.M.			min.	h. m.			
30–1	8.17	·15	8.40	·15	9.27	88	94	63	1.46	91	·21	
1–2	8.25	·15	8.52	·15	9.45	88	94	60	1.55	92	·25	
2–3	8.5	·15	8.40	·15	9.27	88	95	60	1.48	91	·20	
3–4	8.15	·13	8.45	·14	9.30	88	94	60	1.45	91	·20	
4–5	8.17	·14	8.46	·14	9.32	88	94	63	1.53	90	·20	
5–6	8.23	·13	9.0	·14	9.49	88	94	60	1.56	91	·22	
6–7	8.20	·13	9.0	·14	9.51	88	94	60	1.55	90	·22	
7–8	8.32	·14	9.6	·14	9.55	88	95	60	1.48	91	·20	
8–9	8.20	·13	8.48	·15	9.36	88	94	60	1.49	91	·21	
9–10	8.12	·13	8.45	·13	9.30	88	94	60	2.5	90	·20	
10–11	8.13	·14	8.45	·15	9.34	87	95	65	1.49	91	·22	
11–12	8.10	·13	8.50	·14	9.40	88	95	60	1.50	90	·23	
12–13	8.15	·13	9.0	·14	9.50	87	96	60	2.10	91	·21	
13–14	8.8	·13	8.55	·15	9.47	88	94	60	1.50	90	·21	
14–15	8.10	·13	9.0	·15	9.55	88	94	60	1.55	90	·23	
15–16	8.26	·14	9.10	·14	10.3	88	94	60	1.47	90	·22	
16–17	8.26	·13	9.5	·15	9.57	88	94	60	1.53	89	·24	
17–18	8.35	·14	9.17	·15	10.8	88	94	60	1.45	90	·22	
18–19	8.45	·14	9.20	·14	10.15	88	95	60	1.45	90	·23	
19–20	8.37	·13	9.10	·14	10.5	88	94	60	1.50	90	·24	
20–21	8.35	·13	9.12	·14	10.7	88	96	60	1.50	91	·22	
21–22	8.48	·13	9.30	·14	10.20	88	94	60	2.5	88	·21	
22–23	9.0	·13	9.30	·14	10.22	88	96	62	1.58	90	·20	
23–24	8.46	·13	9.32	·14	10.25	88	94	60	2.5	88	·23	
24–25	8.45	·13	9.33	·14	10.27	87	93	60	2.1	86	·21	
25–26	8.45	·13	9.32	·14	10.20	87	97	60	2.2	91	·20	
26–27	8.58	·13	9.40	·14	10.35	88	96	60	2.10	90	·23	
27–28	8.56	·13	9.31	·13	10.18	88	95	60	1.58	89	·21	
28–29	8.43	·13	9.38	·15	10.28	88	97	60	1.48	91	·23	
29–30	8.30	·13	9.14	·14	10.3	87	96	60	2.2	88	·21	
30–31	8.28	·13	9.10	·14	9.57	88	96	60	1.43	89	·21	

F ENGLAND SOCIETY'S CHEESE SCHOOL, OCT., 1891—*contd.*

36	37	38	39	40	41	42	43	44	45	46	47	48
ime urd mains iled.	Time Curd is taken from Tub.	Temp. of Curd when taken from Tub.	Acidity of Whey during Treatment of Curd. When taken to Cooler.	After 1st Cutting.	After 2nd Cutting.	After 1st Turning.	After 2nd Turning.	After 3rd Turning.	After 4th Turning.	Acidity of Curd when milled.	Salt Added. Weight.	Percentage.
nin.											lbs. oz.	
37	12.11	91	·50	·55	·67	·78	·92	·96	1·08	3·80	1 13	2·10
27	12.27	92	·56	·61	·68	·82	·92	1·00	..	3·80	1 10	2·03
37	12.7	91	·48	·54	·68	·83	·90	·96	..	3·60	1 10	1·99
34	12.7	90	·45	·56	·67	·79	·98	..	..	3·20	1 11	2·05
45	12.32	91	·50	·50	·67	·80	·90	1·00	..	3·10	1 10	2·01
37	12.50	91	·61	·67	·78	·90	·95	1·08	..	2·90	1 10	2·01
30	12.40	90	·50	·57	·70	·84	·99	1·04	..	3·20	1 9	2·00
35	12.40	91	·49	·58	·72	·89	·95	1·04	..	3·40	1 8	1·97
36	12.20	90	·52	·59	·85	·85	·94	·97	1·15	3·70	1 10	2·08
35	12.30	90	·46	·54	·73	·88	·97	1·05	..	3·30	1 9	2·11
30	12.11	91	·50	·55	·70	·92	·93	..	..	3·60	1 8	2·08
30	12.13	90	·51	·59	·72	·89	·98	1.05	..	3·70	1 7	2·11
30	12.55	90	50	·57	·74	·88	·98	..	..	3·60	1 6	2·03
43	12.43	89	·57	·64	·77	·90	·98	1·04	..	3·70	1 7	2·08
30	12.45	89	·56	·59	·74	·86	·98	1·07	..	3·60	1 6	2·05
32	12.47	89	·55	·58	·75	·90	1·01	1·05	..	3·70	1 7	2·10
30	12.40	89	·52	·56	·77	·92	1·05	1·06	..	3·30	1 8	2·14
25	12.40	90	·52	·57	·71	·79	·98	..	..	3·40	1 7	2·09
25	12.52	90	·46	·52	·72	·89	1·05	1·06	..	2·80	1 8	2·17
30	12.48	89	·50	·55	·68	·87	·87	1·04	..	2·80	1 6	2·02
36	12.55	90	·54	·56	·78	·84	·92	1·00	1·08	2·60	1 6	2 09
35	1.20	88	·47	·59	·73	·85	·89	·92	..	2·80	1 6	2·16
35	1.22	90	·55	·58	·72	·79	·87	1·00	1·07	2·90	1 5	2·20
30	1.25	88	·56	·59	·65	·78	·92	·95	1·02	2·70	1 4	2·05
40	1.30	88	·47	·56	·66	·83	·98	..	..	2·60	1 4	2·05
34	1.20	91	·50	·54	·70	·86	·89	1·00	..	2·70	1 3	2·13
32	1.38	90	·43	·45	·66	·75	·96	1·06	..	2·80	1 2	2·08
35	1.13	90	·59	·62	·74	·84	·97	..	..	2·60	1 2	2·06
37	1.8	90	·59	·70	·83	·87	·95	..	..	2·90	1 1	2·16
30	12.53	88	·47	·53	·70	·75	·80	·90	·94	2·80	1 1	2·23
35	12.40	89	·53	·57	·57	·73	·75	·80	..	2·90	1 1	2·28

RECORD OF OBSERVATIONS, OCTOBER, 1891—*continued.*

	49	50	51	53	54	55	56		57		58		59	
	Relating to Curd.			Relating to Cheeses.										
Day of Month.	Temp. in Vat.	Weight when Vatted.	Time of Vatting.	Acidity of liquid from Press.	Weight taken to Cheese Room.	Loss in Press.	Temp. of Cheese Room. Morning.		Evening.		Hygrometer Readings. Morning.		Evening.	
							Min.	Max.	Min.	Max.	Dry.	Wet.	Dry.	Wet.
		lbs.	P.M.	Per cent.	lbs.	lbs.								
30–1	71	86	8.0	1·23	81½	4½	59	63	61	64	61	59	62	60
1-2	71	80	6.15	1·20	75	5	57	61	58	62	58	57	60	58
2–3	72	81½	4.48	1·13	77½	4	56	61	58	61	58	56	61	59
3-4	70	82	5.30	1·15	76	6	55	60	56	61	58	56	62	60
4-5	70	80½	6·17	1·15	75½	5	56	60	56	63	58	56	60	58
5-6	70	80½	6·17	1·05	75½	5	55	61	58	62	58	56	60	68
6–7	70	78	7.0	1·23	73	5	56	60	56	60	58	56	60	58
7–8	70	76	6.30	1·22	70	6	56	59	56	61	58	56	60	59
8–9	70	78	8.15	1·34	72	6	58	60	55	60	60	59	59	57
9–10	72	74	6.10	1·32	69	5	57	61	56	58	60	59	58	56
10–11	73	72	4·27	1·18	68	4	58	63	59	63	60	59	61	60
11–12	70	68	5.37	1·25	65	3	56	60	56	62	58	57	62	60
12–13	70	67½	5.40	1·27	63	4½	56	61	56	59	58	57	59	57
13–14	70	69	5.34	1·29	66	3	56	58	56	58	58	56	58	57
14–15	70	67	5.45	1·24	64	3	56	57	55	58	57	55	58	56
15–16	69	68	5.50	1·33	64	4	55	57	54	58	56	55	58	56
16–17	69	70	6.5	1·37	65	5	54	58	53	60	55	53	58	56
17–18	69	68½	5.15	1·26	66½	2	52	58	52	58	54	52	58	56
18–19	68	69	6.25	1·28	65	4	54	57	54	60	56	55	58	56
19–20	69	68	6.20	1·16	64	4	53	57	54	59	56	55	57	55
20–21	68	65½	7.35	1·17	61	4½	54	59	55	60	58	57	58	57
21–22	68	63½	7.20	1·18	61	2½	53	60	54	59	58	57	57	55
22–23	66	59½	10.10	1·29	56	3½	54	63	53	58	56	54	58	56
23–24	67	61	7.5	1·35	57½	3½	54	61	52	58	56	55	56	54
24–25	67	61	6.2	1·20	57	4	56	62	54	59	56	55	58	57
25–26	69	55½	8.55	1·21	52½	3	53	63	55	60	60	59	58	56
26–27	72	54	7.40	1·21	49	5	54	59	53	60	58	57	59	57
27–28	73	54½	4.40	1·16	49	5½	54	62	55	60	57	55	58	57
28–29	74	49	4.27	1·16	45	4	53	59	54	59	58	57	59	57
29–30	70	47½	6.7	1·17	44	3½	54	61	53	60	59	57	58	57
30–31	70	46½	6.18	1·22	43	3½	50	59	54	60	58	56	57	55

October.	Composition of Mixed Milk.							Composition of Whey.			Composition of Curd.			
	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	Ash.
30–1	86·52	13·48	4·44	3·13	·45	4·68	·78	7·09	·24	·60	40·85	59·15	..	2·00
1–2	86·64	13·36	4·34	2·76	·52	4·98	·76	7·01	·35	·60	40·45	59·55	..	1·95
2–3	86·20	13·80	4·70	2·97	·51	4·84	·78	6·67	·26	·59	40·80	59·20	..	1·95
3–4	86·54	13·46	4·33	2·95	·49	4·89	·80	6·87	·43	·57	40·15	59·85	..	2·00
4–5	86·74	13·26	4·27	3·20	·46	4·55	·78	6·90	·35	·57	39·35	60·65	..	2·05
5–6	86·58	13·42	4·26	3·05	·48	4·87	·76	7·06	·40	·60	40·85	59·15	..	..
6–7	..	..	..	..	..	..	..	6·66	·35	·65	39·90	60·10	..	..
7–8	86·50	13·50	4·47	3·21	·48	4·56	·78	6·92	·30	·62	37·45	62·55	..	..
8–9	86·64	13·36	4·44	3·36	·54	4·24	·78	6·82	·44	·67	38·90	61·10	..	..
9–10	86·70	13·30	4·35	3·10	·32	4·77	·76	7·05	·33	·64	39·05	60·95	..	..
10–11	86·54	13·46	4·46	3·28	·48	4·48	·76	6·51	·45	·62	41·15	58·95	..	1·80
11–12	86·42	13·58	4·62	3·13	·50	4·57	·76	6·86	·53	·60	40·35	59·65	..	1·65
12–13	85·94	14·06	5·02	3·23	·48	4·55	·78	6·95	·46	·63	40·75	59·25	..	1·75
13–14	86·02	13·98	4·93	3·40	·38	4·53	·74	7·21	·41	·61	40·60	59·40	..	1·65
14–15	85·78	14·22	5·14	3·26	·47	4·57	·78	6·84	·60	·60	40·30	59·70	..	1·80
15–16	86·22	13·78	4·64	3·26	·56	4·58	·74	6·75	·55	·62	40·45	59·55	..	1·65
16–17	86·22	13·78	4·64	3·26	·50	4·60	·78	6·83	·43	·59	41·45	58·55	27·75	1·85
17–18	86·34	13·66	4·54	3·30	·48	4·58	·76	6·96	·49	·60	40·90	59·10	29·10	1·85
18–19	86·26	13·74	4·71	3·23	·49	4·53	·78	6·87	·51	·60	40·95	59·05	25·60	1·80
19–20	86·06	13·94	4·84	3·26	·49	4·57	·78	6·87	·47	·62	40·85	59·15	23·05	1·65
20–21	85·94	14·06	4·98	3·20	·46	4·66	·76	6·86	·47	·61	40·00	60·00	27·75	1·85
21–22	86·22	13·78	4·77	3·24	·42	4·57	·78	6·97	·31	·61	41·30	58·70	29·20	1·80
22–23	86·14	13·86	4·72	3·15	·45	4·80	·74	6·75	·51	·60	40·25	59·75	26·65	1·80
23–24	85·86	14·14	5·07	3·26	·51	4·54	·76	6·91	·55	·61	40·50	59·50	..	1·65
24–25	86·00	14·00	4·91	3·25	·31	4·79	·74	7·06	·53	·61	42·60	57·40	..	1·75
25–26	85·86	14·14	5·05	3·31	·33	4·67	·78	7·18	·62	·63	40·45	59·55	..	1·65
26–27	85·70	14·30	5·20	3·25	·53	4·56	·76	6·79	·60	·63	40·90	59·10	..	1·65
27–28	85·82	14·18	5·12	3·26	·54	4·48	·78	6·91	·48	·60	40·90	59·10	..	1·80
28–29	85·66	14·34	5·25	3·37	·50	4·46	·76	7·25	·42	·64	40·60	59·40	..	1·65
29–30	85·84	14·16	5·16	3·35	·49	4·38	·78	6·93	·49	·62	40·80	59·20	..	1·65
30–31	85·78	14·22	5·11	3·35	·51	5·51	·74	6·87	·49	·61	39·45	60·55	..	1·70
Average	86·19	13·81	4·75	3·21	·47	4·61	·77	6·91	·44	·61	40·43	59·57	27·01	1·78

EXPLANATION OF THE TABLES.

It will now be advisable to explain these tables, and to facilitate reference thereto the columns have been numbered, and these numbers will be used in all subsequent references.

Col. 3.—The milk was not weighed, but the weight calculated from the number of gallons as estimated by the usual tub gauge. Those who wish to convert these pounds into gallons have merely to divide by 10·3.

Cols. 5, 6, &c. *Temperatures.*—The temperature of the milk, whey, cheese, &c., was taken with an accurate solid glass thermometer. The temperature of the rooms was read from thermometers suspended from the walls, which register of themselves the maximum and minimum temperatures reached between one reading and the next, at each reading the thermometer being reset by the aid of a magnet.

Cols. 7, 11, 14, &c. *Acidity.*—The figures in these columns give the percentage of acid (lactic acid) present in the liquids tested. These, the most important determinations recorded, were made in the following manner:—

There is a chemical substance called Phenol-phthalein produced from carbolic acid, which, when dissolved in water, or, better still, alcohol, gives a perfectly clear, colourless solution.

If a trace of washing-soda be added to this solution it immediately turns a bright crimson colour; if, subsequently, some sour whey be added, the crimson colour gradually disappears until at last a point is reached when the liquid has just lost its colour and yet has scarcely become white. This indicates that the liquid is neither alkaline, from the presence of soda, nor acid, from the presence of whey, but is in a condition which, being neither acid nor alkaline, is termed by chemists "neutral." Therefore the solution of Phenol-phthalein is called an "Indicator," for if the liquid is turned crimson it indicates the presence of an alkaline substance, like ammonia or soda; if white, it indicates the presence of an acid, such as lactic acid. If then to some whey about five drops of the solution of Phenol-phthalein be added, no change in colour will take place because the whey is acid. But if, from a graduated measure termed a burette, a solution of soda be now gradually added to the whey, as each drop enters, a pink colour is produced, which, however, disappears on stirring the whey; but a point is finally reached when the colour no longer disappears, for the acid in the whey will now be neutralised. The burette is divided into twenty equal divisions, marked one to twenty, each of which is subdivided into ten parts; the quantity of soda required can thus be estimated very accurately. If then the solution of soda be so made that each division represents a certain percentage of lactic acid, we have a simple means of estimating the quantity of acid present. Such a solution is called a "standard solution."

In our operations, as is usual with chemists at the present day, the French system of measurements was adopted. A standard solution of caustic soda was employed, each cubic centimetre of which would exactly neutralise one-hundredth of a gramme (·01) of lactic acid. In all estimations ten cubic centimetres of milk or whey were taken for the test. If, therefore, this ten cubic centimetres took two divisions or cubic centimetres of soda to neutralise it, then it contained two-hundredths of a gramme of lactic acid, and there would therefore be two-tenths of a gramme in one hundred cubic centimetres, in other words, two-tenths per cent. (·20). Therefore, using ten cubic centimetres of the liquid to be tested, and a solution of caustic soda of this strength, each division or cubic centimetre of soda used represented ·1 per cent. of lactic acid, and each of the smaller divisions represented one one-hundredth (·01) per cent.

To facilitate the exact reading of the standard solution the burette contains a white float having a black line upon it, which float rises and falls with the liquid in the burette. Given the necessary solutions and the apparatus, the determination of acidity is very simple, and was made frequently not only by Miss Cannon, the Teacher, but also by several of the pupils, all of whom showed the greatest interest in the determination. I think that such determinations might easily be made by any one who has sufficient skill to make Cheddar cheese.

There are, however, several difficulties which would have to be guarded against. 1. The solution of caustic soda must be absolutely accurate, and would have to be prepared by a competent chemist; other standard solutions are, however, at present sold, and, should there be any demand, this also would be supplied. 2. The chief difficulty lies in the fact that a solution of caustic soda, if exposed to the air, loses its strength. This, however, can be, and is, prevented in the chemist's laboratory by means of certain precautions which would have to be adopted in dairies in which the solution was employed.

With the consent of the Committee, I purpose next season to supply the School with the apparatus necessary for determining the acidity during the progress of the cheese-making, and such as I hope may subsequently be found capable of introduction into cheese dairies generally. While this will enable the pupils to learn the method of estimating acidity, it will also enable me to find out what difficulties are liable to arise in its more general application, and, if possible, to remedy them. I do not think it would be advisable for cheese-makers who have had no instruction, nor experience, in the determination of acidity to introduce this test into their dairies until it has had a fair trial by those who have received the necessary instruction in its application.

Cols. 7 and 14.—It is somewhat remarkable that the milk immediately after it was drawn from the cows should have invariably shown so high a proportion of acidity. We cannot look upon this as being lactic acid, nor was it, as I proved by experiment, carbonic acid. Milk is known to contain acid salts, and, until further investigation can be made into this very interesting subject, we must assume that these explain the results obtained.

Col. 11.—The small rise in the acidity of the evening's milk by the following morning is also striking. It is partly and probably due mainly to the dairy being lofty, well ventilated, and cool, to say nothing of the care with which the milk was looked after by Miss Cannon. Thus on September 17th there was a slight taint in the whey, so that none was kept over for the next day's make, and it was therefore determined to keep the heat in the evening's milk so as to ripen it, the result being that the acidity rose from ·20 to ·25 during the night.

Cols. 16, 17, 18, 19, 22.—Full information regarding these data will be found in the paper by Miss Cannon and myself on "The Manufacture of Cheddar Cheese."

The temperature of milk when rennet was added was, in every single instance throughout the three months, exactly 84° F.

Col. 23.—These figures represent the number of parts of milk by volume to which one part of rennet was added. They are obtained by multiplying the number of gallons of milk by 160 to convert them into fluid ounces, and dividing by the amount of rennet taken.

Example, August 27 :—

```
Milk            ..     90      gallons.
                       160
                      ------
Rennet ounces  1·7)  14400·0  (8470
                      136
                      ----
                        80
                        68
                       ----
                        120
                        119
                        ----
                         10
```

This proportion is of considerable interest, and the lessons to be learnt from it are of the utmost importance, as will be seen in the subsequent portion of this report. A rather remarkable fact is proved by the figures, namely, that while cheese-makers tell you that in the autumn, when the milk is richer, they employ a larger proportion of rennet, as a matter of fact they use a smaller proportion, and this in my opinion is the more correct practice.

Cols. 25 and 27.—The figures in these columns prove a very remarkable fact, namely, that, in the act of setting, the acidity of the milk is considerably reduced, so that the whey shows only about two-thirds the acidity present in the milk before adding the rennet. It may be that the lime, with which the casein in the milk is combined, is partly separated, and neutralises some of the acid in the milk, for I shall show later on that the separation of lime is carried on throughout all the subsequent stages of the manufacture of cheese.

Cols. 34 and 35.—It will be seen that the formation of acidity begins to take place before the whey is drawn, while the fact that the drainings from the curd are more acid than the whey, shows that this formation of acidity is more rapid in the curd itself than in the whey. The reason for this will be found in my lecture on "The Composition of Milk," wherein I pointed out that the bacteria which form this acid become imbedded in the curd.

Cols. 39 to 45.—In the preceding paper, by Miss Cannon and myself, it will have been noticed that at each stage in the treatment of the curd when in cooler, a quantity of whey drains from it. The drainings from each stage were collected separately, and the acidity of each determined, with the results given in the tables under these columns. The reason why on August 18th, 25th, and many subsequent days, there is no acidity shown after the first turning, is that at that stage Miss Cannon considering the curd fit to grind proceeded with this operation.

Col. 46. *Acidity of Curd.*—Considerable difficulty was experienced in estimating the acidity of the curd. After frequent attempts, the only plan found practicable was to cut the curd into very fine pieces, to weigh out 1 gramme, place it in a glass tube, and boil with 25 c.c. of standard soda solution, until the whole of the curd was entirely dissolved. The solution was then washed into a glass vessel, and the quantity of free soda present estimated by standard sulphuric acid. This being deducted from the quantity originally taken, showed the amount of alkali neutralised by the curd. Thus:

	c.c.
Quantity of alkali taken	25·0
Quantity present after boiling with curd ..	21·3
Neutralised by curd	3·7

which would represent 3·7 per cent. of lactic acid, only 1 gramme of curd having been taken.

Finding this difficulty in the estimation of the acidity of the curd, a difficulty which, though capable of being overcome by a chemist, evidently puts the determination beyond the reach of any ordinary cheese-maker, I confined my estimations to this one stage of the curd only. The high results obtained are probably due not so much to lactic acid as to the fact that casein is itself an acid substance.

Col. 52.—This has been left out, owing to the difficulty of otherwise getting the tables into pages. It recorded the min. and max. temp. of the dairy during the day, and up to the time of vatting the curd. The temp. rose during the day about 3° F. or 4° F., rarely 5°.

Col. 53.—It will be seen that, even during the addition of salt and the placing of the curd in the vat, the formation of acidity has been still going on, so that the liquid which comes away from the press is more acid than the last draining from the curd before grinding.

Some ten tests made of this liquid immediately pressure was placed on the cheese, gave an average of 1·075 per cent., while the liquid coming away half an hour afterwards gave an average of 1·088 per cent. of acidity. It is generally supposed that the addition of salt stops the development of acidity. This is an error, as shown by the above figures, as also subsequently in this report.

Col. 60.—The cheeses, with the exception of those made on the first nine days of August, were sold and weighed on the 31st of December.

All the observations in these tables, except those relating to acidity, are such as can be made by any one with a little intelligence. I am, moreover, of opinion that it would be quite possible for any skilful cheese-maker, having once learned the method, and after a little practice, to make the necessary determinations of acidity.

THE RECORD OF ANALYSES OF MILK, WHEY, AND CURD.

The sample of milk for analysis was taken after the evening's milk had been heated and mixed with the morning's, but before the stale whey was added.

The sample of whey was taken as it was being drawn from the tub.

The sample of curd was taken immediately after it was milled and before any salt had been added.

Very considerable difficulty was found in making these analyses on the farm in the extemporised laboratory, more especially owing to the absence of gas, and some of the work had to be brought to London to my laboratory to be completed. The small number of fat determinations in the curd is due mainly to these difficulties.

ANALYSES OF THE CHEESES.

It was only possible to take a few samples of the cheeses on the 31st of December. These, however, were analysed with the following results.

COMPOSITION of CHEESES.

AUGUST.

	11.	14.	21.	23.	30.
Moisture	35·35	35·63	35·27	33·24	34·43
Fat	32·70	32·82	30·10	29·11	31·20
Casein, &c.	28·20	27·68	30·85	33·91	29·36
*Miueral matter ..	3·75	3·87	3·78	3·74	4·01
	100·00	100·00	100·00	100·00	100·00
*Containing salt ..	1·55	1·48	1·58	1·21	1·50

SEPTEMBER.

	10.	15.	21.	23.	26.
Moisture	34·94	35·47	37·64	35·76	35·17
Fat	32·14	31·58	29·33	30·96	31·17
Casein, &c.	29·01	29·41	28 81	29·45	29·43
*Mineral matter ..	3·91	3·54	4·22	3·83	4·23
	100·00	100·00	100·00	100·00	100·00
*Containing salt ..	1·43	1·52	1·81	1·62	1·63

OCTOBER.

	11.	17.	21.	22.	23.
Moisture	38·88	36·94	37·36	38·16	36·58
Fat	29·16	30·01	30·23	31·78	31·20
Casein, &c.	27·93	29·18	28·71	26·32	29·01
*Mineral matter ..	4·03	3·87	3·70	3·74	3·21
	100·00	100·00	100·00	100·00	100·00
*Containing salt ..	1·82	1·76	1·76	1·75	1·75

ANALYSIS OF WATER.

The water supplied to the farm was analysed with the result shown in the following table. It is a very pure water and a hard water, which is, in my opinion, a desirable quality in water drunk by cows whose milk is converted into cheese.

COMPOSITION OF WATER.

	grains.
Organic matter and water of combination	1·54
Oxide of iron and alumina	1·40
Carbonate of lime	20·02
Magnesia	0·42
Sodium chloride	1·15
Other alkaline salts	1·35
Sulphuric acid	0·60
Silica	0·14
Total solid matter per gallon	26·62
Free (saline) ammonia	·0015
Albuminoid (organic) ammonia	·0035

The quantity of solids was estimated from time to time, and was not found to vary greatly.

RAINFALL.

I am indebted to the Frome Water Company for the rainfall as taken by them during the three months of the observations, of which the following is a copy:—

RAINFALL.

August.		September.		October.	
	in.		in.		in.
1 ..	·04	1 ..	·39	1 ..	·06
2 ..	·02	5 ..	·05	2 ..	·24
3 ..	·23	7 ..	·04	6 ..	·72
4 ..	·01	8 ..	·02	7 ..	1·80
5 ..	·14	14 ..	·52	8 ..	·21
6 ..	·02	15 ..	·13	9 ..	·34
9 ..	·14	18 ..	·09	10 ..	·61
10 ..	·44	19 ..	·16	11 ..	·37
11 ..	·13	20 ..	·15	12 ..	·24
12 ..	·08	21 ..	·03	13 ..	·14
15 ..	·03	22 ..	·20	14 ..	·58
18 ..	·61	23 ..	·01	15 ..	·51
19 ..	·11	24 ..	·01	16 ..	·54
20 ..	·28	25 ..	·06	17 ..	·25
21 ..	1·37	26 ..	·05	18 ..	·05
23 ..	·05	28 ..	·03	19 ..	1·14
24 ..	·04	30 ..	·10	20 ..	·15
25 ..	·08			21 ..	·28
27 ..	·89			22 ..	·76
28 ..	·54			23 ..	·79
29 ..	·17			26 ..	·04
30 ..	·13			27 ..	·57
31 ..	·35				

On the 29th of September, Professor Carruthers visited Vallis Farm, and went most carefully over the pastures, upon which he subsequently reported as follows.

REPORT OF PROFESSOR CARRUTHERS, F.R.S., ON THE PASTURE LANDS OF VALLIS FARM.

The soil of the fields is a somewhat stiff loam, except in that called *the Mead*, a level field by the side of the stream, which has a rich alluvial soil. With the exception of the field called *the Leaze*, the pastures may be looked on as natural, for, though the different fields show evidences of cultivation, it is not known how long it is since they were cultivated. *The Leaze* was laid down to pasture about twenty years ago.

The pastures may be classified as follows:—

I. Natural pasture on the rich alluvial soil of the valley.

The Mead.—The grasses are cocksfoot and fiorin, with some ryegrass. There is a fair amount of white and red clover. But there are many weeds, some liked by stock, like the cow parsnip, locally called "eltrot," and others injurious, like the larger plantain, the common daisy, and the buttercup.

This very rich soil, notwithstanding the weeds, produces a large amount of very nutritious food.

II. Natural pasture on deep stiff loam.

Summer Leaze.—The grasses are cocksfoot, hard fescue, yellow oat-grass, dogstail and timothy. There is a considerable quantity of white clover, a little red clover, and some yarrow and cow parsnip. The worthless weeds are buttercup, daisy, and ox-eye.

Stevens.—The grasses are cocksfoot, hard fescue, yellow oat-grass, rough-stalked meadow-grass, and smooth-stalked meadow-grass. There is a good bottom of white clover, some red clover, and a good deal of yarrow.

Stevens' second field.—The grasses are the same as in the adjoining Stevens' field, but in the bottom of the field the cocksfoot largely predominates, and there is no clover.

Oxen Leaze.—The grasses are cocksfoot, dogstail, yellow oat-grass, rough-stalked meadow-grass, and ryegrass. There is some white clover and yarrow, a good deal of rib-grass, and some of the larger plantain.

The chief characteristics of these four pastures are the large quantity of cocksfoot in them, and the fair amount of clover and yarrow.

III. Natural pasture on shallow stiff loam, resting on limestone.

The Front.—The chief grass is hard fescue, and with it is associated cocksfoot, ryegrass, fiorin and dogstail. There is a good deal of clover both white and red; a considerable quantity of yarrow, with some rib-grass, buttercup and the larger plantain.

Stevens' second field, Upper Part.—The grasses are hard fescue, cocksfoot and dogstail, with a good deal of white clover and a little red. Daisy and buttercup abounded in this field.

The chief characteristic of these two fields is the predominance of the hard fescue.

IV. Pasture laid down twenty years ago.

The Leaze.—The grasses are ryegrass, dogstail, Yorkshire fog, and yellow oat-grass. There is a very good bottom of white clover and a good deal of red clover. There are also a good many weeds, chiefly the larger plantain, daisy, and dandelion. There was no cocksfoot in this field.

The farmer had noticed that the cows were very fond of this field. It stands by itself in the character of the vegetation. It would be interesting to determine the quantity and quality of the cheese made when the cows were feeding in this field.

The other fields have practically the same herbage; but the rich growth in *the Mead* yields probably a larger quantity of rich milk than any of the other fields.

WILLIAM CARRUTHERS.

Oct. 22, 1891.

Shortly after Professor Carruthers' visit, samples of the soils of the various fields were taken and forwarded to Dr. Voelcker, who has supplied the following analyses and report.

REPORT OF DR. VOELCKER ON THE SOILS.

COMPOSITION of PASTURE SOILS from VALLIS FARM, FROME.

Soils dried at 212° F. contain	No. 1. Oxen Leaze.	No. 2. The Mead.	No. 3. The Front and Stevens.	No. 4. The Leaze.	No. 5. Summer Leaze.
*Organic matter and water of combination	17·12	15·13	12·95	13·87	14·43
Oxide of iron	3·83	5·61	1·56	1·88	6·64
Alumina	5·45	7·28	10·31	14·59	8·41
Lime	10·32	2·07	·96	4·56	2·25
Magnesia	·77	·55	·37	·36	·72
Potash	·77	·55	·65	·65	·65
Soda	·16	·16	·30	·79	·20
Phosphoric acid ..	·29	·24	·32	·27	·25
Sulphuric acid	·23	·14	·24	·13	·13
**Chlorine	·13	trace	·002	·01	trace
Carbonic acid	6·60	·60	·23	2·14	·95
Insoluble silicate and saud	54·33	67·67	72·11	60·75	65·37
	100·00	100·00	100·00	100·00	100·00
*Containing nitrogen..	·77	·54	·51	·51	·54
Equal to ammonia ..	·93	·66	·62	·62	·66
Nitric acid	·0035	·0035	·004	·003	·0035
**Equal to chloride of sodium	·22	..	·004	·014	..

The soils appeared to be rich brown loams, not varying much in colour. In Nos. 1 and 2 small pieces of lime were discernible, and No. 4 contained quite large pieces; in Nos. 3 and 5 none were noticeable. The soils Nos. 1 and 2 especially contained a considerable quantity of rootlets.

The soils were all more or less heavy loams approaching, in the case of No. 1, to a marl.

Taking them generally, the soils were all extremely rich, and the analyses evidently show that the land must be old and rich pasture. The richness is specially seen in the large proportion of organic matter and accumulated nitrogen, this latter being, with the exception of naturally peaty soils, far more than would be found in any arable field, or in any soil, I should say, but one which had been for a very long time down in pasture.

The proportions of iron and alumina together are large in each case, though varying *inter se*. No. 4 contains much the most alumina, then No. 3, and both of them much less iron than the other three.

In all the soils there is abundant lime, the least quantity being in No. 3, although there is ample there, I think, for all needs. No. 1 contains the most lime by far, and No. 4, in which big pieces of lime were noticed, also has a considerable quantity.

In phosphoric acid the soils are exceptionally rich, the lowest amount being 0·24 per cent., namely in No. 2, but here, even, there is quite double what is met with in good arable soils. All the soils are, again, well supplied with magnesia.

It is, perhaps, in potash that the soils one and all show unusual richness; indeed such high proportions will be seldom met with in five soils taken together as these were.

I have remarked on the richness in nitrogen, and therefore one is altogether justified in considering the soils as very fine ones indeed, so far as abundance of plant food is concerned, and I should be inclined to think nothing is needed or could even be done to improve their condition by any manuring.

I have also determined in them the chlorine, and this brings out one exceptional feature in the case of No. 1, namely, that it contains 0·13 per cent. of chlorine, equal to 0·22 per cent. of chloride of sodium, a quantity which one would be inclined to consider large.

Whether or not it has exercised any deteriorating effect upon the pastures, or produced any mark on the herbage, I should be interested in hearing.

J. AUGUSTUS VOELCKER.

II.—THE BACTERIOLOGICAL OBSERVATIONS.

Introductory.—It is well known that the changes which take place in milk during its conversion into cheese are brought about by the action of what are usually called "ferments." The term ferment is best applied to a chemical substance, and should not be applied to those living organisms or minute plants which are known as bacteria.

These organisms probably do, in many instances, secrete a true ferment, but there is no evidence to show that those with which the cheese-maker is concerned act in this manner. Bacteria are present everywhere; they have various shapes, are only capable of growing under certain conditions, which vary with different individuals, while each seems to have a special power of inducing chemical change.

As to their presence; we find them in the air, in water, and in the soil. It is in its passage through the air, between the cow and the pail, that milk first receives bacteria, for, if the cow be healthy, no bacteria are present in the milk when it is in the udder. If, therefore, the air of the shed in which the cows are milked be impure, the milk will for a certainty take up this impurity. The same result happens when the hands of the milkers, or the utensils, are not clean. And if any of the droppings of the cow be upon the teats, the milk becomes impregnated with those organisms which are peculiar to these droppings. Hence any uncleanliness in the milking introduces into the milk bacteria, which are as likely as not to spoil the cheese.

With regard to the shapes of these organisms. Those which are round are termed cocci or micrococci, owing to their likeness to eggs; those which are in the form of little rods are termed bacilli, even if these are very short as compared with their length.

There are several other forms, but we need not trouble about their names.

Next as to the conditions of growth. While some require air to enable them to live actively—for these plants are capable of resting, without active growth, yet without dying, for very long periods—others are only active when no air is present, while some are capable of growing under either condition. All these varieties are supposed to take an active part in the manufacture of Cheddar cheese.

Finally, as to the chemical changes produced by these organisms. Those with which the Cheddar cheese-maker is principally concerned are of two kinds. The one produces lactic acid, and the other butyric acid.

The former organism grows best in the presence of air, the latter only grows when the air is absent.

The Air of the Dairy.—On the 24th of October, at a time when the dairy had not been previously entered by the students for about ten or fifteen minutes, but during the manufacture of a cheese, I exposed a prepared surface for two minutes. No less than forty-eight organisms fell upon that surface of under nine square inches in the two minutes. Of these six were moulds, and the remainder were bacteria.

The moulds I have not studied. Among the bacteria I have isolated at least six, and possibly eight, varieties, one of which was the organism that produces lactic acid. This is a stumpy bacillus known as the Bacillus Acidi Lactici. I shall subsequently refer to it by the abbreviation B. Acidi Lactici, while it will be fully described later on.

The question will at once arise, How is it that with so many organisms present in the air of the dairy it is possible to make good cheese?

It will be well to at once explain this. These organisms have, I find, little or no action on milk. Moreover, the lactic acid formed in the manufacture of the cheese destroys the power of most of them to grow, and thus prevents them doing any harm.

Confirmation of this is found in the fact that, although the bacteria have been studied at every stage in the manufacture of the cheese, most of these air organisms disappear towards the later stages.

The Milk.—The milk has been examined frequently, both as it came into the dairy and when it had stood in the dairy over night. The B. Acidi Lactici has invariably been present, but not in large numbers. And this explains why it was necessary to use so much sour whey in the manufacture of the cheese. I have been struck with the freedom of the milk from other organisms. There were always some present, but their number was comparatively small.

The number of organisms in the evening's milk has by the morning considerably increased.

Here it may be well to mention one of the peculiarities of bacteria. They are comparatively very heavy, and consequently sink to the bottom of a liquid, and carry on their peculiar chemical action there far more rapidly than at the top of the liquid. For it must be remembered that, just as a house is built more rapidly the greater the number of men at work, the chemical action of the bacteria is the more rapid the greater the number of organisms present. This peculiarity of sinking to the bottom I have proved by placing some of these organisms in a test-tube containing milk, and, after thorough mixing, keeping the tube at a temperature suitable for their growth and free from disturbance; with the result that the milk at the bottom of the tube has curdled into a solid mass, while the milk at the top of the tube has remained quite liquid. Hence the practice of keeping the evening's milk well stirred has probably an important bearing on the thorough ripening of the evening's milk, as also its well-known action of keeping the fat from rising.

The Rennet.—I have not had the time necessary to make even a superficial study of the bacteria present in the rennet; suffice it to say that they are very numerous and of several varieties. Two only of these have I studied, and these, as yet, not sufficiently to justify my making any definite statement, further than to say that one of these organisms is distinctly characteristic, and is sometimes present in all subsequent stages of the manufacture and even in the cheese; but what part, if any, it plays in the production of a good cheese must be left for future investigation. Neither organism possesses the power of curdling milk.

Whey put aside.—This liquid has been examined from time to time, and in every case found freer from extraneous bacteria than any other liquid examined. It has seldom contained more than two or three varieties of organisms other than the B. Acidi Lactici, hence it is admirably suited for the purpose to which it is applied. Thus science explains the true foundation of a practice, which, I understand, is not universal in Cheddar cheese-making, but which undoubtedly should be wherever stale whey is used, for the whey at no other stage of the manufacture possesses the same purity.

The Whey.—This when drawn, and also the droppings from every stage in the treatment of the curd, have been carefully examined. They become more and more contaminated with the organisms of the atmosphere, due in great measure undoubtedly to the difficulty of taking samples free from contamination. But side by side, and of far greater importance, has been the constantly and rapidly increasing number of the B. Acidi Lactici.

Result of Observations.—It will be evident that, so far as the manufacture of Cheddar cheese, up to the time of vatting the curd, is dependent on the growth and chemical action of bacteria, any organism essential to these changes must be invariably present at all stages, and that any other organisms found can only be considered as accidental and contaminations. It therefore became necessary to first isolate those which were always present from those which were only occasionally found, and subsequently to study those most frequently found with a view to determine what action, if any, they had on milk.

The amount of work which this study has entailed will be evident from the contaminations due to the air alone, but, to indicate that the results have not been rashly arrived at, it may be well to state that over 100 separate cultivations have been made and studied day by day between the commencement of the observations and the writing of this report.

One fact has been conclusively proved, namely, that in the manufacture of Cheddar cheese at the Society's School, one, and only one, organism plays an important part up to the time the curd is put into the vat, and that organism is the Bacillus Acidi Lactici.

As there are several bacteria which possess the property of forming lactic acid, and authorities do not seem quite agreed as to which is the true B. Acidi Lactici, it will be well to describe minutely the organism to which I refer. This description of course is intended for workers at bacteriology only, and will be of little interest to farmers.

Growth of B. Acidi Lactici at a Temperature of 68° to 70° F.—In gelatine plate cultures the bacillus grows slowly, and appears only after several days as a small white circular colony. In ten days or a fortnight this colony may have become the size of a pin's head, but only on a plate which contains a very few colonies; when these are numerous they seldom grow to this size. Sometimes the colonies become oval or egg-shaped. When examined with a 2-in. objective they appear yellowish-brown, brown, or even black, and have a sharply defined outline. The colonies growing on the surface are much larger and lighter in colour than those growing in the depth.

A gelatine streak culture makes little growth for the first two days; it subsequently shows as a faint white streak made up of numerous minute colonies. These subsequently run together, but the streak remains very thin, seldom more than $\frac{1}{8}$ in. wide and transparent, spreading very slightly in semicircular projections.

The organism when examined under the microscope is a small stumpy bacillus. It varies, however, in size considerably, partly according to the age of the culture, though frequently in the same culture there will be present organisms of very different sizes, and in old cultures I have noticed some remarkably large ones, probably resting-stages.

As a rule, two organisms grow together in the form of a dumb-bell. This is very characteristic of the bacillus, and is best seen when growing in milk or curd. Occasionally small chains of four are met with. The organism does not grow well on agar-agar, at this temperature forming a very thin, faint streak, composed of numerous colonies, and not running together as on gelatine.

When growing in milk the bacillus produces lactic acid, and in about four days the milk curdles. The time which elapses before the milk curdles depends partly on the number of organisms present, partly on temperature.

I have determined the rate of formation of lactic acid in a series of milk tubes, to which had been added, so far as possible, a similar number of organisms. The following are the results obtained :—

PRODUCTION OF LACTIC ACID IN MILK BY A PURE CULTURE OF THE BACILLUS ACIDI LACTICI.

Date.	Interval.	Acidity of Sterile Tubes of Milk.	Acidity of Inoculated Tubes.			Acid formed in 12 hours over average of Sterile Tubes.	
			1st.	2nd.	Mean.	Total.	Increase.
	hrs.						
Nov. 10 ..	..	·23	·40	·40	·40	·20	·20
" 11 ..	12	·19	·47	·48	·475	·275	·075
" 12 ..	12	·18	·48	·53	·505	·305	·030
" 14 ..	24	·19	·55	·56	·555	·355	·050
" 15 ..	12	..	·64	..	·640	·440	·085
" 16 ..	12	..	·66	..	·660	·460	·020
" 17 ..	12	..	·68	..	·680	·480	·020
" 18 ..	12	..	·70	..	·700	·500	·020

The Cheese.—The examination of the cheeses shows that when ripe only two or three organisms are present in any number. Those in most abundance are the B. Acidi Lactici. The others are a long and very thin bacillus, and a shorter and thicker bacillus. Comparatively few of these are present in the later-made cheeses. We now have to deal with a substance from which the air is excluded, and consequently should expect to find those organisms which hitherto have had no opportunity of growing, namely, the Bacillus Amylobacter or butyric acid organism, present. These are the short thick rods above referred to.

That there should be so few organisms in the cheese would be somewhat surprising were it not for the recent investigations of Freudenreich into the ripening of Emmenthaler cheese. Duclaux having found in Cantal cheese ten kinds of bacteria, it has been assumed that many varieties play each their part in the ripening of cheese. Freudenreich, however, was unable to discover in Emmenthaler cheese these varieties, though others were present. And as it would appear from these observations that only two or three varieties are present in Cheddar cheese, we are justified in concluding that the ripening of each variety of cheese is dependent upon bacteria peculiar to that variety. In the cheese made at the School these organisms would appear to be the B. Acidi Lactici and the B. Amylobacter. This subject will, however, need considerable further investigation.

After having examined several of the cheeses made in August last, and upon finding now in January that the organism present in infinitely largest numbers is the B. Acidi Lactici, it would appear that as in the making, so in the ripening of Cheddar cheese, this organism plays the chief rôle. Hitherto it has been supposed that the ripening of cheese was due to the action of the Bacillus Amylobacter, but these observations do not support that view.

Analyses were therefore made of a few of the cheeses to determine whether the acidity had increased in the process of ripening. The following are the results obtained:—

Acidity of Curd when vatted on		Acidity of Cheese on Jan. 4, 1892.	Increase.
		Per cent.	
August 23	= 2·90	9·8	6·90
September 23	= 3·50	9·6	6·1
October 23	= 2·90	6·0	3·1

Thus it appears that the ripening of Cheddar cheese is during the first few months dependent mainly on the continued action of the B. Acidi Lactici, supplemented as the cheese grows older by the growth and action of the Bacillus Amylobacter.

Time has not permitted me to study the chemical changes which are brought about by these organisms in the cheese during its ripening. On one point, however, my results afford interesting information. It was for long maintained that, in the ripening of cheese, fat was formed out of the curd. The analyses of some of the cheeses made last August show that when sold in January no such change had taken place.

Technique.—The examination of the bacteria in cheese is somewhat difficult, owing first to the presence of so much fat, and secondly to the ease with which the curd takes up any stain used, and thereby hides the bacteria. I therefore append a description of a method which I have found to give admirable results.

A small portion from the interior of a cheese is taken up with a sterile platinum rod and rubbed down into a very fine layer on a cover glass. This is well dried, passed through the flame of a Bunsen burner or spirit-lamp, washed in a watch-glass, film downward, with ether, and again dried. This removes the fat without affecting the bacteria. Next insert the cover-glass in the staining solution and stain very deeply. I find an alkaline solution of methylene blue gives the best results. Wash off the excess of stain, then insert the glass in a 2 per cent. solution of acetic acid B. P. until *just discolorised*, and *immediately* afterwards in a 3 per cent. solution of ammonia for a few seconds. Subsequently wash in distilled water. If successful, the bacteria will now be deeply stained on a colourless ground. If they are not sufficiently stained, again place the glass in the stain for a minute or two. They will now take up sufficient stain, and as the casein has been mostly removed by this treatment, if properly conducted, the ground will be only slightly coloured. The best results are, however, obtained when this further treatment is not necessary. I always adopt the same method for the examination of milk, and have found it invaluable in these investigations.

III.—Results of Observations.

The data which have been obtained by and in connection with these Observations have now been given, and it merely remains to determine how far, and what answers they afford to the questions which were submitted to me by the Society's Council.

a. The conditions essential to the manufacture of Cheddar Cheese of high quality.

It will be well to first ask, "What is it that the practical cheese-maker has in view, whether consciously or unconsciously, in subjecting the milk and curd to the many operations described by Miss Cannon and myself in the preceding paper?" It is to obtain the curd, with the least possible loss of fat, in such a condition that it will ripen into a good cheese.

The tests applied by the maker to ensure this result are empirical, and depend upon the senses of touch and taste and smell. Hence the cause of failure with many to produce a first-class cheese is due mainly to their not possessing naturally, or as the result of education or experience, the requisite delicacy or degree of sensitiveness in touch and taste and smell. For instance, after visiting the School several times, I could judge by the sense of taste, fairly accurately, the condition of the curd and as to its fitness for grinding, though some of the students seemed utterly unable to do this. On the other hand, I was never able to form a correct judgment, by the sense of touch, of the condition of the curd when in scald, and whether it was fit to allow the whey to be drawn, though the students, who at a later stage were unable to estimate its fitness for grinding, appeared to have no difficulty now in estimating whether the curd was fit to permit the whey to be drawn or not. Evidently to overcome this natural inaptitude of estimating the various stages in the progress of the curd, it would be necessary to substitute some means of determining them, which would not depend upon individual capacity. This problem now attracted my attention, and to solve it the first thing necessary was to determine what that condition was, which Miss Cannon, with such remarkable ability at every stage, estimated by her exceptionally keen senses of taste and touch and smell. Was it a chemical condition, capable of being determined by chemical methods of investigation?

By referring to cols. 20 and 25, it will be seen that, in the act of setting (coagulation), the milk loses a large proportion of its acidity, which by the time the whey is drawn (col. 34) has been again reproduced. Thus the average acidity of the mixed milks, &c., before renneting during August was ·24 per cent., and the average acidity of the whey before breaking, during the same month, was only ·16 per cent.; but the average acidity of the whey when drawn was ·25 per cent., thus showing that, by all the operations to which the curd in the meantime had been subjected, the original acidity had only been slightly more than reproduced. At first this did not attract my attention, until, towards the end of the month of August, I was struck by the fact that while on the 28th, when the time in scald was only 1 h. 27 min., more acidity was present in the whey than in the milk to start with, yet on the 24th, although the curd had been in scald 2 hours, less acidity had been produced than was originally present in the milk. This led me to watch very closely the progress of the development of acidity from the moment the curd was cut to the time the whey was drawn, and it will be interesting to here produce from my note-book a copy of the observations taken on one such occasion.

THE DEVELOPMENT OF ACIDITY IN WHEY.—SEPTEMBER 18.

Acidity of milk before renneting	·25 per cent.
Acidity of whey after cutting curd	·17 „
Before breaking	·17 „
After breaking	·18 „
Whey put aside	·19 „
During first scald	·20 „
Before second scald	·21 „
10 A.M. (after second scald whey put in)	·23 „
10.5	·25 „
10.10	·25 „
10.15	·25 „
10.20 (stirring finished, very good curd)	·27 „
Acidity of whey when drawn	·29 „

It will be seen that no sooner had Miss Cannon obtained in the whey during scald an amount of acidity greater than that present in the milk before renneting, than she pronounced the curd fit to settle, prior to drawing off the whey. She was not aware of my results, and was guided solely by her sense of touch and taste. I repeated these observations occasionally, and always found the same result, namely, that the fitness of the curd to settle in scald was coincident with the whey attaining an acidity slightly greater than the acidity of the milk before renneting.

In September the average acidity of mixed milk was	·224 per cent.
„ „ „ whey was	·232 „
In October the average acidity of mixed milk was	·214 „
„ „ „ whey	·217 „

From the time of drawing the whey to the time of milling (grinding) the curd every step in the manufacture, excepting the time curd remains piled (see subsequently), proceeds by time stages of certain duration as explained in the preceding paper, and no special aptitude is required until it becomes necessary to judge whether the curd is fit for grinding or not. This, without doubt, is the time when the greatest demand is made upon the cheese-maker's judgment, and when any large error will hopelessly ruin the cheese. An error in judgment at any previous stage may, by a skilful maker, be very largely counteracted in subsequent operations, but not so any error at this stage. At first it was hoped that the determination of the acidity of the curd at this stage would enable one to ascertain definitely whether the curd was fit for grinding, but this had to be abandoned for reasons already given. I have since come to the conclusion that the acidity of the whey which drains from the curd when in the cooler, if estimated after each operation therein, is a sufficiently accurate guide to the condition of the curd before grinding. The difficulty of judging the condition of the curd at this stage is well shown by the figures given in cols. 42, 43, 44, and 45. If so skilful a maker as Miss Cannon is unable to judge of this stage with the same degree of accuracy as she is able to attain when judging the condition of the curd in scald, what, we may ask, would be the condition of the curd before grinding in the hands of an unskilful maker? Thus, on August the 30th the acidity of the liquid last coming from the curd before grinding was ·84 per cent., while three days before, on the 27th, it was ·93, and three days before that, on the 24th, it was as high as 1·05 per cent. Again, in September we find the acidity ranging from ·87 on the 18th to 1·10 per cent. on the 15th, and in October it ranges from ·92 on the 22nd to 1·15 per cent. on the 9th. And yet, as I shall subsequently show, the quality of the cheese when ripe will depend mainly on its condition when milled. We shall probably best estimate the requisite acidity by taking the average for each month. This in August was ·93 per cent., in September ·96 per cent., and in October 1·01 per cent.

As, in my opinion, the two stages in the manufacture of Cheddar cheese most difficult to determine empirically are those which have just been referred to, viz., when to stop stirring and when to grind the curd, I determined to make a cheese myself without touching, tasting, or smelling the curd from commencement to end, and to be guided at these stages by the determinations of acidity alone. The following were the conditions which were to be observed.

1. The proportion of rennet to be 1 part of rennet by volume to 9500 parts of milk by weight, or 9274 by volume.

2. The curd to be allowed to settle in scald immediately the whey showed more acidity than that of the mixed milk before renneting.

3. The curd to be milled when the drainings from last turning showed ·93 per cent. or more of acidity. [This figure was obtained as the average for August.]

On the 10th of September this cheese was made by me, and is probably the first cheese ever made with scientific standards whereby to estimate the critical stages in its manufacture.

The mechanical operations, which of course require skill and experience that I do not possess, were kindly performed for me by Miss Cannon; but she offered no opinion during the making, so that I might not be in the least biassed. The following is a copy of my notes:—

Acidity of milk before renneting	·21 per cent.
Acidity of whey when curd cut	·14 „
Acidity after breaking	·17 „
10.12 (acidity after second scald put in)	·19 „
10.17	·20 „
10.23	·20 „
10.28	·20 „
10.33	·21 „
10·38	·21 „
10.43 (stopped stirring)	·22 „

On the 31st of December, when the cheeses were sold, Mr. Hill's opinion was particularly requested of a certain number of cheeses, among them being this one. It was considered excellent. The cheese has been kept, and will be submitted to the Council for their opinions in March.

This is in reality the only true experiment which has been conducted at the School. It is most desirable not only that it should be repeated, but that by a series of experiments the acidity at each stage which gives the best result should be determined for each month of the cheese-making season.

It will now be advisable to consider more closely the influence of the three principal factors in cheese-making, namely, (1) the rennet, (2) the development of acidity, and (3) the time required to make a cheese.

The Influence of Rennet.—It will not be possible to enter here into this subject fully, but I will endeavour to show its practical import. The effect of an excess of rennet is to draw the curd together too rapidly, and so express the whey before this has had time to perform its proper function, viz., to bring about the desired acidity; on the other hand, the use of too little rennet will cause the curd to remain with too much moisture in it, and to develop acidity somewhat too rapidly. Figures in support of this assertion will be found later on in this report. An excess of rennet, by contracting the curd with too much force, also causes some of the fat to be pressed out of it and lost in the whey; this takes place more certainly and more rapidly the greater the acidity of the milk before renneting. Hence, when the milk is very ripe, more than usual care should be taken not to use an excess of rennet.

A better cheese is made where there is a small proportion of rennet than where there is a large proportion. The cheese made on August the 14th had the lowest proportion of rennet of any cheese made that month, while the cheese made on the 11th had the highest proportion. On December 31st the cheese of August 14th was pronounced by Mr. Hill to be one of the best cheeses, if not the best cheese, tasted, and it was, in his opinion, far superior to that of August 11th. So also the cheese of September 12th, made with the lowest proportion of rennet employed in that month, was "excellent," while that of the 26th, made with the largest proportion of rennet, was considered by him to be "not so good" as the average make. Mr. Hill was not aware of the differences in the make of these cheeses, nor of my reason for obtaining his opinion of them. Moreover, his judgment was supported by that of Mr. Gibbons. I think there can be no question as to the accuracy of the conclusion to which these facts point, namely, that the use of an excess of rennet is detrimental to the production of a first-class cheese.

The effect of Acidity.—Taking the drainings from the curd at the last turning before grinding as an index of the acidity produced, my next point was to determine whether the cheeses themselves showed any variation in quality. Mr. Hill's opinion was therefore obtained as to the cheese made on August 23rd, the highest acidity during that month (see col. 44), and then of the cheese made on August 30th, the curd of which had been milled when the drainings showed the least acidity produced during the month (see col. 42). The opinion was, that the cheese of 23rd was better than that of 30th, which latter was "not so nutty." Passing to the cheeses made in September, that of the 15th, the drainings from which had shown 1·10 per cent. of lactic acid (col. 43), was compared with that of the 18th, the drainings from which contained only 0·87 per cent. of acid. The opinion was, that the cheese of 15th was "much better than that of 18th." Here, then, we have an expert who,—ignorant of the different conditions under which these curds were vatted, in fact, not aware that there was any difference until after his opinions had been given on all the cheeses, and whose opinion was taken not in any special order, except that the two to be compared were tasted one after the other,—finds in the cheeses a distinct difference, and in each case gives the preference to the cheese made from curd which had developed the most acidity; indeed, in both cases finds that the more acid curd has made a distinctly "better" cheese.

I wish to draw special attention to the fact that the want of acidity caused the absence of that "nutty" flavour which every Cheddar cheese-maker strives to obtain.

In my opinion these two factors, rennet and acidity, go together. If you use an excess of rennet you will fail, or have great trouble to obtain sufficient acidity; but given the right amount of rennet and the development of acidity will, with a little patience, easily follow.

From these results it would appear that the development of lactic acid in the curd is the primary and essential condition of success. There are many well-known and generally recognized facts to support this view, as also some less known scientific grounds.

The bacteriological observations have shown that many of the organisms likely to get into milk are not able to exist in an acid material, consequently, that by ensuring a proper development of acidity in the curd, we destroy their activity, which would otherwise spoil the cheese.

Why does the development of so much acidity in the curd result in the production of a good cheese? This is a question which, to completely answer, will need much further investigation. I mention it here merely to point out one of its results, viz., the removal of the mineral matters from the curd. This is well shown in the following analyses of the liquids which drained from the curd after it was placed on the cooler.

ANALYSES of DRAININGS from CURD (SEPTEMBER 12).

	When taken to cooler.	1st cutting.	2nd cutting.	1st turning.	2nd turning.
Fat	2·54	3·46	3·59	2·74	1·65
Casein Sugar, &c.	5·80	5·68	5·79	5·94	6·13
Mineral matter	·90	1·04	1·30	1·40	1·64
Total solids	9·24	10·18	10·68	10·08	9·42

The Time which is required to make a Cheese.

By referring to the table for September, it will be seen that on the 16th the curd was not vatted until 10·17 P.M. (col. 51), while the acidity of the last drainage had only reached ·87 per cent. of lactic acid (col. 45). On the 19th it was 7·55 P.M. with an acidity of ·98 per cent., and on the 20th, 3·38 P.M., with 1·05 per cent. of acidity. Now it appeared to me that the only fault to be found with the method of manufacture adopted at the School was the uncertainty, and sometimes great length of time required, while practical cheese-makers appear to be totally unable to explain why the time before the curd is fit for vatting varies so greatly.

It is evident that it would be a great advantage if the curd could be vatted by 4 P.M., which frequently happened without any loss of quality; and one of the best cheeses made, *e.g.*, that of the 14th of August, was vatted by this time. I have therefore paid considerable attention to this question, and find undoubtedly many causes operate to this end.

1. The time will depend partly upon the number of bacteria originally present in the milk, especially the evening's milk. This, at present, the cheese-maker cannot control. The use of stale whey is mainly to increase their number, and consequently we find that when no stale whey was used, as on the 14th and 16th of September, the cheeses took longer in making. How is it, then, that on the 17th and 18th of that month, although no stale whey was used, the curd was vatted early? The explanation of the cause as regards the 18th will be found upon referring to col. 11, which shows that the acidity of the evening's milk had risen by the morning from ·20 to ·25 per cent., while col. 10 shows why—namely, that it had been kept warm. In other words, the growth of the bacteria present in the evening's milk had been promoted and kept up during the night, so that the number present in the morning in the mixed milks was probably greater than when, under ordinary conditions, stale whey was employed. The explanation of the 17th is entirely different, and will come under the third cause.

2. The quantity, or rather the proportion of rennet used, will, for reasons already mentioned, considerably affect the time of vatting. This is well shown in the following table:—

INFLUENCE of RENNET on time of VATTING.

Highest Proportion.		Lowest Proportion.	
Date.	Time of Vatting.	Date.	Time of Vatting.
	P.M.		P.M.
August 11	5·55	August 14	4·10
„ 4	6·15	„ 19	3·30
„ 8	8·30	„ 18	3·15
September 26..	5·45	September 12	3·35
„ 1..	3·5	„ 11	2·58
„ 23..	5·15	„ 13	3·25
October 24	7·5	October 16	5·50
„ 7	7·0	„ 15	5·45
„ 8	6·30	„ 22	7·20
Average time	6·9	Average time	4·39

It will thus be seen that the average daily gain in time by using the smaller proportion of rennet was 1 hr. 30 min.

The cheese of September 30th has been discarded, for the conditions on this day were exceptional.

3. The development of sufficient acidity in the whey during second scald, before allowing curd to settle prior to drawing the whey off, appears to exercise considerable effect upon the time when the curd will be fit to grind.

Thus, if the acidity of the whey when drawn is less than that of the mixed milk before renneting, the subsequent development of acidity in the curd will be very slow, so that the curd will not be vatted until late in the evening, while if the acidity developed in the whey before drawing off be high compared with that of the mixed milk, the time of vatting will be earlier. The following instances will illustrate these facts :—

Date.	Acid in Milk.	Acid in Whey.	Time of Vatting.
	Per cent.	Per cent.	P.M.
August 28	·24	·26	2·50
„ 21	·25	·22	5·30
September 20..	·22	·25	3·38
„ 19..	·23	·19	7·55
October 20	·21	·24	6·20
„ 26	·21	·20	8·55

I have selected only a few examples, but, on consulting the tables, it will be found that in each of these cases the acidity developed in the curds vatted early was as great or greater than that in the curds vatted late. From these observations it would appear that, besides the saving in time and trouble, there is a distinct advantage gained by so working as to ensure the rapid development of acidity in the curd, and that one means to this end is to keep the curd in scald until the requisite acidity has been developed in the whey.

There will be found in the tables here and there cases in which the curd has been slow to develop the necessary acidity, even though the whey has been slightly more acid than the milk. These exceptions are, I think, explained partly by the first cause mentioned—namely, a want of bacteria in the milk to start with—and partly by the second cause.

Should by accident the whey be drawn before sufficient acidity is developed, I would recommend that the curd be allowed to remain piled longer than usual, for now, when it is warmer than it will be at any subsequent stage, the formation of lactic acid will take place most rapidly.

The rapidity with which the formation of acid takes place at this stage is well shown by the following figures, obtained on September 4th, when the curd remained piled only 17 min. :

Acidity of whey when first drawn	·23	per cent.
Towards the end of drawing (just before piling) ..	·29	„
Liquid from curd when first piled	·36	„
After a short time	·37	„
Final droppings	·41	„

I find in my notes that Miss Cannon always tasted the whey which first came from the piled curd, and determined in this manner how long the curd should remain piled. But how very few makers possess sufficient delicacy of taste to form an accurate opinion on such basis.

The addition of some more sour whey to the second scald would, I fear, fail to bring about the desired end; the development of acidity is needed *within* the curd, while this addition would promote the development outside, in the whey.

4. Probably the temperature of scald has considerable influence on the time which it takes to obtain the requisite acidity. Thus I find that at Kilmarnock Dairy School the curd is ready to be milled between 1 and 2 P.M., the temperature of second scald being 101° F. Whether the same degree of acidity has been developed as at the Society's School, I am not in a position to say. Miss Cannon is, unfortunately for these observations, too accurate a worker to have given me the opportunity of testing this point from her work.

(b) *The Effect of Different Pastures on the Quality of Milk.*

This, the second subject of enquiry, is not only one which presents considerable difficulties, but results obtained in any one year must not for one moment be expected to apply to all seasons, nor those obtained in one place to be applicable to others. Moreover, to satisfactorily investigate such a subject almost ideal conditions are requisite, and these certainly did not obtain at Vallis Farm. As already mentioned, keep was short, and the cows could not be left upon the same field or fields for any length of time. In order, however, to see whether any information is thrown by these experiments upon this difficult question, I have drawn up the following table (p. 51), showing the average percentage of the chief constituents of milk produced upon the various fields during each month, also stating the number of days' milk which these averages represent. The results are interesting, though I do not think they would warrant any hard-and-fast conclusions.

1. It will at first sight be noticed that the milk improves in quality each month upon all the fields.

2. It will next be noticed that the milk produced in August on the Leaze and Stevens is superior in solids and fat, and

TABLE showing the AVERAGE COMPOSITION of the MILK, arranged according to the FIELDS on which the COWS were feeding.

NAMES OF FIELDS.	AUGUST.					SEPTEMBER.					OCTOBER.				
	Days fed.	Composition of Milk.				Days fed.	Composition of Milk.				Days fed.	Composition of Milk.			
		Solids.	Fat.	Casein.	Ash.		Solids.	Fat.	Casein.	Ash.		Solids.	Fat.	Casein.	Ash.
The Leaze and Stevens	3	12·92	4·09	2·78	·77	2	12·88	4·14	2·93	·79	..	..	..	..	..
Summer Leaze and The Leaze ..	6	12·82	4·02	2·86	·76	1	12 80	4·07	2·95	·80	..	..	..	..	..
The Front and The Leaze	3	12·65	3·88	2·84	·75	3	13·22	4·27	3·07	·77	6	14·18	5·11	3·30	·76
Oxen Leaze and The Leaze	3	12·46	3·79	2·76	·79	10	13·13	4·19	3·04	·78	16	13·74	4·68	3·21	·77
Mixed Fields	6	12·53	3·80	2·72	·77	11	12·93	4·07	2·94	·77	7	13·69	4·64	3·17	·77
The Leaze *	4	12·38	3·71	2·71	·78	2	12·86	4·08	2 93	·79	..	..	..	..	..

* The Leaze was fed by itself only on 6 days—on other days it was fed in conjunction with "Stevens," "Summer Leaze," "The Front," or "Oxen Leaze."

inferior in casein, to that produced on the Summer Leaze and Leaze, and that the same result is obtained in September. This might have been accidental, but curiously enough the milk produced upon the Front and the Leaze is superior in both solids, fat, and casein, to that produced upon the Oxen Leaze and Leaze, or upon the Mixed Fields during August, while the same relative superiority is maintained throughout both September and October. This comparison might be carried further, but sufficient has been pointed out to show that in this instance there would appear to be a fluctuation in the quality of milk depending upon the pastures, and independent of that fluctuation in quality which is dependent upon season.

There are some minor subjects arising out of these tables of averages, one of which is of considerable interest. I know of no continuous series of analyses of milk in which the percentage of casein has been determined; the result is, that a somewhat new and important fact is revealed regarding the fluctuations of this constituent. It will be noticed that the casein is affected both by the time of the year and the nature of the pasture, though only to a slight extent when compared with the fat.

(c) *The Causes of Defects.*

Only twice during the three months had the milk any taint. The first occasion was on the first day of my attending the school, and before the apparatus was unpacked, hence I had no opportunity of making any exact observations. On the second occasion it was very slight, and the milk presented no abnormal chemical aspect. Unfortunately I was not present, so that no bacteriological examination was made on that day.* Particular notice was paid by me to these cheeses subsequently, but they showed no, or scarcely any, perceptible difference from the other cheeses. This is, I think, a strong argument in support of the view that success in cheese-making depends mainly upon the skill of the maker; and I doubt whether the many causes which are so glibly given to explain the manufacture of inferior cheese have really much to do with the failures.

SUGGESTIONS FOR THE FUTURE.

In writing this report, I have endeavoured, so far as possible, to keep to those points which appeared to me to be of immediate and practical importance. Considerable light has been

* The day before this the food of some of the cows had been changed, some of them receiving decorticated cotton-cake and linseed-cake. Whether this had any effect or not, I am unable to say.

thrown upon several scientific questions connected with the manufacture of cheese, but these must remain over for further confirmation. Scattered throughout this report will be found suggestions for future observations and experiments, and it may be as well to here summarize these suggestions.

1. The data which have been obtained for the months of August, September, and October, should be obtained for the earlier months of the cheese-making season.
2. It is desirable to determine the causes which result in a loss of fat during the manufacture of a cheese. (This question I have not attempted to touch, and it will necessitate some very special observations.)
3. To prove whether the result obtained on September 10th, when the cheese was made by the aid of acidity determinations only, can be obtained by pupils who have learnt to make these determinations.
4. The milk on one day should be divided into equal parts, and one cheese made by Miss Cannon in the usual way, another by a competent pupil under my direction, with a view of testing the conclusions which these observations appear to have justified.
5. The bacteriological observations should be continued.
6. An opportunity should be given to visit two or three dairies where a difficulty has been found in making good cheese, so as to determine, if possible, the causes of these failures.

Conclusion.

I must not conclude without one word of warning to the English Cheddar cheese-makers. That which is here written is for their benefit, but when once published it becomes the property of the whole world; and if I have succeeded in throwing any light upon the causes which result in the production of cheese of first-class quality, have indicated any errors to be avoided, or any points to be observed, those who abroad are striving to produce and place upon the English market Cheddar cheese which shall compete with our own manufacture will not be slow to utilize these suggestions.

I wish to thank Miss Cannon for the very great assistance she has rendered me in my endeavour to make these observations of practical utility, also my chief assistant Mr. Oswald Hewitt for the time and labour he bestowed in recording the observations and in making the analyses, and, lastly, Dr. F. W. Andrewes, for much valuable advice in the bacteriological work.

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BATH AND WEST AND SOUTHERN COUNTIES SOCIETY.

INSTRUCTION IN CHEESE-MAKING.

Under an arrangement with the Somerset County Council the Society has opened a School, for instruction in Cheddar Cheese-making, at Compton House Farm, Axbridge, for a period of Six Months.

The School is under the supervision of Mr. Cannon, of Milton Clevedon, Evercreech, whose daughter, Miss Cannon, is engaged as Teacher.

A complete course consists of four weeks' instruction, for which the fee is eight guineas, which includes board and lodging. The following are the rates for students who attend the School for shorter periods :—

		£	s.	d.
For the first week (with board and lodging)	..	3	3	0
„ second „ „ „	..	2	2	0
„ third „ „ „	..	1	11	6
„ fourth „ „ „	..	1	11	6
„ one day (with board)	..	1	1	0

Day Students are admitted only when the class for longer periods is not full. Students may attend beyond the four weeks, if the School arrangements permit it, on payment of £2 2*s.* a week, inclusive of board and lodging. Those who attend for a week in the Spring or Summer may attend again in the Autumn at the reduced rates stated above.

If more persons apply to be admitted as Students than can be instructed at any one time, preference is given to the wives, sons, or daughters of dairy farmers and dairymen; the families of Members of the Society having priority.

The number of Students to be instructed at one time is, as a general rule, limited to five, but under exceptional circumstances this number may be exceeded.

Cheese-making commences each morning at seven o'clock, and is carried on all through the week, but it is optional to Students to attend, or not, on Sundays.

Applications to join the School must be made to the Society's Secretary,

THOS. F. PLOWMAN,

April, 1892. 4, *Terrace Walk*, *Bath.*

BATH AND WEST AND SOUTHERN COUNTIES SOCIETY.

TERMS AND PRIVILEGES OF MEMBERSHIP.

A Subscriber of £1 annually is a Member entitled to all the privileges of the Society, but tenant-farmers, the rateable value of whose holdings does not exceed £200 a-year, can become Members on subscribing 10*s*. annually. All members are entitled:—

1. To receive the Society's *Journal* free of expense.
2. To obtain opinions and analyses with regard to Manures, Soils, Feeding Stuffs, &c., at very low rates.
3. To obtain reports and results of examinations of Seeds and Plants at very low rates.

Members subscribing £1 annually are, in addition to the above-named privileges, entitled:—

4. To make an unlimited number of Stock Entries at the Society's Annual Exhibitions at reduced fees.

Admission to Exhibitions.

5. Members subscribing less than £1 annually are admitted free to the Society's Exhibitions and to the Reserved Seats in the Grand Stand, the Working Dairy, and the Band Enclosure for *one day* only, but Members subscribing £1 annually are admitted free during THE WHOLE TIME of the Annual Show.

The payment of £10 in one sum constitutes a Member for life.

A Member subscribing £2 annually is a Governor and eligible for election as a Vice-President. In addition to all the above-named privileges, he is entitled:—

6. To nominate one friend to the Society's Exhibitions, and to the Reserved Seats in the Grand Stand, the Working Dairy, and the Band Enclosure during THE WHOLE TIME of the Annual Show, and another friend for every further pound subscribed.

The payment of £20 in one sum constitutes a Governor for life.

Any person desirous of joining the Society can be proposed by a Member or by the Secretary (Thos. F. Plowman, 4, Terrace Walk, Bath).

OBSERVATIONS

ON

CHEDDAR CHEESE-MAKING.

REPORT FOR 1892.

BY F. J. LLOYD, F.C.S., F.I.C.

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1893.

OBSERVATIONS

ON

CHEDDAR CHEESE-MAKING.

REPORT FOR 1892.

IN the early part of 1892 I received instructions to conduct Observations at the Society's School at Axbridge, similar to those made in the autumn of 1891, and reported upon in the 'Journal' (vol. ii. p. 144).

I was requested to carry out the observations, so far as possible, on the same lines as in 1891, and also to endeavour to adopt the suggestions which were made at the conclusion of the report thereon. Permission was also given me to conduct such experiments as might be deemed desirable to further this object, even at the risk of diminishing the value of the cheeses produced. For convenience of reference the subject of this Report is treated under the following heads:—

1. The Conditions under which the Cheeses were made.
2. The Record of Observations.
3. The Bacteriological Investigation.
4. The Experimental Cheeses.
5. The Results of Observations.

I.—THE CONDITIONS UNDER WHICH THE CHEESES WERE MADE.

THE FARM AND SOILS.

The dairy of Compton House, Axbridge, is attached to the dwelling-house, and surrounded by farm buildings; it is not large, and there was no possibility of having two vats in use together. Moreover, as is well known, the yield of milk last season was small, hence it was not possible to act upon suggestion No. 4 of last year's Report.

The dairy faces south and west, and the atmosphere which entered into it would pass over buildings whichever way the wind blew.

The fields upon which the cows were pastured lay in the low level land, about one mile from the house. This land has evidently once been marsh land. It would appear to have been reclaimed from the sea some centuries ago,* and whether the herbage is distinct or not is a botanical question which I regret Professor Carruthers did not investigate, he, unfortunately, not being able to visit the farm.

To me the grass appeared of rough quality, and there seemed to be many useless plants in the pastures. The fields upon which the cows fed were as follows:—

Large Leaze	22 acres.
The 12 acres	12 "
The 10 acres	10 "
Sharnams, or the 7 and 8 acres..	15 "
The 14 acres	14 "
Moor House Field	14 "
Botany Bay..	6 "
The after Grass	15 "

The nature of the land is best shown by the analyses and Report of Dr. Voelcker, to whom carefully mixed samples were sent for analysis.

* This I gather from a work entitled 'A General View of tho Agriculture of the County of Somerset.' By Jno. Billingsley. 1798.

REPORT OF DR. VOELCKER ON THE SOILS.

Analytical Laboratory,
22, Tudor Street,
New Bridge Street, London.
January 7th, 1893.

The results of analysis of the five soils taken in connection with the Bath and West and Southern Counties Society's Experiments are as follows:—

Soil dried at 212° F. contain—	10 Acres.	14 Acres.	Moor House.	7 and 8 Acres.	Large Leaze.
*Organic matter and water of combination	13·99	15·67	15·23	15·60	17·98
Ferric oxide	2·60	3·81	3·78	4·02	3·81
Ferrous oxide	1·49	·94	·73	66	1·09
Alumina	5·42	6·28	6·19	6·54	7·06
Lime	·87	1 01	·90	·90	1·03
Magnesia	1·17	1·50	1·10	1·27	1·30
Potash	·73	·71	·65	·85	·86
Soda	·37	·46	·87	·47	·66
Phosphoric acid	·19	·23	·22	·18	·22
Sulphuric acid	·10	·10	·11	·14	·14
Sulphur (as sulphides)	·04	·02	·02	·04	·02
Insoluble silicates and sand ..	73·03	69·27	70·20	69·33	65·83
	100·00	100 00	100·00	100·00	100·00
*Containing nitrogen	·60	·65	·69	·66	·75
Equal to ammonia	·73	·79	·83	·80	·91
Nitric acid	·0025	·0025	·003	·003	·0035
Chloride of sodium	·005	·005	·005	·005	·005

The samples sent were small in amount, the soils themselves being already nearly quite dry and in small lumps, so that I had no opportunity of seeing them as they occurred *in situ*. They contained a great deal of rootlets, which tended to show high results in organic (vegetable) matter and in nitrogen resulting therefrom.

The five different soils were very similar in appearance, being of a greyish-brown colour, and of the nature, I should say, of a clay loam.

The analytical results brought out the fact that all five soils were strikingly alike in general composition. Indeed, there is no one point that markedly distinguishes any one soil from another, and remarks made on the composition of one will apply almost equally to all.

I have noted on the high amounts of organic matter and nitrogen. Lime also is present in ample quantity in all, though there are no cases of the occurrence of the amounts found in the Frome soil (Vallis Farm) last year.

The soils further show richness in potash, and both in this respect and in that of the supply of phosphoric acid, all the soils are in good fertility.

The separate estimation of chlorides did not bring out any case in which any excess of salt was shown, such as occurred with one of the Frome soils last year.

On the other hand, I found a good deal of iron present in the ferrous and not merely in the ferric state, and consequently I estimated the amounts separately. Analysis also showed that sulphides (probably as pyrites) were present to a small degree.

These two last-named points would lead me to think that the soils were not in the best condition of cultivation possible, but that further aeration and opening of the soil would be beneficial. Whether they are effectually drained or not appears to me worthy of consideration. J. AUGUSTUS VOELCKER.

THE STOCK AND YIELD OF MILK.

On April 1st they began with 30 cows in milk. These had increased to 48 by May 25th, leaving 2 more to calve. Ten were heifers with their first calf. The cows were ordinary Shorthorns of no precise character. No especial care appeared to have been taken to breed good milkers, and no register or record of the milk of individual cows was kept.

The cows were on the pastures day and night during the whole period. They received a little cake in the early months, and also in the autumn.

The water supply to the cattle was by means of dykes or ditches, the water in which, owing to the dry season, ran at times very low. The water appeared to be of very varying composition, at times mainly surface drainage water, which is not, in my opinion, well adapted for cows in milk. Such water is, as a rule, deficient in lime, too soft in fact, and it is well known that, owing to the considerable amount of lime secreted by the cow in her milk, hard water is a desideratum.

The season was most unfavourable to the growth of grass, and the cows were, therefore, compelled to travel about and keep moving to get sufficient food. It is evident then that the conditions were such as to prohibit either the largest quantity or the best quality of milk being obtained. Though it is difficult to compare the milk of one herd with that of another, much less at a year's interval, and to say definitely what causes the difference, if any, between them, yet the following comparison, between the composition of the milk yielded at Frome in 1891, and at Axbridge in 1892, during the three months, August, September, and October, is interesting:—

	Average Composition of Milk.						
	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.
Vallis Farm, Frome. Aug. 1891	87·39	12·61	3·87	2·76	·37	4·84	·77
Compton House Farm, Axbridge. Aug. 1892 ..	87·72	12·28	3·38	2·65	·37	5·20	·68
Vallis Farm, Frome. Sept. 1891	87·00	13·00	4·13	2·99	·41	4·69	·78
Compton House Farm, Axbridge. Sept. 1892 ..	87·44	12·56	3·57	2·87	·41	5·05	·66
Vallis Farm, Frome. Oct. 1891	86·19	13·81	4·75	3·21	·47	4·61	·77
Compton House Farm, Axbridge. Oct. 1892 ..	86·87	13·13	4·00	3·08	·51	4·84	·70

As it seemed probable that the difference first observed in August was due mainly to season, Mr. Armstrong, the occupier of Vallis Farm, was asked to send me samples of the mixed milk he was then obtaining, taken from his cheese tub at the same time as the samples were being taken at Axbridge. This he did in September, and again in October, and the results of the analyses of these samples are given in the following table side by side with the results obtained on the same days in 1891 at Vallis, and in 1892 at Axbridge:—

Composition of Milk at Vallis and Axbridge Compared.

Date.	Vallis, 1891.			Vallis, 1892.			Axbridge, 1892.		
	Fat.	Casein, &c.	Solids.	Fat.	Casein, &c.	Solids.	Fat.	Casein, &c.	Solids.
Sept. 12	4·03	8·75	12·78	3·66	8·69	12·35	3·65	8·99	12·64
" 13	4·07	8·73	12·80	4·02	8·70	12·72	3·55	8·97	12·52
" 14	3·85	8·75	12·60	3·88	8·56	12·44	3·69	8·93	12·62
" 15	3·98	9·06	12·84	3·96	8·76	12·72	3·57	8·87	12·44
" 16	3·75	9·13	12·88	3·84	8·66	12·50	3·65	8·97	12·62
" 19	4·06	9·00	13·06	3·85	8·71	12·56	3·45	9·07	12·52
Average	3·96	8·90	12·83	3·87	8·68	12·55	3·59	8·97	12·56
Oct. 20	4·84	9·10	13·94	4·16	9·02	13·18	3·88	9·16	13·04
" 21	4·98	9·08	14·16	4·24	9·04	13·28	4·08	9·20	13·28
" 24	5·07	9·07	14·14	4·05	9·05	13·19	4·08	9·20	13·28
" 25	4·91	9·09	14·00	4·16	9·22	13·38	4·13	9·25	13·38
" 26	5·05	9·09	14·14	4·52	9·06	13·58	4·01	9·25	13·26
" 27	5·20	9·10	14·30	4·49	9·05	13·58	3·80	9·20	13·00
Average	5·01	9·09	14·11	4·27	9·07	13·36	3·99	9·21	13·21

It will be seen that the milk obtained at Vallis in 1892 was poorer than in 1891, but was richer than that given at Axbridge. So the poorer quality of the milk yielded at Axbridge cannot be due solely to season, but is probably characteristic of the milk yielded by such pastures.

II.—THE RECORD OF OBSERVATIONS.

The tables drawn up in 1891 so fully covered the ground of cheese-making that they were adopted last year with only one slight addition: the volume of whey. The whey was collected in a tank which was roughly graduated to show the volume. The figures are only approximate, however, for the tank was not fixed, and, though care was taken to have it always in the same position, slight variations may have occurred.

The tables also record the temperature of the dairy each day. Greater attention should be paid to the temperature of the dairy and cheese room than is at present by many cheese-makers, for evidence seems to point to the fact that temperature plays a part in cheese-making even more important than is generally supposed. It is, in my opinion, as necessary to have thermometers permanently fixed in the dairy and cheese-room as it is to use one in the actual operations of cheese-making.

The following tables give the results of the observations. But the mass of figures is so great that their careful study is no easy task. To facilitate this, the average monthly results of some of the more important observations have been calculated and inserted. Those who are interested in other figures not so averaged can obtain these averages for themselves and fill up the spaces left for them. For the more rapid consideration of the results a table of monthly averages is given on the opposite page.

MONTHLY AVERAGES OF RESULTS OF OBSERVATIONS.

	3	5	6	7	9		10	11	13	14	15	19	20	23	25	27	34	34a	35	41–45	46	51	53	54	55	60
Month.	Relating to Evening's Milk.								Morning's Milk.		Total Volume of Milk.	Acidity of Stale Whey.	Mixed Milk, &c.		Acidity of Whey before breaking.	Acidity of Whey put aside.	Acidity of Whey when drawn.	Volume of Whey.	Acidity of draining from piled Curd.	Acidity of draining from Curd before grinding.	Acidity of Curd when milled.	Weight of Curd when vatted.	Acidity of Liquid from press.	Weight of Cheese taken to cheese room.	Loss in Press.	Weight of Cheese when sold.
	Volume of Milk.	At night.			In morning.																					
		Temp. of Dairy.	Temp. of Milk.	Acidity.	Temp. of Dairy.		Temp. of Milk.	Acidity.	Volume.	Acidity.			Acidity.	Proportion of Rennet added.												
	galls.				min.	max.			galls.		galls.							galls.				lbs.		lbs.	lbs.	lbs.
April . .	37	55	81	·18	52	55	65	·19	44	·17	81	·34	·18	9031	·13	·14	·17	..	·22	·85	4·00	77	1·08	71½	5½	68
May . .	50	62	82	·21	60	64	67	·23	59	·20	109	·40	·22	9135	·16	·16	·20	..	·26	·92	5·24	110½	1·18	102	8½	94
June . .	60	64	87	·22	62	65	69	·23	67	·21	127	·44	·22	9403	·15	·16	·22	111	·32	·99	4·60	132	1·16	122	10	113
July .	56	65	87	·21	63	66	69	·23	60	·21	116	·46	·22	9419	·15	·16	·21	97	·29	1·00	4·66	127	1·18	115	12	108
August .	47	66	87	·21	64	66	69	·23	53	·21	100	·45	·23	9423	·15	·16	·21	84	·30	·89	4·47	112	1·14	102½	9½	94
September	39	61	84	·21	60	62	68	23	45	·22	84	·44	·23	9302	·15	·16	·20	69	·26	·91	4·69	99	1·07	91	8	85
October .	26	66	76	·21	60	65	63	·22	32	·21	58	·41	·22	9041	·14	·15	·19	47	·24	·90	4·10	72	1·11	68	4	62

MONTHLY AVERAGES OF RESULTS OF ANALYSES.

Month.	Composition of Mixed Milk.							Composition of Whey.			Composition of Curd.			
	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	Ash.
April. . .	88·25	11·75	3·06	2·35	·43	5·28	·66	7·00	·31	·54	42·04	57·96	28·82	2·54
May . . .	87·96	12·04	3·12	2·55	·40	5·25	·72	6·95	·38	·55	42·48	57·52	29·49	2·49
June . . .	87·80	12·20	3·17	2·65	·39	5·26	·73	6·91	·35	·55	41·14	58·86	29·59	2·46
July . . .	87·80	12·20	3·21	2·66	·39	5·22	·72	6·87	·34	·55	41·82	58·18	29·17	2·34
August . .	87·72	12·28	3·38	2·65	·37	5·20	·68	6 86	·32	·54	42·25	57·75	29·49	2·16
September .	87·44	12·56	3·57	2·87	·41	5·05	·66	6·78	·33	·53	42·17	57·83	29·49	2·14
October . .	86·87	13·13	4·00	3·08	·51	4·84	·70	6·89	·34	·55	41·66	58·34	30·06	2·25

RECORD OF OBSERVATIONS MADE AT THE BATH AND

1	2	3	4	5	6	7	8	9		10	11
	Relating to Evening's Milk.										
Day of Month.	Name of Field.	Volume of Milk.	At Night.				In Morning.				
			Time.	Temp. of Dairy.	Temp. of Milk.	Acidity.	Time.	Temp. of Dairy.		Temp. of Milk.	Acidity.
		galls.	P.M.				A.M.	min.	max.		
8–9	Ten acres and Botany Bay .	36	6.4	61	86	·17	6.45	55	..	69	·17
9–10	Ditto . . .	37	6.8	61	88	·17	7.4	57	..	69	·20
10–11	Ditto . . .	35	5.15	62	89	·18	6.52	57	..	65	·19
11–12	Ditto . . .	38	7.5	61	84	·19	7.5	56	..	65	·20
12–13	Ditto . . .	38	6.20	59	84	·18	6.55	56	..	63	·18
13–14	Ditto . . .	34	6.10	54	77	·17	6.50	50	54	57	·19
14–15	Ditto . . .	39	6.15	51	79	·18	7.12	48	53	63	·19
15–16	Ditto . . .	34	5.8	53	82	·17	7.15	48	53	60	·20
16–17	Ditto . . .	38	6.5	50	78	·18	7.15	49	53	61	·18
17–18	Ditto . . .	35	5.15	52	79	·18	7.10	48	52	59	·18
18–19	Ditto . . .	36	6.20	53	79	·18	7.15	48	58	63	·19
19–20	Ditto . . .	38	6.10	52	76	·17	7.10	50	53	66	·19
20–21	Ditto . . .	38	6.15	53	82	·17	7.30	52	56	65	·18
21–22	Ditto . . .	37	6.20	54	83	·18	7.10	54	57	67	·19
22–23	Ditto . . .	37	6.12	54	82	·18	6.55	54	62	65	·18
23–24	Ditto . . .	37	6.15	55	79	·19	7.22	55	57	65	·20
24–25	Ditto . . .	35	5.15	55	82	·18	7.5	55	57	66	·21
25–26	Ditto . . .	39	6.30	54	81	·18	7.10	55	57	67	·21
26–27	Ditto . . .	39	6.20	53	80	·18	7.0	54	57	69	·19
27–28	Ditto . . .	40	6.21	54	80	·19	7.21	52	56	67	·21
28–29	Ditto . . .	37	6.15	53	81	·19	7.10	53	56	66	·20
29–30	Ditto . . .	38	6.30	54	80	·20	7.15	52	56	66	·21
Average . . .		37	..	55	81	·18	..	52	55	65	·19

WEST OF ENGLAND SOCIETY'S CHEESE SCHOOL, APRIL, 1892.

12	13	14	15	16	17	18	19	20	21	22	23
MORNING'S MILK.				MILK HEATED.		STALE WHEY.		MIXED MILK, &c.			
										Rennet added.	
Name of Field.	Volume of Milk.	Acidity.	Total Volume of Milk.	Quantity.	To Temp.	Quantity.	Acidity.	Acidity before Renneting.	Time of Renneting.	Vol.	Proportion by Volume.
	galls.		galls.	galls.		galls.			A.M.	ounces.	
The Moor .	40	·17	76	35	90	4	·24	·17	7.8	1·37	8876
Ditto . .	41	·17	78	25	90	4	·33	·18	7.40	1·39	8978
Ditto . .	44	·17	79	22	90	..	..	·18	7.45	1·40	9029
Ditto . .	41	·18	79	43	90	..	..	·18	7.45	1·40	9029
Ditto . .	41	·17	79	40	90	..	..	·17	7.45	1·40	9029
Ditto . .	44	·17	78	34	90	..	..	·17	7.50	1·38	9043
Ditto . .	45	·17	84	35	90	4	·25	·17	7.50	1·46	9205
Ditto . .	47	·18	81	37	90	4	·33	·18	7.50	1·43	9063
Ditto . .	43	·17	81	32	90	4	·35	·17	7.50	1·43	9063
Ditto . .	46	·17	81	28	90	4	·33	·18	7.50	1·43	9063
Ditto . .	45	·17	81	32	90	4	·36	·19	7.45	1·43	9063
Ditto . .	43	·17	81	31	90	4	·33	·18	7.40	1·43	9063
Ditto . .	43	·18	81	28	90	4	·28	·20	7.50	1·43	9063
Ditto . .	45	·18	82	30	90	4	·30	·19	7.45	1·45	9048
Ditto . .	48	·17	85	28	90	4	·35	·19	7.50	1·51	9007
Ditto . .	47	·18	84	28	88	4	·38	·20	8.0	1·49	9020
Ditto . .	49	·18	84	33	90	4	·38	·19	8.4	1·49	9020
Ten acres Botany Bay	44	·18	83	35	90	4	·40	·18	7.45	1·47	9034
Ditto . .	44	·18	83	30	90	4	·36	·19	7.50	1·48	8973
Ditto . .	44	·20	84	33	90	4	·39	·21	7.57	1·49	9020
Ditto . .	45	·18	82	31	90	4	·38	·19	7.55	1·46	8986
Ditto . .	46	·18	84	31	90	4	·38	·20	7.45	1·49	9020
	44	·17	81	..	..	..	·34	·18	7.47	..	9031

RECORD OF OBSERVATIONS MADE AT THE BATH AND WEST

	24	25	26	27	28	29	30	31	32	33	34	35
						Temp. of Scald.				Relating to Whey.		
Day of Month.	Time when Curd cut.	Acidity of Whey before Breaking.	Time of Breaking.	Acidity of Whey put aside.	Time Scalding commences.	1st.	2nd.	Time taken in Stirring.	Time in Scald.	Temp. when drawn.	Acidity.	Acidity of draining from piled Curd.
	A.M.		A.M.		A.M.			min.	h. m.			
8–9	8.0	·12	9.25	·12	10.15	88	90	60	2 10	86	·15	·19
9–10	8.25	·13	8.45	·14	9.37	87	89	60	2 8	87	·15	·20
10–11	8.50	·12	9.3	none	9.55	88	91	55	2 3	87	·17	·29
11–12	8.43	·11	9.0	·12	9.57	88	90	60	2 7	86	·14	·17
12–13	8.45	·11	9.0	·11	10.0	88	90	60	2 20	85	·12	·13
13–14	8.50	·11	9.25	·11	10.15	88	90	60	2 9	84	·11	·13
14–15	8.50	·12	9.15	·12	10.10	88	90	60	2 25	85	·16	·28
15–16	8.50	·12	9.10	·14	10.10	88	90	35	1 30	87	·19	·31
16–17	8.50	·12	9.10	·12	10.12	88	90	40	1 28	88	·16	·21
17–18	8.45	·13	9.5	.13	10.5	88	91	30	1 30	87	·20	·30
18–19	8.40	·13	9.0	·14	10.0	88	91	30	1 25	88	·18	·22
19–20	8.40	·13	9.10	·14	10.5	88	91	60	2 2	87	·14	·15
20–21	8.50	·13	9.20	·13	10.18	88	91	60	2 2	86	·16	·16
21–22	8.40	·15	9.5	·15	10.0	88	90	60	2 0	85	·17	·17
22–23	8.44	·14	9 0	·14	9.55	88	90	60	2 5	86	·20	·24
23–24	8 45	·14	9.5	·14	10.0	88	91	60	2 35	87	·19	·22
24–25	8.50	·14	9.5	·14	10.0	88	91	50	1 35	88	·18	·24
25–26	8.35	·13	8.48	·14	9.40	88	91	63	1 55	86	·18	·20
26–27	8.42	·14	9.5	·14	10.3	88	90	60	2 7	86	·21	·25
27–28	8.45	·14	9.5	·15	10.5	88	90	40	1 40	86	·20	·24
28–29	8.40	·14	8.55	·15	9.53	88	90	35	1 30	86	·19	·25
29–30	8.30	·14	8.45	·15	9.38	88	91	40	2 0	86	·22	·29
Average ..		·13	..	·14	..	..	..	52	1 56	..	·17	·22

OF ENGLAND SOCIETY'S CHEESE SCHOOL, APRIL, 1892.—*contd.*

36	37	38	39	40	41	42	43	44	45	46	47	48	49	
			ACIDITY OF WHEY DURING TREATMENT OF CURD.								SALT ADDED.			
Time Curd remains piled.	Time Curd is taken from Tub.	Temp. of Curd when taken from Tub.	When taken to Cooler.	After 1st Cutting.	After 2nd Cutting.	After 1st Turning.	After 2nd Turning.	After 3rd Turning.	After 4th Turning.	Acidity of curd when Milled.	Weight.	Percentage.	Temp. of Dairy.	
min.	P.M.										lbs. oz.		min.	max.
64	1.52	86	·21	·32	·42	·64	·69	..	..	..	1 10	2·20	62	..
30	12.35	86	·32	·44	·60	·76	·86	..	..	..	1 11	2·23	62	..
20	12.50	86	·47	·63	·81	·84	..	..	..	..	1 11	2·26	62	..
60	1.30	83	·36	·55	·62	·97	1·02	..	..	4·60	1 11	2·20	59	..
60	1.45	81	·19	·26	·46	·58	·74	..	..	6·00	1 11	2·18	52	63
65	1.50	84	·15	·24	·42	·63	·76	..	..	5·10	1 11	2·23	51	59
40	1.35	84	·54	·70	·82	·97	1·02	..	..	3·40	1 12	2·13	49	57
23	12.30	83	·51	·72	·89	·92	..	..	..	4·20	1 10	2·06	50	57
45	12.45	88	·39	·57	·78	·86	·96	..	..	{3·60 4·00}	1 10	2·04	49	57
35	12.35	88	·44	·50	·80	·87	·98	..	..	3·80	1 10	2·14	48	60
30	12.25	87	·26	·31	·40	·48	·56	·61	·79	3·60	1 10	2·11	50	57
35	1.5	86	·16	·20	·31	·33	·55	..	..	6·20	1 10	2·14	51	59
67	2.0	84	·23	·31	·44	·53	..	..	..	5·20	1 10	2·19	54	60
75	1.45	86	·25	·32	·50	·50	..	..	..	5·80	1 10	2·10	54	62
45	1.15	85	·30	·37	·52	·69	·83	..	..	5·60	1 12	2·19	55	62
60	1.30	86	·27	·33	·52	·63	..	..	..	5·20	1 11	2·15	51	62
45	12.50	88	·30	·39	·60	·73	·81	..	..	5·10	1 11	2·19	50	63
60	1.5	86	·31	·51	·67	·87	·93	..	..	5·20	1 10	2·08	55	62
65	1.35	86	·49	·67	·89	1·02	..	..	..	3·80	1 10	2·08	54	63
40	12.45	87	·39	·52	·68	·88	·97	1·08	..	3·90	1 11	2·14	54	61
35	12.30	88	·41	·54	·72	·81	·94	1·05	..	3·80	1 10	2·14	53	61
35	12.25	87	·49	·66	·80	·92	·98	1·11	..	3·70	1 11	2·15	53	61
	1.10									4·00			54	60

RECORD OF OBSERVATIONS, APRIL, 1892.—*continued.*

	50	51	52	53	54	55	56		57		58		59		60
	RELATING TO CURD.			RELATING TO CHEESES.											
							Temp. of Cheese Room.				Hygrometer Reading.				
Day of Month.	Temp. in Vat.	Weight when Vatted.	Time of Vatting.	Acidity of liquid from Press.	Weight taken to Cheese Room.	Loss in Press.	Morning.		Evening.		Morning.		Evening.		Weight of Cheese when sold.
							Min.	Max.	Min.	Max.	Wet.	Dry.	Wet.	Dry.	
		lbs.	P.M.	per cent.	lbs.	lbs.									lbs.
8–9	71	74	6.55	1·06	65½	8½	..	..	..	..	..	..	..	..	62½
9–10	72	75½	3.55	1·09	68	7½	..	..	..	..	..	..	..	..	64
10–11	72	74½	3.50	1·10	67½	7	..	..	..	..	59	62	56½	60	63
11–12	70	76½	6.28	1·14	70	6½	..	..	..	..	52	55½	57	61	65½
12–13	60	77½	9.40	0·95	70½	7	..	..	50	52	51½	55	49	52	66½
13–14	61	75½	9.47	0·97	69	6½	46	50	45	61	44½	46½	52	56	65
14–15	75	82	5.20	1·23	76½	5½	44	54	44	62	43	45	56½	62	72
15–16	72	79	3.25	1·15	74½	4½	44	61	44	57	44	66	52½	56½	68½
16–17	67	79½	5.10	1·08	74	5½	46	59	45	50	45	47	48	50	70
17–18	66	76	5.10	1·09	71½	4½	44	48	42	56	43	45	49	52	65½
18–19	65	77	9.30	1·06	72½	4½	50	55	54	59	50	52	53	57	68½
19–20	63	76	A.M. 7.35	1·02	70	6	50	58	52	59	49	51½	54	56½	66
20–21	62	74½	A.M. 7.30	0·97	70	4½	50	64	52	65	53	55½	59½	62	67
21–22	63	77½	A.M. 7.30	1·00	71½	6	53	66	55	57	54	57	55	57	68½
22–23	68	80	9.50	1·12	74	6	51	55	51	58	51	53	55	57	71
23–24	67	78½	9.55	1·07	74	4½	52	56	53	58	53	55	55	58	70
24–25	69	77	8.25	1·10	72	5	52	58	51	55	51	53	52	55	68
25–26	68	78	9.7	1·06	72	6	51	58	50	55	52	54	52	54	68½
26–27	68	78	6.55	1·05	73	5	48	55	48	52	48	50	49½	52	69
27–28	68	79	6.22	1·11	75	4	47	50	46	60	47	49	52½	55	70½
28–29	68	76	6.0	1·17	72½	3½	48	54	47	61	47	49	52	54	69
29–30	70	78½	5.6	1·15	73½	5	46	53	46	56	46	48	53	56	70
..	..	77	6.58	1·08	71½	5½	..	..	..	..	..	..	..	..	68

RECORD OF ANALYSES—APRIL, 1892.

Day of Month.	Composition of Mixed Milk.							Composition of Whey.			Composition of Curd.			
	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	Ash.
8–9	88·20	11·80	2·97	2·41	·39	5·45	·58	6·76	·30	·44	43·35	56·65	27·54	2·60
9–10	88·12	11·88	3·16	2·39	·40	5·21	·72	7·10	·31	·59	43·35	56·65	27·56	3·05
10–11	88·46	11·54	2·84	2·42	·40	5·24	·64	6·94	·32	·52	43·20	56·80	21·66	..
11–12	88·04	11·96	3·19	2·00	·41	5·82	·54	7·02	·28	·50	42·05	57·95	28·68	2·55
12–13	88·08	11·92	3·18	2·12	·53	5·61	·68	7·06	·33	·49	42·15	57·85	29·15	2·60
13–14	88·24	11·76	3·06	2·38	·49	5·15	·68	7·04	·34	·51	42·90	57·10	27·61	2·80
14–15	88·14	11·86	3·13	2·80	·63	4·64	·66	7·06	·30	·48	41·65	58·35	30·12	2·50
15–16	88·10	11·90	3·22	..	..	..	·68	7·01	·30	·54	43·10	56·90	28·71	2·35
16–17	88·02	11·98	3·29	..	..	..	·66	7·10	·30	·56	42·45	57·55	29·37	2·40
17–18	88·52	11·48	2·81	..	..	..	·70	7·00	·32	·59	44·20	55·70	26·73	2·75
18–19	88·26	11·74	2·99	2·64	·40	5·05	·66	7·06	·26	·51	41·30	58·70	32·37	2·55
19–20	88·48	11·52	2·98	..	..	..	·64	7·05	·29	·55	40·50	59·50	29·76	2·60
20–21	88·32	11·68	3·02	..	..	..	·68	7·02	·41	·54	41·60	58·40	29·72	2·45
21–22	88·32	11·68	2·91	..	..	..	·68	6·92	·26	·52	41·35	58·65	28·86	2·45
22–23	88·32	11·68	3·10	..	..	..	·66	7·05	·39	·56	41·75	58·25	29·40	2·30
23–24	88·24	11·76	3·02	..	..	..	·66	7·04	·25	·56	41·20	58·80	28·86	2·40
24–25	88·40	11·60	3·03	..	..	..	·64	6·90	·38	·57	42·10	57·90	28·55	2·35
25–26	88·16	11·84	3·25	..	..	..	·68	7·05	·29	·56	40·75	59·25	30·00	2·55
26–27	88·26	11·74	3·13	2·42	·38	5·13	·68	6·98	·26	·55	41·10	58·90	30·26	2·50
27–28	88·40	11·60	2·95	2·42	·40	5·17	·66	6·94	·32	·55	41·70	58·30	29·40	2·55
28–29	88·16	11·84	3·21	2·23	·40	5·34	·66	6·98	·42	·59	41·85	58·15	29·75	2·60
29–30	88·22	11·78	3·04	2·01	·39	5·60	·74	6·99	·34	·56	41·25	58·75	30·08	2·50
Average	88·25	11·75	3·06	2·35	·43	5·28	·66	7·00	·31	·54	42·04	57·96	28·82	2·54

RECORD OF OBSERVATIONS MADE AT THE BATH AND WEST

1	2	3	4	5	6	7	8	9		10	11
	RELATING TO EVENING'S MILK.										
			At Night.				In Morning.				
Day of Month.	Name of Field.	Volume of Milk.	Time.	Temp. of Dairy.	Temp. of Milk.	Acidity.	Time.	Temp. of Dairy.		Temp. of Milk.	Acidity.
		galls.	P.M.				A.M.	min.	max.		
30–1	Ten acres Botany Bay . . .	39	6.20	54	83	·21	7.20	52	57	65	·21
1–2	Ditto	39	5.30	54	79	·21	7.20	53	57	65	·21
2–3	Moor House, 12 acres Large Leaze	39	6.10	64	79	·20	7.20	61	65	64	·21
3–4	Ditto	45	6.20	62	80	·20	7.25	60	68	66	·22
4–5	Ditto	45	7.0	65	79	·21	7.25	59	66	66	·22
5–6	Ditto	47	6.35	64	78	·20	7.20	62	66	65	·21
6–7	Ditto	49	6.25	64	85	·22	7·20	57	68	66	·22
7–8	Ditto	47	6.15	59	82	·23	7.25	59	66	65	·23
8–9	Ditto	45	5.20	64	84	·22	7.10	63	70	66	·23
9–10	Ditto	46	7.30	66	84	·22	7.2	62	66	67	·23
10–11	Ditto	48	6.20	64	87	·21	7.10	60	64	69	·23
11–12	Sharman's . . .	49	6.5	64	87	·22	7.20	60	64	69	·23
12–13	Ditto	49	6.15	63	87	·22	7.3	61	64	68	·24
13–14	Ditto	51	6.17	64	88	·21	7.20	61	63	67	..
14–15	Ditto	52	6.35	61	77	·22	7.15	60	63	65	·22
15–16	Ditto	48	5.15	61	83	·22	7.20	58	61	65	·23
16–17	Ditto	50	6.15	59	77	·22	7.15	58	68	65	·23
17–18	Moor House, Large Leaze . . .	56	6.20	58	78	·21	7.20	58	60	64	·22
18–19	Ditto	53	6.15	60	84	·22	7.20	58	61	66	·22
19–20	Moor House, Large Leaze, 12 acres .	55	6.20	60	83	·21	7.20	58	62	66	·23
20–21	Ditto	54	6.15	60	82	·23	7.10	58	61	65	·23
21–22	Ditto	54	6.10	60	84	·22	7.20	58	60	66	·23
22–23	Ditto	50	5.20	60	83	·22	7.7	60	62	66	·22
23–24	Ditto	57	6.15	62	84	·21	7.0	60	64	69	·24
24–25	Ditto	56	6.20	61	83	·22	7.10	62	64	70	·23
25–26	Ditto	57	6.10	64	83	·22	7.5	63	66	70	·24
26–27	Sharnam's, Large Leaze . . .	55	6.20	65	85	·23	7.15	64	67	70	·24
27–28	Ditto	59	6.15	65	84	·22	7.15	64	66	71	·24
28–29	Ditto	57	6.25	65	82	·23	7.10	64	66	70	·24
29–30	Ditto	55	5.15	66	83	·23	7.15	63	65	70	·23
30–31	Ditto	60	6.30	66	87	·22	7.15	64	67	72	·24
Average		50	..	62	82	·21	..	60	64	67	·23

OF ENGLAND SOCIETY'S CHEESE SCHOOL, MAY, 1892.

12	13	14	15	16	17	18	19	20	21	22	23
MORNING'S MILK.				MILK HEATED.		STALE WHEY.		MIXED MILKS, &c.			
Name of Field.	Vol. of Milk.	Acidity.	Total Vol. of Milk.	Quantity.	To Temp.	Quantity.	Acidity.	Acidity before Renneting.	Time of Renneting.	Rennet added. Vol.	Rennet added. Proportion by Volume.
	galls.		galls.	galls.		galls.			A.M.	ounces.	
Ten acres Botany Bay	45	·18	84	33	90	4	·39	·20	7.40	1·49	9024
Ditto	46	·20	85	38	90	4	·38	·21	8.5	1·51	9007
Moor House, Large Leaze, 12 acres .	50	·19	89	37	90	4	·35	·21	7.54	1·58	9012
Ditto	52	·20	97	38	90	4	·35	·21	7.52	1·72	9023
Ditto	54	·19	99	33	90	none	..	·21	7.45	1·76	9000
Ditto	53	·18	100	33	90	4	·37	·21	7.57	1·77	9039
Ditto	53	·20	102	43	90	4	·43	·22	7.45	1·81	9016
Ditto	55	·20	102	33	90	4	·41	·22	7.50	1·81	9016
Ditto	57	·21	102	33	90	4	·40	·22	8.45	1·81	9016
Ditto	52	·21	98	35	90	4	·42	·22	7.42	1·74	9011
Ditto	51	·20	99	38	90	4	·41	·22	7.32	1·76	9000
Large Leaze, Sharnam's . . .	54	·21	103	36	90	4	·41	·22	7.32	1·79	9206
Ditto	55	·21	104	40	90	none	..	·23	7.37	1·80	9244
Ditto	51	·21	102	23	90	4	·39	·23	7.49	1·77	9220
Ditto	60	·21	112	39	90	4	·43	·22	7.55	1·94	9231
Ditto	61	·21	109	46	90	4	·43	·22	7.55	1·89	9227
Ditto	62	·21	112	46	90	4	·33	·23	7.55	1·94	9231
Moor House, Large Leaze . . .	60	·21	116	54	90	4	·40	·22	7.45	2·02	9188
Ditto	63	·21	116	39	90	4	·44	·21	7.45	2·02	9188
Ditto	62	·22	117	48	90	4	·43	·22	7.49	2·04	9171
Moor House, Large Leaze, 12 acres .	61	·21	115	40	87	4	·41	·22	7.35	2 00	9200
Ditto	64	·21	118	45	88	4	·43	·24	7.40	2·05	9209
Ditto	66	·22	116	31	90	4	·39	·22	7.27	2·02	9188
Ditto	61	·22	118	41	90	4	·33	·24	7.35	2 05	9209
Ditto	63	·21	119	38	81	4	·44	·22	7.23	2 07	9198
Ditto	64	·21	121	41	82	4	·45	·22	7.38	2·11	9175
Sharnam's, Large Leaze . . .	66	·22	121	35	84	4	·41	·23	7.47	2·11	9175
Ditto	64	·21	123	34	90	4	·46	·23	7.45	2·14	9196
Ditto	66	·21	123	42	90	4	·44	·23	7.45	2·14	9196
Ditto	73	·21	128	40	90	4	·39	·23	7.32	2·23	9183
Ditto	65	·20	125	41	82	4	·44	·23	7.40	2·17	9216
	59	·20	109	..	..	..	·40	·22	7.46	..	9135

RECORD OF OBSERVATIONS MADE AT THE BATH AND WEST

	24	25	26	27	28	29	30	31	32	33	34	35
Day of Month.	Time when Curd cut.	Acidity of Whey before Breaking.	Time of Breaking.	Acidity of Whey put aside.	Time Scalding commences.	Temp. of Scald. 1st.	Temp. of Scald. 2nd.	Time taken in Stirring.	Time in Scald.	Relating to Whey. Temp. when drawn.	Relating to Whey. Acidity.	Relating to Whey. Acidity of draining from piled Curd.
	A.M.		A.M.		A.M.			min.	h. m.			
30–1	8.30	·14	8.45	·15	9.40	88	90	55	1 45	86	·20	·28
1–2	8.50	·14	9.5	·15	9.57	88	90	45	1 43	87	·18	·21
2–3	8.40	·14	9.0	·15	9.50	88	90	55	1 55	87	·18	·23
3–4	8.40	·15	8.57	·15	9.50	88	90	35	1 25	87	·17	·22
4–5	8.35	·14	9.7	·15	10.5	88	90	60	1 52	87	·18	·23
5–6	8.50	·16	9.25	·17	10.13	88	90	60	2 0	86	·25	·36
6–7	8.35	·16	8.55	·17	9.40	87	90	45	1 30	86	·19	·24
7–8	8.40	·15	9.7	·16	10.5	88	90	60	1 40	88	·19	·24
8–9	8.35	·16	9.3	·16	10.5	88	90	35	1 30	88	·19	·24
9–10	8.30	·15	8.50	·16	9.54	88	90	45	1 36	86	·19	·24
10–11	8.20	·15	8.50	·16	9.45	87	90	57	1 50	85	·22	·28
11–12	8.15	·16	8.45	·16	9.40	88	90	52	1 45	86	·22	·30
12–13	8.24	·15	8.57	·15	9.58	88	90	60	1 55	86	·18	·20
13–14	8.34	·16	9.7	·17	10.5	88	90	60	1 50	86	·22	·34
14–15	8.40	·17	9.0	·17	10.0	88	90	38	1 25	86	·19	·26
15–16	8.40	·16	9.0	·16	10.4	87	90	60	1 55	85	·20	·27
16–17	8.38	·15	9.10	·15	10.9	88	90	60	2 2	85	·17	·22
17–18	8.38	·16	8.57	·17	9.57	88	90	45	1 43	86	·20	·30
18–19	8.28	·16	8.55	·17	9.55	88	90	37	1 30	86	·20	·27
19–20	8.35	·15	8.53	·16	9.55	88	90	60	1 50	85	·20	·25
20–21	8.25	·15	8.43	·16	9.45	88	90	60	2 0	85	·21	·29
21–22	8.25	·17	8.40	·17	9.40	88	90	40	1 30	86	·20	·26
22–23	8.15	·16	8·38	·17	9.38	88	90	60	1 52	86	·19	·21
23–24	8.20	·16	8.40	·16	9.40	88	90	60	1 45	86	·19	·24
24–25	8.12	·17	8.37	·17	9.28	88	90	60	2 7	86	·21	·28
25–26	8.25	·17	8.40	·17	9.44	88	90	60	1 51	87	·20	·25
26–27	8.30	·16	8.51	·17	9.53	88	90	60	2 2	87	·22	·26
27–28	8.30	·16	8.54	·18	9.55	88	90	60	2 5	87	·23	·31
28–29	8.30	·16	8.53	·17	9.55	88	90	60	2 5	87	·21	·27
29–30	8.17	·16	8.32	·17	9.35	88	90	60	1 45	87	·21	·26
30–31	8.28	·16	8.40	·16	9.40	88	90	104	2 35	85	·25	·38
Average ..		·16	..	·16	..	..	..	55	1 49	..	·20	·26

OF ENGLAND SOCIETY'S CHEESE SCHOOL, MAY, 1892—*contd.*

36	37	38	39	40	41	42	43	44	45	46	47	48	49	
			Acidity of Whey during Treatment of Curd.								Salt Added.			
Time Curd remains piled.	Time Curd was taken from Tub.	Temp. of Curd when taken from Tub.	When taken to Cooler.	After 1st Cutting.	After 2nd Cutting.	After 1st Turning.	After 2nd Turning.	After 3rd Turning.	After 4th Turning.	Acidity of Curd when Milled.	Weight.	Percentage.	Temp. of Dairy.	
min.	P.M.										lbs. oz.		min.	max.
40	12.20	88	·48	·63	·77	·88	1·00	1·14	..	5·00	1 11	2·16	54	61
60	1.10	86	·36	·44	·65	·76	·92	·96	..	6·40	1 11	2·16	54	65
40	12.50	86	·33	·42	·63	·76	·91	·93	..	6·00	1 12	2·13	62	67
55	12.35	87	·35	·48	·64	·83	·86	1·03	..	5·80	2 0	2·17	62	67
55	1.15	87	·24	·30	·45	·64	·81	..	..	5·00	2 1	2·16	59	65
30	1.0	86	·55	·71	·85	1·00	..	..	..	4·00	2 1	1·96	62	69
35	12.30	86	·33	·44	·60	·67	·80	·85	95	4·20	2 2	2·13	58	70
35	12.45	87	·33	·43	·60	·70	·93	·95	..	3·90	2 2	2·06	62	71
40	12.40	87	·32	·48	·67	·81	·90	·92	..	4·20	2 2	2·07	64	71
45	12.45	85	·33	·38	·54	·55	·58	·67	·72	4·20	2 0	2·06	61	65
30	12.40	85	·38	·45	·55	·67	·77	·86	..	4·80	2 1	2·10	61	64
38	12.45	85	·48	..	·76	·87	·90	..	..	4·80	2 2	2·02	61	65
40	1.5	85	·23	·32	·49	·68	·75	..	..	4·00	2 2	2·02	61	64
40	1.10	85	·57	·72	·86	·92	·99	..	..	6·80	2 1	1·80	61	64
38	12.37	87	·42	·59	·75	·82	·92	..	..	7·00	2 6	2·00	60	62
40	1.10	85	·37	·49	·66	·75	·88	·98	..	6·70	2 5	2·04	58	61
60	1.50	84	·31	·42	·57	·71	·77	..	..	5·40	2 6	2·02	58	62
60	1.10	88	·64	·82	1·05	1·11	..	..	..	5·20	2 8	1·99	59	62
40	12.40	87	·48	·67	·86	1·02	1·15	1·21	..	6·00	2 8	2·06	58	62
45	1.0	86	·41	·59	·77	·88	·97	1·08	..	5·10	2 8	2·06	59	62
30	12.40	84	·46	·65	·84	·99	1·08	..	..	5·20	2 8	2·07	58	62
50	12.35	86	·40	·49	·62	·74	·82	·89	..	6·00	2 9	2·17	60	66
75	1.25	86	·31	·34	·47	·54	·64	·85	..	4·80	2 8	2·14	60	64
80	1.40	86	·41	·54	·76	·85	·89	..	..	5·00	2 9	2·16	61	65
30	12.40	86	·37	·48	·64	·84	·92	·92	..	5·10	2 9	2·12	62	67
54	1.5	86	·31	·38	·51	·58	·65	..	..	5·20	2 10	2·14	63	67
60	1.25	85	·40	·51	·65	·71	..	..	..	5·60	2 10	2·09	64	67
30	1.0	85	·43	·54	·66	·77	·85	·94	..	4·80	2 11	2·09	64	70
47	1.25	87	·40	·58	·66	·78	..	..	..	5·00	2 11	2·11	64	67
20	12.20	85	·35	·48	·68	·81	·89	·95	..	5·30	2 11	2·07	64	68
30	1.25	86	·57	·62	·85	·91	·95	..	..	6·00	2 10	2·01	64	69
..	12.57	..	..	..	..	..	..	..	..	5·24	..	..	61	66

RECORD OF OBSERVATIONS, MAY, 1892—*continued.*

	50	51	52	53	54	55	56		57		58		59		60
	Relating to Curd.			Relating to Cheeses.											
							Temp. of Cheese Room.				Hygrometer Reading.				
							Morning.		Evening.		Morning.		Evening.		
Day of Month.	Temp. in Vat.	Weight when Vatted.	Time of Vatting.	Acidity of Liquid from Press.	Weight taken to Cheese Room.	Loss in Press.	Min.	Max.	Min.	Max.	Wet.	Dry.	Wet.	Dry.	Weight of Cheese when sold.
		lbs.	P.M.	per cent.	lbs.	lbs.									lbs.
31–1	67	78	5.45	1·23	73	5	46	54	47	56	52	54	53	56	66
1–2	69	78	7.15	1·09	72	6	52	54	48	69	47	50	60½	65½	65
2–3	71	82	8.0	1·12	76½	5½	55	67	50	68	55	57	62	66	69½
3–4	71	92	7.15	1·08	84	8	50	54	51	74	51	53	63	68	77½
4–5	71	95½	9.50	1·17	90	5½	50	68	50	71	51	54	61	64	82
5–6	76	105	4.10	1·25	98	7	48	54	49	55	49	51	53	55	87
6–7	70	99½	7.35	1·23	96	3½	49	55	50	61	48½	51	57	59	89
7–8	73	103	8.10	1·16	95½	7½	49	58	53	62	53	55	58	61	88
8–9	74	102½	7.50	1·12	95	7½	53	60	53	64	52	55	60	63	87½
9–10	71	97	9.57	1·32	90½	6½	57	63	57	66	55	58½	61½	64½	83½
10–11	71	98	8.20	1·24	90	8	57	64	58	65	55	58	63	65	83
11–12	73	105	5.30	1·25	96½	8½	57	59	58	66	56	59	63	66	88½
12–13	71	105	9.55	1·15	96	9	60	66	60	64	58	61½	61	63	90
13–14	72	114½	5.40	1·26	106	8½	61	67	60	64	66	63	60	63	96½
14–15	73	118½	5.25	1·19	108	10½	57	63	57	58	56	59	57	59	100½
15–16	69	113	8.35	1·24	105½	7½	54	58	54	60	56	58	56	59	97
16–17	70	117½	10.0	1·30	108½	9	54	58	53	59	55	57½	55	58	100½
17–18	74	125½	4.40	1·18	112½	13	52	59	54	58	52½	55	56	58	105½
18–19	72	121½	5.15	1·24	110	11½	54	56	54	60	54	56	58	61	102½
19–20	71	121½	6.35	1·11	113	8½	56	60	56	60	56	58	57½	60	105½
20–21	72	121	5.0	1·16	111½	9½	53	58	53	60	53	55	58	60	103[illegible]
21–22	71	118	9.35	1·10	109	9	56	59	56	62	56	58	59	61	101[illegible]
			A.M.												
22–23	69	116½	7.20	1·13	107	9½	58	60	54	61	58	60	54	57	99
23–24	73	118½	9.45	1·13	109	9½	58	63	53	60	59	62	58	60	101
24–25	73	120½	8.55	1·15	110	10½	60	64	54	65	60	62	58	61	103[illegible]
25–26	74	122½	9.55	1·13	112	10½	61	67	52	63	61	63	60	63	104[illegible]
26–27	76	126	8.45	1·22	113½	12½	62	66	53	62	63	65	56	59	107
27–28	76	128½	7.0	1·12	118	10½	63	66	63	68	63	65	64	66½	111
28–29	74	127	9.5	1·18	118	9	61	66	64	67	61	63	64	66	109
29–30	76	130	8.15	1·16	118½	11½	61	64	62	68	62	64	65	68	11[illegible]
30–31	77	130½	5.35	1·17	119½	11	63	68	64	69	63	65	66	69	11[illegible]
..	..	110½	7.31	1·18	102	8½	..	..	..	..	..	..	..	..	9[illegible]

RECORD OF ANALYSES—MAY, 1892.

Day of Month.	Composition of Mixed Milk.							Composition of Whey.			Composition of Curd.			
	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	Ash.
30–1	88·28	11·72	2·92	2·32	·40	5·40	·68	6·94	·36	·56	48·10	51·90	28·08	2·40
1–2	88·42	11·58	2·87	2·27	·42	5·34	·68	6·67	·34	·48	42·50	57·50	28·00	2·70
2–3	88·18	11·82	2·92	2·50	·42	5·28	·70	7·01	·34	·55	41·20	58·80	29·40	2·90
3–4	88·24	11·76	2·93	..	..	..	·74	6·82	·38	·54	41·20	58·80	27·39	2·55
4–5	88·28	11·72	2·82	..	..	..	·70	6 88	·34	·55	41·55	58·45	28·46	2·50
5–6	87 88	12·12	3·25	..	..	..	·70	6·96	·39	·55	42·70	57·30	28·35	2·25
6–7	87·98	12·02	3·17	..	..	..	·68	7 00	·37	·54	40·95	59 05	29·26	2·50
7–8	88·04	11·96	3·17	..	..	..	·72	6·86	·37	·55	41·45	58·55	28·74	2·60
8–9	88·22	11·78	2·87	2·50	·41	5·34	·66	6·93	·29	·55	41·40	58·60	27·81	2·50
9–10	88·02	11·98	3·06	2·50	·36	5·34	·72	6·82	·37	·56	41·90	58·10	29·37	2·45
10–11	88·42	11·58	2·70	..	..	..	·70	6·67	·31	·56	42·25	57·75	29·50	2·25
11–12	88·24	11·76	2·95	..	..	..	·74	6·93	·37	·56	41·25	58·75	30·59	2·25
12–13	87·98	12·02	3·03	..	..	..	·72	6·97	·36	·57	40·85	59·15	30·24	2·45
13–14	88·20	11·80	2·95	2·34	·40	5·35	·76	6·92	·43	·58	42·40	57·60	28·97	2·35
14–15	87·74	12·26	3·29	2·37	·40	5·46	·74	7·00	·42	·54	41·40	58·60	29·96	2·50
15–16	87·90	12·10	3·20	2·60	·40	5·18	·72	7·03	·39	·55	42·40	57·60	29·32	2·45
16–17	87·76	12·24	3·16	2·68	·42	5·28	·70	7·02	·41	·55	41·75	58·25	28·21	2·60
17–18	87·72	12·28	3·35	2·62	·40	5·17	·74	7·03	·32	·56	62·50	37·50	29·64	1·80
18–19	87·94	12·06	3·20	2·65	·40	5·07	·74	6·97	·34	·56	42·60	57·40	28·67	2·60
19–20	87·62	12·38	3·47	2·54	·41	5·22	·74	7·01	·41	·54	46·50	53·50	32·26	2·45
20–21	87·68	12·32	3·42	2·33	·39	5·50	·68	7·04	·48	·55	41·55	58·45	29·50	2·65
21–22	87·76	12·24	3·21	2·65	·40	5·24	·74	7·02	·37	·54	40·65	59·35	29·96	2·60
22–23	87·88	12·12	3·11	2·61	·40	5·28	·72	7·03	·43	·55	39·55	60·45	30·94	2·95
23–24	87·98	12·02	3·13	2·60	·41	5·18	·70	6·97	·44	·54	40·15	59·85	29·64	2·45
24–25	87·80	12·20	3·24	2·63	·42	5·15	·76	7·01	·40	·54	41·20	58·80	29·76	2·30
25–26	..	..	..	..	..	..	..	6·99	·34	·55	40·40	59·60	30·66	2·55
26–27	87·80	12·20	3·32	2·74	·41	4·99	·74	7·03	·36	·56	40·75	59·25	30·25	2·50
27–28	87·74	12·26	3·23	2·72	·41	5·14	·76	6·98	·42	·56	40·50	59·50	30·66	2·50
28–29	87·78	12·22	3·19	2·70	·41	5·20	·72	7·03	·37	·56	40·55	59·45	29·71	2·55
29–30	87·66	12·34	3·30	2·65	·38	5·25	·76	6·98	·41	·56	40·20	59·80	30·25	2·60
30–31	87·70	12·30	3·32	2·62	·39	5·23	·74	7·04	·42	·56	41·45	58·55	30·74	2·45
Average	87·96	12·04	3·12	2·55	·40	5·25	·72	6·95	·38	·55	42·48	57·52	29·49	2·49

RECORD OF OBSERVATIONS MADE AT THE BATH AND WEST

1	2	3	4	5	6	7	8	9		10	11
		Relating to Evening's Milk.									
			At Night.				In Morning.				
Day of Month.	Name of Field.	Volume of Milk	Time.	Temp. of Dairy.	Temp. of Milk.	Acidity.	Time.	Temp. of Dairy.		Temp. of Milk.	Acidity.
		Galls.	P.M.				A.M.	min.	max.		
31–1	Sharnam's, Large Leaze . . .	59	6.30	65	86	·22	7.10	64	68	70	·23
1–2	Ditto	60	6.30	64	87	·22	..	..	..	..	..
2–3	Moor House, Large Leaze . . .	..	..	..	..	..	7.15	62	66	70	·24
3–4	Ditto	60	6.20	64	87	·23	7.15	61	64	68	·24
4–5	Ditto	61	6.5	63	86	·23	7.20	61	63	69	[illegible]
5–6	Ditto	57	5.30	63	85	·21	6.45	61	65	68	[illegible]
6–7	Ditto	64	6.30	64	87	·21	7.5	63	64	70	[illegible]
7–8	Ditto	64	6.20	66	86	·22	7.10	64	67	73	[illegible]
8–9	Ditto	62	6.40	66	87	·21	7.10	65	68	73	·24
9–10	Ditto, 12 acres . .	63	6.45	69	92	·23	7.10	66	70	74	[illegible]
10–11	Sharnam's Large Leaze . . .	60	6.30	67	89	·22	7.20	65	70	72	[illegible]
11–12	Ditto	58	6.20	66	90	·22	7.20	65	68	70	·25
12–13	Ditto	55	5.10	65	90	·23	7.15	63	66	68	·25
13–14	Ditto	61	6.30	66	85	·23	7.7	63	66	69	·23
14–15	Ditto	63	6.35	62	86	·22	7.0	61	65	70	[illegible]
15–16	Ditto	63	6.30	63	86	·22	7.7	62	64	69	·23
16–17	Ditto	60	6.15	62	85	·23	6.40	61	64	67	·24
17–18	Moor House, Large Leaze . . .	63	6.35	62	87	·22	7.15	61	64	69	[illegible]
18–19	Ditto	58	6.30	64	86	·22	7.10	60	62	67	[illegible]
19–20	Large Leaze, 14 acres	54	5.45	62	82	·22	6.50	60	63	67	·23
20–21	Ditto	58	6.30	63	84	·22	7.0	60	63	67	.23
21–22	Ditto	66	6.15	63	83	·22	7.10	62	64	71	·25
22–23	Ditto	62	6.10	64	90	·21	7.15	62	65	71	·25
23–24	Ditto	59	6.30	63	87	·21	7.10	62	64	69	·23
24–25	Ditto	60	6.45	64	87	·21	7.3	63	65	69	[illegible]
25–26	Moor House, Large Leaze . . .	61	6.40	64	86	·21	7.30	63	65	70	[illegible]
26–27	Ditto	57	6.00	67	90	·21	7.15	64	67	71	[illegible]
27–28	Mixed Fields . .	60	6.30	66	91	·21	7.30	65	69	72	[illegible]
28–29	Ditto	57	6.20	65	90	·22	7.30	65	70	68	[illegible]
29–30	Ditto	57	6.30	64	90	·21	7.15	63	67	69	·24
Average		60	..	64	87	·22	..	62	65	69	·23

)F ENGLAND SOCIETY'S CHEESE SCHOOL, JUNE, 1892.

12	13	14	15	16	17	18	19	20	21	22	23
MORNING'S MILK.				MILK HEATED.		STALE WHEY.		MIXED MILKS, &C.			
										Rennet added.	
Name of Field.	Vol. of Milk.	Acidity.	Total Vol. of Milk.	Quantity.	Temp.	Quantity.	Acidity.	Acidity before Renneting.	Time of Renneting.	Vol.	Proportion by Volume.
	galls.		galls.	galls.		lbs.			A.M.	ounces.	
Sharnam's Large Leaze	64	·21	123	43	86	4	·48	·23	7.40	2·14	9196
Ditto	67	..	127	..	..	..	..	..	7.38	2·18	9321
Moor House, Large Leaze	..	·20	126	40	89	4	·45	·23	7.35	2·14	9420
Ditto	68	·21	128	40	90	4	·47	·22	7 40	2·17	9437
Ditto	67	·21	128	39	91	4	·45	·22	7.45	2·17	9437
Ditto	70	·21	127	43	85	4	·45	·23	7.10	2·16	9407
Ditto	65	·21	129	41	84	4	·45	·22	7.43	2·19	9424
Ditto	65	·22	129	40	81	4	·44	·23	7.25	2·19	9424
Ditto	65	·22	127	39	79	4	·45	·24	7.27	2·16	9407
Ditto, 12 acres	66	·22	129	31	79	none	..	·23	7.35	2·19	9424
Sharnam's Large Leaze	64	·21	124	28	90	4	·45	·22	7.48	2·11	9403
Ditto	71	·22	129	30	84	4	·46	·24	7.55	2·19	9424
Ditto	73	·21	128	43	90	4	·44	·23	7.41	2·17	9437
Ditto	67	·22	128	45	90	4	·44	·23	7.40	2·17	9437
Ditto	67	·22	130	43	90	4	·44	·23	7.25	2·21	9411
Ditto	66	·21	129	36	90	4	·43	·23	7.33	2·19	9424
Ditto	69	·21	129	38	90	4	·46	·23	7.35	2·19	9424
Moor House, Large Leaze	65	·21	128	34	90	4	·46	·23	7.38	2·17	9437
Ditto	69	·21	127	34	88	4	·41	·22	7.41	2·15	9451
Large Leaze, 14 acres	72	·21	126	35	90	4	·42	·22	7.22	2·15	9376
Ditto	66	·21	124	30	90	4	·41	·22	7.47	2·11	9403
Ditto	69	21	135	27	90	4	·41	·22	7.40	2·28	9473
Ditto	69	·21	131	38	90	4	·42	·22	8.20	2·23	9399
Ditto	69	·21	128	32	88	4	·41	·22	7.35	2·17	9437
Ditto	64	·21	124	30	90	4	42	·21	7.33	2·11	9403
Moor House, Large Leaze	68	·21	129	33	90	4	·44	·22	7.52	2·21	9339
Mixed Fields	66	·20	123	30	86	4	·44	·22	7.40	2·12	9283
Ditto	65	·20	125	29	84	3	·46	·22	7.55	2·12	9434
Ditto	60	·20	117	24	90	4	·46	·22	7.45	1·99	9407
Ditto	63	·21	120	27	90	3	·46	·23	7.42	2·04	9411
	67	·21	127	..	..	..	·44	·22	7.39	..	9403

RECORD OF OBSERVATIONS MADE AT THE BATH AND WEST

	24	25	26	27	28	29	30	31	32	33	34	34a	35
						Temp. of Scald.				Relating to Whey.			
Day of Month.	Time when Curd cut.	Acidity of Whey before breaking.	Time of breaking.	Acidity of Whey put aside.	Time Scalding commences.	1st.	2nd.	Time taken in Stirring.	Time in Scald.	Temp. when drawn.	Acidity.	Volume.	Acidity of draining from piled Curd.
	A.M.		A.M.		A.M.			min.	h. m.			galls.	
31–1	8.22	·16	8.35	·17	9.40	88	90	75	2 5	87	·22	108	·29
1–2	..	..	..	..	..	..	..	..	..	..	..	..	..
2–3	8.22	·16	8.40	·17	9.35	88	90	60	2 5	86	·23	110	·33
3–4	8.25	·16	8.45	·16	9.40	88	90	60	2 5	87	·24	114	·53
4–5	8.30	·15	8.55	·16	9.50	88	90	60	2 20	87	·22	117	·33
5–6	7.55	·15	8.15	·15	9.10	88	90	60	2 15	86	·21	110	·30
6–7	8.30	·15	8.50	·16	9.50	88	90	60	2 20	86	·21	113	·28
7–8	8.10	·16	8.30	·17	9.34	88	90	60	1 51	87	·21	117	·27
8–9	8.14	·16	8.27	·17	9.30	88	90	60	2 0	87	·23	113	·30
9–10	8 15	·16	8.35	·16	9.32	88	90	60	2 8	86	·23	111	·34
10–11	8.32	·16	8.50	·17	9.44	88	90	60	1 53	87	·23	111	·32
11–12	8.40	·16	8.57	·18	9.52	88	90	60	1 48	86	·22	116	·30
12–13	8.26	·16	8.51	·18	9.51	88	90	60	2 9	85	·24	113	·34
13–14	8.27	·16	8.50	·17	9.51	87	90	60	2 9	82	·23	114	·35
14–15	8.12	·15	8.35	·16	9.35	88	90	60	2 0	84	·20	115	·24
15–16	8.21	·15	8.40	·16	9.45	88	90	60	1 45	87	·21	113	·26
16–17	8.20	·15	8.45	·15	9.49	88	95	90	2 35	89	·27	118	·43
17–18	8.35	·16	8.45	·16	9.40	88	90	60	2 0	86	·21	109	·26
18–19	8.35	·15	8.55	·16	10.0	88	90	60	1 52	86	·22	112	·28
19–20	8.20	·15	8.37	·16	9.33	88	90	60	2 7	86	·23	109	·29
20–21	8.45	·15	9.7	·16	10.5	88	90	60	1 50	86	·22	108	·27
21–22	8.25	·16	8.52	·17	9.47	88	90	47	1 37	86	·23	121	·30
22–23	9.12	·16	9.30	·17	10.25	88	90	60	1 50	85	·22	115	·28
23–24	8.30	·14	8.45	·15	9.40	88	90	60	2 0	87	·21	113	·27
24–25	8.20	·14	8.40	·15	9.40	88	90	71	2 13	88	·22	108	·32
25–26	8.45	·15	9.2	·15	10.7	88	94	20	2 8	92	·23	110	·45
26–27	8.30	·16	8.43	·17	9.45	88	90	45	1 31	88	·25	107	·35
27–28	8.40	·15	9.00	·17	10.0	88	90	47	1 35	87	·23	106	·34
28–29	8.35	·15	8.55	·15	9.57	89	90	45	1 41	86	·23	103	·34
29–30	8.30	·15	8.55	·16	9.54	88	90	45	1 43	87	·22	101	·33
Average .		·15	..	·16	..	..	..	56	1 59	..	·22	111	·32

OF ENGLAND SOCIETY'S CHEESE SCHOOL, JUNE, 1892—*contd.*

36	37	38	39	40	41	42	43	44	45	46	47	48	49	
			Acidity of Whey during Treatment of Curd.								Salt Added.			
Time Curd remains piled.	Time Curd was taken from Tub.	Temp. of Curd when taken from Tub.	When taken to Cooler.	After 1st Cutting.	After 2nd Cutting.	After 1st Turning.	After 2nd Turning.	After 3rd Turning.	After 4th Turning.	Acidity of Curd when milled.	Weight.	Percentage.	Temp. of Dairy.	
min.											lbs. oz.		min.	max.
30	12.50	85	·41	·50	·70	·81	·92	..	..	6·20	2 10	2·15	64	67
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
35	12.50	87	·50	·64	·80	·86	·92	1·01	..	7·20	2 9	1·94	62	65
35	12.55	88	·53	·65	·80	·84	·92	·97	..	4·00	2 11	1·99	61	64
40	1.20	86	·52	·67	·82	·89	·91	..	..	5·60	2 11	2·05	61	64
30	12.25	87	·47	·60	·73	·84	·88	·96	..	4·90	2 10	2·01	62	66
45	1.30	85	·42	·50	·62	·73	·80	·82	..	5·00	2 12	2·06	64	67
35	12.35	86	·38	·50	·71	·86	·90	·97	..	4·20	2 12	2·08	64	67
35	12.40	86	·46	·60	·74	·81	·88	·94	..	7·10	2 11	2·05	66	72
30	12.40	87	·45	·69	·87	·91	·96	..	..	6·30	2 12	2·05	67	72
25	12.35	87	·53	·68	·82	·91	·96	..	..	4·00	2 10	2·02	66	69
35	12.50	86	·49	·64	·80	·88	·95	1·04	..	4·40	2 12	2·04	65	67
30	1.5	86	·46	·60	·75	·89	·98	..	..	5·20	2 12	2·13	63	66
23	12.55	84	·55	·75	·97	1·09	..	..	..	3·90	2 12	2·02	62	65
50	1.00	87	·41	·61	·80	·94	1·05	..	..	6·40	2 13	2·07	62	64
35	12.35	87	·42	·58	·77	·89	·97	1·08	..	5·20	2 12	2·03	62	64
20	1.15	89	·63	·79	·90	1·01	..	..	..	4·00	2 12	2·07	61	64
35	12.50	85	·40	·58	·78	·95	1·00	..	..	3·60	2 12	2·03	61	62
25	12.50	85	·43	·56	·76	·87	·97	1·08	..	{3·90 3·80}	2 11	2·07	61	64
35	12.45	86	·45	·60	·79	·87	1·01	1·09	..	5·00	2 11	2·05	61	64
30	1.0	86	·41	·51	·68	·76	·94	1·01	..	3·90	2 10	2·06	62	65
25	12.25	86	·39	·53	·64	·75	·83	1·03	1·06	4·20	2 15	2·11	62	66
45	1.30	88	·44	·57	·71	·78	·89	·95	..	6·00	2 14	2 13	63	65
32	12.50	86	·42	·54	·68	·80	·86	·96	1·00	{4·30 4·30}	2 13	2·11	63	66
37	1.5	88	·54	·65	·78	·89	·93	1·00	..	5·30	2 11	2·05	63	66
15	1.2	87	·57	·67	·85	·83	·96	..	..	..	2 12	2·08	63	67
30	12.15	88	·57	·71	·80	·92	·99	..	..	4·30	2 10	2·03	66	69
30	12.55	87	·56	·67	·82	·89	·93	..	..	4·00	2 11	2·09	66	70
35	12.40	87	·60	·74	·88	·93	..	..	..	4·20	2 8	1·99	66	68
30	12.35	88	·54	·69	·83	·93	..	..	..	4·00	2 10	1·97	64	67
..	12.51	..	..	..	..	..	..	..	..	4·60			63	66

RECORD OF OBSERVATIONS, JUNE, 1892—*continued.*

	50	51	52	53	54	55	56		57		58		59		60
	RELATING TO CURD.			RELATING TO CHEESES.											
Day of Month.	Temp. in Vat.	Weight when Vatted.	Time of Vatting.	Acidity of liquid from Press.	Weight taken to Cheese Room.	Loss in Press.	Temp. of Cheese Room. Morning.		Evening.		Hygrometer Readings. Morning.		Evening.		Weight of Cheese when sold.
							Min.	Max.	Min.	Max.	Wet.	Dry.	Wet.	Dry.	
		lbs.	P.M.		lbs.	lbs.									lbs.
31–1	74	128	6.55	1·14	118½	9½	63	68	63	64	62	64	62	64	109½
1–2	..	..	..	..	119	..	..	..	..	..	..	..	..	..	110
2–3	74	132½	5.37	1·21	122	10½	57	63	58	62	58	59½	60	63	112½
3–4	73	135½	6.0	1·21	127	8½	56	61	53	60	56	58	58	60	115
4–5	74	131	5.45	1·16	121½	9½	58	59	58	61	57	59	60	62	112½
5–6	75	130½	5.25	1·18	120	10½	58	61	58	64	58	60	63	65	112
6–7	75	133	9.0	1·18	122	11	60	64	57	62	61	63	59	62	113½
7–8	75	132	8.50	1·15	119½	12½	62	67	58	67	61	63	59	63	112
8–9	77	130½	7.15	1·24	120	10½	62	67	66	74	62	64	70	73	111½
9–10	78	134	4.40	1·18	121	13	67	72	68	74	66	70	71	74	112½
10–11	77	129½	4.55	1·20	118	11½	66	74	66	68	65	67	66	70	109½
11–12	73	134½	6.0	1·20	123½	11	64	68	64	64	63	65	63	65	114½
12–13	74	135	5.30	1·15	125	10	58	64	58	63	58	61	61	64	117
13–14	77	136	4.10	1·10	127½	8½	58	62	58	62	57	59	60	62½	117½
14–15	74	135½	5.50	1·09	126	9½	53	61	56	61	55	58	59	62	117
15–16	74	135½	5.45	1·18	125	10½	57	61	58	59	57	59	58	60	117
16–17	76	132½	4.40	1·14	125	7½	56	58	57	58	56	57½	56	58	113½
17–18	73	135½	5.50	1·13	125½	10	54	59	55	60	55	57	58	61	116½
18–19	72	129½	6.0	1·14	121	8½	54	60	57	62	57	59	58½	61	112
19–20	73	131	5.25	1·16	121½	9½	56	60	54	63	56	58	59	62	113
20–21	72	127	6.30	1·16	117½	9½	56	60	57	59	57	59	59	61	109
21–22	72	139	6.30	1·19	127½	11½	58	60	59	64	58	60	62	64	119½
22–23	73	134½	7.10	1·18	125½	9	60	63	60	62	61	63	60½	62½	115½
23–24	73	133	6.50	1·17	124	9	59	61	57	64	59	61	62½	64	114½
24–25	76	131	6.0	1·14	120	11	60	63	60	64	60	62	62	64	112
25–26	77	132	5.0	1·13	121	11	61	63	61	66	60½	62	65	67	113
26–27	78	129	4.0	1·19	117	12	64	66	64	69	63½	65	68	70	109
27–28	78	135	5.10	1·22	123	12	64	69	62	67	65	67	63	65	112½
28–29	77	125½	4.0	1·16	116	9½	64	69	63	67	65	67	65	67	107
29–30	76	133	3.50	1·13	121	12	61	66	62	65	62	64	62	64	112
..	..	132	5.37	1·16	122	10	..	..	..	..	..	..	..	..	113

RECORD OF ANALYSES—JUNE, 1892.

Day of Month.	Composition of Mixed Milk.							Composition of Whey.			Composition of Curd.			
	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	Ash.
31–1	87·70	12·30	3·26	2·54	·39	5·39	·72	7·02	·34	·55	39·15	60·85	32·17	2·55
1–2	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2–3	87·62	12·38	3·43	2·59	·41	5·21	·74	6·98	·43	·56	41·00	59·00	31·05	2·50
3–4	87·58	12·42	3·33	2·57	·40	5·33	·76	6·98	·36	·56	41·25	58·75	30·37	2·55
4–5	87·76	12·24	3·16	2·55	·39	5·40	·74	6·92	·34	·55	41·55	58·45	29·78	2·60
5–6	87·62	12·38	3·30	2·57	·40	5·39	·72	6·81	·37	·56	40·65	59·35	30·25	2·60
6–7	87·80	12·20	3·13	2·57	·37	5·41	·72	6·84	·40	·56	40·00	60·00	30·47	2·40
7–8	88·08	11·92	3·01	2·78	·38	5·07	·68	6·88	·38	·56	41·25	58·75	29·97	2·40
8–9	87·96	12·04	2·96	2·72	·37	5·23	·76	6·95	·30	·55	41·65	58·35	28·60	2·40
9–10	87·80	12·20	3·09	2·88	·36	5·15	·72	6·90	·27	·57	40·85	59·15	30·97	2·40
10–11	87·60	12·40	3·35	2·77	·37	5·17	·74	6·95	·38	·55	41·85	58·15	29·27	2·40
11–12	87·62	12·38	3·39	2·73	·40	5·12	·74	6·98	·36	·56	41·50	58·50	29·51	2·45
12–13	87·58	12·42	3·36	2·78	·42	5·12	·74	6·97	·37	·57	39·75	60·25	30·94	2·45
13–14	87·64	12·36	3·31	2·69	·39	5·23	·74	7·02	·36	·55	41·60	58·40	29·22	2·40
14–15	87·50	12·50	3·40	2·56	·40	5·38	·76	6·94	·39	·55	41·45	58·55	29·81	2·55
15–16	87·82	12·18	3·16	2·61	·41	5·28	·72	6·89	·26	·56	42·45	57·55	28·08	2·45
16–17	87·96	12·04	3·05	2·56	·39	5·28	·76	6·82	·41	·57	40·80	59·20	29·90	2·45
17–18	87·50	12·50	3·45	2·62	·39	5·32	·72	6·93	·40	·55	41·40	58·60	28·88	2·50
18–19	87·82	12·18	3·13	2·61	·41	5·29	·74	6·91	·34	·53	41·60	58·40	28·18	2·45
19–20	87·96	12·04	3·02	2·50	·40	5·40	·72	6·72	·38	·55	42·40	57·60	28·21	2·35
20–21	87·76	12·24	3·14	2·68	·38	5·28	·76	6·91	·27	·55	42·15	57·85	28·47	2·50
21–22	87·86	12·14	3·08	2·66	·38	5·28	·74	6·97	·29	·56	40·85	59·15	29·35	2·35
22–23	87·98	12·02	3·07	2·62	·39	5·26	·68	7·01	·32	·57	40·85	59·15	29·16	2·45
23–24	88·08	11·92	3·01	2·74	·40	5·03	·74	6·87	·40	·55	41·20	58·80	30·01	2·50
24–25	87·82	12·18	3·18	2·69	·38	5·21	·72	6·91	·32	·54	41·00	59·00	29·40	2·45
25–26	87·96	12·04	3·15	2·69	·41	5·09	·70	6·82	·31	·55	..	..	..	..
26–27	88·24	11·76	2·72	2·70	·40	5·18	·76	6·92	·35	·56	41·10	58·90	29·02	2·40
27–28	87·88	12·12	3·00	2·63	·39	5·40	·70	6·89	·33	·55	40·50	59·50	29·90	2·50
28–29	87·80	12·20	3·15	2·63	·38	5·30	·74	6·94	·33	·55	41·55	58·45	28·09	2·40
29–30	87·96	12·04	3·07	2·64	·40	5·21	·72	6·97	·35	·56	40·65	59·35	29·54	2·45
Average	87·80	12·20	3·17	2·65	·39	5·26	·73	6·91	·35	·55	41·14	58·86	29·59	2·46

RECORD OF OBSERVATIONS MADE AT THE BATH AND WEST

1	2	3	4	5	6	7	8	9		10	11
	Relating to Evening's Milk.										
			At Night.				In Morning.				
Day of Month.	Name of Field.	Volume of Milk.	Time.	Temp. of Dairy.	Temp. of Milk.	Acidity.	Time.	Temp. of Dairy.		Temp. of Milk.	Acidity.
		galls.	P.M.				A.M.	min.	max.		
30–1	Mixed Fields . .	59	6.20	63	89	·21	7.15	63	66	68	·23
1–2	Ditto	60	6.30	64	88	·22	7.10	64	68	70	·22
2–3	Ditto	58	6.20	66	89	·21	7.23	65	68	71	·23
3–4	Ditto	49	6.0	68	91	·21	7.5	65	70	70	·22
4–5	Ditto	56	6.50	66	88	·20	7.35	65	69	69	·24
5–6	Ditto	57	7.5	64	87	·21	7.15	64	67	73	·23
6–7	Ditto	58	6.30	65	86	·21	7.20	63	66	68	·22
7–8	Ditto	56	7.5	64	87	·22	7.5	62	67	66	·22
8–9	Ditto	56	6.25	64	88	·21	7.20	63	66	68	·22
9–10	Ditto	56	6.50	65	87	·20	7.35	62	66	68	·23
10–11	Ditto	51	5.15	66	89	·21	7.10	63	66	68	·22
11–12	Ditto	57	7.0	66	88	·20	7.15	63	67	69	·23
12–13	Ditto	59	7.5	66	89	·21	7.20	63	66	71	·22
13–14	Ditto	57	7.15	64	85	·21	7.30	63	65	69	·22
14–15	Ditto	58	6.55	65	86	·21	7.30	63	66	70	·23
15–16	Ditto	57	7.0	65	89	·21	7.30	64	66	70	·23
16–17	Ditto	56	6.50	65	85	·20	7.30	63	66	69	·22
17–18	Ditto	52	5.25	63	85	·22	7.30	62	65	67	·23
18–19	Sharnam's Large Leaze . . .	57	6.55	64	86	·21	7.10	62	65	68	·25
19–20	Ditto	54	6.45	62	85	·21	7.30	61	64	66	·22
20–21	Ditto	56	7.5	63	87	·20	7.20	61	65	67	·22
21–22	Ditto	55	6.45	63	88	·21	7.15	61	65	66	·22
22–23	Ditto	56	8.15	64	85	·21	7.25	62	64	69	·22
23–24	Ditto	58	6.50	66	91	·22	7.25	63	65	70	·2
24–25	Ditto	50	5.50	67	89	·21	7.25	63	68	68	·2
25–26	Moor House, Large Leaze . . .	55	7.5	65	88	·20	6.50	63	66	67	·2
26–27	Ditto	55	6.50	65	87	·21	7.10	63	66	69	·2
27–28	Ditto	57	6.55	65	86	·21	7.30	64	68	68	·2
28–29	Ditto	56	6.45	67	89	·22	6.40	63	70	69	·2
29–30	Ditto	53	6.45	66	88	·22	7.25	64	67	69	·2
30–31	Ditto	55	6.40	67	87	·21	7.5	64	68	70	·2
Average		56	..	65	87	·21	..	63	66	69	·2

OF ENGLAND SOCIETY'S CHEESE SCHOOL, JULY, 1892.

12	13	14	15	16	17	18	19	20	21	22	23
MORNING'S MILK.				MILK HEATED.		STALE WHEY.		MIXED MILK, &c.			
Name of Field.	Vol. of Milk.	Acidity.	Total Vol. of Milk.	Quantity.	To Temp.	Quantity.	Acidity.	Acidity before Renneting.	Time of Renneting.	Rennet Added. Vol.	Rennet Added. Proportion by Volume.
	galls.		galls.	galls.					A.M.	ounces.	
Mixed Fields . .	61	·20	120	30	90	4	·46	·22	7.53	2·04	9411
Ditto	59	·20	119	27	94	4	·47	·23	7.37	2·01	9472
Ditto	61	·21	119	26	84	3	·48	·23	7.50	2·01	9472
Ditto	64	·20	113	22	90	3	·48	·22	7.26	1·92	9416
Ditto	56	·21	112	18	90	3	·47	·23	7.38	1·90	9431
Ditto	61	·21	118	22	90	3	·48	·22	7.31	2·08	9077
Ditto	57	·21	115	32	90	4	·45	·22	7.40	1·95	9436
Ditto	60	·21	116	31	90	4	·46	·22	7.50	1·97	9421
Ditto	60	·21	116	22	90	4	·46	·22	7.48	1·97	9421
Ditto	60	·21	116	30	90	4	·48	·22	7.55	1·97	9421
Ditto	65	·20	115	30	84	none	..	·22	7.36	1·95	9436
Ditto	58	·20	115	35	90	none	..	·21	7.50	1 95	9436
Ditto	62	·20	121	30	91	none	..	·21	7.43	2·05	9443
Ditto	60	·20	117	31	90	4	·44	·22	7.49	1·99	9407
Ditto	61	·20	119	29	90	none	..	·22	7.45	2·02	9425
Ditto	62	·20	119	28	90	4	·45	·22	7.46	2·02	9425
Ditto	63	·20	119	37	90	4	·43	·23	7.56	2·02	9425
Ditto	66	·20	118	33	85	3	·46	·22	7.45	2·00	9440
Large Leaze, Sharnam's . . .	60	·20	117	34	90	none	..	·21	7.42	1·98	9454
Ditto	62	·20	116	49	90	4	·46	·22	8.0	1·95	9518
Ditto	60	·20	116	44	87	4	·45	·22	7.55	1·95	9518
Ditto	60	·21	115	33	90	4	·45	·22	7.40	1·95	9436
Ditto	58	·21	114	36	88	2	·47	·21	7.45	1·94	9402
Ditto	58	·22	116	32	90	1	·49	·23	7.45	1·97	9421
Ditto	61	·21	111	39	90	2	·48	·23	7.48	1·89	9396
Moor House, Large Leaze . . .	60	·22	115	44	91	2	·47	·23	7.48	1·95	9436
Ditto	57	·22	112	39	90	2	·49	·24	7.44	1·91	9385
Ditto	61	·21	118	40	90	2	·48	·24	7.55	2·00	9440
Ditto	59	·22	115	37	91	2	·49	·23	7.44	1·95	9436
Ditto	60	·21	113	34	90	none	..	·22	7.42	1·93	9367
Ditto	58	·21	113	44	86	none	..	·23	7.47	1·93	9367
	60	·21	116	..	..	..	·46	·22	7.46	..	9419

RECORD OF OBSERVATIONS MADE AT THE BATH AND WEST

	24	25	26	27	28	29	30	31	32	33	34	34a	35
Day of Month.	Time when Curd cut.	Acidity of Whey before breaking.	Time of breaking.	Acidity of Whey put aside.	Time scalding commences.	Temp. of Scalding. 1st	Temp. of Scalding. 2nd	Time taken in stirring.	Time in Scald.	Relating to Whey. Temp. when drawn.	Relating to Whey. Acidity.	Relating to Whey. Volume.	Relating to Whey. Acidity of draining from piled Curd.
	A.M.		A.M.		A.M.			min.	h. m.			galls.	
30–1	8.40	·16	9.6	·16	10.10	88	90	42	1 35	86	·22	101	·34
1–2	8.24	·16	8.45	·16	9.44	88	90	45	1 36	87	·23	101	·34
2–3	8.40	·16	8 57	·16	9.59	88	90	38	1 31	88	·22	100	·30
3–4	8.18	·15	8.42	·16	9.35	88	90	50	1 35	87	·22	98	·31
4–5	8.25	·15	8.43	·16	9.42	88	90	33	1 20	88	·20	93	·27
5–6	8.25	·15	8.50	·15	9.41	88	90	60	1 49	87	·22	98	·31
6–7	8.27	·14	8.53	·15	9.50	88	90	45	1 40	87	·24	98	·38
7–8	8.35	·15	9.0	·16	10.0	88	90	30	1 21	88	·21	97	·29
8–9	8.40	·15	9.7	·16	9.58	88	90	30	1 27	88	·22	98	·31
9–10	8.55	·14	9.15	·15	10.12	88	90	60	1 48	87	·20	98	·26
10–11	8.45	·14	9.22	·15	10.20	88	90	60	1 59	88	·17	95	·19
11–12	8.57	·13	9.35	·14	10.37	88	90	60	2 13	87	·15	90	·16
12–13	8.40	·14	9.15	·15	10.23	88	90	55	1 47	88	·19	99	·26
13–14	8.45	·16	9.15	·17	10.5	88	90	30	1 20	88	·24	97	·38
14–15	8.25	·14	9.10	·15	10.9	88	90	30	1 31	88	·18	97	·25
15–16	8.48	·14	9.15	·14	10.13	88	90	60	1 47	87	·21	98	·25
16–17	8.41	·15	9.10	·17	10.10	88	90	30	1 25	88	·25	98	·39
17–18	8.30	·15	8.57	·16	10.0	88	90	30	1 25	88	·22	100	·32
18–19	8.51	·16	9.35	·16	11.15	100	100	5	45	96	·22	92	·40
19–20	8.50	·15	9.15	·16	10.15	88	90	30	1 15	88	·20	98	·32
20–21	8.40	·15	9.5	·16	10.3	88	90	30	1 19	88	·23	101	·35
21–22	8.25	·16	8.43	·17	9.45	88	90	30	1 22	87	·22	101	·34
22–23	8.30	·15	9.0	·16	9.55	88	90	30	1 15	87	·20	97	·29
23–24	8.37	·16	8.55	·17	9.53	88	90	30	1 18	87	·20	95	·24
24–25	8.35	·16	9.5	·17	10.4	88	90	30	1 11	87	·21	92	·28
25–26	8.35	·16	9·0	·16	10.3	88	90	30	1 17	87	·20	97	·27
26–27	8.30	·17	8.45	·17	9.38	88	90	30	1 17	88	·21	97	·26
27–28	8.42	·15	9.8	·15	10.3	88	90	30	1 17	88	·21	100	·27
28–29	8.30	·15	8.50	·16	9.48	88	90	30	1 21	88	·23	98	·34
29–30	8.30	·14	8.54	·15	9.55	88	90	45	1 35	88	·18	94	·24
30–31	8.45	·16	9.7	·16	10.15	89	100	5	30	97	·17	94	·18
Average..		·15	..	·16	..	..	..	37	1 29	..	·21	97	·29

OF ENGLAND'S SOCIETY'S CHEESE SCHOOL, JULY, 1892—*continued.*

36	37	38	39	40	41	42	43	44	45	46	47	48	49	
			Acidity of Whey during Treatment of Curd.								Salt Added.			
Time Curd remains piled.	Time Curd was taken from Tub.	Temp. of Curd when taken from Tub.	When taken to Cooler.	After 1st cutting.	After 2nd cutting.	After 1st Turning.	After 2nd Turning.	After 3rd Turning.	After 4th Turning.	Acidity of Curd when milled.	Weight.	Percentage.	Temp. of Dairy.	
min.	P.M.										lbs. oz.		min.	max.
23	12.30	88	·50	·68	·86	·88	·96	..	..	4·60	2 10	1·99	64	67
33	12.30	88	·61	·69	·90	·92	1·06	..	..	4·40	2 9	2.03	64	69
33	12.30	88	·55	·68	·85	·92	1·00	..	..	5·20	2 9	1·99	66	70
30	12.10	88	·55	·72	·86	1·01	..	..	..	6·10	2 9	2·12	66	70
40	12.10	88	·47	·62	·76	·84	·96	·94	..	4·00	2 8	2·09	66	68
25	12.25	86	·48	·66	·83	·98	..	..	..	5·10	2 10	2·07	66	68
44	12.47	88	·69	·84	1·03	..	..	..	..	6·20	2 9	2·02	64	67
30	12.20	88	·55	·71	(·85)	(·95)	(·97)	..	..	{4·00 {4·80	1 5} 1 5}	2·02	62	67
30	12.25	88	·57	·72	·92	1·01	..	..	..	5·00	2 9	2·02	63	67
35	1.10	88	·43	·52	·69	·80	·89	·93	..	4·00	2 9	2·09	63	67
1.35	2.20	87	·45	·69	·79	·94	..	..	..	3·80	2 9	2·08	64	68
1.25	2.45	86	·27	·44	·58	·67	·80	..	..	4·20	2 9	2·11	64	67
45	1.25	88	·47	·67	·85	·98	..	..	..	3·80	2 11	2·07	64	67
25	12.25	87	·64	·77	·90	1·04	..	..	..	5·10	2 10	2·05	64	66
55	1.10	87	·44	·56	·70	·80	·83	·90	·98	4·00	2 9	2·03	64	67
56	1.36	87	·38	·50	·74	·86	1·01	..	..	6·20	2 9	1·99	64	67
17	12.25	88	·61	·89	1·06	..	..	..	..	{5·20} {5 30}	2 11	2·07	64	66
35	12.25	89	·63	·87	1·11	..	..	..	..	5·40	2 11	2·06	63	66
10	12 35	97	·56	·68	·80	·92	..	..	..	4·30	2 10	2·18	62	66
30	12.25	88	·60	·82	·98	..	..	..	..	6·20	2 10	1·97	61	65
30	12.20	89	·63	·89	1·08	..	..	..	..	4·90	2 9	1·95	61	65
25	12.0	89	·61	·91	1·10	..	..	..	..	3·80	2 9	1·98	61	67
30	12.5	87	·52	·85	1·04	..	..	..	..	5·20	2 9	2·02	62	68
45	12.25	88	·44	·66	·90	1·07	..	..	..	5·00	2 9	2·02	65	68
49	12.35	88	·61	·87	1·10	..	..	..	..	4·20	2 8	1·98	64	66
33	12.23	88	·49	·74	1·00	..	..	..	..	3·80	2 9	2·02	63	67
35	11.55	88	·47	·71	·90	1·05	..	..	..	5·80	2 8	2 02	63	67
55	12.45	88	·60	·83	1·05	..	..	..	..	5 00	2 10	1·99	64	68
34	12.10	89	·61	·76	·92	1·00	..	..	..	4·60	2 9	2·02	63	68
45	12.50	89	·47	·69	·86	1·03	..	..	..	4·80	2 8	2·04	64	67
37	11.50	95	·25	·32	·42	·53	·80	·83	..	3·60	2 8	2·05	64	69
..	12.38	..	...	...	..	...	..	..	..	4·66	..	...	64	67

RECORD OF OBSERVATIONS MADE, JULY, 1892—*continued.*

	50	51	52	53	54	55	56		57		58		59		60
	RELATING TO CURD.			RELATING TO CHEESES.											
							Temp. of Cheese Room.				Hygrometer Reading.				
Day of Month.	Temp. in Vat.	Weight when Vatted.	Time of Vatting.	Acidity of Liquid from Press.	Weight taken to Cheese Room.	Loss in Press.	Morning.		Evening.		Morning.		Evening.		Weight of Cheese when Sold.
							Min.	Max.	Min.	Max.	Wet.	Dry.	Wet.	Dry.	
		lbs.	P.M.		lbs.	lbs.									lbs.
30–1	76	131½	5.0	1·28	119	12½	62	66	63	65	62	64	63	65	111
1–2	76	126	4.30	1·28	113	13	59	65	62	69	60	62	67	69	106½
2–3	78	128½	4.35	1·17	117	11½	65	69	66	72	65	67	68	72	109½
3–4	77	121	3.40	1·16	109	12	67	71	64	68	65	68	65	67	101½
4–5	74	119½	4.50	1·13	109½	10	64	71	61	66	64	67	62	64	101½
5–6	76	127	4.0	1·14	115½	11½	63	68	62	68	64	66	63	65	109
6–7	77	127	3.35	1·18	114	13	61	64	62	65	61½	63	62	64	107
7–8	79 75	64½ 65	2.35 4.30	1·06 1·26	58½ 60½	6 4½	60	63	60	66	60	62	63	65½	106
8–9	76	127	4.30	1·24	115½	11½	61	65	61	64	61	64	63	65	108
9–10	74	122½	8.20	1·12	114	8½	61	64	61	66	61	63	65	67	107½
10–11	76	123	7.45	1·14	112	11	61	66	62	64	61	63	61	63	104½
11–12	74	121½	9.45	·93	110	11½	62	67	63	65	63	65	63	65	104
12–13	76	130	5.30	1·19	118	12	62	64	61	64	61½	63	62	64	111½
13–14	75	128	4.0	1·20	117	11	60	62	60	64	60	62	63	65	109
14–15	73	126	10.5	1·11	116	10	62	64	62	64	62	64	62	64	109
15–16	75	128½	10.2	1·19	116½	12	62	65	61	63	62	64	61	63	110
16–17	77	130	3.15	1·18	120	10	62	66	61	63	62	64	62	63	110½
17–18	76	134	3.15	1·20	120½	13½	60	62	62	65	61	62	62	64	112
18–19	76	124½	3.55	1·15	113	11½	58	61	58	59	58	60	59	60	107½
19–20	77	133	3.25	1·20	118½	14½	57	59	60	66	58	59	62	64	111½
20–21	76	134½	3.15	1·20	119	15½	56	60	58	62	58	59	60	62	109½
21–22	77	129	3.0	1·22	115½	13½	57	63	59	66	59	61	64	66	107½
22–23	77	127	3.10	1·25	113½	13½	62	64	63	68	62	64	64	66	113
23–24	77	127½	4.25	1·16	113½	14	63	68	62	69	64	66	63	65	109
24–25	77	126	3.40	1·16	111½	14½	64	68	63	68	63	65	66	68	105
25–26	76	128	3.30	1·18	116½	11½	63	67	63	66	62	64	65	67	109
26–27	77	123½	3.35	1·21	111½	12½	63	66	63	67	63	65	65	67	104½
27–28	78	131½	3.45	1·19	117½	14	63	67	62	69	62	64	66	68	111
28–29	77	127½	3.50	1·26	117	10½	63	68	63	68	62	64	66	68	110½
29–30	78	122½	4.40	1·24	111	11½	63	67	64	69	63	65	65	67	105
30–31	76	122	8.40	1·03	110½	11½	63	68	66	68	64	66	66	67½	103
..	..	127	4.53	1·18	115	12	..	..	..	..	..	..	..	..	108

RECORD OF ANALYSES, JULY, 1892.

Day of Month.	Composition of Mixed Milk.							Composition of Whey.			Composition of Curd.			
	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	Ash.
30–1	88·02	11·98	3·00	2·60	·39	5·25	·74	6·92	·31	·55	40·55	59·45	28·99	2·50
1–2	87·90	12·10	3·16	2·64	·39	5·17	·74	6·85	·33	·56	41·50	58·50	28·75	2·45
2–3	88·06	11·94	2·98	2·64	·40	5·16	·76	6·89	·32	·55	40·80	59·20	28·60	2·50
3–4	88·08	11·92	2·99	2·66	·41	5·14	·72	6·97	·32	·54	41·60	58·40	27 54	2·35
4–5	87·88	12·12	3·13	2·66	·40	5·19	·74	6·96	·34	·56	41·45	58·55	28·35	2·45
5–6	87·88	12·12	3·21	2·59	·39	5·19	·74	6·92	·33	·56	41 80	58·20	28·12	2·50
6–7	87·94	12·06	3·18	2·68	·39	5·05	·76	6·87	·37	·57	43·30	56·70	28·89	2·15
7–8	87·80	12·20	3·22	2·61	·38	5·31	·68	6·83	·38	·52	41·40	58·60	30·09	2·35
8–9	87·76	12·26	3·29	2·59	·39	5·31	·68	6·76	·30	·59	41·45	58·55	29·25	2·20
9–10	87·88	12·12	3·17	2·69	·38	5·20	·68	6·68	·34	·56	41·10	58·90	30·29	2·30
10–11	87·82	12·18	3·05	2·71	·39	5·29	·74	6·81	·38	·54	42·50	57·50	29·01	2·35
11–12	87·92	12·08	3·08	2·60	·40	5·24	·76	6·83	·30	·55	41·60	58·40	28·92	2·50
12–13	87·76	12·24	3·37	2·63	·38	5·20	·66	6·78	·31	·56	42·05	57·95	30·21	2·30
13–14	87·68	12·32	3·19	2·71	·38	5·34	·70	6·84	·32	·57	43·50	56·50	28·14	2·05
14–15	87·78	12·22	3·22	2·71	·40	5·13	·76	6·84	·33	·56	41·25	58·75	30·24	2·35
15–16	87·64	12·36	3·31	2·57	·39	5·35	·74	6·89	·38	·56	41·10	58·90	30·34	2·35
16–17	87 72	12·28	3·18	2·65	·40	5·33	·72	6·93	·34	·55	43·50	56·50	28·09	2·15
17–18	87·88	12·12	3·21	2·70	·40	5·07	·74	6·84	·32	·56	42·95	57·05	29·54	2·30
18–19	87·70	12·30	3·32	2·94	·39	4·93	·72	6·83	·34	·54	42·10	57 90	28·87	2·35
19–20	87·68	12·32	3·28	2·84	·38	5·12	·70	6·87	·38	·55	41·95	58·05	29 12	2·35
20–21	87·64	12·36	3·33	2·60	·40	5·31	·72	6·81	·37	·56	42·10	57·90	29·40	2·40
21–22	87·80	12·20	3·18	2·68	·38	5·24	·72	6·79	·34	·55	42·00	58·00	28·88	2·45
22–23	87·72	12·28	3·25	2 66	·39	5·22	·76	6·93	·35	·55	42·30	57·70	28 87	2·35
23–24	87·88	12·12	3·11	2·33	·39	5·59	·70	6·90	·36	·56	41·80	58·20	28·98	2·40
24–25	87·78	12·22	3·20	2·68	·39	5·21	·74	6·90	·33	·57	40 80	59·20	29·02	2·40
25–26	87·48	12·52	3·55	2·64	·40	5·19	·74	6·95	·33	·54	42 45	57·55	29·40	2·15
26–27	87·68	12·32	3·34	2·58	·39	5·25	76	6·83	·38	·54	42·00	58·00	28·35	2·25
27–28	87·76	12·24	3·27	2·74	·40	5·09	·74	6·90	·30	·56	41·50	58·50	30·10	2·35
28–29	87·70	12·30	3·28	2·68	·41	5·25	·68	6·93	·39	·56	41·15	58·85	30·10	2·35
29–30	87·76	12·24	3·21	2·70	·39	5·26	·68	6·97	·37	·56	41·10	58·90	29·83	2·50
30–31	87·84	12·16	3·23	2·73	·38	5·12	·70	6·88	·32	·55	41·90	58·10	30·10	2·25
Average	87·80	12·20	3·21	2·66	·39	5·22	·72	6·87	·34	·55	41·82	58·18	29·17	2·34

RECORD OF OBSERVATIONS MADE AT THE BATH AND WES

1	2	3	4	5	6	7	8	9		10	11
	Relating to Evening's Milk.										
			At Night.				In Morning.				
Day of Month.	Name of Field.	Volume of Milk.	Time.	Temp. of Dairy.	Temp. of Milk.	Acidity.	Time.	Temp. of Dairy.		Temp. of Milk.	Acidity.
		galls.	P.M.				A.M.	min.	max.		
31–1	Moor House, Large Leaze	49	5.30	67	88	·22	7.5	65	67	69	·24
1–2	Ditto	52	6.40	67	89	·22	6.45	65	68	69	·24
2–3	Ditto	51	6.30	66	89	·21	6.35	65	67	69	·23
3–4	Ditto	52	6.20	65	86	·22	6.40	64	68	69	·23
4–5	Ditto	52	6.40	66	87	·21	6.25	62	67	67	·22
5–6	Ditto	48	6.15	65	88	·22	7.25	64	67	68	·23
6–7	Ditto	49	6.25	65	85	·22	7.30	64	68	68	·22
7–8	Ditto	45	5.25	66	89	·22	6.45	64	66	68	·22
8–9	Ditto	48	6.35	66	88	·21	7.5	64	67	70	·23
9–10	Ditto	50	6.45	65	87	·21	6.50	63	67	67	·24
10–11	Ditto	45	6.40	64	88	·20	6.20	62	66	67	·24
11–12	Ditto	50	6.45	64	88	·21	7.30	63	67	68	·23
12–13	Ditto	48	6.40	65	89	·21	6.0	64	68	69	·23
13–14	Large Leaze, Sharnam's	48	7.0	65	87	·21	7.14	64	65	69	·23
14–15	Ditto	43	5.50	66	83	·23	7.7	64	66	66	·24
15–16	Ditto	52	7.30	66	84	·22	7.15	63	66	69	·22
16–17	Ditto	48	6.55	66	87	·20	7.25	65	66	69	·22
17–18	Ditto	54	7.15	67	89	·21	7.10	66	68	71	·23
18–19	Moor House, Large Leaze	48	7.45	67	88	22	7.0	65	67	70	·24
19–20	Ditto	44	6.30	67	86	·21	7.0	64	67	68	·23
20–21	Ditto	48	7.20	65	85	·20	6.45	64	67	69	·22
21–22	Ditto	42	5.20	69	91	21	6.55	64	69	68	·23
22–23	Ditto	48	6.30	67	92	·22	7.10	65	68	71	·23
23–24	Ditto	46	6.22	67	91	·21	7.15	66	70	70	·23
24–25	Ditto	45	6.45	67	90	·22	7.15	65	68	68	·2[illegible]
25–26	Ditto	43	6.15	65	91	·22	6.55	64	66	67	·2[illegible]
26–27	Ditto	43	6.55	64	89	·21	7.35	64	65	68	·2[illegible]
27–28	Ditto	42	6.50	65	88	·21	7.30	63	65	66	·2[illegible]
28–29	Ditto	38	5.45	64	82	·20	7.30	64	65	66	[illegible]
29–30	Ditto	45	7.0	66	85	·20	7 8	64	66	71	[illegible]
30–31	Sharnam's Large Leaze	42	6.50	64	83	·21	7.20	62	64	68	[illegible]
Average		47	..	66	87	21	..	64	66	69	[illegible]

OF ENGLAND SOCIETY'S CHEESE SCHOOL, AUGUST, 1892.

12	13	14	15	16	17	18	19	20	21	22	23
MORNING'S MILK.				MILK HEATED.		STALE WHEY.		MIXED MILK, &C.			
										Rennet Added.	
Name of Field.	Vol. of Milk.	Acidity.	Total Vol. of Milk.	Quantity.	To Temp.	Quantity.	Acidity.	Acidity before Renneting.	Time of Renneting.	Vol.	Proportion by Volume.
	galls.		galls.	galls.		galls.			A.M.	ounces.	
Moor House, Large Leaze . . .	63	·22	112	34	88	none	..	·23	7.40	1·92	9333
Ditto	59	·21	111	43	86	none	..	·23	7.49	1·89	9396
Ditto	58	·21	109	40	83	1	·46	·22	7.45	1·85	9427
Ditto	59	·20	111	40	86	2	·47	·23	7.45	1·89	9396
Ditto	59	·21	111	40	86	2	·47	·22	7.45	1·89	9396
Ditto	60	·21	108	38	86	2	·48	·22	7.55	1·84	9391
Ditto	56	·21	105	31	88	2	·49	·22	8.0	1·78	9438
Ditto	61	·21	106	36	84	2	·47	·23	7.42	1·80	9422
Ditto	57	·21	105	33	90	2	·48	·22	7.55	1·78	9438
Ditto	54	·20	104	37	87	2	·46	·23	7.36	1·76	9454
Ditto	59	·20	104	37	88	2	·46	·23	7.40	1·77	9401
Ditto	56	·20	106	34	88	2	·48	·23	7.49	1·80	9422
Ditto	54	·21	102	37	90	2	·47	·22	7.50	1·73	9433
Large Leaze, Sharnam's . . .	55	·21	103	34	90	2	·46	·22	7.48	1·75	9417
Ditto	58	·21	101	33	86	2	·47	·23	7.35	1·71	9450
Ditto	48	·21	100	37	90	2	·48	·22	7.49	1·70	9411
Ditto	52	·21	100	36	88	none	..	·22	7.48	1·70	9411
Ditto	45	·21	99	36	84	none	..	·22	7.34	1·68	9428
Moor House, Large Leaze . . .	53	·22	101	37	84	2	·49	·22	7.47	1·71	9450
Ditto	52	·21	96	33	88	none	..	·22	7.56	1·63	9423
Ditto	50	·20	98	36	88	2	·46	·23	7.47	1·65	9503
Ditto	53	·21	95	33	85	2	·49	·23	7.27	1·61	9441
Ditto	49	·22	97	32	83	2	·48	·23	7.35	1·63	9521
Ditto	50	·22	96	28	86	1	·46	·22	7.45	1·63	9423
Ditto	48	·20	93	30	90	2	·26	·23	7.32	1·58	9417
Ditto	48	·21	91	28	90	2	·43	·22	7.43	1·54	9454
Ditto	50	·20	93	28	90	2	·45	·23	7.45	1·57	9477
Ditto	49	·20	91	33	90	2	·26	·22	7.57	1·54	9454
Ditto	49	·21	87	27	92	none	..	·23	7.50	1·48	9405
Ditto	44	·21	89	26	86	2	·37	·24	7.50	1·50	9493
Sharnam's Large Leaze . . .	48	·21	90	31	90	2	·36	·24	7.50	1·53	9411
.. ..	53	·21	100	..	..	..	·45	·23	7.45	..	9423

RECORD OF OBSERVATIONS MADE AT THE BATH AND WEST

	24	25	26	27	28	29	30	31	32	33	34	34a	35
						Temp. of Scald.				Relating to Whey.			
Day of Month.	Time when Curd cut.	Acidity of Whey before breaking.	Time of breaking.	Acidity of Whey put aside.	Time Scalding commences.	1st	2nd	Time taken in stirring.	Time in Scald.	Temp. when drawn.	Acidity.	Volume.	Acidity of draining from piled Curd.
	A.M.		A.M.		A.M.			min.	h. m.			galls.	
31–1	8.30	·15	9.0	·16	10.0	88	90	45	1 35	88	·18	88	·21
1–2	8.35	·15	9.10	·16	10.7	88	90	60	1 43	87	·19	92	·23
2–3	8.35	·14	9.3	·15	10.3	88	90	60	1 57	88	·20	90	·30
3–4	8.30	·15	8.50	·16	9.45	88	90	30	1 15	88	·22	90	·31
4–5	8.37	·15	9.2	·15	10.6	88	90	30	1 20	87	·20	93	·28
5–6	8.40	·15	9.14	·16	10.10	88	90	30	1 20	88	·22	91	·33
6–7	8.53	·15	9.20	·16	10.20	88	90	30	1 20	88	·22	88	·32
7–8	8.27	·16	8.53	·17	9.50	88	90	30	1 20	88	·24	89	·34
8–9	8.40	·16	9.15	·16	10.15	88	90	30	1 17	88	·22	87	·30
9–10	8.21	·16	8.47	·16	9.44	88	90	40	1 33	89	·21	88	·29
10–11	8.25	·15	8.55	·16	9.57	88	90	30	1 18	88	·23	87	·33
11–12	8.38	·15	9.11	·16	10.0	88	90	30	1 20	87	·21	88	·32
12–13	8.35	·15	9.5	·16	10.0	88	90	30	1 20	87	·22	87	·30
13–14	8.35	·15	9.0	·17	9.50	88	90	60	1 50	86	·26	90	·38
14–15	8.22	·15	8.52	·16	10.23	90	101	5	40	98	·24	90	·38
15–16	8.35	·15	9.10	·16	10.12	88	90	30	1 18	87	·23	88	·31
16–17	8.35	·15	9.5	·15	10.5	90	100	5	46	97	·17	87	·19
17–18	8.34	·15	9.10	·16	10.4	88	90	75	2 0	86	·20	81	·24
18–19	8.35	·16	9.5	·17	10.5	88	90	40	1 30	87	·24	90	·34
19–20	9.5	·15	9.40	·15	10.30	89	100	15	55	97	·15	81	·16
20–21	8.33	·15	9.0	·17	9.57	88	90	30	1 24	88	·21	87	·28
21–22	8.20	·16	8.35	·17	9.30	88	90	30	1 18	88	·27	78	·45
22–23	8.18	·17	8.40	·18	9.30	88	90	20	1 3	87	·26	84	·36
23–24	8.35	·15	9.10	·15	10.5	88	90	30	1 20	87	·21	81	·27
24–25	8.20	·16	8.40	·16	9.28	88	90	30	1 20	87	·19	75	·22
25–26	8.38	·15	9.3	·16	9.55	88	90	35	1 20	87	·19	77	·29
26–27	8.30	·15	9.0	·16	9.52	88	90	30	1 21	87	·18	77	·23
27–28	8.50	·14	9.13	·16	10.10	88	90	35	1 20	87	·19	75	·22
28–29	8.48	·14	9.15	·15	10.0	88	91	45	1 30	87	·18	71	·20
29–30	8.43	·17	8.50	·18	9.40	88	90	30	1 15	87	·21	72	·27
30–31	8.35	·16	8.50	·18	9.43	88	90	60	2 27	86	·25	75	·45
Average	..	·15	..	·16	..	..	..	37	1 23	..	·21	84	·30

OF ENGLAND'S SOCIETY'S CHEESE SCHOOL, AUGUST, 1892—*contd.*

36	37	38	39	40	41	42	43	44	45	46	47		48	49	
			Acidity of Whey during Treatment of Curd.								Salt Added.				
Time Curd remains piled.	Time Curd was taken from tub.	Temp. of Curd when taken from tub.	When taken to Cooler.	After 1st cutting.	After 2nd cutting.	After 1st turning.	After 2nd turning.	After 3rd turning.	After 4th turning.	Acidity of Curd when milled.	Weight.		Percentage.	Temp. of Dairy.	
min.	P.M.										lbs.	oz.		min.	max.
43	12.45	88	·30	·43	·60	·79	·84	..	..	5·00	2	8	2·08	65	69
40	1.0	87	·38	·56	·80	·90	..	..	..	5·40	2	8	1·95	65	68
35	1.5	88	·54	·76	·96	..	..	..	..	4·40	2	7	2·04	65	68
30	12.0	89	·56	·82	1·00	..	..	..	..	4·00	2	8	1·99	64	68
51	12.47	89	·60	·83	1·00	..	..	..	..	6·20	2	8	1·95	62	67
50	12.50	89	·67	·90	·97	..	..	..	..	4·60	2	7	2·03	64	67
30	12.45	89	·53	·71	·90	1·00	..	..	..	4·80	2	6	2·05	65	68
25	12.5	88	·54	·75	·91	1·01	..	..	..	5·80	2	6	2·07	64	68
50	12.50	89	·59	·68	·90	·94	..	..	..	4·00	2	6	2·05	64	68
40	12.30	88	·53	·66	·90	1·00	..	..	..	4·20	2	5	1·97	63	66
45	12.40	88	·67	·85	1·05	..	..	..	..	4·20	2	5	1·99	62	66
50	12.45	89	·70	·85	1·06	..	..	..	..	3·80	2	6	2·01	64	67
30	12.15	89	·54	·72	·96	..	..	..	..	5·20	2	4	1·98	64	67
30	12.30	88	·62	·77	·94	..	..	..	..	5·00	2	4	1·96	64	68
30	12.10	98	·61	·65	..	..	..	..	..	5·80	2	3	2·00	63	69
45	12.45	90	·63	·77	..	..	..	..	..	4·60	2	4	1·93	64	68
43	12.0	98	·33	·43	·54	·64	..	..	..	6·0	2	3	2·02	65	70
35	1.10	86	·41	·57	·79	..	..	..	..	6·4	2	3	1·98	66	69
45	12.50	89	·74	·90	..	..	..	..	..	..	2	4	2·01	64	69
60	12.50	96	·29	·37	·50	·60	..	..	..	..	2	2	1·97	64	69
40	11.25	88	·51	·69	·89	..	..	..	..	5·30	2	3	1·99	64	70
25	11.45	89	·68	·80	·93	..	..	..	..	6·20	2	2	1·94	64	70
30	11.30	89	·56	·70	·85	·90	..	..	..	4·40	2	3	2·03	66	70
50	12.45	88	·55	·72	·87	..	..	..	..	4·20	2	3	2·03	66	70
55	12.8	87	·42	·55	·73	·83	..	..	..	5·60	2	1	1·96	66	68
45	12.25	89	·59	·75	·96	..	..	..	..	4·60	2	1	1·99	64	68
60	12.45	88	·49	·66	·80	·93	..	..	..	4·40	2	1	1·96	65	68
45	12.45	87	·38	·49	·67	·76	·81	..	..	5·00	2	0	1·92	63	67
58	12 58	87	·30	·41	·57	·76	·81	..	..	1·20	1	15	2·02	64	68
40	12.5	89	·43	·53	·68	·73	·84	..	..	4·80	2	1	2·05	64	67
25	12.55	88	·66	·82	..	..	..	..	..	3·80	2	0	1·90	62	65
..	12.31	..	..	..	..	..	..	..	..	4·47	..		..	64	69

RECORD OF OBSERVATIONS, AUGUST, 1892—*continued.*

	50	51	52	53	54	55	56		57		58		59		60
	Relating to Curd.			Relating to Cheeses.											
							Temp. of Cheese Room.				Hygrometer Reading.				
							Morning.		Evening.		Morning.		Evening.		
Day of Month.	Temp. in Vat.	Weight when Vatted.	Time of Vatting.	Acidity of Liquid from Press.	Weight taken to Cheese Room.	Loss in Press.	Min	Max.	Min.	Max.	Wet.	Dry.	Wet.	Dry.	Weight of Cheese when sold.
		lbs.	P.M.		lbs.	lbs.									lbs.
31-1	75	120	8.50	1·18	109	11	64	66	66	70	64	66	69	70	101
1-2	77	124½	5.15	1·14	112	12½	65	69	65	69	65	67	67	69	105
2-3	78	119½	3.45	1·18	108½	11	64	68	65	67	65	66	66	67	100
3-4	79	125½	2.45	1·13	112	13½	64	66	64	68	64	66	66	68	104
4-5	77	124½	3.50	1·15	112	12½	62	67	62	69	62	63½	67	68	106
5-6	76	120	3.35	1·14	109½	10½	64	67	64	68	64	66	66	68	100
6-7	76	11[illegible]	4.25	1·18	105½	10½	65	67	65	67	66	67	67	68	96
7-8	77	114½	3.55	1·21	105	9½	64	67	66	69	64	65½	68	69	97
8-9	76	116	4.15	1·19	106	10	64	66	64	68	64	65½	65	67	96
9-10	73	117	4.25	1·19	106	11	59	64	58	64	60	61	59½	60½	99
10-11	76	116	3.55	1·22	105½	10½	59	62	58	65	64	65	66	67	97
11-12	77	118	3.40	1·21	107	11	60	64	61	67	61½	62½	67	68	99
12-13	77	113½	3.20	1·12	102½	11	63	67	63	66	63	65	65	66	94
13-14	77	114½	3.20	1·16	107	7½	63	64	62	66	63	64	66	67	98
14-15	73	109	4.40	1·34	102	7	63	65	63	68	63	64	66	67	96
15-16	77	116½	2.55	1·17	106½	10	63	66	65	66	63	64	66	67	98
16-17	75	108	5.14	1·12	98½	9½	64	66	64	70	64	65	69	70	92
17-18	77	110	5.0	1·02	98½	11½	66	69	66	68	66	67	67	68	92
18-19	78	111½	2.50	1·16	101	10½	64	67	64	69	65	66	67	69	92
19-20	73	107½	7.10	1·17	96½	11	64	68	64	69	64	65	69	69	90
20-21	80	109½	3.30	1·15	100	9½	66	69	66	72	66	67	71	72	92
21-22	78	109½	1.55	1·16	101	8½	66	71	..	..	67	68	..	..	91
22-23	78	107½	2.0	1·11	100	7½	66	71	66	70	68	69	69	70	91
23-24	79	107½	3.15	1·04	98½	9	66	71	66	70	66	67	68	70	91
24-25	76	105	3.45	1·05	97½	7½	66	68	65	68	66	67	67	68½	91
25-26	76	103½	3.10	1·09	95½	8	64	67	64	68	64½	65½	65	67	88
26-27	75	105	4.5	1·04	96½	8½	64	66	64	65	64	65	64	65	89
27-28	74	104	5.5	1·03	96	8	62	64	62	65	62	63	64½	65½	87
28-29	74	95½	7.0	1·08	88	7½	62	64	61	63	62½	63½	64	65	82
29-30	75	100½	4.10	1·00	95	5½	63	64	63	64	63	64	63	64	88
30-31	76	105	3.4	1·18	99	6	59	63	60	62	61	62	61	62	91
..	..	112	4·8	1·14	102½	9½	..	..	..	..	..	..	..	..	94

RECORD OF ANALYSES, AUGUST, 1892.

Day of Month.	Composition of Mixed Milk.							Composition of Whey.			Composition of Curd.			
	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	Ash.
31–1	87·72	12·28	3·37	2·76	·39	5·04	·72	6·58	·37	·56	41·35	58·65	30·03	2·35
1–2	87·70	12·30	3·36	2·59	·40	5·27	·68	6·73	·39	·54	41·85	58·15	30·91	2·30
2–3	87·94	12·06	3·12	2·51	·39	5·32	·72	6·96	·33	·55	42·60	57·40	30·08	2·15
3–4	87·60	12·40	3·41	2·70	·36	5·25	·68	6·97	·32	·56	42·95	57·05	28·88	2·10
4–5	87·64	12·36	3·47	2·62	·40	5·25	·62	6·95	·30	·54	41·75	58·25	30·39	2·25
5–6	87·80	12·20	3·24	2·74	·39	5·17	·66	6·91	·34	·54	42·85	57·15	28·42	2·20
6–7	87·66	12·34	3·36	2·71	·38	5·27	·62	6·92	·37	·56	41·55	58·45	29·00	2·20
7–8	87·84	12·16	3·23	2·76	·37	5·12	·68	6·74	·33	·58	42·00	58·00	30·11	2·15
8–9	87·80	12·20	3·28	2·68	·39	5·11	·74	6·68	·37	·55	42·75	57·25	29·08	2·10
9–10	87·74	12·26	3·35	2·63	·38	5·26	·64	6·89	·36	·52	41·60	58·40	29·51	2·10
10–11	87·74	12·26	3·29	2·72	·39	5·18	·68	6·90	·30	·55	43·35	56·65	28·72	2·05
11–12	87·76	12·24	3·27	2·62	·38	5·19	·78	6·97	·33	·50	43·05	56·95	27·90	2·20
12–13	88·14	11·86	3·06	2·64	·41	5·13	·62	6·58	·33	·53	43·55	56·45	28·43	2·30
13–14	87·92	12·08	3·22	2·64	..	..	·76	6·82	·23	·58	43·70	56·30	29·07	2·05
14–15	87·62	12·38	3·52	2·72	·31	5·13	·70	7·09	·25	·53	39·35	60·65	31·16	2·25
15–16	87·66	12·34	3·53	2·65	·35	5·13	·68	7·00	·37	·54	44·85	55·15	28·30	2·05
16–17	87·76	12·24	3·50	2·63	·37	5·06	·68	7·08	·30	·52	41·65	58·35	30·00	2·45
17–18	87·64	12·36	3·54	2·59	·43	5·18	·62	6·95	·24	·54	42·15	57·85	31·05	2·40
18–19	88·00	12·00	3·17	2·56	·38	5·17	·72	7·06	·19	·56	45·35	54·65	27·54	2·15
19–20	87·76	12·24	3·40	2·65	·42	5·05	·72	6·96	·31	·52		No curd kept.		
20–21	88·02	11·98	3·10	2·63	·39	5·26	·60	6·79	·33	·56	42·35	57·65	28·74	2·10
21–22	87·60	12·40	3·56	2·63	·32	5·19	·70	6·87	·34	·57	43·00	57·00	29·40	1·80
22–23	87·94	12·06	3·20	2·57	·33	5·32	·64	6·59	·38	·51	43·00	57·00	29·70	1·85
23–24	87·78	12·22	3·28	2·59	·31	5·32	·72	6·83	·38	·52	41·40	58·60	29·15	2·15
24–25	87·48	12·52	3·59	2·66	·33	5·28	·66	6·81	·36	·53	41·60	58·40	30·03	2·15
25–26	87·56	12·44	3·50	2·60	·35	5·33	·66	6·91	·23	·57	41·85	58·15	29·20	2·15
26–27	87·60	12·40	3·45	2·66	·39	5·26	·64	6·93	·27	·52	41·70	58·30	29·15	2·20
27–28	87·52	12·48	3·57	2·73	·42	5·02	·74	6·81	·32	·51	41·30	58·70	29·43	2·25
28–29	87·72	12·28	3·44	2·65	·35	5·16	·68	6·73	32	·50	40·75	59·25	29·78	2·40
29–30	87·44	12·56	3·64	2·67	·38	5·21	·63	6·82	·34	·53	41·45	58·55	30·51	2·10
30–31	87·22	12·78	3·80	2·77	·42	5·09	·70	6·78	37	·54	41·00	59·00	31·07	1·95
Average .	87·72	12·28	3·38	2·65	·37	5·20	·68	6·86	·32	·54	42·25	57·75	29·49	2·16

RECORD OF OBSERVATIONS MADE AT THE BATH AND WEST

1	2	3	4	5	6	7	8	9		10	11
	Relating to Evening's Milk.										
			At Night.				In Morning.				
Day of Month.	Name of Field.	Volume of Milk.	Time.	Temp. of Dairy.	Temp. of Milk.	Acidity.	Time.	Temp. of Dairy.		Temp. of Milk.	Acidity.
		galls.	P.M.				A.M.	min.	max.		
31–1	Sharnam's Large Leaze . . .	43	6.55	62	84	·22	6.50	61	63	68	·24
1–2	Ditto	43	6.35	63	82	·21	7.30	62	64	70	·25
2-3	Ditto	42	6.40	62	83	·20	7.30	61	63	67	·22
3–4	Ditto	42	6.28	61	79	·22	7.30	60	61	67	·23
4–5	Moor House, Large Leaze . . .	38	5.30	62	85	·20	7.30	60	62	67	·23
5–6	Ditto	42	6.30	62	88	·22	7.30	60	62	69	·24
6–7	Ditto	41	6.40	62	84	·21	7.30	60	62	69	·25
7–8	Ditto	42	7.0	61	83	·21	7.15	60	62	67	·23
8–9	Ditto	43	6.20	61	85	·22	7.30	59	62	65	·23
9–10	Ditto	43	6.45	62	85	·21	7.10	61	62	71	·24
10–11	Ditto	40	6.15	62	84	·22	7.30	60	62	70	·24
11–12	Ditto	38	5.40	63	83	·22	7.30	62	64	69	·24
12–13	Ditto	40	6.15	63	87	·22	7.15	63	64	71	·23
13–14	Ditto	41	6.30	62	84	·21	7.25	60	62	66	23
14–15	Ditto	40	6 20	62	87	·22	6.40	60	63	69	·23
15–16	Ditto	41	6.15	63	86	·21	6.35	61	63	70	·23
16–17	Ditto	38	6.30	61	82	·21	6.25	61	62	68	·22
17–18	Ditto	39	6 30	61	86	·22	7.20	59	61	67	·23
18–19	Sharnam's Large Leaze . . .	36	5.10	61	86	·22	7.20	60	62	67	·22
19–20	Ditto	43	6.45	62	89	22	7.25	62	62	72	·25
20–21	Ditto	40	6.45	63	89	·23	6.50	62	65	70	·24
21–22	Ditto . . .	38	6.25	63	80	·22	6.45	61	63	68	·23
22–23	Ditto	38	6.40	61	80	·21	7.5	61	62	69	·23
23–24	Moor House, Large Leaze . . .	37	6.30	62	82	·20	7.30	62	63	70	·22
24–25	Ditto	37	6.10	62	85	·21	7.25	61	62	64	·22
25–26	Ditto	36	5.10	62	85	·22	7.25	61	63	69	·23
26–27	Ditto	37	6.10	63	85	21	7.20	62	63	70	·23
27–28	Ditto	33	6.20	62	82	·22	7.10	59	62	64	·22
28–29	Ditto	35	6.30	60	84	·21	7.30	59	61	66	·22
29–30	Ditto	33	6.10	59	83	·21	7.30	59	61	66	·24
Average	.. .. ..	39	..	61	84	·21	..	60	62	68	·23

OF ENGLAND SOCIETY'S CHEESE SCHOOL, SEPTEMBER, 1892.

12	13	14	15	16	17	18	19	20	21	22	23
Morning's Milk.				Milk Heated.		Stale Whey.		Mixed Milk, &c.			
										Rennet Added.	
Name of Field.	Vol. of Milk.	Acidity.	Total Vol. of Milk.	Quantity.	To Temp.	Quantity.	Acidity.	Acidity before Renneting.	Time of Renneting.	Vol.	Proportion by Volume.
	galls.		galls.	galls.		galls.			A.M.	ounces.	
Sharnam's Large Leaze . . .	50	·22	93	32	92	2	·46	·23	7.40	1·57	9477
Ditto	45	·21	88	36	90	2	·46	·23	7.56	1·49	9449
Ditto	47	·21	89	36	91	2	·46	·24	7.58	1·51	9430
Ditto	44	·21	86	35	88	2	·44	·22	8.3	1·46	9424
Moor House, Large Leaze . . .	48	·22	86	38	82	2	·42	·23	8.13	1·46	9424
Ditto	50	·22	92	42	82	2	·43	·24	8.5	1·48	9945
Ditto	47	·22	88	41	83	2	·44	·23	8.0	1·49	9449
Ditto	46	·22	88	42	84	2	·42	·24	7.45	1·49	9449
Ditto	47	·21	90	43	83	2	·43	·23	7.56	1·52	9473
Ditto	47	·22	90	43	83	2	·43	·23	7.44	1 52	9473
Ditto	47	·22	87	40	83	2	·45	·23	7.55	1·48	9405
Ditto	51	·22	89	38	83	2	·46	·23	7.40	1·51	9430
Ditto	46	·22	86	40	82	2	·46	·23	7.40	1·46	9424
Ditto	45	·22	86	41	85	2	·46	·24	7.47	1·46	9424
Ditto	45	·22	85	40	84	2	·45	·23	7.45	1.45	9379
Ditto	46	·21	87	41	82	2	·45	·22	7.45	1·48	9405
Ditto	45	·22	83	38	84	2	·44	·23	7.37	1·41	9418
Ditto	44	·22	83	39	86	2	·45	·23	7.50	1·44	9222
Sharnam's Large Leaze . . .	47	·22	83	36	84	2	·45	·22	7.36	1·44	9222
Ditto	44	·21	87	43	82	none	..	·22	8.2	1·51	9218
Ditto	44	·21	84	40	84	1	·40	·23	7.42	1·46	9205
Ditto	44	·21	82	38	86	1	·44	·22	7.45	1·43	9174
Ditto	42	·22	80	38	82	1	·43	·22	7.43	1·42	9014
Moor House, Large Leaze . . .	43	·22	80	37	84	1	·47	·23	7.49	1·42	9014
Ditto	43	·21	80	37	82	1	·48	·23	7.55	1·42	9014
Ditto	45	·22	81	36	84	none	..	·23	7.43	1·44	9000
Ditto	42	·21	79	37	85	1	·43	·23	7.54	1·40	9028
Ditto	42	·22	75	33	88	2	·45	·24	7.32	1·33	9022
Ditto	41	·22	76	35	90	2	·47	·23	7.52	1·35	9007
Ditto	40	·21	73	33	89	2	·45	·23	7.53	1·29	9054
.. ..	45	·22	84	...	...	..	·44	·23	7.49	..	9302

RECORD OF OBSERVATIONS MADE AT THE BATH AND WEST

	24	25	26	27	28	29	30	31	32	33	34	34a	35
						Temp. of Scald.				Relating to Whey.			
Day of Month.	Time when Curd cut.	Acidity of Whey before breaking.	Time of breaking.	Acidity of Whey put aside.	Time Scalding commences.	1st	2nd	Time taken in stirring.	Time in Scald.	Temp. when drawn.	Acidity.	Volume.	Acidity of draining from piled Curd.
	A.M.		A.M.		A.M.			min.	h. m.			galls.	
31–1	8.37	·16	8.53	·17	9.50	88	90	30	1 15	87	·20	77	·26
1–2	8.45	·18	9.5	·18	10.0	88	90	30	1 17	88	·22	73	·30
2–3	8.45	·17	9.8	·17	10.6	88	90	35	1 24	87	·20	73	·27
3–4	8.53	·14	9.15	·16	10.0	88	90	45	1 30	87	·19	72	·23
4–5	9.0	·15	9.20	·17	10.10	88	90	40	1 30	86	·20	72	·27
5–6	9.0	·16	9.20	·17	10.10	88	90	35	1 24	87	·20	76	·28
6–7	8.47	·16	9.10	·17	10.5	88	90	30	1 22	87	·19	73	·24
7–8	8.45	·15	9.8	·16	10.5	88	90	30	1 21	87	·20	72	·25
8–9	8.45	·15	9.15	·15	10.12	88	90	30	1 9	87	·18	73	·22
9–10	8.32	·15	9.0	·16	9.48	88	90	35	1 25	87	·19	73	·26
10–11	8.50	·15	9.27	·17	10.22	88	90	30	1 18	87	·20	73	27
11–12	8.27	·16	8.50	·17	9.52	88	90	30	1 19	87	·20	73	·26
12–13	8.30	·15	8.55	·16	9.49	88	90	30	1 14	86	·21	68	·28
13–14	8 32	·15	9.0	·16	9.50	88	90	30	1 17	87	·21	70	·28
14–15	8.30	·15	9.0	·17	9.53	88	90	30	1 20	87	·21	70	·28
15–16	8.35	·15	8.55	·16	9.48	88	91	30	1 18	87	·20	67	·27
16–17	8.33	·15	9.0	·16	9.47	88	90	35	1 23	87	21	68	·28
17–18	8.35	·15	8.52	·16	9.49	88	90	33	1 22	87	·19	68	·25
18–19	8.28	·15	8.50	·16	9.40	88	90	35	1 20	86	·22	70	·28
19–20	8.46	·15	8.10	·16	10.5	88	90	30	1 13	87	·17	70	·18
20–21	8.35	·15	9.0	·15	10.0	88	90	47	1 35	87	·20	68	·29
21–22	8.45	·15	9.15	·15	10.2	88	90	45	1 33	87	·18	67	·24
22–23	8.27	·15	8.54	·15	9.45	88	90	35	1 29	86	·18	65	·24
23–24	8.35	·15	9.0	·15	9.48	88	90	30	1 18	87	·18	65	·24
24–25	8.50	·14	9.30	·15	10.17	88	90	45	1 33	87	·19	65	·28
25–26	8.45	·13	9.15	·14	10.8	88	90	60	1 57	87	·17	66	·22
26–27	8.50	·14	9.20	·15	10.15	88	90	30	1 20	88	·18	64	·26
27–28	8.17	·14	8.45	·16	9.34	88	90	30	1 11	87	·20	61	·28
28–29	8.37	·15	9.5	·16	9.55	88	90	33	1 25	87	·21	63	·3[illegible]
29–30	8.45	·15	9.15	..	10.5	88	90	30	1 13	87	·19	57	·2[illegible]
Average	..	·15	..	·16	..	..	..	35	1 22	..	·20	69	·2[illegible]

ENGLAND SOCIETY'S CHEESE SCHOOL, SEPTEMBER, 1892.—*contd.*

37	38	39	40	41	42	43	44	45	46	47		48	49	
Time Curd was taken from Tub.	Temp. of Curd when taken from Tub.	Acidity of Whey during Treatment of Curd.							Acidity of Curd when Milled.	Salt Added.			Temp. of Dairy.	
		When taken to Cooler.	After 1st Cutting.	After 2nd Cutting.	After 1st Turning.	After 2nd Turning.	After 3rd Turning.	After 4th Turning.		Weight.		Percentage.		
P.M.										lbs.	oz.		min.	max.
12.20	89	·48	·64	83	·94	..	..	..	6·20	2	1	1·94	61	65
12.30	89	·57	·78	·94	..	..	..	..	6·00	1	15	1·92	62	65
12.35	88	·46	·61	·75	·92	..	..	..	4·60	2	0	1·91	62	65
12.50	88	·42	·59	·78	·83	..	..	..	5·40	1	14	1·82	61	64
12 50	87	·45	·59	·79	·94	..	..	..	5·40	1	14	1·87	61	64
12.40	88	·43	·61	·77	·84	..	..	..	4·40	2	1	1·96	60	64
12.50	87	·44	·65	·81	·99	..	..	..	4·20	2	0	2 01	60	64
12.50	88	·44	·61	·81	·95	..	..	..	5·40	2	0	1·96	60	63
1.3	87	·45	·65	·86	·97	..	..	..	6·00	2	1	1·98	60	63
12.35	87	·53	·68	·90	..	..	..	..	3·80	2	1	1·97	61	65
12.40	88	·49	·69	·91	..	..	..	..	4·20	2	0	1·95	62	65
12.33	88	·59	·75	1·03	..	..	..	..	4·20	2	1	1·97	63	66
12.15	88	·61	·84	·95	..	..	..	..	3·80	2	0	1·94	63	66
12.15	88	·61	·85	1·00	..	..	..	..	4·00	2	0	1·95	61	64
12.20	88	·58	·82	1·00	..	..	..	..	5·2	2	0	2·00	60	65
12.5	89	·46	·75	·98	..	..	..	..	4·20	2	1	1·98	61	64
12.13	88	·50	·73	96	..	..	..	..	4·00	2	0	2·00	60	64
12.19	88	·45	·65	·84	..	..	..	..	6·10	2	0	2 02	59	63
12.5	89	·55	·87	1·00	..	..	..	..	5·40	2	0	2·04	60	65
12.25	87	·24	·30	·41	·51	·68	·79	..	4·20	2	1	2·10	62	65
12.35	87	·56	·77	·92	..	..	..	..	4·20	2	0	2·02	62	65
12.45	89	·42	·63	·85	..	..	..	..	4·80	2	0	2 04	61	64
12.18	88	·47	·68	·93	..	..	..	..	5·20	1	15	2·04	61	64
12.10	89	·44	·67	·85	..	..	..	..	3·80	1	15	2·07	62	65
12.48	88	·46	·64	·85	..	..	..	..	4·40	1	15	2·01	62	65
1.15	88	·37	·56	·78	·87	..	..	..	4·00	1	15	2·08	62	65
12.37	88	·47	·69	·89	..	..	..	..	4·20	1	15	2·06	62	65
11.45	89	·49	·71	·86	..	..	..	..	5·00	1	14	2·09	59	64
12.15	87	·50	·72	·87	..	..	..	..	4·80	1	14	2·07	60	62
12.25	88	·46	·63	·85	..	..	..	..	4·00	1	14	2·07	59	62
12.30	..	..	..	..	..	..	..	..	4·69	..		..	61	64

RECORD OF OBSERVATIONS, SEPTEMBER, 1892—*continued.*

	50	51	52	53	54	55	56		57		58		59	
	Relating to Curd.			Relating to Cheeses.										
							Temp. of Cheese Room.				Hygrometer Reading.			
Day of Month.	Temp. in Vat.	Weight when Vatted.	Time of Vatting.	Acidity of Liquid from Press.	Weight taken to Cheese Room.	Loss in Press.	Morning.		Evening		Morning.		Evening.	
							Min.	Max.	Min.	Max.	Wet.	Dry.	Wet.	Dry.
		lbs.	P.M.		lbs.	lbs.								
31–1	76	106	3.55	1·13	97	9	58	60	58	63	59	60	61	62
1–2	76	100½	3.35	1·17	92½	8	60	62	60	62	61	62	60	62
2–3	74	104½	4.7	1·15	96½	8	57	60	58	61	59	60	59	60
3–4	73	102½	4.25	1·10	94½	8	56	59	56	58	57	58	57	58
4–5	74	100	4.20	1·11	92½	7½	55	58	55	60	57	58	59	60
5–6	74	105	4.30	1·10	96	9	57	59	56	59	58	59	58	59
6–7	74	99½	4.30	1·06	92	7½	57	60	55	60	59	60	58	59
7–8	75	102	4.30	1·08	95	7	56	59	54	59	57	58	57	58
8–9	74	104	4.30	1·11	96	8	55	60	56	60	58	59	59	60
9–10	76	104½	3.55	1·18	95	9½	57	60	60	63	59	60	62	63
10–11	76	102½	3.35	1·09	93½	9	60	62	60	63	60	61	62	63
11–12	75	104½	3.5	1·08	95½	9	60	62	61	63	61	62	62	63
12–13	76	103	2.30	1·11	95	8	62	63	60	62	62	63	60	61
13–14	74	102½	2.55	1·19	95½	7	58	62	61	63	58	59	61	62
14–15	75	100	3.0	1·11	92	8	57	62	60	64	59	60	61½	63
15–16	74	104	2.45	1·17	95	9	60	62	60	62	60	62	59	61
16–17	75	100	2.53	1·10	92	8	57	60	56	62	57	59	58	60½
17–18	75	99	2.55	1·05	91	8	55	59	55	61	54	57	59	62
18–19	76	98	2.50	1·20	88½	9½	58	61	57	65	56	59	62	64
19–20	74	98	7.10	·98	91	7	62	62	62	64	61	63	62	64
20–21	76	99	2.55	1·10	91	8	62	63	60	63	61	63	61	63
21–22	75	98	3.30	·98	92	6	58	61	61	64	58	60	61	63
22–23	75	95	2.55	1·01	87½	7½	58	60	59	62	58	60	60	62
23–24	76	93½	2.40	·95	86	7½	58	60	60	64	60	61	62	63
24–25	75	96	3.30	1·00	88	8	59	62	57	66	59	61	61	63
25–26	75	93	4.30	1·00	86	7	57	62	57	60	58	59	60	62
26–27	76	94	3.10	1·01	86½	7½	60	62	59	61	60	61	60	61
27–28	76	89½	2.0	1·03	83½	6	56	60	56	59	57	58	58	59
28–29	74	91½	2.40	1·00	86½	5	54	58	58	61	55	56	60	61
29–30	73	91½	3.0	·95	86½	5	54	56	54	58	55	56	56	58
..	..	99	3.33	1·07	91	8	..	..	..	..	..	..	..	..

Day of Month.	Composition of Mixed Milk.							Composition of Whey.			Composition of Curd.			
	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	Ash.
31–1	87·38	12·62	3·63	2·73	·37	5·21	·68	6·92	·36	·50	41·40	58·60	29·82	2·15
1–2	87·62	12·38	3·47	2·77	·36	5·12	·66	6·81	·32	·52	43·60	56·40	29·43	2·05
2–3	87·38	12·62	3·63	2·78	·38	5·15	·68	6·90	·29	·56	40·95	59·05	30·98	2·10
3–4	87·46	12·54	3 62	2·82	·38	5·04	·68	6·87	·39	·53	40·95	59·05	31·22	2·30
4–5	87·34	12 66	3·66	2 70	·38	5·26	·66	6·86	·34	·52	42·55	57·45	30·73	2·10
5–6	87·58	12·42	3 42	2·75	·40	5·19	·66	6·76	28	·55	42·60	57·40	30·38	2·15
6–7	87·62	12·38	3·39	2·81	·40	5·14	·64	6·58	·32	·54	41·85	58·15	29·51	2·20
7–8	87·56	12·44	3·44	2·82	·41	5·11	·66	6·85	·33	·57	41·70	58·30	29·84	2·35
8–9	87·58	12·42	3 46	..	..	..	·62	6·82	·31	53	41·80	58·20	30·36	2·25
9–10	87·54	12 46	3·50	2·79	·38	5·11	68	6·64	·39	·54	41·70	58·30	30·49	2·10
10–11	87·56	12·44	3·42	2·85	·40	5·09	·68	6·79	·36	·54	42·95	57·05	28·56	2·10
11–12	87·36	12·64	3·65	2·84	·39	5·05	·64	6·86	·32	·54	42·75	57·25	29·26	2·05
12–13	87·48	12·52	3·55	2·79	·42	5·12	·64	6·83	·37	·51	42·45	57·55	29·83	2·05
13–14	87·38	12·62	3·69	2·87	·40	5 00	·66	6·73	·31	·52	42·65	57·35	29·29	2·10
14–15	87·56	12·44	3·57	2·89	·39	4·93	·66	6·81	·30	·52	43·15	56·85	29·51	2·10
15–16	87·38	12·62	3·65	2·88	·39	5·02	·68	6·65	·34	·51	43·00	57·00	29·15	2·05
16–17	87·24	12 76	3·71	2·93	·40	4·98	·74	6·82	·37	·51	43·55	56·45	29·15	2·05
17–18	87·48	12·52	3·51	2·94	·40	5·01	·66	6·81	·30	·53	42·60	57·40	28·48	2·10
18–19	87·48	12 52	3·45	2·93	·41	5·05	·68	6·68	·32	·51	41·45	58 55	29·37	2·20
19–20	87·52	12·48	3·47	2·91	·40	5·02	·68	6 77	·34	·52	40·85	59·15	30·19	2·25
20–21	87·64	12·36	3·28	2·96	·41	5·07	·64	6·54	·32	·53	42 35	57·65	29·96	2·15
21–22	87·22	12·78	3·74	2 95	·40	5 03	·66	6 87	·36	·53	40·00	60·00	30·08	2·25
22–23	87·36	12 64	3·65	2·95	·42	5·06	·66	6·87	·32	·54	43·25	56·75	29·43	2·15
23–24	87·56	12 44	3 48	2·90	·40	5·02	·64	6·82	·30	·51	41·15	58·85	29·92	2 15
24–25	87·23	12·72	3·71	2·92	·41	5·00	·68	6·78	·32	·54	42·15	57·85	30·21	2·10
25–26	87·44	12·56	3·64	2·88	·42	4·92	·70	6·69	·36	·52	40·85	59·15	30·78	2·35
26–27	87·44	12 56	3·58	2·93	·42	4·97	·66	6·78	·32	·53	42·25	57·75	29·69	2·15
27–28	87·48	12·52	3·51	2·98	·46	4·91	·66	6·73	·31	·55	42·40	57·60	29 58	2·10
28-29	87 28	12·72	3·71	2·98	·45	4·92	·66	6·78	·26	·55	43·15	56·85	28·86	2·05
29–30	86 98	13·02	3·96	3·03	·47	4·92	·64	6·93	·31	·55	43·00	57·00	30·66	2·05
Average	87·44	12·56	3·57	2·87	·41	5·05	·66	6·78	·33	·53	42·17	57·83	29·49	2·14

RECORD OF OBSERVATIONS MADE AT THE BATH AND

1	2	3	4	5	6	7	8	9		10
	Relating to Evening's Milk.									
			At Night.				In Morning.			
Day of Month.	Name of Field.	Volume of Milk.	Time.	Temp. of Dairy.	Temp. of Milk.	Acidity.	Time.	Temp. of Dairy.		Temp. of Milk.
		galls.	P.M.				A.M.	min.	max.	
30–1	Moor House, Large Leaze . . .	33	5.50	60	84	·20	7.5	58	60	65
1–2	Ditto	31	6.10	56	78	·21	7.25	56	58	63
2–3	Ditto	29	5.10	57	81	·21	7.30	57	58	63
3–4	Ditto	31	6.20	58	78	·22	7.30	57	59	63
4–5	Ditto	32	6.10	59	84	·20	7.25	57	59	64
5–6	Sharnam's Large Leaze . . .	33	6.30	59	83	·22	7.35	58	59	66
6–7	Ditto	32	6.25	60	83	·21	7.35	58	60	66
7–8	Ditto	29	6.15	59	76	·21	7.30	58	59	62
8–9	Mixed Fields . .	30	6.15	58	73	·21	7.35	57	58	62
9–10	Ditto	27	5.10	58	71	·22	7.25	57	58	60
10–11	Ditto	31	6.10	58	78	·23	7.30	55	58	62
11–12	Ditto	28	6.20	57	78	·21	7.30	56	57	61
12–13	Ditto	30	6.20	57	75	·21	7.30	56	57	62
13–14	Ditto	28	6.5	62	75	·22	7.30	57	65	65
14–15	Ditto	28	6.5	65	70	·21	7.35	64	66	64
15–16	Ditto	27	6.7	64	76	·20	7.40	63	65	65
16–17	Ditto	24	5.35	69	75	·21	7.10	60	71	63
17–18	Ditto	25	6.10	64	76	·21	7.30	59	65	62
18–19	Ditto	23	6.20	66	73	·21	7.35	58	71	62
19–20	Ditto	24	6.25	68	75	·21	7.40	65	69	63
20–21	Ditto	24	6.0	67	79	·20	7.40	66	71	66
21–22	Ditto	25	6.10	68	76	·21	7.55	66	77	65
22–23	Ditto	23	6.20	65	71	·20	7.40	64	73	62
23–24	Ditto	22	5.15	67	74	·21	7.40	64	72	63
24–25	Ditto	22	6.25	68	72	·20	7.40	64	70	63
25–26	Ditto	23	6.10	67	72	·20	7.20	57	64	59
26–27	Ditto	22	6.0	66	71	·21	7.50	62	68	61
27–28	Ditto	24	6.5	68	76	·20	7.45	66	72	67
28–29	Ditto	21	5.50	70	75	·21	7.40	67	71	68
29–30	Ditto	19	6.5	69	78	·20	7.55	67	69	65
30–31	Ditto	18	5.0	69	77	·20	7.30	67	69	66
Average		26	..	66	76	·21	..	60	65	63

OF ENGLAND SOCIETY'S CHEESE SCHOOL, OCTOBER, 1892.

12	13	14	15	16	17	18	19	20	21	22	23
Morning's Milk.				Milk Heated.		Stale Whey.		Mixed Milk, &c.			
										Rennet added.	
Name of Field.	Vol. of Milk.	Acidity.	Total Vol. of Milk.	Quantity.	To Temp.	Quantity.	Acidity.	Acidity before Renneting.	Time of Renneting.	Vol.	Proportion by Volume.
	galls.		galls.	galls.		galls.			A.M.	ounces.	
Moor House, Large Leaze . . .	38	·21	71	33	90	2	·44	·23	8.8	1·26	9015
Ditto	38	·21	69	31	87	2	·46	·23	8.3	1·22	9049
Ditto	39	·21	68	29	90	2	·43	·22	7.51	1·20	9066
Ditto	37	·22	68	31	90	2	·40	·23	7.53	1·20	9066
Ditto	37	·21	69	39	90	2	·41	·22	8.14	1·22	9049
Sharnam's Large Leaze . . .	37	·22	70	38	90	2	·43	·23	8.18	1·24	9032
Ditto	37	·22	69	32	88	2	·43	·24	7.56	1·22	9049
Ditto	36	·21	65	38	90	2	·40	·22	7.55	1·15	9043
Mixed Fields . .	36	·21	66	36	90	2	·40	·22	8.0	1·17	9025
Ditto	35	·21	62	37	90	2	·40	·22	7.43	1·10	9018
Ditto	33	·21	64	38	90	2	·38	·23	7.52	1·13	9062
Ditto	35	·21	63	43	89	2	·38	·22	7.52	1·12	9000
Ditto	35	·21	65	43	90	2	·39	·23	8.0	1·15	9043
Ditto	34	·21	62	41	90	2	·38	·21	8.13	1·10	9018
Ditto	32	·21	60	39	90	2	·41	·23	8.2	1·06	9056
Ditto	32	·21	59	39	90	2	·42	·23	8.7	1·04	9077
Ditto	33	·22	57	38	90	2	·40	·23	8.5	1·01	9029
Ditto	31	·21	56	41	90	2	·40	·23	8.3	·99	9050
Ditto	31	·21	55	38	90	2	·37	·22	7.55	·97	9072
Ditto	30	·20	54	38	90	2	·38	·23	8.11	·96	9000
Ditto	30	·21	54	38	90	2	·40	·23	8.4	·96	9000
Ditto	27	·21	52	36	90	2	·40	·23	8.9	·92	9043
Ditto	29	·21	52	38	90	2	·39	·22	8.13	·92	9043
Ditto	30	·21	52	38	90	2	·39	·21	8.4	·92	9043
Ditto	30	·21	52	38	90	2	·41	·23	8.20	·92	9043
Ditto	29	·21	52	42	90	2	·40	·22	8.13	·92	9043
Ditto	25	·20	47	33	90	2	·41	·22	8.16	·83	9060
Ditto	27	·21	51	32	90	2	·44	·22	8.18	·90	9066
Ditto	26	·20	47	33	90	2	·45	·23	8.15	·83	9060
Ditto	25	·20	44	31	90	2	·45	·22	8.17	·78	9025
Ditto	26	·21	44	28	90	2	·44	·22	8.3	·78	9025
	32	·21	58	..	..	..	·41	·22	8.5	..	9041

RECORD OF OBSERVATIONS MADE AT THE BATH AND WEST

	24	25	26	27	28	29	30	31	32	33	34	34a	35
						Temp. of Scald.				Relating to Whey.			
Day of Month.	Time when Curd cut.	Acidity of Whey before breaking.	Time of breaking.	Acidity of Whey put aside.	Time Scalding commences.	1st	2nd	Time taken in stirring.	Time in Scald.	Temp. when drawn.	Acidity.	Volume.	Acidity of draining from piled Curd.
	A.M.		A.M.		A.M.			min.	h. m.			galls.	
30–1	8.53	·16	9.28	·16	10.17	88	90	30	1 13	87	·20	57	·29
1–2	8.52	·15	9.18	·16	10.10	88	90	33	1 25	85	·22	57	·29
2–3	8.37	·15	9.5	·16	10.5	88	90	30	1 30	85	·21	55	·29
3–4	8.40	·15	9.15	·16	10.5	88	90	30	1 15	87	·18	56	·23
4–5	9.10	·15	9.37	·15	10.30	88	91	30	1 20	87	·19	57	·26
5–6	9.10	·15	9.40	·16	10.30	88	91	31	1 18	88	·19	57	·24
6–7	8.43	·14	9.10	·16	10.5	88	90	35	1 30	86	·20	57	·27
7–8	8.43	·14	9.15	·15	10.7	88	90	40	1 13	86	·18	53	·24
8–9	8.52	·14	9.25	·15	10.13	88	90	33	1 11	86	·17	52	·21
9–10	8.30	·14	9.0	·14	9.51	88	90	45	1 30	87	·18	50	·25
10–11	8.38	·13	9.18	·15	10.6	88	90	40	1 35	85	·19	54	·23
11–12	8.45	·13	9.20	·14	10.10	88	90	45	1 45	85	·20	52	·27
12–13	8.55	·14	9.20	·15	10.7	88	90	60	1 45	85	·18	53	·21
13–14	9.3	·14	9.35	·15	10.25	88	90	45	1 30	86	·18	51	·21
14–15	8.48	·14	9.25	·14	10.15	88	90	57	1 35	85	·18	48	·21
15–16	8.58	·14	9.30	·15	10.23	88	90	37	1 27	86	·17	48	·21
16–17	8.50	·14	9.20	·15	10.25	88	90	35	1 25	85	·19	46	·25
17–18	8.50	·14	9.24	·15	10.13	88	90	50	1 37	85	·18	44	·20
18–19	8.42	·14	9.30	·15	10.32	88	90	35	1 20	85	·18	43	·22
19–20	9.0	·14	9.40	·16	10.30	88	90	40	1 28	86	·18	43	·25
20–21	8.52	·15	9.27	·15	10.12	88	90	35	1 28	86	·17	43	·21
21–22	8.55	·15	9.34	·15	10.29	88	90	40	1 31	86	·18	40	·24
22–23	8.55	·13	9.40	·14	10.32	88	90	37	1 23	86	·16	40	·21
23–24	9.0	·13	9.35	·15	10.25	88	90	40	1 33	85	·17	40	·20
24–25	9.10	·14	9.40	·15	10.28	88	90	40	1 32	86	·18	40	·25
25–26	9.6	·14	9.40	·16	10.30	88	90	45	1 30	85	·18	40	·25
26–27	9.16	·14	10.3	·16	10.50	88	90	45	1 45	86	·22	37	·32
27–28	9.13	·14	9.45	·15	10.33	88	90	40	1 27	86	·20	38	·27
28–29	9.4	·15	9.35	·16	10.22	88	91	30	1 16	86	·22	37	·28
29–30	9.5	·15	9.35	·16	10.20	88	90	45	1 19	86	·20	35	·28
30–31	8.50	·15	9.20	·16	10.5	88	90	45	1 20	85	·24	..	·25
Average	..	·14	..	·15	..	..	..	39	1 27	..	·19	47	·24

OF ENGLAND SOCIETY'S CHEESE SCHOOL, OCTOBER, 1892—*contd.*

36	37	38	39	40	41	42	43	44	45	46	47	48	49	
Time Curd remains piled.	Time Curd was taken from Tub.	Temp. of Curd when taken from Tub.	Acidity of Whey during Treatment of Curd.							Acidity of Curd when Milled.	Salt Added.		Temp. of Dairy.	
			When taken to Cooler.	After 1st Cutting.	After 2nd Cutting.	After 1st Turning.	After 2nd Turning.	After 3rd Turning.	After 4th Turning.		Weight	Percentage.		
	P.M.										lbs. oz.		min.	max.
30	12.35	88	·46	·61	·77	·89	..	..	..	3·80	1 12	2·00	58	61
30	12.30	87	·46	·61	·78	·82	..	..	..	4·60	1 12	2·03	58	61
30	12.30	88	·49	·60	·83	..	..	..	..	5·40	1 11	1·99	58	61
42	12.27	87	·39	·52	·72	·75	·80	1·01	..	5·60	1 11	2·07	58	62
35	12.50	88	·41	·58	·70	·74	..	..	..	4·20	1 12	2·07	57	62
45	12 58	88	·42	·56	·68	·87	..	..	..	4·20	1 12	2·05	58	62
38	12 36	87	·44	·56	·82	·85	..	..	..	3·60	1 12	2·05	59	62
45	12.55	88	·43	·52	·72	·80	·85	..	..	3·40	1 10	2·01	58	60
45	12.40	86	·35	·49	·65	·75	·76	·99	..	3·80	1 10	2·02	57	60
45	12.37	87	·43	·55	·68	·79	·89	..	..	3·60	1 9	2·01	57	60
35	12.45	85	·35	·48	·67	·74	·81	·93	..	4·00	1 10	2·02	56	60
32	12.47	85	·41	·52	·71	·72	·83	·86	..	3·60	1 9	2·01	56	60
35	12.50	84	·29	·38	·52	·65	·73	·84	..	3·40	1 10	2·05	57	65
55	1.22	87	·42	·55	·70	·76	·85	..	..	3·40	1 9	2·18	63	68
65	1.16	87	·42	·53	·68	·75	·82	..	..	3·80	1 9	2·06	64	69
35	12.50	87	·35	·43	·60	·71	·76	·84	..	4·10	1 8	2·09	66	74
30	12.45	88	·36	·51	·61	·71	·77	·90	..	..	1 8	2·05	59	71
48	1.0	86	·37	·46	·65	·72	·82	·85	..	..	1 8	2·12	65	75
30	12.45	86	·31	·43	·60	·68	·77	·90	..	5·00	1 7	2·09	59	70
40	1.0	86	·42	·54	·69	·81	·86	..	..	4·60	1 7	2·13	67	72
50	12.49	87	·37	·49	·66	·80	·81	·90	..	4·00	1 7	2·17	67	74
35	12.55	86	·38	·52	·66	·80	·81	·88	..	4·20	1 6	2·14	64	70
60	1.15	87	·43	·55	·70	·74	·86	..	..	3·40	1 6	2·14	66	70
40	1.0	86	·35	·44	·60	·82	·81	·89	..	3·60	1 6	2·11	65	72
37	12.55	86	·39	·49	·62	·68	·82	·85	1·01	3·40	1 6	2·11	64	70
43	1.8	86	·50	·68	·71	·83	·98	..	..	4·20	1 6	2·13	56	69
30	1.23	87	·50	·69	·74	·96	..	..	..	4·40	1 4	2·15	66	74
45	1.5	87	·58	·71	·90	1·01	..	..	..	3·80	1 5	2·13	67	71
35	12.34	88	·49	·64	·85	·87	1·03	..	..	4·80	1 4	2·17	66	71
35	12.45	86	·48	·68	·82	·96	..	..	..	4·00	1 3	2·17	66	73
35	12.20	88	·47	·64	·76	·84	·94	..	..	5·10	1 3	2·16	68	72
..	12.51	..	..	..	..	..	..	..	..	4·10	..	..	61	67

RECORD OF OBSERVATIONS, OCTOBER, 1892—*continued.*

	50	51	52	53	54	55	56		57		58		59		60
	Relating to Curd.			Relating to Cheeses.											
Day of Month.	Temp. in Vat.	Weight when Vatted.	Time of Vatting.	Acidity of Liquid from Press.	Weight taken to Cheese Room.	Loss in Press.	Temp. of Cheese Room.				Hygrometer Reading.				Wei o Che wh sol
							Morning.		Evening.		Morning.		Evening.		
							Min.	Max.	Min.	Max.	Wet.	Dry.	Wet.	Dry.	
		lbs.	P.M.		lbs.	lbs.									lb
30–1	72	87½	3.15	1·05	81½	6	52	55	52	56	53	54	55	57	7
1–2	73	86	3.40	1·02	81	5	54	65	54	64	55	56	59	62	7
2–3	74	84½	3.0	·92	80	4½	52	64	53	68	54	56	61	65	7
3–4	70	81½	5.55	1·17	77½	4	56	64	60	67	58	61	62	66	7
4–5	73	84½	4.10	·94	79	5½	57	69	56	66	56	59	61	66	7
5–6	73	85	4.8	1·05	78½	6½	59	67	59	66	58	61	62	65	7
6–7	74	85	3.45	·99	80	5	59	71	64	66	62½	67½	62	64	7
7–8	74	80½	5.18	1·07	76	4½	59	66	58	62	59	61	58	62	7
8–9	67	80	8.5	1·30	75½	4½	57	63	60	65	58	62	59	63	7
9–10	70	77½	4.55	1·14	74	3½	56	62	55	63	54	57	57	61	6
10–11	69	80	6.45	1·16	75½	4½	52	59	52	61	52	54	55	57	6
11–12	69	77½	5.35	1·14	74	3½	52	64	55	65	55	57	61	63	6
12–13	70	79	7.55	1·16	75	4	55	62	57	68	57	58½	60	62	(
13–14	71	71½	6.20	1·15	68	3½	57	64	56	67	56	58	59	64	
14–15	72	75½	6.0	1·13	71½	4	56	70	56	68	55	58	65	69	
15–16	71½	71½	7.45	1·17	67½	4	59	68	56	58	59	61	57	58	
16–17	71	73	6.45	1·14	68½	4½	52	56	51	54	52	54	53	55	
17–18	71	70½	6.40	1·11	66½	4	59	63	49	56	59	61	55	58	
18–19	71	68½	6.40	1·10	64½	4	51	54	50	56	50	53	54	57	
19–20	73	67	5.55	1·15	63	4	53	65	53	68	53	55	59	63	
20–21	70	66	6.15	1·09	61½	4½	57	66	61	69	59	64	59	65	
21–22	70	64	7.0	1·20	59	5	54	64	54	61	53	56	56	61	
22–23	70	64	6.0	1·09	59	5	54	60	59	63	58	61	62	65	
23–24	71	65	7.15	1·17	59½	5½	56	62	58	62	57	59	59	60	
24–25	69	65	7.15	1·18	60½	4½	54	59	56	57	55	60	56	59	
25–26	71	64½	5.15	1·14	59½	5	48	57	48	57	47	50	50	52	
26–27	74	58	4.30	1·12	54½	3½	50	51	50	60	50	52	57	60	
27–28	75	61½	4.20	1·03	57	4½	58	63	58	61	59	61	60	61	
28–29	74	57½	4.30	1·07	53½	4	58	60	58	62	58	59	61	64	
29–30	75	54½	3.55	1·13	51½	3	56	66	55	66	55	58	61	65	
30–31	73	55	4.0	1·07	51	4	55	67	55	56	55	58	54	57	
..	..	72	5.34	1·11	68	4	..	..	..	..	..	..	..	..	

RECORD OF ANALYSES, OCTOBER, 1892.

Day of Month.	Composition of Mixed Milk.							Composition of Whey.			Composition of Curd.			
	Water.	Solids.	Fat.	Casein.	Albumin	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	Ash.
30–1	87·10	12·90	3·92	3·00	·50	4·82	·66	6·91	·37	·53	42·45	57·55	30·08	2·10
1–2	87·16	12·84	3·75	3·03	·47	4·93	·66	6·79	·29	·54	42·05	57·95	29·96	2·15
2–3	86·98	13·02	3·96	3·01	·51	4·86	·68	6·87	·29	·55	41·45	58·55	31·05	2·15
3–4	86·88	13·12	4·01	3·13	·52	4·80	·66	6·90	·36	·56	40·90	59·10	30·74	2·20
4–5	87·14	12·86	3·79	3·05	·53	4·83	·66	6·84	·32	·53	41·30	58·70	26·75	2·35
5–6	87·08	12·92	3·82	3·07	·43	4·92	·68	6·84	·40	·51	41·30	58·70	31·56	2·30
6–7	87·04	12·96	3·93	3·10	·42	4·77	·74	6·90	·28	·51	42·65	57·35	29·84	2·15
7–8	86·82	13·18	4·04	3·12	·47	4·89	·66	6·85	·37	·54	41·95	58·05	28·75	2·25
8–9	86·94	13·06	3·94	3·08	·52	4·80	·72	6·89	·35	·55	41·75	58·25	30·16	2·25
9–10	86·64	13·36	4·21	3·22	·54	4·71	·68	6·86	·32	·56	41·65	58·35	30·09	2·20
10–11	86·80	13·20	4·11	3·04	·50	4·83	·72	6·93	·33	·55	41·75	58·25	30·09	2·15
11–12	86·92	13·08	3·91	3·07	·48	4·88	·74	6·85	·31	·53	41·60	58·40	30·49	2·20
12–13	87·02	12·98	3·87	3·04	·47	4·92	·68	6·88	·23	·52	40·30	59·70	30·19	2·45
13–14	87·28	12·72	3·58	3·13	·47	4·82	·72	6·86	·30	·54	40·65	59·35	29·58	2·45
14–15	86·62	13·38	4·16	3·04	·50	4·96	·72	6·91	·37	·54	40·65	59·35	29·78	2·40
15–16	86·88	13·12	4·01	3·09	·51	4·75	·76	6·96	·26	·54	41·35	58·65	29·41	2·30
16–17	86·64	13·36	4·21	2·99	·53	4·95	·63	6·91	·33	·54	40·60	59·40	31·22	2·30
17–18	86·80	13·20	4·03	3·02	·54	4·87	·74	6·94	·33	·56	40·55	59·45	30·66	2·30
18–19	86·82	13·18	4·02	3·11	·55	4·78	·72	6·93	·42	·53	41·45	58·55	30·24	2·40
19–20	86·96	13·04	3·88	3·00	·56	4·90	·70	6·92	·40	·55	41·80	58·20	30·39	2·30
20–21	86·72	13·28	4·08	3·00	·53	4·95	·72	6·91	·39	·56	41·50	58·50	30·64	2·45
21–22	86·56	13·44	4·27	3·12	·50	4·81	·74	6·94	·37	·56	40·95	59·05	30·38	2·35
22–23	86·55	13·44	4·18	3·19	·50	4·85	·72	6·89	·33	·55	42·05	57·95	28·98	2·20
23–24	86·72	13·28	4·08	3·12	·53	4·83	·72	6·93	·29	·55	41·45	58·55	29·43	2·35
24–25	86·62	13·38	4·13	3·15	·60	4·80	·70	6·97	·40	·56	41·85	58·15	31·27	2·30
25–26	86·74	13·26	4·01	3·10	·50	4·93	·72	6·89	·36	·57	42·10	57·90	29·87	2·20
26–27	87·00	13·00	3·80	3·09	·55	4·86	·70	6·97	·27	·57	43·95	56·05	28·35	2·00
27·28	86·98	13·02	3·98	3·18	·48	4·66	·72	6·84	·37	·55	42·65	57·35	28·64	2·15
28–29	86·96	13·04	3·98	3·11	·46	4·83	·66	6·78	·35	·55	42·15	57·85	30·82	2·10
29–30	86·84	13·16	4·14	3·10	·51	4·69	·72	6·87	·39	·55	42·20	57·80	31·03	2·10
30–31	86·70	13·30	4·29	3·12	·56	4·67	·66	6·81	·33	·54	42·35	57·65	30·76	2·15
Average	86·87	13·13	4·00	3·08	·51	4·84	·70	6·89	·34	·55	41·66	58·34	30·06	2·25

EXPLANATION OF THE TABLES.

There is little to add to the remarks made last year in explanation of these tables.

Cols. 3, 13, and 15.—It will be noticed that this year the volume of milk in gallons is given in preference to the weight of milk, this being more readily appreciated by the farmer than the weight in pounds, which, however, may easily be obtained by multiplying the number of gallons by 10·3.

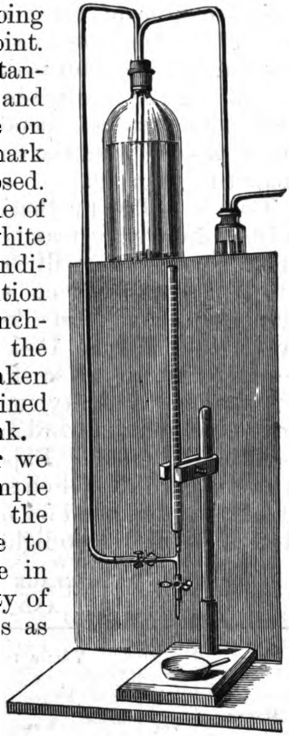
Cols. 5, 6, &c. *Temperatures.*—It is necessary to point out that, before the results can be taken as a guide by others, it is essential that the accuracy of the thermometer in use be made certain of. The majority of cheap thermometers are inaccurate, frequently two or three degrees out, and it makes very considerable difference, say in the temperature for renneting, if your thermometer registers 84°, while in fact the milk may be 87° F., or 81° F. Last year I supplied Miss Cannon with thermometers, every one of which was tested against my Kew Standard Thermometer and found to be within half a degree of absolute accuracy, and nearly every pupil attending the school was glad to obtain an accurate instrument. It might greatly promote the cheese-making industry if the Society could see its way to have thermometers tested for cheese-makers at a nominal charge.

Cols. 7, 11, 14, &c. *Acidity.*—These figures represent the percentage of lactic acid present. The method of conducting these determinations was given in the last Journal. It was then stated that an attempt would be made to find a means of determining acidity capable of being introduced into cheese dairies generally. The apparatus which was set up at the School for this purpose worked admirably during the seven months for which the observations were conducted.

As some of the pupils who learnt how to make the determinations desire to have the apparatus in future, I will give a full description thereof.

The standard solution of caustic soda was contained in a Winchester quart bottle placed on a shelf well above the rest of the apparatus. From this, by means of a glass syphon tube, the solution was brought down automatically to the burette. As this standard solution, if exposed to the air, deteriorates by absorbing carbonic acid, it must be kept in an air-tight bottle. But, unless the air could enter the bottle, none of the solution would syphon over. The air so drawn into the bottle of standard solution was, therefore, first made to pass through a small bottle of strong soda solution, coloured pink, with a few drops of the Indicator Phenol phthalein. This wash-bottle absorbs all the carbonic acid from the air before it passes into the standard solution, while the moment the solution in the wash-bottle loses its power of absorbing carbonic acid, it also loses its colour. It was found to work admirably, and the strength of the standard solution remained unaltered until used up.

The syphon tube containing the standard solution was attached to the bottom of a burette by a ⊣ joint, and the flow of the solution was stopped by a pinch-cock acting on a piece of indiarubber tubing which connected the syphon and ⊢ joint. Upon opening this pinch-cock the standard solution flows into the burette and carries up the float. When the line on this float corresponds with the first mark on the burette, the pinch-cock is closed. The burette is now full. The sample of milk having been placed in a white porcelain dish, and 3 or 4 drops of indicator added, the standard soda solution is dropped in by opening another pinch-cock attached to the burette below the ⊣ piece, and the quantity of soda taken to produce the pink tint is ascertained by observing how far the float has sunk.



I have often been asked whether we could not get a test for acidity as simple as the thermometer. Once set up, the above apparatus is nearly as simple to work. All that is necessary is care in accurately measuring out the quantity of milk, &c., to be tested, and then it is as easy to read the fall of the float as to read the rise or fall of the mercury in a thermometer.

The temperature of the milk when rennet was added was in nearly every instance exactly 84° Fahrenheit, so that this column has been left out as last year.

Col. 23.—It will again be observed that the proportion of rennet used is smaller in the autumn, when the milk is rich, than in the earlier part of the year when the milk is not of such good quality.

Cols. 31 and 32.—The time which it was necessary to keep the curd in scald was, during the months of April, May, and June, considerable, but decreased after the latter date. I was surprised at the difficulty experienced during those months in obtaining sufficient acidity in the whey before drawing off, and, as a deficiency at this period generally entails subsequent difficulty in obtaining cheese of sufficient ripeness, it is of considerable importance that the cause of this should, if possible, be discovered. Subsequently, in my report, I shall again have need to refer to this matter.

Cols. 41 to 45.—In the table of monthly averages, p. 9, the final acidity of the "whey during the treatment of curd" for each day has been averaged, and, on comparing these averages, we again observe the difficulty of obtaining sufficient acidity in the early months of the year. This table, moreover, shows how close, comparatively speaking, is the average degree of acidity obtained by a careful maker throughout the season, though, upon examining the results obtained from day to day, it will be seen that there are considerable fluctuations in the acidity of the whey passing from the curd when that curd is considered by the maker fit to grind.

Col. 46.—The fluctuations in the acidity of the curd when milled are very great, yet I am totally at a loss to explain their cause. It will be seen, upon a careful examination of the tables, that on several occasions, in order to confirm the results, two tests were made in the curd; for instance, April 16–17, June 18–19, 23–24, and subsequently; and the results obtained are so close as to preclude the supposition that the method is faulty, moreover many tests were made which gave absolutely concordant results, and are therefore not duplicated in the tables. Experiments have been made to discover why the curd should on some days show, for example, an acidity of 7·2 per cent., and on others only 3·6, but, up to the present, they have thrown no light on this somewhat difficult problem.

COMPARISON OF AVERAGE RESULTS OBTAINED AT VALLIS IN 1891 AND AXBRIDGE IN 1892.

MONTH.	VALLIS, 1891.					AXBRIDGE, 1892.				
	Vol. of Milk.	Cheese taken from Press.	Cheese when sold.	Shrinkage in ripening.	Cheese from one gallon of Milk.	Vol. of Milk.	Cheese taken from Press.	Cheese when sold.	Shrinkage in ripening.	Cheese from one gallon of Milk.
	galls.	lbs.	lbs.	lbs.	lbs.	galls.	lbs.	lbs.	lbs.	lbs.
April ..	81	73	69	4	·85	79	70	66	4	·835
May ..	119	117	111	6	·93	109	102	94	8	·86
June ..	132	132	123	9	·93	127	122	113	9	·90
July ..	112	114	107	7	·96	116	115	108	7	·93
August ..	91	99	91	8	1·00	100	102½	94	8½	·94
September	79	87½	82	5½	1·04	84	91	85	6	1·01
October ..	52	64	59½	4½	1·14	58	68	62	6	1·07

Cols. 54 and 60.—In order to show the amount of cheese made from the milk and taken to cheese room, and the amount of ripe cheese produced, the table above has been drawn up, giving, in addition, the weight of cheese in pounds made on an average each month out of one gallon of milk. To illustrate the inferiority of the milk I have inserted in this table the results obtained at Vallis in 1891.

When it is considered that, in a fairly good season, a cheese-maker may naturally expect one pound of cheese for every gallon of milk employed, we see, in a striking manner, how detrimental the past season was, and how small the yield of cheese from the milk employed; while it is well known that the yield of milk itself was in all cases far below the average.

THE RECORD OF ANALYSES OF MILK, &c.

Owing to my being given a special room, which it was possible to fit up as a laboratory, the record of analyses is far more complete this year than it was last. The analyses of the milk during the months of April and May are, however, deficient by not showing the amount of casein and albumin on many occasions. It was found impossible upon these days, in spite of every endeavour, to determine the proportion of casein and albumin by the method of analyses employed on other occasions. Hearing from Mr. Hewitt of the difficulty he had met with, I went to Axbridge, and made many attempts at this time to determine the casein, but without any satisfactory result. Then, from no cause which we could discover, the determinations would be made for a day or two with ease, while soon after, and for three or four days, the same method would utterly fail to separate the casein and albumin in the milk. All difficulty disappeared on the 14th May, and from that date to the end of the experiments the milk was as usual analysed. I cannot explain these facts, but must wait to see whether in the spring of this year a similar difficulty arises, and, if so, I shall devote further study to discover the cause thereof.

The sample of milk was taken for analysis after the evening's milk had been heated and mixed with the morning's, and before any stale whey was added.

The sample of whey was taken after the whole of the whey had been collected in the whey tank, and not, as last year, while the whey was being drawn from the tub.

The sample of curd was taken immediately after the curd was milled and before any salt had been added.

ANALYSES OF WHEY DURING TREATMENT OF CURD.

The following analyses of the whey, taken during the various stages of the manufacture of the cheese, are interesting as giving some idea of the chemical changes which are taking place, and of the stages in the manufacture when fat is most likely to be lost:—

—	August 5.				August 27.			
Percentage of:—	Solids.	Fat.	Sugar, Albumin, &c.	Ash.	Solids.	Fat.	Sugar, Albumin, &c.	Ash.
Whey before breaking ..	6·87	·25	6·09	·53	6·74	·20	6·00	·54
Whey after breaking ..	7 10	·44*	6·08	·58	6·98	·35	6·12	·51
Whey when drawn ..	6·95	·29	6·12	·54	6·93	·27	6·13	·53
Drainings from piled curd	6·66	·04	5·89	·73	6·65	·07	5·93	·65
Whey from curd taken to cooler	7·73	1·13	5·58	1·02	7·67	1·07	5·64	·96
Whey after first cutting	8·22	1·30	5·56	1·36	7·78	1·12	5·51	1·15
Whey after second cutting	8·60	1·32	5·64	1·64	7·81	·95	5·55	1·31
Whey after first turning	..	..	..	..	7·96	·94	5·55	1·47
Drainings from press ..	13·90	1·03	3·89	8·98	13·46	·78	3·78	8·90

* This result is probably too high, as the curd was allowed to settle before the sample was taken, and probably a portion of the fat had risen to the surface during this time.

The above figures confirm the results which were obtained in 1891. They show how, with the development of acidity, there is a constant abstraction of the mineral matter from the curd, and that the chief loss of fat is during the first and second cutting of the curd. Hence the necessity of care being taken in performing this operation.

There are times when a far larger amount of fat than usual comes from the cheese when in the press. This fat rises to the surface of the liquid from the press in the form of an oily layer, and it is impossible to so incorporate it with the liquid as to enable a fair sample to be taken for analysis; the whole of the liquid must be analysed to obtain accurate results.

Time did not permit of this being done in conjunction with the heavy analytical work entailed by these observations, and the consideration both of the amount of fat lost on these exceptional occasions, and of the causes of the loss, must stand over for future investigation.

I am inclined to think the above results throw some light upon one or two questions of scientific and popular interest.

First, we cannot possibly account for the uniform proportion of sugar and albumin in these liquids, and the irregular amounts of ash, without coming to the conclusion that these bodies do not exist in the curd in a similar state.

There is no reason to suppose that the sugar and albumin, which are in solution in the milk, have been rendered insoluble by the processes of cheese-making. And there is good reason to believe that at least a portion of the lime in the milk, if no other ash constituent, is in an insoluble form combined with the casein. If this is so the above results are easily explained. The acid, as it is formed, combines with this lime and withdraws it from the casein, forming calcium lactate. Hence the difference between freshly coagulated curd and cheese might be described by saying that the one was a compound of lime and casein, the other was free casein. But this change will not be limited to the time which elapses between the curdling of the milk and the vatting of the curd. It will also proceed during the ripening of the cheese; and may probably be the chief chemical change which takes place during ripening. This inference is supported by the observations of last year and this. And the calcium lactate so formed in the cheese would supply an admirable food for bacteria, one which would more easily explain the formation of the chemical compounds, upon which aroma and flavour depend, than does the more complex substance casein.

There is another interesting and possible deduction. It is certain that the acid in the human stomach would be even more capable of withdrawing this lime from curd than the lactic acid produced during the manufacture and ripening of the cheese. But anything that tends to neutralise the acidity of the stomach tends to produce indigestion. May there not be then a good chemical explanation of the popular belief that cheese, especially new cheese, is indigestible? I think this suggestion worthy consideration. Moreover, if it contain a truth, may it not account in some way for the diminished favour with which cheese is looked upon as a food by the working man, he being able to obtain only cheese which is almost new, and this opens up once more the economical question as to the advantages of the early ripening methods of cheese manufacture.

ANALYSES OF THE CHEESES.

The cheeses for April and May were sold and sent from the School without my taking samples, as I had forgotten to give instructions to the contrary. Some of the cheeses made during the other months have been analysed, and the following table gives the results of these analyses :—

COMPOSITION OF CHEESES.

—	Water.	Fat.	Casein, &c.	Mineral Matter.
June 3	35·25	32·76	28·39	3·60
„ 5	36·45	32·10	27·70	3·75
„ 14	36·95	32·49	26·91	3·65
„ 17	36·25	33·29	26·91	3·55
„ 18	37·00	31·86	27·44	3·70
„ 26	36·35	32·49	27·51	3·65
July 5	37·55	30·52	28·43	3·50
„ 8	38·30	30·80	27·35	3·55
„ 19	35·75	33·32	27·38	3·55
„ 26	36·95	33·21	26·34	3·50
„ 31	36·00	32·59	27·66	3·75
August 5	36·60	33·80	26·05	3·55
„ 15	34·75	31·82	29·38	4·05
„ 16	37·25	32·12	27·03	3·60
„ 19	34·70	34·10	27·55	3·65
„ 22	35·00	33·64	28·16	3·20
September 3	36·60	34·34	25·46	3·60
„ 4	36·05	35·10	25·00	3·85
„ 11	37·85	28·80	29·75	3·60
„ 12	36·85	30·69	28·71	3·75
„ 24	34·85	33·39	27·91	3·85
„ 30	36·50	32·86	26·69	3·95
October 3	35·70	31·72	28·85	3·75
„ 9	38·00	28·20	28·00	3·80
„ 12	38·55	30·08	27·52	3·85
„ 17	33·20	34·37	28·53	3·90
„ 24	36·95	31·68	27·52	3·85
„ 28	37·70	32·34	26·51	3·45
„ 29	36·95	29·25	30·15	3·65

III.—THE BACTERIOLOGICAL INVESTIGATION.

Although the general observations made for the Society have been confined to the seven months, April to October, the study of the bacteria in cheese, which was commenced in 1891, has been carried on continuously from the time of writing my last report to the present, and is still in progress. Under these circumstances it might be thought that a good deal of ground would have been covered and much valuable information obtained. I regret to say that this is not the result. Although much work has been done, it has thrown but little light upon the many and complex questions which have to be solved. This, however, is a very frequent outcome of scientific work, and time and patience are needed to make any progress. My duty, however, is to record what has been done, and, if possible, to indicate its practical value.

The Milk.—As during 1891, the chief organism present in the milk has been the Bacillus Acidi Lactici. I have, however, noticed, or thought that I noticed, some slight variations in the manner of growth of this organism at different periods of observation. So marked, indeed, has this variation been that it is doubtful whether these organisms are all the same, or whether there may not be several varieties of the bacillus. I have devoted some time to this question and have accumulated material for its further investigation, but at present am not able to say definitely what the results may be. It is important that this point should be made certain, for it may help to explain a fact which has been very forcibly impressed upon me during the observations, and which may be proved by studying the Tables, that at times the development of acidity in the process of cheese-making is far more rapid than at others, even though the initial acidity of the milk was the same and no cause apparent during subsequent treatment for the variation. It is only right to mention that other observers have described several bacteria having, according to their investigations, the power of forming lactic acid.

While last year I was surprised at "the freedom of the milk from other organisms," this year I was troubled beyond measure by the enormous number and variety of other organisms present. Eight of these, which are not known to me as common air impurities, have been isolated and studied; all those which are common having been discarded, as, for reasons stated in my last report, and confirmed by this year's work, there is reason to think they have no effect upon the cheese. But if the foreign bacteria were troublesome, far more so were the moulds invariably present in the milk. Whence they came completely baffled me. The apparatus was most scrupulously cleaned, and every care taken of it. For the most part these moulds were common varieties, with one exception—a white mould, which did not liquefy the nutrient gelatine upon which the organisms are grown for the purpose of isolating and studying them. The more common moulds I have not paid any special attention to for reasons which will appear hereafter. The white mould appeared to be the Oidium Lactis, about which I could find little that was known. Dr. Warming, Professor of Botany at the University of Copenhagen, in his Handbook of Botany, says "it is uncertain whether it causes the souring of milk or not." I determined to set this point at rest. At first, the fungus when grown in milk invariably curdled it, but, upon making a slide of the curdled milk, the B. Acidi Lactici was always present. At last a pure culture of the mould was obtained, and then it was found to have no curdling effect upon the milk. To prove that the uncurdled milk contained the mould, cultures were made from it, and a growth of the mould was invariably obtained. Although present in the milk so frequently it has not been found in a single cheese, nor can any effect be traced to its presence in the milk. As to its origin:—after many fruitless attempts to discover its source, it was at last found growing abundantly in the earthenware drain-pipe which carried the whey to a receptacle in the farmyard. Here it grew luxuriantly, doubtless contaminating the surrounding atmosphere and so entering the dairy and the milk. It only shows how careful the cheese-maker should be to seek, even at a distance, for causes of contamination which, at first sight, are not easily accounted for, and it proves the folly of allowing, as is often done, the pipe which carries away the whey to open into the dairy.

Taints.—One of the principal objects kept in view during the observations was to determine, if possible, whether the peculiar taints which occasionally arise in the curd during the manufacture of cheese were due to bacteria, and, if possible, to isolate the organisms producing these taints. In spite of every possible endeavour these organisms have so far entirely baffled me. Taints there were on many occasions, and samples of the milk or whey were then most carefully examined, but no organism which, when grown in milk, would cause a taint, could be isolated. Thinking that these taints might perhaps be discernible only as the acidity of the curd increased—for the taint itself is most marked in the latter stages of manufacture—I decided to inoculate the milk with a pure culture of a definite organism, and see the effect it would produce on a large scale. Two such experimental cheeses were made. The organism was first isolated in a pure state, a culture was then made on gelatine, and after three days—which would allow of considerable growth—the whole of this culture, containing millions of the organism, was transferred to a flask of sterile milk, and kept in the Incubator at a warm temperature for a day or two. The contents of this flask were then poured into the evening's milk as soon as it was in the tub, and well stirred in, the milk being subsequently stirred occasionally during the evening. On the following day the cheese was made as usual, and as if nothing had happened, Miss Cannon, however, taking special care to notice if any difference in the curd, or any taint, could be observed. The results of these experiments were most disappointing; I wanted to make bad cheeses, and I could not. In the first experiment the effect during the manufacture of the cheese was nil, and when ripe the cheese was excellent; in the second experiment the curd was "rather soft," and the ripe cheese slightly inferior. But there was no taint in either. Upon examining the cheeses when sold I found that the first contained only a few, whilst the second did not contain a single living specimen of the organisms with which the milk had been inoculated. They had been destroyed either in the process of manufacture, or during the ripening of the cheese. It is not necessary to enter into a minute description of the organisms experimented with. At the offset it was necessary to make sure that the organisms were not capable of producing any disease, *i.e.* were non-pathogenic. The difficulty of doing this, except with organisms well known, prevented my making more than two experiments. Moreover, although the Committee had generously given me a free hand to spoil, if necessary for my experiments, any cheeses, yet I naturally wished to damage the quality of the cheeses as little as possible, and, as the results of such experiments could not be known until the cheeses were fit for sale, I determined to err on the right side and not attempt too much. The organism with which the first experiment was made had been found by other workers in sewer gas, by myself in rennet, milk, and cheese; the second experimental cheese was inoculated with the Bacillus Subtilis. This organism is known as the hay bacillus, and my reasons for selecting it were, that it was frequently present in the milk; that at the time when the hay was being carted home taints were more frequent than at other times; and that taints appeared to be more frequent when the wind was in a certain direction, which was also the direction of the hayrick. Although these experiments have given only negative results, yet the attention of all cheese-makers may be drawn to the apparent fact, that taints appear more frequent when the wind is in one quarter than when in another. This being due probably to the wind then passing over some source of contamination. If cheese-makers would systematically observe whether this happens with them, it might materially help in the discovery of the causes of taints.

The Cheeses.—It has only been possible to examine comparatively few of the cheeses when fit for sale. The method has been as follows:—

(*a*) A portion of the cheese is taken, and a slide made for microscopic examination in the manner described in the report of last year.

(*b*) A portion of the cheese is transferred to a sterile salt solution in a test tube, broken down into a fine paste with a little of the salt solution, and then shaken with the remainder to insure equal distribution. From this solution three minute portions are taken, with which—

1. A test tube of sterile nutrient gelatine is inoculated, and with this a plate culture is made.

2. A test tube, containing sterile milk, is inoculated with a minute portion of the liquid.

3. A second test tube, containing sterile milk, is inoculated as the first, and upon the top of the milk about one inch of melted and sterilised vaseline is carefully poured.

In No. 1, colonies are obtained of all the aerobic organisms (*i.e.* those which require air or oxygen) still living in the cheese. No. 2 shows whether the cheese contains the B. Acidi Lactici or any other organism capable of curdling the milk. And in No. 3 all those organisms in the cheese which are not capable of growing in the air, and are therefore known as anaerobic, grow, and can be studied.

As to the results obtained; a careful examination of the slides prepared direct from the cheeses (*a*) showed that the chief organisms present, or those in greatest abundance, were, a large round organism (a micrococcus), a stumpy bacillus, larger than the B. Acidi Lactici, though in other respects very similar, and here and there a few long thin rod Bacilli. There were also some few other forms present, but only occasionally, and apparently in uncertain numbers.

Next as to the various cultures; the plates (*b*, 1) are distinguished from those prepared from the milk by this striking fact, that no organism is invariably found. Some will contain one variety of organism only, others two or three, and some several. Two varieties stand out prominently as far more frequent than any others. The one is a large stumpy bacillus, which has been found so frequently that I have named it "the cheese organism," the other is the large micrococcus seen in the cheese slides, and which for the present may be styled "the cheese micrococcus." Both of these will be preserved until the cheese-making season returns, when I hope to be able to make some experimental cheeses from milk inoculated with them. In some of the plate cultures other organisms are found, but they are quite exceptional, and must be considered for the present as accidental and not essential.*

But the most remarkable point about these plate cultures is that I have not been able to find in one the B. Acidi Lactici, which last year was the organism most noticeable in the cheeses. There is also another result quite unexpected.

* The long thin rod bacilli form no growth on the plates, showing that they are anaerobic organisms.

In spite of the trouble caused by the presence of moulds in the milk, from which the cheeses were made, yet in the cheeses themselves it was very rare to find the least sign of mould; and, in the few instances where mould has shown itself, I attribute it to accidental impurity, due to the great difficulty of obtaining cheese cultures without more than ordinary exposure to the air. Hence the well-known tendency of cheese to "go mouldy" must be attributed solely to its forming an admirable feeding ground for the moulds which fall upon it from the atmosphere.

A second result is this:—the older the cheese the fewer the aerobic organisms found. Anxious to discover the causes of taints, I was not content to confine my attention to the cheeses made at the School, but thought, by studying tainted cheeses, to come upon some of the causes thereof. The late Rev. J. Constable, who took great interest in these observations from the first, sent me a sample of cheese which far surpassed in abomination any I have ever tasted. In this cheese not a single aerobic organism could be found. This points to one of two conclusions, which are important. If a taint is caused by an aerobic organism it evidently remains long after its cause has been destroyed, and is therefore due to the formation of a definite chemical compound. Here then is a new field for chemical research. But it may be that these taints are due to the action of anaerobic bacteria, and this would account for my failing to discover them. Are there any well-known facts to support this supposition?

The cheese-maker finds that if there is a taint it is well to open up the curd as frequently as possible, thus allowing the air to get to it and forward the growth of acidity; and it is generally recognised that the sooner a tainted cheese is sold the better, for the taint augments with keeping. Both of these facts support the view that taints are due to organisms which do not need air for their growth and development.

The milk tubes inoculated from the cheeses (*b*, 2), to my great surprise, did not curdle. They were carefully watched, and after several weeks showed signs of becoming thick, and finally some curdled completely, others partly. But the time which had elapsed proved that this action could not be due to the B. Acidi Lactici. Slides were now prepared and carefully examined microscopically, and "the cheese organism" and "cheese micrococcus" were found in abundance; but far more striking was the presence of the long thin rod bacilli. This showed that the cheese organisms, having consumed the oxygen available in the milk, had enabled the anaerobic organism to flourish. Curiously enough the acidity of these milks was found to be 0·98 per cent., of which only 0·04 per cent. was volatile. Hence these rod bacilli do not appear to be the Butyric Acid organism. Explanations for these observations will probably be found in time, but my work is not yet far enough advanced to permit of my even stating those which occur to me.

Lastly, there is one fact to record with regard to the results of the study of the anaerobic organisms in the tubes covered with vaseline (*b*, 3). The milk in these tubes invariably curdles. But in some a large volume of gas is evolved, and the plug of solid vaseline is forced up into the tube sometimes to the very top thereof, or until an irregularity in the sides of the tube allows the gas to pass by. This formation of gas does not take place in every tube. Last year it arose only in one or two; this year it was more frequent. Now the cheeses this year were more liable to "puff" than last; hence I attribute the cause of this puffing to an anaerobic organism which has yet to be isolated. If the study of bacteria is difficult when only aerobic organisms are concerned, it is infinitely more difficult when the anaerobic bacteria need to be examined, and it will probably require years of work to make much headway.

The cheese-maker may not unnaturally ask, what is the practical good of all this study? At present little, I grant. But one thing it does show, that the troubles to which cheese-makers are liable may be chiefly due to causes which do not come in at the open window or door of the dairy, but hide in out-of-the-way crannies where no breath of air even may enter, but where a little decomposing milk, or other animal or vegetable matter, may supply all the food which these organisms need to enable them to live and grow and multiply.

IV.—THE EXPERIMENTAL CHEESES.

The Committee having given me permission to carry out any experiments desirable, a certain number of cheeses were made with the twofold object of throwing light upon the problems, and of answering the questions which arose during the course of the observations. The following is a detailed account of these experiments.

1*st Experimental Cheese.* 30–31st May.—In the month of May there appeared much difficulty in getting the curd sufficiently ripe for vatting before a late hour in the evening. The object of this experiment was to determine whether it were possible to carry out the principles laid down in the report for 1891. It is therein shown how "the development of sufficient acidity in the whey during second scald, before allowing the curd to settle prior to drawing the whey off, appears to exercise considerable effect upon the time when the curd will be fit to grind," and also "that if the acidity of the whey when drawn is less than that of the mixed milk before renneting, the subsequent development of acidity in the curd will be very slow, so that the curd will not be vatted until late in the evening." Now, upon referring to the table of observations for May 1892, it will be seen that the average acidity of the whey was lower than the average acidity of the milk before renneting, and this, coupled with the late hour of vatting, confirms the statement in my report for 1891. During this month, however, several cheeses were put away comparatively early.

The following table gives the acidity of the milk and whey on those dates, and, by the side, the figures for those days on which the cheese was put away later than usual. By comparing these tables it will be seen that the principle laid down holds good, though, in individual cases, as pointed out in my former report, exceptions may be found.

INFLUENCE OF ACIDITY OF WHEY ON TIME OF VATTING.

Date.	Acidity in Milk.	Acidity in Whey.	Time of Vatting.	Date.	Acidity in Milk.	Acidity in Whey.	Time of Vatting.
			P.M.				P.M.
May 6 ..	·21	·25	4.10	May 17 ..	·23	·17	10.0
„ 18 ..	·22	·20	4.40	„ 10 ..	·22	·19	9.57
„ 21 ..	·22	·21	5.0	„ 13 ..	·23	·18	9·50
„ 19 ..	·21	·20	5.15	„ 5 ..	·21	·18	9.50
„ 15 ..	·22	·19	5.25	„ 24 ..	·24	·19	9.45
„ 12 ..	·22	·22	5.30	„ 22 ..	·24	·20	9.35
Average ..	·21	·21	5.0	Average ..	·23	·19	9·50

The acidity of the mixed milk on the 31st May was ·23; after cutting, ·15; before breaking, ·16; after first scald, ·17; at commencement of second scald, ·175. The scald commenced at 9.40, and the second scald was in at 10.20, and now a most tedious operation was gone through in order to fulfil the conditions of the experiment, and obtain in the whey, before the curd was allowed to settle, an acidity higher than that of the mixed milk. The acidity of the whey rose most slowly, taking about twenty minutes for a rise of ·01 per cent., so that it was not until 12 o'clock that the whey showed the desired acidity of ·24 per cent.; then the curd was allowed to settle, the time in scald having occupied 2 hours and 35 minutes. Nevertheless, from that moment the acidity progressed rapidly, and the result was that, in spite of this long and tedious process in the morning, the curd was fit to grind at 5.35 P.M. Only six cheeses during the month had been vatted at an earlier hour.

2nd Experimental Cheese. 16–17th June.—This was made to determine the effect of a higher scald. The milk was treated exactly the same as usual up to the time of the first scald. For the second scald it was raised to a temperature of 95°. The acidity of the mixed milk was ·23 per cent. The acidity of the whey after first scald was ·17, and at the commencement of the second scald ·175. It rose very slowly, and had not reached the desired amount of ·24 per cent. until 12.6, having been in scald 2 hours 35 minutes. When the whey was first drawn it showed an acidity of ·25 per cent., but when the whole had been drawn it showed an acidity of ·27, proving that the formation of acid had been going on within the curd, and had not shown itself in the whey. This is confirmed by the acidity of the drainings from the piled curd and the rapid development of acidity afterwards. The curd was vatted at 4.49 P.M., was very dry (as shown by the small loss in press as well as by analysis), and lost considerably in the cheese room.

Judging the curd by the sense of touch, Miss Cannon considered it should have been allowed to settle in the whey at 11.10 A.M., or nearly one hour before the acidity of the whey had reached the standard which was desired. Hence it is probable that heat produces a contraction of the curd similar to that produced by acid. But this is not certainly proved by this experiment, as it is doubtful how much acidity had been produced within the curd.

3rd Experimental Cheese. 25–26th June.—The result of the preceding experiment having pointed to a higher scald promoting the manufacture of the cheese, perhaps this might be adopted in the earlier months of the year with advantage. But the quantity of fat in the whey on the 17th was very great, and undoubtedly due to the long stirring in scald. It was therefore determined to make another experiment with a high scald, but to allow the curd to settle in the whey instead of keeping on with the stirring.

Moreover, as it had been shown that the acidity developed in the curd was not recognisable in the whey, it was not deemed advisable to wait until the whey showed a higher percentage than the mixed milk, but one a little under.

The acidity of the mixed milk was ·22 per cent.; of the whey at the commencement of the second scald, ·17 per cent.: this was at 10.45 A.M. At 11.5 stirring was stopped, and the acidity was then ·19 per cent. It rose very slowly, and at 12.15 reached ·21 per cent. only. The whey was then drawn, and it will be seen that the acidity of the mixed whey was as high as ·23 per cent. But even this does not give any idea of the acidity which was in the curd, and it is only when the drainings from the piled curd were tested, giving ·45 per cent., that we saw how great that acidity was. Miss Cannon considered the curd tasted and smelt far more acid than it ought to. But the subsequent acidity determinations in the whey from curd did not indicate this high acidity. That Miss Cannon was right, however, there can be no doubt, for the cheese when sold was considered far too acid by Mr. Hill.

4th Experimental Cheese. 7–8th July.—This was an attempt to discover to what extent a cheese is affected by not developing so much acidity as usual; and, on the other hand, by developing more acidity than usual. The cheese was made by Miss Cannon in the usual course, but half the curd was vatted after the first cutting, when the acidity of the drainings had reached ·71, and the second half when the acidity of the drainings reached ·97. This experiment was not a success. The highest acidity of the drainings is not so high as the average of the month (1·00 per cent.), and the lowest is not so low as the drainings from some of the cheeses made in April. The Committee having given me permission to take these cheeses to illustrate a lecture at Wells, they were there tasted by many people, and considerable difference of opinion was expressed as to their merits: some considered the one with least acidity the better; others, the one with most acidity. There was, in fact, but little difference between them, showing that some latitude is possible as regards the acidity of the drainings from curd before it is put in the press. But there is another aspect of this fact, and one of considerable importance. Both these cheeses were tasted by Mr. Hill some weeks before the lecture, when the cheese with the least acidity was considered "inferior," and the one with the highest acidity "better, but not prime." Further keeping at a proper temperature appeared to have improved them both. Perhaps it was most marked in the one with least acidity. Can we account for this by the assumption that, in keeping, the acid required had been gradually developed and had given those qualities to the cheese which it lacked at an earlier stage?

5th Experimental Cheese. 18–19th July.—The curd was scalded to 100° F. in two scalds. When the scald was on, the whey showed ·18 per cent. of acidity. The curd was stirred in scald for five minutes, and then allowed to rest for thirty minutes. The acidity of the whey standing on curd was ·20. The acidity of the whey when drawn was ·22. But the drainings from the piled curd showed, as before, a high acidity. The curd was broken up and spread on rack in cooler, covered with a cloth, and no weight put on. The drainings came away pretty freely, and the curd held together well. There was rather a small weight of cheese, but it was considered a good cheese by Mr. Hill. It is now evident that with a high scald it would be necessary to completely alter the system of manufacture, and that the conclusions laid down in my report of 1891 do not hold good, except for a cheese which is made in the manner adopted by Miss Cannon. On referring to the analysis of the whey, it will be seen that there was no rise in the amount of fat due to the high scald, evidently because stirring in the whey had not been adopted. It is probable that, with milk of the quality yielded by the animals this year, it was more difficult to make a good cheese when employing a high scald than with a lower one. Or it may be that there are other conditions necessary to be observed—such as the use of less rennet—when a cheese is made by this system. These points can only be answered by systematic observation and experiment in the future.

6th Experimental Cheese. 30–31st July.—The rise in acidity had been so rapid, and had gone so far, in the preceding cheeses when a high scald was used, that to prevent it no sour whey was employed for this cheese. The scald was raised to 100° F. as rapidly as possible, being first raised to 89° F., and then to 100° F. Stirring lasted for five minutes only, and the curd was then allowed to settle and remain in scald for twenty-five minutes. The whey, when stirring was finished, showed acidity ·17 per cent., and when drawn it was still ·17. So far the object of making a cheese with high scald and low acidity had been attained. The curd was piled for thirty-seven minutes before the whey commenced to drop, was then cut into 6-inch cubes, taken to cooler, and laid out thereon. The acidity of the first drainings was very slight. The curd was turned, allowed to remain one hour and again turned, when the acidity of drainings was ·42. It was late in the evening before the acidity of the drainings was sufficient to justify vatting the curd, and a very poor cheese it made—"tough and no flavour" was the judgment of Mr. Hill. So that keeping down the acidity proved worse than obtaining too much. This indicates how necessary the development of acidity is for the production of a good cheese, and that contracting the curd by heat is not alone sufficient. Here we get the first indication of the cause of the comparatively inferior quality of spring cheese. It will subsequently be shown how difficult it is to obtain sufficient acidity in the whey and curd during the months of April and May. The chemical action which this development of acidity insures has already been dwelt upon, also its influence from the bacteriological point of view.

7th Experimental Cheese. 14th August.—Now that the same time of year had come round as that at which observations were made at Vallis in 1891, it was thought advisable to once more make a cheese guided solely by the determinations of acidity. This was done, and the results confirmed the conclusions of 1891.

But there was one important difference. Although the conditions were so similar to those in 1891, and the curd was vatted when the drainings showed even less acidity than in that year, yet the opinion of Mr. Hill on this cheese was—" of very good flavour, *but a little too acid*."

While this cheese was being made, I had a suspicion that it was not all that might be desired, for in my note-book are the following remarks made at the time: " It is possible that with lower quality of milk it is not so desirable to obtain so much acidity as with richer milk."

8th Experimental Cheese. 14–15th August.—Now, as the contraction of the curd can be brought about by heat, it may be possible so to obtain the necessary dryness of the curd without developing so much acidity; and, if the quality of the milk affects the result, perhaps an equally good cheese may be made. The curd was scalded as quickly as possible to 101° F., stirred for five minutes, allowed to settle for twenty minutes, and the whey drawn. When taken from the tub, the curd was cut into blocks, spread out on the rack in cooler, covered with a cloth, and, while the drainings were still low in acidity, the curd was ground, salted, and spread out to cool. It took 2½ hours to cool, during which time the acidity rose rapidly, so that the liquid from press was more acid than usual. This, however, turned out to be an " excellent cheese."

9th Experimental Cheese.—This was one of the inoculated cheeses referred to in the bacteriological observations.

10th Experimental Cheese. 17–18th August.—The object was to determine whether, when no sour whey was used, and the temperature of scald was the same as usually adopted by Miss Cannon, the sense of touch would give to her the same indication of acidity as when she used sour whey. Miss Cannon considered the curd firm enough to allow stirring to be stopped at 11.45 A.M., the acidity of the whey being then only ·18 per cent. It is thus evident that when no sour whey is used, and there is consequently a deficiency of acidity in the milk before renneting, the toughness of the curd in scald is brought about by heat before the requisite amount of acidity has been developed. This explains much of the difficulty which the cheese-maker finds in the spring of the year. How it is to be overcome is certainly a problem which deserves further study.

11th Experimental Cheese. 18–19th August.—The same conditions exactly as on August 18th were observed, except that sour whey was used. Now the sense of touch and the acidity determinations agree.

12th *Experimental Cheese.*—This was the second inoculated cheese referred to in the bacteriological portion of this report.

V.—THE RESULTS OF OBSERVATIONS.

A. *The Conditions essential to the Manufacture of a Cheddar Cheese of High Quality.*—The results of the observations in 1891 led me to the conclusion that "the fitness of the curd to settle in scald was coincident with the whey obtaining an acidity slightly greater than the acidity of the milk before renneting." The question now naturally arises, how far have the observations of 1892 confirmed those of 1891 in regard to this point? Speaking generally, they have completely confirmed them; but this statement holds good, more especially in the months of June, July, August, and September, rather than in the earlier and later months. In fact, the conditions which exist in the early months appear to be totally different to those which exist during the months June to September, and to give rise to difficulties which require special means to overcome. Nevertheless, confining my remarks solely to the method of manufacture adopted by Miss Cannon, I think there can be little doubt that the condition of the curd in whey, which the practical cheese-maker judges by the touch, is really a condition brought about by a development of acidity. It is here, however, important to point out—what the experimental cheeses prove—that a similar condition may be produced without the development of acidity. What the development of acidity does is to contract the curd, and thereby expel the whey. This same contraction of the curd may be produced by heat, and the whey expelled without there being a simultaneous rise in the development of acidity. Instances of this have already been quoted, but the following figures are striking. The moisture in the curd when taken from the tub was determined on many days, and the following figures relating to two of the August cheeses are interesting. The acidity of the curd at this stage must be estimated by the acidity of the drainings from piled curd:—

—	Temp. of Scald.	Time in Scald.	Acidity of Drainings.	Moisture in Curd.
		h. m.		
August 14	90°	1 50	·38	47·45
„ 15	101°	0 40	·38	41·45

It is well known to Cheddar cheese-makers that there are two systems of manufacture which stand out from all others, inasmuch as those who adopt them have obtained special eminence at the Dairy Shows of the country. The one is that adopted by Miss Cannon, the other that adopted by Mr. Candy. They differ in this respect; that whereas in Miss Cannon's method the extraction of the whey from the curd is obtained by the development of acidity, in Mr. Candy's method the extraction of the whey from the curd is obtained by the high temperature of the scald. It is desirable that the changes and conditions which arise in the manufacture of Cheddar cheese on Mr. Candy's system should be studied, as they might probably throw considerable light upon the many chemical problems which are concerned in the manufacture of Cheddar cheese. Judging from the data given above, the development of acidity in Mr. Candy's system is not so rapid as the contraction of the curd, so that when the maker would consider the curd sufficiently tough to be allowed to settle in whey, prior to drawing the latter off, there would be but a small amount of acidity present. Nevertheless the subsequent development of this acidity in the curd when on the cooler would be more rapid, owing to its having a much higher temperature than with the Cannon method.

Thus the conclusion arrived at in the Report of 1891 holds good, solely when the other conditions are such as described in that report. And those makers who adopt any other system cannot take the same standard of acidity as will hold good for those who adopt the Cannon system of manufacture.

A Standard of Acidity for the Whey.

In my last report I stated that the acidity of the whey, before the curd was allowed to settle prior to drawing off the whey, should be ·01 per cent. higher than the acidity of the mixed milk. Now it will be seen that the acidity of the mixed milk varies greatly during the season. Thus, in April, it averaged ·17 per cent.; in May, June, and July, ·22; in August and September, 23; and in October, ·225.

The question therefore arises, should the acidity of the whey in the spring be ·01 above ·17, *i.e.* ·18, and in the autumn ·01 above ·22, *i.e.* ·23? Again, on some days in the same month, we find that the milk before renneting has an acidity of ·20, and on others of ·24. Ought the acidity of the whey on the one day to be ·21, and on the other ·25, or is it possible to lay down a standard for the acidity which the whey ought to attain before it is allowed to settle? This problem may be approached in many ways. First, let us determine for each month the average acidity of the whey of the cheeses vatted at different hours. This is shown in the following table:—

TABLE SHOWING TIME OF VATTING AND AVERAGE ACIDITY OF WHEY WHEN DRAWN.

—	Cheeses Vatted.									
	At or before 3 P.M.		4 P.M.		5 P.M.		6 P.M.		7 P.M.	
	No.	Average Acidity of Whey.	No.	Average Acidity of Whey.	No.	Average Acidity of Whey.	No.	Average Acidity of Whey.	No.	Average Acidity of Whey.
April ..	none	..	3	·17	none	..	4	·185	5	·18
May ..	none	..	none	..	2	·225	7	·21	1	·20
June ..	none	..	3	·23	5	·24	13	·22	4	·22
July ..	none	..	16	·22	8	·21	7 after 5	·18	..	..
August ..	5	·24	13	·22	7	·21	6 „ 5	·18	..	..
September	13	·20	8	·195	8	·19	1	·17	..	..
October ..	none	..	6	·21	6	·20	6	·18	12 after 6	·18

We see at a glance how the time of vatting depends upon the acidity of the whey when drawn, and also obtain a fair idea of the amount of acidity in whey which is best calculated to produce an early cheese in each month. We have an explanation of the late time of vatting in April and May, and, to a certain extent, of the early vatting in the months of August and September. From a careful perusal of this table, one is forced to the belief that, whatever the acidity of the milk may be, it is not necessary to develop more acidity in the whey when drawn than ·22 per cent. So that I would now slightly modify the conclusion come to in 1891, and say that it is advisable, when possible, to obtain in the whey an acidity of ·22, and not necessarily of ·01 per cent. more than was present in the mixed milk before renneting.

Let us now look through the tables and see if, with a higher and lower percentage of acidity in the mixed milk before renneting, the development of this amount of acidity in the whey has resulted in the production of an early or late cheese.

In April this amount of acidity was only obtained once, viz., on the 30th, the acidity of the milk before renneting being ·20, and the cheese was one of the earliest vatted during the month. In May it was obtained on the 11th, 12th, 14th, and 27th, the acidity of the milk being on these days ·22, ·22, ·23, and ·23 per cent., and the cheeses were vatted at 8.20, 5.30, 5.40, and 8.45 P.M., which, as may be seen by the preceding table, was fairly good.

In June this amount of acidity in the whey was obtained on several occasions, and, in most cases, the cheeses were fairly early. On the 12th we have the first example of the milk showing an acidity of ·24 or ·02 per cent. above that of the whey, yet the cheese, though later than usual, was not very late. In fact, it was vatted at exactly the same time as the cheese of the 25th, which had the same acidity in the whey, and only ·21 in the milk before renneting. It is during these three months that the cheese-maker has the greatest trouble in getting the curd vatted in reasonable time, and this amount of acidity in the whey, no matter what may be the acidity of the milk before renneting, seems to ensure an early cheese. A careful examination of the tables shows that in other months, even in October, which is also a difficult month, ·22 of acidity in the whey ensures the curd being vatted early.

To obtain this amount of acidity in the whey it will not be necessary to continue stirring in scald until the whey shows more than ·20 per cent. of acid, for I find, on referring to my notes, that, as a rule, the acidity of the whey when drawn is ·02 per cent. above what it was when the curd was allowed to settle.

Experiments have shown that to obtain this amount of acidity in the whey will at times be very difficult, especially when the acidity of the milk before renneting is very low, as in the months of April and May, and sometimes even in June. One cause of this want of acidity in the mixed milk will be the exclusion of sour whey, owing to there having been a taint in the previous day's cheese. In such a case, the first thing to do is to keep the evening's milk at a higher temperature than usual, so as to develop the utmost acidity possible. And it appears to me that in the early months of the season it is most necessary to keep the dairy as warm as possible; in fact to obtain artificially the conditions which are natural in August, during which month the average temperature of the dairy during the night was, min. 64°, max. 66°. Even then it may not be possible to obtain the milk sufficiently acid, and in that case probably the best plan will be to raise the temperature of the scald; there are, however, difficulties in the way of doing this which have been pointed out already, and which require further study.

If, however, the sour whey is capable of being used, why should not sufficient be used to give the necessary acidity? In the first place, we must determine what is the amount of acidity desirable in the mixed milk before renneting? For reasons already fully given, I should say ·01 per cent. below that desired in the whey, or ·21 per cent.

It is said by the practical cheese-maker that it is not possible to use more than a limited quantity of sour whey without damaging the quality of the cheese. Otherwise the necessary acidity might be obtained in the mixed milk by means of such sour whey. I can well understand that it is not possible to use sour whey in sufficient quantity to make a sensible difference in the acidity of the milk. For supposing the milk had an acidity of ·18 per cent., and the sour whey an acidity of ·36 per cent., it would require 15 gallons of such whey to raise the acidity of 80 gallons of milk to ·21 per cent. Such a quantity certainly could not be used. But I would point out that in the early months, and again in October, the sour whey does not attain that degree of acidity which it does in the months of July and August. (See Table of Averages.) And this points to a want of heat in the dairy, and the necessity of supplying it artificially, if only to the sour whey.

One other method would be to inoculate the milk with the bacillus of lactic acid. It may be found that this can be done by adding a little sour whey to the evening's milk, and the subject deserves investigation.

Acidity of Curd before Grinding.

The second conclusion of importance to which the observations of 1891 led was that "the acidity of the whey which drains from the curd when in the cooler is a sufficiently accurate guide to the condition of the curd before grinding." The observations of 1892 confirm this conclusion, though there are one or two points which still remain to be explained.

Now arises the most important question, What should this acidity be?

In the first place, let me compare the cheeses made in August, September, and October of 1892 with those made in the corresponding months of 1891. It will be best to at once give Mr. Hill's opinion of these cheeses. Of the August cheeses, he says, August 2nd, "richer curd, really nutty flavour, and excellent." And he selected the cheeses of the 15th, 24th, and 31st as all being very good. Now, from the Record of Observations, we find the following acidity in the drainings from the curd before it was ground, on these days. On August 2nd, ·90; on the 15th, ·65; on the 24th, ·87; and on the 31st, ·89 per cent.; the average acidity being, ·83 per cent. But the cheeses made on the 9th and 14th of August, and having an acidity in the drainings from curd before grinding of ·94 per cent., were considered too acid. In September, the best cheeses were those of the 3rd, 11th, 21st, and 23rd, the acidity of the drainings from curd being ·92, ·91, ·92, and ·93 per cent., or an average of ·92 per cent.

Now, upon referring to my notes of 1891, I find that the best cheeses in August had an acidity of ·94 in the drainings from curd; that one with an acidity of ·84 was not so good; and that even a cheese, the drainings from which had shown so high an acidity as 1·07 before vatting, was better than one which only showed an acidity of ·84 per cent.

Evidently then what held good in 1891 did not hold good in 1892. Take again the September cheeses. In 1891, those which had a high acidity in the liquid from curd before grinding, were better than those which had a low acidity; the best ranging from ·95 up to 1·10 per cent. There must evidently be some distinct cause for this difference between the cheeses of 1891 and 1892. My opinion is that this difference is due to the quality of the milk, and that the high acidity is only permissible when the milk is rich in fat. From the preceding facts it will be seen that the acidity, which in 1891 was capable of giving a good cheese in August, did not give a good cheese in 1892 until September. Let us compare the milk of August, 1891, with that of August and September, 1892. The results are as follows:—

—	Solids.	Fat.	Casein.	Ash.
Average composition of Milk, Aug. 1891	12·61	3·87	2·76	·77
,, ,, ,, Sept. 1892	12·56	3·57	2·87	·66
,, ,, ,, Aug. 1892	12·28	3·38	2·65	·68

It will be seen that the milk of September, 1892, compares with that of August, 1891, far better than does that of August, 1892. If then the amount of acidity which may be produced with advantage in the curd, as indicated by the acidity of the drainings before vatting, depends upon the amount of solids and fat in the milk, *i.e.* upon the quality of the milk, we should expect the amount of acidity permissible in the earlier months of the year to be even less than in August. Upon referring to my notes of Mr. Hill's opinion on the cheeses, I find as follows:—"Mr. Hill considers the cheeses generally to be a little too acid, but of good flavour." In June "the cheese of the 3rd (acidity of drainings 1·01) was too acid," that of the 5th (·91) "better than 3rd," and that of 7th (·82) "good."

It would not be fair to overlook the fact that there were exceptions to this rule, and that some of the cheeses of higher acidity were of good quality. Moreover, I noticed that a high development of acidity was more generally associated with the "nutty" flavour than was a low acidity. So it would seem somewhat difficult to say when the acidity was too great, and likely to produce an acid cheese.

Of the July cheeses, those of the 5th and 26th * were very good. And yet the acidity was greater than in the best cheeses of August, being ·94 and 1·00 per cent. respectively.

While all the evidence seems to point to the fact that the degree of acidity which may be obtained with advantage, depends upon the composition of the milk, it is more difficult to say why this is so. In the examples already given, it is seen that the fat is the factor in which there is most variation. But we should naturally expect that the amount of acidity would depend rather upon the amount of mineral matter in the milk than upon the amount of fat. Upon comparing the analyses of the milk at Vallis in 1891 with that of Axbridge in 1892, it is striking how much more mineral matter the former has. The results are as follows:—

—	August.	September.	October.
1891 Vallis	·77	·78	·77
1892 Axbridge	·68	·66	·70

And again, if we refer to the analyses of the milk for June and July of 1892, we see that the mineral matter is then higher than in the later months, being ·73 in June and ·72 per cent. in July. This might account for the fact already mentioned, that in the months of June and July a higher acidity seemed permissible than in the later months. Whether it be due to the proportion of fat, or to the proportion of mineral matter in the milk, future investigation can alone prove; but one thing seems certain, that the quality of the milk affects most seriously the amount of acidity which may with advantage be obtained in the curd before grinding.

But the quality of the milk will itself depend largely on the nature of the soil and pasture, and so we begin to see into the probable cause of the difficulty, which has always been found on strong land, in making a good cheese. For strong land has a tendency to produce larger quantities of milk, but milk of poorer quality both as regards fat and mineral matter, than

* The milk on this day was exceptionally rich in fat.

lighter and more lime-containing soils. What, then, is the remedy? The observations and experiments of 1892 seem to point to its being found in keeping down the acidity in the curd before vatting, in keeping the cheeses in the ripening-room for a longer period than would be necessary with cheese from better land, and in taking care to maintain the temperature of the cheese-room at a uniform and higher temperature than would be necessary with the richer cheese.

While I state fully the facts that have been obtained, yet I do not feel in a position to draw conclusive and practical deductions therefrom.

The Time required to Make a Cheese.

This being, to the majority of cheese-makers, one of the most important considerations, it is well to refer to it again. There is little to add to what was said in the Report of last year beyond what has been already stated in the body of this Report, and those who may not have read it I would refer to the tables given on pp. 65, 72. If there is one point which these observations have conclusively proved, it is this: that the time required to make a cheese depends upon the amount of acid formed in the whey when it is drawn.

Loss of Fat in Cheese-making.

One of the questions to which an answer was sought, was: To what extent is the fat originally present in the milk lost during the manufacture of a cheese, and what proportion of that loss falls upon each operation?

The following table, though it does not entirely answer the question, gives some interesting facts:—

Fat present in—	Weight of Fat in pounds.	
	August 5.	August 27.
Milk	39·66	33·11
Curd	37·07	30·60
Whey	2·79	2·14
Drainings from cooler ..	·12	·15
Total found	39·98	32·89
Error of Analysis	·32	·22
Fat in liquid from press ..	·11	·06

The errors in the examples I have here given, taken from several sets of analyses made to determine this question, are slight. In other cases I find greater divergence, due to the fact that lactic acid is estimated with and reckoned as fat, and, unless special precautions are taken to correct this, there appears to be more fat in the curd, &c., than was actually present in the milk. To this fact may probably be due the notion which was, and is, in some cases, even now held, that in the ripening of cheese fat is formed.

SUMMARY OF CONCLUSIONS.

For the benefit of those who may not have the time to go through this somewhat long and necessarily somewhat technical report, I will attempt to briefly state the conclusions which the observations of 1891 and 1892 appear to justify.

1. The quality of milk varies on the same farm each year, owing to the season, and on the same fields each month, owing to the food. It varies on two farms during the same year, and on each has a characteristic composition due to the nature of the soil.

2. The quality of a cheese, assuming that the manufacture was conducted by a skilled maker, depends largely on the quality of the milk from which the cheese was made.

3. The manufacture of a cheese must also vary in accordance with the varying quality of the milk. Not only is this true as regards the quantity of rennet to be used, but it influences the degree of acidity which may with advantage be obtained in the curd before vatting.

4. On good soils and with rich milk a high acidity in the curd is desirable; but on heavy land yielding poor milk a low acidity is desirable.

5. A cheese made with low acidity requires longer to ripen, and probably a higher temperature than a cheese with high acidity.

6. In the spring the temperature of the dairy should be maintained artificially at from 64° to 66° Fahr.

7. In order that the curd may be put away in good time, it is essential to obtain sufficient acid in the whey before drawing it off.

8. The acidity of the mixed milk, &c., before renneting should, if possible, be ·21 per cent., and of the whey in the tub before drawing, ·20 per cent., so as to insure in the whey when drawn an acidity of ·22 per cent.

SUGGESTIONS FOR THE FUTURE.

Should it be deemed desirable to continue these observations and investigations in the future, I would suggest that the following course should be pursued:—

1. That a laboratory be fitted up at the school as last year, but before the commencement of the cheese-making, so that the work might commence with a knowledge of the composition of the milk to be dealt with. Also of the various feeding stuffs employed with a view of determining, in the future, how far certain foods affect the quality of the cheese.

2. That during April and May the chief consideration should be to experiment on the best means of promoting the manufacture of the cheese and the effect of varying degrees of acidity in the curd on the product. Also that experiments be started on the effect of keeping these cheeses at various and fixed temperatures.

3. That further experiments be made to try to elucidate some of the points still unanswered, and any others which may arise under new conditions.

4. That if possible one or more systems of making Cheddar cheese, as adopted in the county, should be studied.

5. That if any maker, within reasonable distance of the school, should meet with any difficulty, and be desirous of my investigating the same, and willing to afford the necessary facilities, I should be empowered to visit such Dairy for the purpose of investigation. By this means the school might become each year a centre of investigation for the district visited.

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BATH AND WEST AND SOUTHERN COUNTIES SOCIETY.

INSTRUCTION IN CHEESE-MAKING.

Under an arrangement with the Somerset County Council the Society has opened a School, for instruction in Cheddar Cheese-making, at Lower Rock Farm, Butleigh, near Glastonbury, for a period of Six Months, commencing from April 6th last.

The School is under the supervision of Mr. Cannon, of Milton Clevedon, Evercreech, whose daughter, Miss Cannon, is engaged as Teacher.

The fee (payable in advance) to Residents in Somerset for a complete course of four consecutive weeks' instruction is £6, which includes board and lodging, the charge to Non-Residents in the County being £8 8*s*.

The following are the rates for shorter periods:—

	Residents in Somerset.				Non-Residents.		
	£	*s.*	*d.*		£	*s.*	*d.*
For the first week (with board and lodging)	2	0	0	..	3	3	0
„ second „ „ „	1	10	0	..	2	2	0
„ third „ „ „	1	10	0	..	1	11	6
„ fourth „ „ „	1	7	6	..	1	11	6
„ one day (with board)	1	1	0	..	1	1	0

Day Students will be admitted only when the class for longer periods is not full.

If more persons apply to be admitted as Students than can be instructed at any one time, preference is given to the wives, sons, or daughters of dairy farmers and dairymen; the families of Members of the Society having priority.

The number of Students to be instructed at one time is, as a general rule, limited to five, but under exceptional circumstances this number may be exceeded.

Cheese-making commences each morning at seven o'clock, and is carried on all through the week, but it is optional to Students to attend, or not, on Sundays.

Applications to join the School must be made to the Society's Secretary,

THOS. F. PLOWMAN,

May, 1893. 4, *Terrace Walk, Bath.*

BATH AND WEST AND SOUTHERN COUNTIES SOCIETY

FOR THE

Encouragement of Agriculture, Arts, Manufactures and Commerce.

TERMS OF MEMBERSHIP.

ANNUAL SUBSCRIPTIONS.

Governors, who are eligible for election as President or Vice-President, not less than	£2
Ordinary Members, not less than	£1
Tenant farmers, the rateable value of whose holdings does not exceed £200 a-year, not less than	10/-

LIFE COMPOSITIONS.

Governors may compound for their Subscriptions for future years by payment, in advance, of £20; and Members by payment, in advance, of £10.

Governors and Members who have subscribed for not less than twenty years, may become Life-Members on payment of half these amounts.

Any person desirous of joining the Society can be proposed by a Member, or by the Secretary (THOS. F. PLOWMAN, 4, Terrace Walk, Bath).

SUMMARY OF PRIVILEGES.

GOVERNORS AND ORDINARY MEMBERS.

1. To receive the Society's *Annual Journal* free of expense.
2. To obtain opinions and analyses with regard to Manures, Soils, Feeding Stuffs, &c., at very low rates.
3. To obtain reports and results of examinations of Seeds and Plants at very low rates.
4. To make an unlimited number of Stock and other Entries at the Society's Annual Exhibitions at reduced fees.
5. To be admitted free during *the whole time* of the Annual Exhibition, and to the Reserved Seats in the Grand Stand, the Working Dairy, and the Military Band Enclosure.
6. To use the Special Pavilion for Reading, Writing, &c., provided for Governors and Members attending the Annual Exhibitions.
7. To take part in the Society's Experiments on Crops, &c., and to receive reports thereon.
8. To be admitted free to witness the Teaching and Competitions at any of the Society's Dairy Schools.

10/- MEMBERS.

Members subscribing less than £1 are entitled to all the above-named privileges except No. 4; and, in the case of No. 5, the Ticket is available for *one day only*, instead of the whole time of the Exhibition.

GOVERNORS' SPECIAL PRIVILEGES.

Governors are entitled, in addition to the privileges already mentioned, to an Extra Season Ticket for the Annual Exhibition and for the Reserved Seats in the Grand Stand, the Working Dairy, and the Military Band Enclosure. Governors subscribing more than £2 are entitled to a further Ticket for every additional £1 subscribed.

OBSERVATIONS

ON

CHEDDAR CHEESE-MAKING.

REPORT FOR 1893.

By F. J. LLOYD, F.I.C., F.C.S.

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OBSERVATIONS

ON

CHEDDAR CHEESE-MAKING.

REPORT FOR 1893.

THERE are certain soils or farms in England, especially in Somerset, upon which, if tradition can be believed, there are spectre sign-boards bearing the words, "Good cheese cannot be made here." Unfortunately, no one is able to see these signs except the tenant for the time being. But the belief in the inability to make good cheese on certain soils is so wide-spread, and the conviction that it is founded upon fact is so strong, that the subject deserves careful attention and enquiry. Some people have said that the Society always selected a site for its Cheese School where it was possible to make not only good but the best cheese, but that if a site were selected where good cheese had not been made before, they would find out that it was impossible to make good cheese on such soil.

In 1892 such a site was selected, the milk being produced off alluvial land overlying peat; and in 1893 the Committee again determined to select such a site, with the result that a farm was chosen, known as the "Lower Rock Farm," situate at Butleigh, about four miles from Glastonbury station, on the property of Mr. R. Neville Grenville.

Now, as the prices fetched by the cheeses made at the Dairy School (which have already been published) averaged from June to October 68*s.* per cwt. and 66*s.* per cwt. for the season, it might be inferred that no difficulty was found in making cheese upon this site. Such supposition would be far from the truth. The difficulties were great, and such as had not been met with during the two preceding years. Although these difficulties fluctuated from day to day, being at times very great, at others only slight, and this even when the cows were on the same pasture, yet as a matter of fact they were nearly always present. All the skill and experience, which Miss Cannon possesses in an exceptional degree, were needed to cope with them, and I can quite believe that an ordinary cheese-maker would find such difficulties insurmountable.

Before entering further into this question, however, I will proceed with my Report, and observing the same order as hitherto, consider first

I.—THE CONDITIONS UNDER WHICH THE CHEESES WERE MADE.

THE FARMS AND SOILS.

The house and some of the fields lie upon high ground, but the fields upon which the cattle were pastured for the greater portion of the time were on the low-lying lands which border the river Brue. This part of the county is noted for certain land, which is termed the scouring land of Somerset, to be referred to again later on in this Report. The cattle were never fed upon this scouring land. The dairy was rather small, and had a low roof; the walls were whitewashed, and also the ceiling.

The number of cows kept by Mr. Bethell, the tenant of Lower Rock Farm, was not sufficient to supply all the milk required, so that some of the milk had to be supplied by Mr. Hunt, tenant of Bridge Farm, whose fields adjoin Mr. Bethell's. Both Mr. Bethell and Mr. Hunt were, so far as I could gather, firmly convinced that no good cheese would be made from their land. Moreover, they pointed out among the fields certain which were noted as causing the milk to be unsuitable for cheese-making. It was evident that, if this were so, the cause might reasonably be expected to be found in the nature of the herbage growing upon the land. Mr. Carruthers was therefore requested to visit the farm and inspect the herbage, which he did on the 27th June.

Mr. Bethell, Mr. Hunt, myself, and assistant went with Mr. Carruthers over the land, and tried our best to discover any or what difference there might be between the grasses and plants on the different fields. The following is Mr. Carruthers' Report:—

REPORT OF PROFESSOR CARRUTHERS, F.R.S., ON THE VEGETATION OF THE TWO FARMS WHICH SUPPLY THE MILK FOR THE DAIRY SCHOOL.

I visited these farms on the 27th June, and examined with care the vegetation of the ten fields in which the milch cows graze. All these fields are on the flat alluvium of the valley, which consists throughout of a fairly uniform stiff loam. With but slight modification, the vegetation is also singularly uniform.

The principal grasses are wild barley grass, broom grass, rye grass, and false fiorin. Less frequently are found meadow fescue, tall fescue, sheep's fescue, cocksfoot, and Yorkshire fog. The most abundant grasses are those of inferior quality, but the rich alluvial soil produces a vigorous growth on which the cows thrive. The only grasses that are permitted by the stock to run to seed are rye grass, barley grass, and false fiorin; very few heads were to be seen, the whole pasture being very closely eaten down.

A fair amount of white clover exists in all the fields, being very thick in some places. A few scattered plants of red clover are present in all the fields. There was a considerable quantity of the yellow bird's foot trefoil on Mr. Hunt's farm.

The most abundant weed was buttercup; this weed was specially observed in Lower Rock Farm. There was an absence of yarrow in all the fields of this farm. On the other hand, yarrow was present in all the fields of Mr. Hunt's farm, and with it "all-heal" and some thistles. One field on this farm contains a good deal of yellow rattle.

I compared the vegetation of the fields which (it was said) always supplied good milk with that in the fields in which the milk was of inferior quality, and made inferior cheese. There was no difference in the vegetation to account for the difference in the quality of the milk.

I believe Mr. Lloyd is prosecuting researches which will determine the real cause of the injury to the milk. He has already discovered several different bacteria in the milk and cheese, besides that which is necessary for the production of the cheese. The separate and pure culture of these organisms which Mr. Lloyd is carrying on, and the experiments of adding these pure cultures to good milk, must lead to important results.

4th July, 1893. (Signed) WILLIAM CARRUTHERS.

The fields were ten in number, and of various sizes. I found the soils very similar in appearance, and Mr. Carruthers, as will be seen from his Report, formed the same opinion. Samples of the soil were taken from every field, but subsequently I selected only a few of the most typical samples.

Thus the "Thirty acres" of Mr. Bethell was a little lighter in colour and more ferruginous than the other soils. It was considered the best of all the fields. Hyatt's Common, which was considered the worst field, appeared identical with Mr. Bethell's worst field known as "Horses." The other soils wore very similar; but I selected two which appeared to me least like one another.

These four samples of soil were then forwarded to Dr.

Voelcker, and it will be seen from his Report that chemically, and as regards fertility, the "Thirty acres" is the best soil, and "Hyatt's Common" the worst soil.

REPORT OF DR. VOELCKER ON THE SOILS.

Analytical Laboratory,
22, Tudor Street,
New Bridge Street, London.
September 13th, 1893.

The four samples of soil from fields at the Cheese School at Butleigh were duly submitted by me to analyse, and gave the following results:—

Soil dried at 212° F.	1. Inside Common, considered the poorest of 3 Commons, mainly sub-soil, 2–8 in.	2. Hyatt's Common, Mr. Hunt.	3. Clapps Corner Common.	4. Thirty Acres.
Organic matter and loss on heating	17·48	14·69	19·54	20·88
Ferric oxide	5·20	7·17	4·88	6·36
Ferrous oxide	2·01	·88	1·28	1·03
Alumina	13·93	8·41	13·63	15·10
Lime	·87	1·30	·99	·89
Magnesia	1·10	·90	1·03	·90
Potash	1·02	·85	1·02	1·45
Soda	·24	·34	·56	·92
Phosphoric acid	·36	·41	·37	·40
Sulphuric acid	·16	·15	·17	·14
Insoluble silicates and sand	57·63	64·90	56·53	51·93
	100·00	100·00	100·00	100·00
Nitrogen	·61	·55	·73	·81
Equal to ammonia	·74	·67	·89	·98
Nitric acid	·008	·008	·008	·008

Each soil contained a trace of chlorides, but not more. The four soils were very similar in appearance, and are all of a distinctly clayey nature.

Although, as is but natural in the case of different samples, the four soils show in their respective analysis certain small differences of chemical composition, yet it must be said generally that they resemble one another very fairly indeed, and, so far as I can see, there is no such striking variation between any one of them and another as to in this way account for the superiority claimed locally for this or that soil.

The most marked difference which occurs is in the small quantity of alumina in No. 2, and in the slightly increased amount of lime which it contains. This soil would appear to be somewhat the lightest of the four.

The fact that No. 1 shows a larger proportion of ferrous oxide than any of the others, may possibly be taken as some indication of its being in a less fully oxidised condition, and this may have to do with its being considered the poorest of the three common soils. Beyond this, I see no possible reason, on the chemical side at least, to account for inferiority in it.

I should not at the same time be surprised to hear that No. 2 was reckoned the better soil, owing to its being lighter, to the larger amount of lime in it, richness in phosphoric acid, and more fully oxidised state of its iron salts.

All four soils are very rich alike in phosphoric acid, potash, and nitrogenous organic matter, and the differences in any of these shown by the respective soils are not sufficiently marked to account for any superiority of one over the other.

(Signed) J. AUGUSTUS VOELCKER.

It will thus be seen that neither a botanical examination of the herbage, nor yet a chemical examination of the soils, found any reason for the local opinion as to the unsuitability of the land for cheese-making, nor did they throw any light on the difficulty met with in practice.

THE STOCK AND YIELD OF MILK.

On the 1st April there were 38 cows in milk, 21 belonging to Mr. Bethell, and 17 to Mr. Hunt. They were then being stall fed, Mr. Bethell's cows receiving six pounds of cotton-cake per diem and mangels, and Mr. Hunt's a little less cake but additional hay. Soon after the cheese-making began, they were turned out to grass in the home fields, and on the 25th April went down to "The Moor," owing to the exceptionally warm season. They were, however, given some compound cake for some little time afterwards. On the 18th April there were 42 cows in milk, 24 of Mr. Bethell's, and 18 of Mr. Hunt's; and on the 29th, Mr. Bethell had 25, and Mr. Hunt 19 in milk. On the 11th May they were increased to 52, and on the 25th there were 55 in milk. The number remained about the same for the rest of the period. They were mostly Shorthorns; and the average yield from Mr. Bethell's cows was greater than that from Mr. Hunt's. This Mr. Bethell attributed to the fact that he took great care in selecting the cows, and got rid of those which he found to yield less than he considered a fair amount of milk. The cattle drank from the river Brue, which, in spite of the very dry season, always afforded them an ample supply of water of good quality.

The season, as is well known, was an exceptional one, and the result thereof is seen in many ways.

First. The effect of the warmth was already felt in April. Thus in 1892 the average time of vatting in that month was 6.58 P.M., while in 1893 the average time was 4.34 P.M., nearly 2½ hours sooner. That this was due to the heat is shown by the fact that the average temperature of the dairy in 1892 was 54–60°, and in 1893 from 59–68°. It is also seen by comparing the average temperature of the curd when in vat, which in 1892 was 67° Fahr., while in 1893 it was 76° Fahr.

Secondly. If we compare the average results obtained at Butleigh in 1893 with those obtained at Vallis and Axbridge in 1891 and 1892, as given in the following table, it will be seen that the yield of milk, owing to the shortness of keep, declined in June, and still further in July, while in each of the preceding years it rose in June very considerably, and even in July was in one case more than, and in the other nearly equal to, the yield in May (see table opposite).

Great as was the influence of the heat, even as seen when we compare the monthly average of milk, it was greater still when we compare the yield week by week. Indeed, the fluctuations were quite remarkable, the yield sometimes rising, and then again falling in a manner not easily to be accounted for.

The following facts are of interest as showing the effect of the drought, and they also indicate how very rapidly under such circumstances the cows felt the effect of the change produced in the food. The milk supply on the whole gradually decreased from the end of May. During the last week of May the cows were yielding about 160 gallons of milk. From that date no rain to speak of fell until the 22nd and 23rd June (see table, p. 11). The average yield of milk for the week preceding this fall was 131·7 gallons per day, but for the week after it rose to 137·1 gallons per day. Then it began to diminish, until on the 11th July it amounted to only 126 gallons. A slight fall of rain on this day, followed by another on 15th and again on 19th, had such effect that whereas the average yield for the first ten days in the month was only 130·6 gallons per day, the average daily yield for the last ten days was 142·9 gallons.

The effect of the season on the quality of the milk was also most marked. Thus, while in April of each year the amount of cheese made from one gallon of milk has been practically identical (see table, p. 9), and in former years has increased every month, yet in 1893, after slightly increasing in May, it actually fell again in June, and in July and August was less than in either of the preceding years. We are justified therefore in concluding that, both in quality as well as in quantity, the milk was diminished by the prolonged drought.

AVERAGE RESULTS OBTAINED IN 1891, 1892, AND 1893.

Month.	Vallis, 1891.					Axbridge, 1892.					Butleigh, 1893.				
	Vol. of Milk.	Cheese taken from Press.	Cheese when sold.	Shrinkage in ripening.	Cheese from one gallon of Milk.	Vol. of Milk.	Cheese taken from Press.	Cheese when sold.	Shrinkage in ripening.	Cheese from one gallon of Milk.	Vol. of Milk.	Cheese taken from Press.	Cheese when sold.	Shrinkage in ripening.	Cheese from one gallon of milk.
	galls.	lbs.	lbs.	lbs.	lbs.	galls.	lbs.	lbs.	lbs.	lbs.	galls.	lbs.	lbs.	lbs.	lbs.
April	81	73	69	4	·85	79	70	66	4	·83	106	96	89	7	·84
May	119	117	111	6	·93	109	102	94	8	·86	149	142	132	10	·88
June	132	132	123	9	·93	127	122	113	9	·90	141	130	121½	8½	·85
July	112	114	107	7	·96	116	115	108	7	·93	134	129	122	7	·91
August	91	99	91	8	1·00	100	102½	94	8½	·94	134	131½	124	7½	·92
September	79	87½	82	5½	1·04	84	91	85	6	1·01	102½	109½	104	5½	1·02
October	52	64	59½	4½	1·14	58	68	62	6	1·07	68	80	77	3	1·13

Being anxious to discover what effect the drought was having upon the composition of the milk yielded at Vallis and Axbridge, where the Cheese School was held in 1891 and 1892, I wrote to Mr. Armstrong and Mr. Tilley asking for samples. These they very kindly forwarded. Unfortunately, the time taken in the transit of these samples was so long, and the heat so great, that sometimes when they reached me they were curdled, and a full and satisfactory analysis could not be made.

The following are the results obtained, and they are interesting:—

AVERAGE COMPOSITION OF MILK FROM VALLIS, AXBRIDGE, AND BUTLEIGH, between 19th and 24th May, 1893.

Milk from—	Fat.	Casein, &c.	Solids.
Vallis..	3·08	8·86	11·94
Axbridge	3·16	8·91	12·07
„ in 1892	3·25	8·95	12·20
Butleigh	3·18	8·98	12·16

It is noteworthy that the milk from Vallis, which in an ordinary season, as shown by the results in 1891 (see table, p. 9), is richer than that yielded at Axbridge, or than that yielded in 1893 at Butleigh, was poorer in May last than the milk at either Axbridge or Butleigh. The reason of this is doubtless the fact that high ground like that at Vallis felt the drought and heat more than the moor lands of Axbridge and Butleigh. In the milk from these soils there was remarkable similarity.

We can also compare the milk yielded at Vallis, Axbridge, and Butleigh for the later portion of the season during the three years.

COMPOSITION OF MILK AT VALLIS, AXBRIDGE, AND BUTLEIGH COMPARED.

——	Fat.	Casein, &c.	Solids.
1891. Vallis, 1st week in September, 4–9	4·15	8·76	12·91
1892. Axbridge „ „ „	3·50	8·96	12·46
1893. Butleigh „ „ „	3·53	9·00	12·53
1891. Vallis, 1st week in October, 2–7	4·39	9·08	13·47
1892. Axbridge „ „ „	3·87	9·08	12·95
1893. Butleigh „ „ „	4·30	9·19	13·49

It will be seen that the composition of the milk at Butleigh in September was again very similar to that yielded at Axbridge during the same month of 1892. And the rapid rise in quality of the milk at Butleigh in October is due to the equally rapid and exceptional fall in the quantity yielded, and is therefore no criterion of the influence of the land or the pastures or the season.

Reference will be made subsequently to other influences and effects which may in part be attributed to the season.

The following table, for which I am indebted to Mr. Neville Grenville, shows the rainfall as recorded by him at Butleigh during the seven months of the observations.

RAINFALL AT BUTLEIGH, 1893.

	April.	May.	June.	July.	August.	September.	October.
	in.	in.	in.	in.	in.	in.	in.
1	·03	·03	..	..	·02	..	·09
2	..	..	..	..	..	..	·60
3	..	..	..	..	·41	..	·08
4	..	..	·08	·54	·21	..	..
5	..	..	·03	..	..	..	·32
6	..	..	..	..	·06	·42	·30
7	..	..	..	..	..	·03	·40
8	..	..	..	·15	..	·55	·12
9	..	..	..	·10	..	..	·03
10	..	..	..	·08	..	..	·29
11	..	..	..	·41	·04	..	·20
12	..	..	..	·12	..	..	..
13	..	..	·04	·25	..	..	·07
14	..	·07	..	..	..	..	·19
15	..	·03	..	·79	..	..	..
16	·03	·17	..	..	..	..	·06
17	..	·19	..	·10	..	·06	·15
18	..	·20	..	·02	·10	·17	..
19	..	·05	..	·85	..	·25	..
20	..	..	..	..	·23	·06	..
21	..	..	..	·10	..	..	·12
22	..	·03	·30	..	·28	·21	·03
23	·02	·09	·40	·41	..	·13	..
24	..	..	·10	..	..	..	..
25	..	..	·04	·05	..	..	·19
26	..	..	·15	..	..	·15	·37
27	..	..	·17	..	..	·05	..
28	..	..	..	..	..	·36	·05
29	·09	·02	..	..	..	·11	..
30	..	..	..	·09	..	·05	..
31	..	..	..	·06	·08	..	..
Total inches	·17	·88	1·31	4·12	1·43	2·60	3·66

II.—THE RECORD OF OBSERVATIONS.

The same tables were used for recording observations as in preceding years; but, as greater attention was paid this year to the bacteriological work, the results were not recorded every day, and after May were only made when necessary, though completely for the first week in each month. The results of these observations are shown in the following tables, though many which were made are not given, but will be stated where necessary, should reference be made to them subsequently :—

RECORD OF OBSERVATIONS MADE AT THE BATH AND

1	2	3	4	5	6	7	9		10	11
	RELATING TO EVENING'S MILK.									
Day of Month.	Name of Field.	Volume of Milk.	At Night.				In Morning.			
			Time.	Temp. of Dairy.	Temp. of Milk.	Acidity.	Temp. of Dairy.		Temp. of Milk.	Acidity.
		galls.	P.M.				min.	max.		
2–3	Stall fed, and Home Field	..	..	..	..	..	54	62	..	..
3–4	Ditto	37	6.20	66	86	·16	58	61	71	·18
4–5	Ditto	42	6.25	64	86	·16	56	64	69	·18
5–6	Beggar's Well, Park Gates	42	6 15	64	85	·18	60	79	68	·19
6–7	Ditto	47	6.0	65	91	·18	56	65	68	·18
7–8	Ditto	48	6.5	65	89	·18	56	66	63	·19
8–9										
9–10	Ditto	45	4.35	64	86	·18	57	65	62	·19
10–11	Ditto	50	6.15	64	87	·18	57	65	64	..
11–12	Ditto	53	6.10	59	83	·19	53	61	60	·20
12–13	Ditto	50	6.5	60	86	·19	52	61	60	·20
13–14	Ditto	54	6.15	59	86	·19	52	61	61	·19
14–15	Ditto	52	6.5	58	86	·19	50	60	60	·19
15–16										
16–17	Ditto	48	4.40	61	87	·18	56	61	62	·19
17–18	Ditto	50	5.55	61	87	·19	56	62	63	·19
18–19	Morning's milk only used.									
19–20	Ditto	49	6.5	66	85	·18	59	66	65	·19
20–21	Ditto	50	6.5	68	91	·19	61	68	66	·19
21–22	Ditto	50	6.10	69	89	·19	61	69	68	·19
22–23										
23–24	Ditto	44	4.50	69	88	·18	59	69	63	·19
24–25	Thirty acres, Common Mead	49	6.10	67	88	·18	58	72	64	·18
25–26	Ditto	61	6.10	69	92	·18	61	70	69	·18
26–27	Ditto	61	6.15	69	90	·19	60	69	67	·19
27–28	Ditto	63	6.30	67	90	·19	57	67	66	·19
28–29	Ditto	61	6.20	66	88	·19	59	70	66	·19
29–30	Ditto	60	6.20	63	85	·19	57	64	64	·19
Average		50	..	64	87	·18	57	65	65	·19

WEST OF ENGLAND SOCIETY'S CHEESE SCHOOL, APRIL, 1893.

12	13	14	15	16	17	18	19	20	21	22	23
MORNING'S MILK.				MILK HEATED		STALE WHEY.		RELATING TO MIXED MILK, &c.			
										Rennet added.	
Name of Field.	Vol. of Milk.	Acidity.	Total Vol. of Milk.	Quantity.	Temp.	Vol.	Acidity.	Acidity before Renneting.	Time of Renneting.	Vol.	Proportion.
	galls.		galls.	galls.		galls.			A.M.	ounces.	
Stall fed, and Home Field	..	..	80	25	90	none	..	..	7.28	1·42	9014
Ditto	44	·18	81	23	87	none	..	·18	7.32	1·44	9000
Ditto	46	·18	88	25	86	4	·38	·19	7.27	1·56	9025
Beggar's Well, Park Gates . .	44	·17	86	28	90	none	..	·19	7.10	1·52	9052
Ditto	55	·18	102	30	90	none	..	·19	8.15	1·81	9016
Ditto	54	·18	102	32	90	none	..	·19	7.37	1·81	9016
Ditto	62	·19	107	29	88	2	·22	·19	7.20	1·90	9010
Ditto	56	·19	106	45	90	2	·37	·19	7.27	1·88	9021
Ditto	58	·19	111	44	90	2	·38	·20	7.45	1·97	9015
Ditto	60	·19	110	40	90	3	·29	·19	8.14	1·96	8979
Ditto	60	·18	114	45	90	3	·39	·19	7.40	2·02	9029
Ditto	59	·19	111	42	88	3	·40	·19	7.20	1·97	9015
Ditto	65	·19	113	40	81	3	·41	·19	7.8	2·00	9040
Ditto	60	·17	110	34	83	3	·40	·19	7.12	1·95	9025
Ditto	60	·18	60	none	..	2½	·42	·19	7.55	1·06	9056
Ditto	58	·19	107	40	81	2	·42	·18	6.55	1·90	9010
Ditto	56	·20	106	37	84	2	·43	·18	7.10	1·88	9021
Ditto	56	·18	106	34	90	2	·42	·18	7.15	1·88	9021
Ditto	60	·20	104	34	84	3	·43	·18	7.5	1·84	9043
Thirty acres, Common Mead . .	55	·19	104	35	90	3	·45	·18	7.26	1·84	9043
Ditto	63	·19	124	43	88	3	·45	·19	7.22	2·25	8817
Ditto	64	·19	125	42	90	3	·45	·19	7.22	2·27	8810
Ditto	67	·20	130	46	90	2	·46	·21	7.50	2·35	8851
Ditto	71	·19	132	45	88	2	44	·19	7.34	2·38	9000
Ditto	72	·19	132	43	90	1½	·45	·20	7.25	2·38	9000
	59	·19	106	..	..	..	·40	·19	7.30	1·89	8997

RECORD OF OBSERVATIONS MADE AT THE BATH AND

	24	25	26	27	28	29	30	31	32	33	34	34a	35
						Temp. of Scald.				Relating to Whey.			
Day of Month.	Time when Curd cut.	Acidity of Whey before Breaking.	Time of Breaking.	Acidity of Whey put aside.	Time Scalding commences.	1st.	2nd.	Time taken in Stirring.	Time in Scald.	Temp. when drawn.	Acidity.	Volume.	Acidity of draining from piled Curd.
	A.M.		A.M.		A.M.			min.	h. m.			galls.	
2–3	8.30	·11	9.10	·13	10.8	88	92	30	2 0	88	·12	..	·15
3–4	8.32	·11	9.10	·14	10.23	88	92	30	2 12	90	·13	..	·16
4–5	8.27	·13	8.48	·14	9.40	88	91	20	1 20	89	·17	..	·30
5–6	7.55	·12	8.20	·14	9·42	88	91	12	1 7	90	·19	..	·31
6–7	9.15	·13	9.40	·13	10.45	88	92	20	1 12	89	·17	..	·27
7–8	8.37	·13	9.10	·13	10.5	88	92	45	2 0	88	·13	..	·15
8–9													
9–10	8.23	·13	8.50	·13	9.50	88	92	40	1 40	89	·15	..	·20
10–11	8.25	·12	8.50	·13	9.43	88	92	60	1 57	87	·16	..	·23
11–12	8.30	·13	9.0	·13	10.0	88	92	50	1 45	87	·15	..	·18
12–13	9.0	·12	9.27	·13	10.25	88	92	55	1 50	87	·17	..	·23
13–14	8.35	·13	9.0	·13	10.6	88	92	35	1 28	88	·19	..	·24
14–15	8.15	·13	8.42	·14	9.38	88	92	42	1 32	88	·16	..	·19
15–16													
16–17	7.55	·12	8.20	·13	9.15	88	92	49	1 40	88	·16	..	·22
17–18	7.57	·13	8.25	.13	9.20	88	92	45	1 35	89	·15	..	·19
18–19	8.37	·13	8.50	·14	9.42	88	92	60	1 53	87	·17	..	·20
19–20	7.55	·12	8.20	·13	9.15	88	92	40	2 5	89	·16	..	·20
20–21	8.10	·12	8.30	·13	9.50	88	92	50	1 40	89	·15	..	·19
21–22	8.15	·12	8.35	·13	9.34	88	92	42	1 31	89	·15	..	·18
22–23													
23–24	8.0	·13	8.17	·14	9.13	88	92	56	1 42	88	·16	95	·20
24–25	8.25	·13	8.50	·14	9.55	88	92	42	1 35	87	·17	100	·21
25–26	8.8	·13	8.30	·14	9.15	88	92	40	1 40	88	·25	118	·30
26–27	8.7	·14	8.25	·14	9.18	88	92	30	1 28	89	·18	119	·23
27–28	8.43	·13	9.5	·14	10.7	88	92	30	1 20	88	·19	122	·23
28–29	8.20	·13	8.35	·13	9.31	88	92	34	1 26	89	·16	124	·21
29–30	8.12	·14	8.30	·14	9.33	88	92	30	1 28	88	·18	125	·21
Average ..		·13	..	·14	..	88	92	39	1 45	88	·16	115	·21

EST OF ENGLAND SOCIEY'S CHEESE SCHOOL, APRIL, 1893.—*contd.*

36	37	38	39	40	41	42	43	44	45	46	47	48	49	
Time Curd remains piled.	Time Curd is taken from Tub.	Temp. of Curd when taken from Tub.	Acidity of Whey during Treatment of Curd.							Acidity of Curd when Milled.	Salt added.		Temp. of Dairy.	
			When taken to Cooler.	After 1st Cutting.	After 2nd Cutting.	After 1st Turning.	After 2nd Turning.	After 3rd Turning.	After 4th Turning.		Weight.	Percentage.		
h. m.											lbs. oz.		min.	max.
1 10	2.0	87	..	..	·42	·61	·83	..	..	..	1 10	2·15	56	67
1 5	2.15	..	·26	·37	·53	·65	·77	..	..	..	1 10	2·16	64	66
0 18	11.48	90	·48	·66	·80	..	..	..	..	3.00	1 12	2·02	58	67
0 10	11.15	90	·41	·59	·70	·81	..	..	..	..	1 12	2·03	62	68
0 30	12.50	90	·47	·70	·92	..	..	..	..	2·80	2 1	2·08	58	69
1 12	1.45	86	·23	·37	·63	·80	..	..	..	2·60	2 1	2·00	58	66
0 30	12.30	87	·33	·51	·74	·94	..	..	..	3·00	2 3	2·06	59	68
0 35	12.45	86	·39	·57	·84	·99	..	..	..	4·20	2 3	2·00	59	64
0 35	12.47	87	·20	·26	·45	·78	·89	..	..	3·80	2 4	2·00	54	64
0 22	1.10	88	·38	·64	·88	·98	..	..	..	4·40	2 4	1·99	54	64
0 30	12.30	90	·42	·64	·89	1·03	..	..	..	4·10	2 6	2·02	53	63
0 30	12.15	88	·30	·40	·60	·75	·96	..	..	..	2 4	2·00	54	64
0 35	12.10	89	·36	·56	·74	·92	·95	..	..	3·60	2 6	2·12	58	65
0 30	12.0	88	·30	·46	·68	·87	·98	..	..	3·20	2 6	2·13	58	68
0 34	12.24	88	·28	·38	·57	·62	·73	·81	·85	3·20	1 4	2·25	59	68
0 37	12.15	89	·35	·51	·77	·90	1·07	..	..	5·00	2 5	2·22	58	72
0 35	12.30	89	·27	·42	·62	·79	·96	..	..	2·60	2 4	2·21	63	73
0 35	12.8	89	·25	·35	·51	·67	·82	·91	..	2·60	2 4	2·21	61	73
0 30	12.2	87	·28	·43	·69	·84	·96	..	..	3·00	2 2	2·06	61	72
0 33	12.35	89	·36	·68	·82	·99	..	..	..	4·20	2 2	1·98	61	72
0 20	11.45	90	·40	·66	·87	1·04	..	..	..	..	2 10	2·09	62	72
0 23	11.35	90	·38	·65	·94	..	..	..	..	2·40	2 10	2·01	62	70
0 35	12.32	90	·44	·71	·95	..	..	..	..	2·20	2 11	2·00	61	70
0 25	11.52	89	·34	·51	·71	·89	1·04	..	..	3·00	2 11	2·02	60	70
0 30	12.0	89	·35	·53	·76	·95	..	..	..	2·00	2 11	1·95	62	68
	12.29	89								3·11	2 3	2·07	59	68

RECORD OF OBSERVATIONS, APRIL, 1893.—*continued.*

	50	51	52	53	54	55	56		57		58		59		60
	Relating to Curd.			Relating to Cheeses.											
Day of Month.	Temp. in Vat.	Weight when Vatted.	Time of Vatting.	Acidity of liquid from Press.	Weight taken to Cheese Room.	Loss in Press.	Temp. of Cheese Room.				Hygrometer Reading.				Weight of Cheese when sold.
							Morning.		Evening.		Morning.		Evening.		
							Min.	Max.	Min.	Max.	Wet.	Dry.	Wet.	Dry.	
		lbs.	P.M.	per cent.	lbs.	lbs.									lbs.
2–3	72	75½	10.50	1·00	70	5½									65
3–4	73	75	9.30	·90	70½	4½									65½
4–5	78	86½	2.0	1·04	78½	8	58	70	59	62	56½	60	59½	62½	70
5–6	77	86	1.15	·97	80	6	60	62	60	63	59	62	61	64	70½
6–7	76	99	3·40	1·06	92	7	60	63	63	63	58	61	62	65	84
7–8	74	103	7.5	1·04	97	6	60	63	60	63	59	62	60	64	91½
8–9															
9–10	77	106	4.30	1·15	100	6	59	63	60	63	58	61	61	64	93½
10–11	74	109	4.0	1·09	102	7	60	63	60	61	58	61	58	61	95
11–12	69	112½	7.30	1·02	107½	5	58	61	58	60	55	59	59	61	100½
12–13	75	113	4.30	1·18	105½	7½	56	60	56	58	55	58	57	60	98½
13–14	74	117½	3.45	1·21	111	6½	54	58	56	59	53	56	57	59	103
14–15	74	112½	4.25	1·10	105½	7	54	58	55	58	53	56	56	59	98½
15–16															
16–17	74	112	3.40	1·11	104	8	55	58	56	58	55	58	57	60	96
17–18	76	111½	4.5	1·12	102	9½	56	58	57	60	56	58½	59	61	95
18–19	74	55½	5.25	1·13	51	4½	58	60	58	62	57	60	60	63	47
19–20	78	104	4.15	1·10	95	9	60	62	61	65	59	62	63	65½	89
20–21	76	101½	4.40	1·07	93½	8	63	66	63	66	61	64	64	67	87
21–22	76	101½	4.30	1·06	93½	8	64	66	64	67	62	66	64	68	87
22–23															
23–24	77	103	4.5	1·06	94	9	65	68	65	68	62½	66	65	69	87½
24–25	78	107	3.50	1·14	97½	9½	65	68	65	68	62½	66	65	69	91½
25–26	79	125½	3.0	1·20	114½	11	66	68	66	68	64	67	65	69	107½
26–27	79	130	2.6	1·12	119	11	66	68	65	68	63	67	65	69	112½
27–28	79	134	3.0	1·07	123½	10½	64	65	65	68	63	67	66	69	116½
28–29	76	133	3.30	1·07	125½	7½	65	68	65	67	63	66	62	67	118
29–30	75	137½	3.15	1·05	125½	12	64	66	64	65	61	65	61	66	118
..	76	106	4.34	1·08	98·3	7·7	60	63	60	63	59	62	61	64	91½

RECORD OF ANALYSES—APRIL, 1893.

Day of Month.	Composition of Milk.							Composition of Whey.			Composition of Curd.			
	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	Ash.
2–3	88·38	11·62	3·05	2·06	·32	5·49	·70	6·98	·44	·54	..	..	..	..
3–4	88·36	11·64	3·04	2·92	·32	4·70	·66	6·90	·45	·54	..	..	..	..
4–5	88·22	11·78	2·87	2·28	·33	5·52	·78	6·83	·51	·59	40·65	59·35	30·93	2·00
5–6	88·32	11·68	3·00	2·21	·35	5·42	·70	6·85	·51	·57	43·30	56·70	29·70	1·90
6–7	88·40	11·60	2·87	2·33	·29	5·43	·68	6·85	·43	·55	41·95	58·05	28·56	2·00
7–8	88·02	11·98	3·10	2·46	·29	5·43	·70	6·87	·39	·54	42·05	57·95	28·98	2·15
8–9	..	..	..	..	..	..	..	..	..	..	..	..	..	..
9–10	88·18	11·82	2·96	2·50	·32	5·32	·72	6·84	·32	·56	42·20	57·80	28·44	2·10
10–11	88·00	12·00	3·20	2·42	·33	5·41	·64	6·90	·49	·55	41·80	58·20	29·38	2·05
11–12	87·90	12·10	3·16	2·48	·33	5·47	·66	6·94	·34	·55	41·05	58·95	29·97	2·05
12–13	88·00	12·00	3·11	2·53	·35	5·33	·68	6·98	·27	·52	41·95	58·05	27·82	2·05
13–14	88·02	11·98	3·10	2·53	·36	5·31	·68	6·99	·37	·54	41·95	58·05	29·16	1·90
14–15	88·02	11·98	3·16	2·55	·36	5·23	·68	6·95	·28	·53	41·25	58·75	29·26	2·15
15–16	..	..	..	..	..	..	..	..	..	..	..	..	..	..
16–17	88·20	11·80	3·06	2·37	·31	5·38	·68	6·92	·31	·55	41·80	58·20	29·02	2·10
17–18	88·02	11·98	3·12	2·38	·33	5·49	·66	6·97	·38	·55	42·50	57·50	28·60	2·00
18–19	88·32	11·68	2·79	2·29	·33	5·55	·72	6·96	·28	·56	40·15	59·85	29·00	2·05
19–20	88·02	11·98	3·10	2·35	·33	5·52	·68	6·80	·35	·56	39·30	60·70	30·63	2·05
20–21	88·20	11·80	3·12	2·38	·35	5·27	·68	6·91	·42	·53	38·30	61·70	29·97	2·30
21–22	88·12	11·88	3·18	2·46	·32	5·24	·68	6·86	·35	·53	40·25	59·75	29·56	2·30
22–23	..	..	..	..	..	..	..	..	..	..	..	..	..	..
23–24	88·16	11·84	3·19	2·19	·32	5·44	·70	6·87	·37	·55	39·90	60·10	30·16	2·25
24–25	87·86	12·14	3·23	2·43	·32	5·46	·70	6·99	·26	·55	42·25	57·75	29·28	2·20
25–26	88·12	11·88	3·22	2·42	·36	5·18	·70	6·94	·38	·57	33·50	66·50	33·78	2·55
26–27	87·94	12·06	3·22	2·48	·35	5·29	·72	6·78	·29	·57	40·25	59·75	29·82	2·30
27–28	87·98	12·02	2·98	2·49	·33	5·52	·70	6·93	·36	·53	40·25	59·75	28·74	2·30
28–29	88·02	11·98	3·25	2·56	·36	5·13	·68	6·75	·31	·56	40·55	59·45	27·86	2·45
29–30	88·02	11·98	3·14	2·55	·39	5·20	·70	6·81	·30	·54	41·55	58·45	28·18	2·25
Average	88·11	11·89	3·09	2·43	·33	5·35	·69	6·89	·37	·55	40·81	59·19	29·43	2·15

RECORD OF OBSERVATIONS MADE AT THE BATH AND

1	2	3	4	5	6	7		9	10	11
	Relating to Evening's Milk.									
Day of Month.	Name of Field.	Volume of Milk.	At Night.				In Morning.			
			Time.	Temp. of Dairy.	Temp. of Milk.	Acidity.	Temp. of Dairy.		Temp. of Milk.	Acidity.
		galls.	P.M.				min.	max.		
30–1	Thirty acres, Common Mead	56	5.5	61	84	·18	59	62	64	·18
1–2	Thirty acres, Duck Pool	60	6.20	64	88	·18	58	67	66	·19
2–3	Ditto	64	6.20	61	84	·19	67	60	62	·19
3–4	Ditto	64	6.10	65	89	·18	59	64	68	·20
4–5	The Commons, Duck Pool	63	6.7	67	90	·18	60	67	69	·20
5–6	Ditto	67	6.14	70	91	·19	60	70	68	·19
6–7										
7–8	Ditto	62	5.30	65	87	·19	58	65	64	·19
8–9	Ditto	68	6.20	65	87	·18	60	65	67	·19
9–10	Ditto	66	6.35	67	88	·18	60	67	68	·20
10–11	Ditto	74	7.45	67	88	·19	60	67	68	·19
11–12	Ditto	73	6.30	68	89	·19	58	68	68	·19
12–13	Ditto	80	6.35	67	86	·19	61	67	70	·19
13–14										
14–15	Ditto	69	5.15	72	88	·20	65	72	71	·20
15–16	Ditto	74	6.38	69	89	·18	65	69	72	·19
16–17	Ditto	70	6.15	67	89	·18	64	67	71	·18
17–18	Thirty Acres, Hyatt's Common	76	6.30	67	86	·18	61	64	70	·19
18–19	Ditto	77	6.35	64	85	·18	61	64	70	·19
19–20	Ditto	75	6.20	65	85	·19	62	65	70	·19
20–21										
21–22	Ditto	70	5.10	66	87	·18	59	..	65	·20
22–23	Ditto	76	7.50	65	83	·17	61	..	68	·20
23–24	Ditto	77	6.35	64	89	·19	61	65	70	·20
24–25	Ditto	79	6.45	64	85	·18	60	64	69	·19
25–26	Ditto	72	6.15	66	84	·18	61	66	68	·19
26–27	Ditto	76	6.30	67	88	·19	61	67	69	·19
27–28										
28–29	Commons, Hyatt's Common	66	5.5	71	89	·19	64	72	68	·20
29–30	Ditto	76	6.25	68	89	·18	64	71	71	·20
30–31	Ditto	75	6.30	66	87	·18	61	66	69	·20
Average		70½	..	66	87	·18	61	66	68	·19

WEST OF ENGLAND SOCIETY'S CHEESE SCHOOL, MAY, 1893.

12	13	14	15	16	17	18	19	20	21	22	23
MORNING'S MILK.				MILK HEATED.		STALE WHEY.		MIXED MILKS, &c.			
										Rennet added.	
Name of Field.	Vol. of Milk.	Acidity.	Total Vol. of Milk.	Quantity.	To Temp.	Quantity.	Acidity.	Acidity before Renneting.	Time of Renneting.	Vol.	Proportion.
	galls.		galls.	galls.		galls.			A.M.	ounces.	
Thirty acres, Common Mead	75	·19	131	39	90	none	..	·19	7.34	2·36	8881
Thirty acres, Duck Pool	72	·19	132	47	84	2½	·18	·19	7.25	2·38	8874
Ditto	73	·18	137	47	88	2	·40	·19	7.35	2·49	8803
Ditto	69	·20	133	45	88	2	·41	·19	7.23	2·36	9020
The Commons, Duck Pool	72	·19	135	45	83	2	·45	·20	7.22	2·40	9000
Ditto	73	·19	140	44	88	2	·41	·19	7.30	2·48	9032
Ditto	79	·19	141	44	90	2	·38	·19	7.23	2·50	9024
Ditto	75	·18	143	49	90	2	·39	·19	7.26	2·54	9008
Ditto	73	·18	139	47	88	2	·40	·20	7.26	2·46	9040
Ditto	81	·19	155	50	85	1	·44	·19	7.23	2·75	9018
Ditto	74	·19	147	50	90	2	·41	·19	6.40	2·61	9011
Ditto	83	·18	163	52	84	1	·42	·19	7.35	2·89	9024
Ditto	87	·18	156	34	80	1	·31	..	7.20	2·77	9011
Ditto	78	·19	152	29	88	1	·41	·19	7.38	2·70	9007
Ditto	87	·18	153	37	90	1	·46	·19	7.36	2·72	9000
Thirty Acres, Hyatt's Common	83	·18	159	40	90	1½	·40	·19	7.30	2·82	9021
Ditto	85	·20	162	44	88	2	·39	·19	7.44	2·88	9000
Ditto	85	·19	160	42	88	2	·35	·19	7.18	2·85	8982
Ditto	90	·18	160	41	85	3	·29	·20	7.29	2·84	9014
Ditto	83	·19	159	41	90	1	·43	·19	7.30	2·82	9021
Ditto	83	·19	160	43	90	1	·45	·20	7.52	2·84	9014
Ditto	82	20	161	41	88	1	·45	·20	7.11	2·86	9007
Ditto	91	·19	163	36	84	1	·44	·19	7.30	2·89	9024
Ditto	81	·18	157	30	90	1	·43	·20	7.20	2·79	9004
Ditto	90	·19	156	29	85	1	·45	·20	7.18	2·77	9011
Ditto	81	·18	157	39	90	1	·40	·20	7.52	2·79	9004
Ditto	81	·18	156	40	87	1	·42	·20	7.25	2 77	9011
	80	·19	151	..	..	..	·40	·19	7.26	2·68	8995

RECORD OF OBSERVATIONS MADE AT THE BATH AND

	24	25	26	27	28	29	30	31	32	33	34	34a	35
						Temp. of Scald.				Relating to Whey.			
Day of Month.	Time when Curd cut.	Acidity of Whey before Breaking.	Time of Breaking.	Acidity of Whey put aside.	Time Scalding commences.	1st.	2nd.	Time taken in Stirring	Time in Scald.	Temp. when drawn.	Acidity.	Volume.	Acidity of draining from piled Curd.
	A.M.		A.M.		A.M.			min.	h. m.			galls.	
30–1	8.35	·12	8.50	·13	9.50	88	92	60	2 0	88	·12	122	·13
1–2	8.22	·12	8.43	·12	9.45	88	92	40	1 40	88	·15	124	·18
2–3	8.18	·13	8.35	·13	9.35	88	92	30	1 20	90	·15	127	·17
3–4	8.18	·12	8.35	·14	9.43	88	92	30	1 17	89	·17	117	·20
4–5	8.15	·13	8.32	·14	9.29	88	92	30	1 33	90	·15	127	·17
5–6	8.30	·13	8.45	·13	9.22	88	92	30	1 43	89	·15	132	·19
6–7													
7–8	8.16	·13	8·38	·14	9.45	88	92	30	1 43	89	·18	135	·25
8–9	8.22	·12	8.43	·13	9.45	88	92	30	1 20	89	·15	132	·18
9–10	8.13	·14	8.27	·14	9.24	88	92	20	1 23	90	·20	131	·35
10–11	8.13	·12	8.35	·13	9.50	88	92	27	1 27	89	·15	146	·20
11–12	7.26	·12	7.38	·13	8.35	88	92	35	1 23	89	·14	138	·16
12–13	8.25	·12	8.47	·12	10.5	88	92	30	1 20	89	·15	153	·17
13–14													
14–15	8.10	·12	8.30	·12	9.35	88	92	30	1 42	89	·13	147	·18
15–16	8.25	·14	8.38	·15	9.40	88	92	10	0 48	90	·22	143	·33
16–17	8.30	·12	8.52	·13	9.50	88	92	40	1 45	88	·14	143	·18
17–18	8.25	·13	8.45	·13	9.47	88	92	43	1 40	89	·14	152	·18
18–19	8.35	·12	9.3	·13	10.5	88	92	47	1 50	89	·14	153	·16
19–20	8.16	·12	8.43	13	10.4	88	92	30	1 34	89	·17	153	·25
20–21													
21–22	8.29	·12	8.51	·12	9.51	88	92	30	1 34	90	·15	153	·25
22–23	8.30	·13	8·50	·14	9.59	88	92	30	1 16	90	·17	150	·26
23–24	8.52	·12	9.10	·13	10.5	88	92	40	1 39	88	·20	152	·28
24–25	8.6	·13	8.24	·13	9.37	88	92	40	1 37	90	·17	152	·23
25–26	8.30	·12	8.50	·12	10.5	88	92	30	1 50	90	·21	150	·29
26–27	8.12	·13	8.35	·13	9.40	88	92	37	1 39	89	·19	147	·26
27–28													
28–29	8.2	·12	8.25	·12	9.25	88	92	45	1 35	90	·16	147	·21
29–30	8.40	·12	9.0	·14	9.55	88	92	30	1 35	90	·20	150	·29
30–31	8.12	·14	8.33	·16	9.30	88	92	15	1 20	90	·29	148	·41
Average ..		·12	..	·13	..	88	92	33	1 32	89	·17	142	·23

WEST OF ENGLAND SOCIETY'S CHEESE SCHOOL, MAY, 1893—*contd.*

36	37	38	39	40	41	42	43	44	45	46	47		48	49	
			Acidity of Whey during Treatment of Curd.								Salt Added.				
Time Curd remains piled.	Time Curd was taken from Tub.	Temp. of Curd when taken from Tub.	When taken to Cooler.	After 1st Cutting.	After 2nd Cutting.	After 1st Turning.	After 2nd Turning.	After 3rd Turning.	After 4th Turning.	Acidity of Curd when Milled.	Weight.		Percentage.	Temp. of Dairy.	
min.											lbs.	oz.		min.	max.
40	1.0	86	·13	·14	·18	·23	·34	·69	..	2·00	2	11	2·07	58	67
45	12.45	89	·27	·40	..	..	..	..	..	2·20	2	12	2·02	61	68
30	11.55	90	·26	·38	·59	·80	·92	..	..	2·20	2	14	2·08	61	69
30	12.0	90	·32	·47	·72	·92	..	..	..	2·40	2	13	2·09	62	71
35	12.5	90	·27	·38	·57	·69	·83	..	..	2·00	2	13	2·08	65	72
40	12.15	90	·30	·47	·69	·90	1·02	..	..	2·80	3	0	2·12	63	72
18	12.15	90	·40	·64	·92	1·03	..	..	..	2·80	3	0	2·07	62	69
30	12.15	90	·29	·43	·65	·86	·98	..	..	2·30	3	0	2·02	62	71
15	11.28	91	·53	·75	·92	1·05	..	..	..	2·60	2	14	1·90	64	73
30	12.22	89	·32	·46	·71	·93	1·07	..	..	2·40	3	5	2·10	63	73
45	11.15	89	·29	·36	·50	·65	·82	·90	..	2·20	3	2	2·05	62	71
30	12.27	89	·27	·40	·57	·75	·93	..	..	2·80	3	8	2·09	65	73
30	12.22	89	·28	·41	·60	·75	·84	..	..	3·00	3	5	2·09	66	74
5	10.58	90	·45	·60	·77	·90	..	..	..	2·80	3	5	2·07	66	73
33	12.45	89	·29	·41	·64	·78	·96	..	..	2 20	3	5	2·18	67	72
38	12.40	90	·26	·37	·55	·71	·85	1·01	..	2·20	3	7	2·04	63	70
45	1.20	88	·25	·36	·48	·59	·73	·88	..	2·40	3	8	2·08	62	69
35	12.40	90	·38	·50	·73	·90	..	..	..	4·00	3	7	2·03	63	68
25	12.25	91	·48	·74	·97	..	..	..	..	3·50	3	8	2·03	67	67
12	12.7	90	·39	·58	·78	·91	..	..	..	3·40	3	7	2·06	67	67
30	12.45	91	·47	·65	87	·97	..	..	..	2·80	3	6	2·02	62	69
30	12.30	90	·45	·63	·78	·91	..	..	..	3·00	3	6	2·04	62	69
30	1.5	90	·46	·55	·68	·77	·98	..	..	3·40	3	7	2·09	65	72
30	12.30	89	·42	·54	·71	·85	·97	..	..	3·00	3	6	2·08	64	70
45	12.15	90	·42	·58	·77	·92	1·01	..	..	2·60	3	5	2·03	65	73
13	12.17	89	·41	·56	·76	·85	·97	..	..	3·20	3	5	2·04	64	71
7	11.29	89	·50	·64	·73	·85	..	..	..	2·80	3	8	2·16	64	71
..	12.14	89	..	..	..	..	..	..	..	2·70	3	2	2·06	63	70

RECORD OF OBSERVATIONS, MAY, 1893—*continued.*

	50	51	52	53	54	55	56		57		58		59		60
	Relating to Curd.			Relating to Cheeses.											
							Temp. of Cheese Room.				Hygrometer Reading.				
Day of Month.	Temp. in Vat.	Weight when Vatted.	Time of Vatting.	Acidity of Liquid from Press.	Weight taken to Cheese Room.	Loss in Press.	Morning.		Evening.		Morning.		Evening.		Weight of Cheese when sold.
							Min.	Max.	Min.	Max.	Wet.	Dry.	Wet.	Dry.	
		lbs.	A.M.	per cent.	lbs.	lbs.									lbs.
30–1	67	129½	7.0	1·09	121½	8	62	65	62	64	60	64	61	64	112½
			P.M.												
1–2	76	136	4.40	1·01	124½	11½	61	63	62	63	62	65	61	63	116½
2–3	76	138	4.5	1·02	127½	10½	61	62	61	64	59	62	61	65	118½
3–4	76	134	3.15	·99	123	11	62	64	62	64	60	63	62	66	116
4–5	78	135	4.0	1·00	125½	9½	63	65	63	66	61	65	63	67	118
5–6	76	141	4.35	1·11	129	12	64	67	64	66	61	65	62	67	120
6–7															
7–8	78	145	3.35	1·10	134	11	63	66	63	65	60	64	62	66	125
8–9	77	148½	4.20	1·07	137	11½	64	65	64	66	61	65	64	67	128
9–10	80	151	1.57	1·10	134½	16½	64	66	64	67	63	66	68	68	123
10–11	78	157½	4.35	1·08	142½	15	64	66	64	67	61	65	63	68	131½
11–12	76	152	3.40	1·00	141½	10½	64	67	64	69	61	66	64	69	130½
12–13	80	167	4.50	1·02	151	16	66	68	66	69	63	67	65	70	141
13–14															
14–15	81	158	4.55	·95	141½	16½	67	69	68	71	65	69	66	71	131½
15–16	82	159½	12.55	·97	143	16½	68	70	68	70	66	70	66	70	129
16–17	76	152	5.0	·96	137½	14½	67	69	67	72	65	69	67	70	128
17–18	75	168½	5.40	1·03	147½	20	66	68	66	68	64	67	64	67	138
18–19	75	168	7.50	·97	152	16	64	66	64	65	62	66	63	66	142½
19–20	75	169½	4.28	1·01	147	22½	63	65	60	64	62	65	64	64	137
20–21															
21–22	76	172½	3.30	1·12	150½	22	60	64	60	64	64	64	62	65	139
22–23	77	166½	3.55	·97	149½	17	62	62	60	64	60	63	62	65	139½
23–24	76	167	3.55	1·02	150½	16½	62	64	62	64	61	64	62	65	141
24–25	76	165	4.12	·98	150½	14½	62	64	63	65	61	64	63	66	140
25–26	76	164½	5.30	1·01	151½	13	63	65	64	66	62	65	64	67	143
26–27	75	162	5.30	1·02	152	10	64	66	64	66	62	65	64	67	142
27–28															
28–29	79	162½	4.15	1·07	149	13½	64	67	66	68	64	67	66	69	138
29–30	76	162	4.35	1·00	152	10	66	68	66	67	65	68	65	68	141½
30–31	75	162	2.10	·97	151	11	66	67	64	66	64	67	64	67	136
..	76	155	4.57	1·02	141	14	64	66	64	66	62	65	64	67	131

RECORD OF ANALYSES—MAY, 1893.

Day of Month.	Composition of Milk.							Composition of Whey.			Composition of Curd.			
	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	Ash.
30–1	88·06	11·94	3·10	2·48	·37	5·31	·68	6·89	·36	·53	41·20	58·80	30·11	2·30
1–2	87·96	12·04	3·09	2·55	·34	5·36	·70	6·92	·27	·52	41·80	58·20	28·15	2·35
2–3	88·24	11·76	3·09	2·59	·34	5·06	·68	6·90	·33	·54	41·00	59·00	26·55	2·50
3–4	88·18	11·82	2·86	2·62	·36	5·26	·72	6·95	·36	·53	41·35	58·65	27·44	2·35
4–5	88·12	11·88	2·86	2·62	·36	5·32	·72	6·95	·34	·52	41·85	58·15	28·70	2·35
5–6	88·06	11·94	2·85	2·66	·37	5·36	·70	6·91	·34	·52	41·00	59·00	27·78	2·50
6–7	..	..	..	..	..	..	..	..	..	..	..	..	..	..
7–8	87·88	12·12	3·02	2·61	·38	5·41	·70	6·96	·33	·54	41·85	58·15	27·64	2·30
8–9	87·84	12·16	3·15	2·62	·40	5·31	·68	6·92	·36	·52	41·60	58·40	26·60	2·30
9–10	88·00	12·00	3·07	2·59	·43	5·19	·72	6·93	·41	·52	41·25	58·75	28·88	2·20
10–11	88·04	11·96	2·98	2·64	·38	5·28	·68	6·94	·17	·54	40·85	59·15	26·95	2·25
11–12	87·84	12·16	3·10	2·68	·37	5·31	·70	6·83	·37	·52	40·15	59·85	29·28	2·30
12–13	87·98	12·02	3·03	2·59	·35	5·37	·68	6·89	·28	·53	41·05	58·95	26·21	2·20
13–14	..	..	..	..	..	..	..	..	..	..	..	..	..	..
14–15	88·10	11·90	2·97	2·62	·38	5·25	·68	6·83	·30	·55	41·40	58·60	28·18	2·25
15–16	88·00	12·00	3·01	2·54	·35	5·44	·66	6·99	·30	·54	42·20	57·80	27·21	2·30
16–17	88·22	11·78	2·85	2·53	·35	5·37	·68	6·92	·36	·51	40·95	59·05	27·86	2·30
17–18	87·88	12·12	3·21	2·49	·39	5·29	·74	6·87	·34	·54	41·65	58·35	27·08	2·35
18–19	87·80	12·20	3·28	2·65	·40	5·13	·74	6·84	·32	·53	40·45	59·55	28·87	2·35
19–20	87·72	12·28	3·25	2·58	·38	5·43	·64	6·78	·22	·54	41·75	58·25	27·84	2·25
20–21	..	..	..	..	..	..	..	..	..	..	..	..	..	..
21–22	87·92	12·08	3·05	2·63	·38	5·38	·64	6·88	·38	·54	42·25	57·75	28·35	2·30
22–23	87·90	12·10	3·20	2·65	·40	5·17	·68	6·69	·38	·53	40·55	59·45	29·09	2·30
23–24	87·86	12·14	3·13	2·60	·39	5·36	·66	6·82	·35	·52	41·60	58·40	28·44	2·25
24–25	88·00	12·00	3·07	2·64	·38	5·27	·64	6·72	·36	·53	40·80	59·20	28·46	2·25
25–26	88·08	11·92	3·01	2·59	·36	5·56	·60	6·80	·37	·54	41·00	59·00	28·64	2·20
26–27	88·10	11·90	2·99	2·56	·36	5·31	·68	6·84	·40	·54	40·35	59·65	30·24	2·20
27–28	..	..	..	..	..	..	..	..	..	..	..	..	..	..
28–29	87·98	12·02	3·03	2·57	·36	5·40	·66	6·79	·37	·54	40·85	59·15	29·58	2·25
29–30	88·00	12·00	3·07	2·52	·39	5·34	·68	6·71	·37	·55	40·75	59·25	29·78	2·20
30–31	87·88	12·12	3·11	2·48	·38	5·49	·66	6·81	·42	·56	41·60	58·40	29·14	2·30
Average	87·99	12·01	3·05	2·59	·37	5·32	·68	6·86	·33	·53	41·23	58·77	28·29	2·29

RECORD OF OBSERVATIONS MADE AT THE BATH AND

1	2	3	4	5	6	7	9		10	11
	Relating to Evening's Milk.									
			At Night.				In Morning.			
Day of Month.	Name of Fields.	Volume of Milk.	Time.	Temp. of Dairy.	Temp. of Milk.	Acidity.	Temp. of Dairy.		Temp. of Milk.	Acidity.
		galls.	P.M.				min.	max.		
	June.									
4–5	Commons:— Hyatt's Common . .	68	5.10	68	86	·18	66	69	68	·19
5–6	Ditto	73	6.20	68	87	·18	64	68	70	·19
6–7	Ditto	70	6.25	69	88	·18	64	69	70	·20
7–8	Ditto	69	6.10	71	92	·19	62	71	70	·20
8–9	Ditto	73	6.20	71	90	·18	63	71	71	·19
9–10	Ditto	73	6.25	71	90	·18	64	71	71	·19
	Average	71	..	69	89	·18	64	70	70	·19
	July.									
2–3	Clapp's Corner, Mixed .	57	5.10	75	91	·18	69	75	72	·21
3–4	Ditto	61	6.15	77	93	·18	67	76	72	·18
4–5	Thirty Acres, Mixed . .	64	6.20	72	90	·18	67	72	70	·18
5–6	Ditto	63	6.10	71	88	·17	66	73	71	·19
6–7	Ditto	60	6.20	74	89	·18	67	76	73	·19
7–8	Clapp's Corner . . .	63	6.15	76	92	·18	69	78	74	·18
	Average	61	..	74	90	·18	67	75	72	·19
	August.									
6–7	Common Mead, Inside Commons	64	5.15	66	86	·19	65	66	70	·21
7–8	Ditto	70	6 30	71	92	·19	65	72	72	·20
8–9	Ditto	69	6.25	72	93	·19	66	74	73	·20
9–10	Ditto	67	6.50	77	90	·18	69	78	74	·20
10–11	Middle Commons . . .	69	6.55	71	89	·19	69	74	74	·20
11–12	Ditto	68	6.55	73	88	·19	69	74	74	·20
	Average	68	..	71	89	·19	67	73	73	·20
	September.									
3–4	Thirty Acres, Hyatt's Common	48	5.55	70	88	·19	63	71	67	·19
4–5	Ditto	53	6.45	69	87	·18	62	72	68	·19
5–6	Ditto	52	7.0	70	88	·18	62	73	66	·19
6–7	Ditto	50	6.35	71	87	·18	66	71	71	·19
7–8	Ditto	52	6.40	70	88	·18	64	72	67	·19
8–9	Ditto	51	6.30	68	86	·18	64	70	67	·19
	Average	51	..	70	87	·18	63	71	68	·19

WEST OF ENGLAND SOCIETY'S CHEESE SCHOOL, 1893.

12	13	14	15	16	17	18	19	20	21	22	23
MORNING'S MILK.				MILK HEATED.		STALE WHEY.		RELATING TO MIXED MILK, &c.			
Name of Fields.	Vol. of Milk.	Acidity.	Total Vol. of Milk.	Quantity.	Temp.	Vol.	Acidity.	Acidity before Renneting.	Time of Renneting.	Rennet Added. Vol.	Rennet Added. Proportion
	galls.		galls.	galls.		galls.			A.M.	ounces.	
				JUNE.							
Commons :— Hyatt's Common	88	·18	156	32	90	1½	·36	·19	7.15	2·60	9600
Ditto	82	·17	155	34	90	none	..	·19	7.15	2·75	9018
Ditto	78	·18	148	46	84	1	·39	·19	7.18	2·63	9000
Ditto	75	·19	144	29	90	1	·42	·20	7.15	2·56	9000
Ditto	77	·19	150	33	85	none	..	·19	7.5	2·66	9022
Ditto	69	·18	142	42	90	1	·38	·19	7.50	2·52	9016
.. ..	78	·18	149	..	..	..	·39	·19	7.20	2·60	9109
				JULY.							
Clapp's Corner, Mixed Fields .	73	·18	130	37	82	1	·35	·21	7.26	2·36	8813
Ditto	62	·17	123	22	90	none	..	·18	7.1	2·23	8825
30 Acres, Mixed .	68	·17	132	32	90	none	..	·18	7.22	2·40	8800
Ditto	72	·18	135	26	86	none	..	·18	7.15	2·45	8816
Ditto	73	·17	133	26	81	none	..	·18	7.32	2·41	8829
Ditto	67	·17	130	26	83	none	..	·18	7.12	2.36	8813
.. ..	69	·17	130	..	..	..	..	·18	7.18	2·37	8816
				AUGUST.							
Common Mead, Inside Common . .	84	·18	148	36	84	none	..	·19	7.37	2·69	8803
Ditto	77	·19	147	29	87	none	..	·20	7.35	2·67	8809
Ditto	73	·19	142	33	84	none	..	·19	7.32	2·58	8806
Ditto	71	·19	138	23	84	none	..	·20	7.38	2 50	8834
Middle Commons .	70	·18	139	28	82	none	..	·20	7.40	2·52	8825
Ditto	76	·19	144	26	84	none	..	·20	7.44	2·61	8827
.. ..	75	·19	143	..	..	..	..	20	7.38	2·59	8817
				SEPTEMBER.							
Thirty Acres, Hyatt's Common .	66	·19	114	27	87	1	·36	·19	7.39	2·07	8811
Ditto	61	·18	114	34	90	1	·45	·19	7.52	2·07	8811
Ditto	61	·18	113	41	90	1	·44	·19	7.53	2·05	8819
Ditto	60	·18	110	28	88	1	·44	·20	7.50	2·00	8800
Ditto	59	·18	111	36	90	1	·41	·18	7.47	2·01	8835
Ditto	60	·18	111	39	90	1	·40	·19	7.44	2·01	8835
.. ..	61	·18	112	..	..	..	·42	·19	7.47	2·03	8818

RECORD OF OBSERVATIONS MADE AT THE BATH AND

	24	25	26	27	28	29	30	31	32	33	34	34a	35
Day of Month.	Time when Curd cut.	Acidity of Whey before breaking.	Time of breaking.	Acidity of Whey put aside.	Time Scalding commences.	Temp. of Scald. 1st	2nd	Time taken in stirring.	Time in Scald.	Relating to Whey. Temp. when drawn.	Acidity.	Volume.	Acidity of draining from piled Curd.
	A.M.		A.M.		A.M.			min.	h. m.				
June.													
4–5	8.0	·12	8.20	·14	9.35	88	92	30	1 30	90	·23	145	·42
5–6	8.0	·12	8.17	·12	9.5	88	92	30	1 25	91	·16	143	·19
6–7	8.5	·12	8.25	·13	9.20	88	94	35	1 35	92	·19	142	·28
7–8	8.3	·13	8.20	·14	9.23	88	94	15	1 12	92	·22	137	·34
8–9	7.52	·12	8.20	·12	9.19	88	94	33	1 59	92	·15	142	·19
9–10	8.35	·13	8.55	..	9.48	88	94	20	1 7	92	·21	135	·32
Average ..		·12	..	·13	..	88	94	27	1 28	91	·19	141	·29
July.													
2–3	8.10	·14	8.26	·14	9.20	89	94	45	1 35	92	·16	123	·19
3–4	8.0	·11	8.26	·11	9.22	88	94	60	2 48	91	·16	117	·25
4–5	8.22	·11	8.50	·11	9.40	88	94	60	2 10	91	·22	126	·36
5–6	8.15	·11	8.42	·12	9.55	88	94	60	2 5	91	·16	127	·22
6–7	8.33	·12	8.56	·12	9.50	88	95	30	1 30	93	·22	125	·30
7–8	8.12	·11	8.35	·13	9.34	88	94	35	1 46	91	·21	122	·32
Average ..		·12	..	·12	..	88	94	48	1 59	91	·19	123	·27
August.													
6–7	8.27	·12	8.50	·13	9.46	88	94	37	1 40	92	·20	140	·28
7–8	8.30	·12	8.55	·12	9.50	88	94	40	1 50	92	·18	137	·25
8–9	8.26	·12	8.51	·13	9.40	88	94	37	1 35	92	·18	133	·29
9–10	8.23	·13	8.47	·13	9.40	88	94	30	1 30	92	·20	132	·30
10–11	8.38	·12	9.3	·12	9.55	88	94	60	1 57	91	·15	130	·19
11–12	8.40	·12	9.4	·13	9.57	88	94	47	1 47	92	·19	132	·27
Average ..		·12	..	·13	..	88	94	42	1 43	92	·18	134	·26
September.													
3–4	8.38	·12	9.0	·12	9.56	88	94	40	1 44	92	·15	106	·26
4–5	8.39	·12	9.5	·13	9.40	88	94	35	1 45	92	·19	105	·28
5–6	8.47	·11	9.17	·12	10.13	88	94	30	1 27	92	·17	106	·26
6–7	8.50	·12	9.23	·12	10.15	88	94	35	1 30	92	·17	102	·27
7–8	8.40	·12	9.9	·12	9.57	88	94	53	1 42	91	·18	103	·29
8–9	8.40	·12	9.8	·12	10.0	88	94	53	1 48	91	·20	104	·28
Average ..		·12	..	·12	..	88	94	41	1 39	92	·18	104	·27

WEST OF ENGLAND'S SOCIETY'S CHEESE SCHOOL, 1893—*contd.*

36	37	38	39	40	41	42	43	44	45	46	47		48	49	
			Acidity of Whey during Treatment.								Salt Added.				
Time Curd remains piled.	Time Curd taken from tub.	Temp. of Curd when taken from tub.	When taken to Cooler.	After 1st cutting.	After 2nd cutting.	After 1st turning.	After 2nd turning.	After 3rd turning.	After 4th turning.	Acidity of Curd when milled.	Weight.		Percentage.	Temp. of Dairy.	
min.	P.M.										lbs.	oz.		min.	max.
						JUNE.									
15	11.55	94	·53	·57	·73	·88	·95	..	..	2·80	3	7	2·17	61	70
60	12.0	91	·35	·50	·65	·78	·85	·91	..	3·26	3	6	2·13	66	73
35	12.7	92	·53	·70	·87	·96	..	..	..	3·40	3	2	2·11	67	74
10	11.15	92	·49	·67	·84	·96	..	..	..	2·60	3	2	2·12	67	72
43	12.35	92	·32	·45	·59	·72	·82	·95	..	3·00	3	3	2·17	66	74
10	11.35	92	·48	·69	·82	·92	..	..	..	2·80	3	2	2·08	65	72
..	11.54	92	..	..	..	..	..	..	..	2·97	3	4	2·13	65	72
						JULY.									
42	12.8	92	·24	·29	·36	·40	·54	·57	..	..	2	12	2·16	67	79
20	1.0	91	·31	·42	·59	·72	·80	..	..	..	2	9	2·13	69	77
15	12.25	91	·49	·66	83	..	..	..	..	..	2	13	2·12	63	74
25	12.45	92	·40	·61	·74	·82	..	..	..	..	2	13	2·10	68	78
20	12.10	93	·48	·62	·80	·91	..	..	..	..	2	12	2·03	70	78
17	12.5	92	·50	·71	·92	..	..	..	..	..	2	12	1·99	71	77
..	12.25	92	..	..	..	..	..	..	..	..	2	12	2·09	68	77
						AUGUST.									
26	12.20	91	·47	·64	·80	·87	..	..	..	..	3	5	2·15	66	74
25	12.33	93	·43	·57	·73	·80	·89	..	..	..	3	5	2·21	67	77
30	12.15	93	·50	·68	·81	·90	..	..	..	..	3	3	2·14	70	80
24	12.8	92	·48	·67	·80	·91	..	..	..	..	3	1	2·12	72	78
35	12.55	91	·35	·49	·67	·75	·75	·88	·92	..	3	1	2·11	71	76
25	12.40	93	·46	·65	·81	·91	..	..	..	..	3	3	2·12	71	77
..	12.28	92	..	..	..	..	..	..	..	..	3	3	2·14	69	77
						SEPTEMBER.									
33	12.35	93	·44	·60	·79	·91	..	..	..	..	2	9	2·07	65	73
23	12.20	91	·46	·64	·79	·91	..	..	..	..	2	9	1·99	66	75
29	12.35	92	·35	·56	·75	·85	·88	..	..	..	2	8	2·01	61	75
32	12.45	93	·42	·57	·70	·80	·87	..	..	..	2	7	2·05	68	75
38	12.43	92	·40	·58	·71	·82	·85	·93	..	..	2	8	2·01	66	73
31	12.46	92	·46	·63	·78	·88	·94	..	..	..	2	8	2·01	64	72
..	12.37	92	..	..	..	..	..	..	..	..	2	8	2·02	65	74

RECORD OF OBSERVATIONS, 1893—*continued.*

	50	51	52	53	54	55	56		57		58		59	
	Relating to Curd.			Relating to Cheeses.										
							Temp. of Cheese Room.				Hygrometer.			
Day of Month.	Temp. in Vat.	Weight when Vatted.	Time of Vatting.	Acidity of Liquid from Press.	Weight taken to Cheese Room.	Loss in Press.	Morning.		Evening		Morning.		Evening.	
							Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max
		lbs.	P.M.	Per cnt.	lbs.	lbs.								
					JUNE.									
4–5	78	158½	2.20	·97	144½	14	63	66	64	66	63	66	63	66
5–6	78	158	5.10	·91	145½	12½	64	66	66	68	63	66	66	69
6–7	79	148	3.40	1·00	135½	12½	66	68	66	68	64	67	66	70
7–8	80	147½	2.0	1·09	134	13½	67	69	67	69	65	68	67	70
8–9	76	146½	7.5	1·07	134½	12	67	69	67	69	65	69	67	71
9–10	78	150	1.55	1·01	137½	12½	68	70	68	69	65	69	66	70
Average	78	151½	3.41	1·01	138½	13	66	68	66	68	64	67	66	69
					JULY.									
2–3	78	127½	10.30	·80	117	10½	68	72	70	73	67	71	69	74
3–4	81	120½	4.45	·92	111½	9	68	73	67	69	65	70	65	69
4–5	80	132½	3.5	·95	124½	8	68	72	68	69	66	70	67	71
5–6	83	133½	3.50	·92	122½	11	67	69	67	69	65	69	67	70
6–7	83	135½	3.25	·86	129	6½	67	70	68	93	66	69	69	94
7–8	82	138	2.45	·91	128½	9½	69	73	69	71	68	71	68	72
Average	81	131	4.45	·89	122	9	68	71	68	74	66	70	67	75
					AUGUST.									
6–7	81	154	3.40	·91	142	12	64	68	65	69	65	68	66	69
7–8	80	149½	4.45	·90	140½	9	66	68	66	69	65	68	66	69
8–9	83	149	3.40	·91	137	12	66	68	68	71	66	69	67	72
9–10	81	144½	3.5	·94	134½	10	69	71	69	71	67	71	66	70
10–11	80	145	6.18	·85	135½	9½	67	70	69	72	68	71	69	72
11–12	83	150	3.57	·87	137½	12½	69	71	68	72	68	71	68	71
Average	81	149	4.14	·90	138	11	67	69	67	71	66	70	67	70
					SEPTEMBER.									
3–4	79	123½	3.43	1·00	112½	11	66	69	66	69	66	69	65	69
4–5	79	128½	3.40	·99	120	8½	66	68	67	69	64	68	65	69
5–6	78	124½	4.35	·91	115	9½	66	69	65	68	66	68	64	68
6–7	79	119	4.47	·89	110½	9½	67	70	64	68	66	69	64	68
7–8	77	124½	6.0	·93	114½	10	66	70	67	68	65	68	64	68
8–9	76	124½	4.40	·93	115	9½	65	67	65	67	64	67	64	68
Average	78	124	4.34	·94	114½	9½	66	69	66	68	65	68	64	68

RECORD OF ANALYSES, 1893.

ay of onth.	Composition of Milk.							Composition of Whey.			Composition of Curd.			
	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	Ash.
						JUNE.								
4-5	87·76	12·24	3·25	2·36	·36	5·61	·66	6·74	·27	·53	41·90	58·10	28·92	2·20
5-6	87·82	12·18	3·18	2·63	·35	5·36	·66	6·81	·25	·56	39·55	60·45	30·18	2·40
6-7	88·16	11·84	3·00	2·90	·36	4·98	·60	6·66	·32	·54	39·60	60·40	29·92	2·40
7-8	88·04	11·96	3·04	2·66	·35	5·25	·66	6·73	·38	·54	40·85	59·15	29·56	2·30
8-9	88·16	11·84	2·83	2·64	·35	5·34	·68	6·79	·34	·57	39·60	60·40	29·70	2·25
9-10	87·90	12·10	3·16	2·70	·35	5·23	·66	6·91	·32	·55	41·75	58·25	29·78	2·15
verage	87·97	12·03	3·08	2·65	·35	5·30	·65	6·77	·31	·55	40·54	59·46	29·68	2·28
						JULY.								
2-3	87·88	12·12	3·00	2·50	·31	5·63	·68	6·84	·40	·55				
3-4	88·00	12·00	3·15	2·48	·34	5·37	·66	6·64	·35	·56	38·50	61·50	30·80	2·60
4-5	88·10	11·90	2·99	2·47	·32	5·44	·68	6·57	·31	·53	41·30	58·70	28·44	2·35
5-6	87·68	12·32	3·44	2·61	·34	5·23	·70	6·63	·41	·55	39·70	60·30	30·92	2·45
6-7	87·96	12·04	3·17	2·36	·34	5·49	·68	6·62	·40	·55	40·55	59·45	29·35	2·20
7-8	87·56	12·44	3·48	2·53	·36	5·41	·66	6·79	·42	·56	41·15	58·85	29·94	2·30
verage	87·86	12·14	3·20	2·49	·34	5·43	·68	6·68	·38	·55	40·24	59·76	29·89	2·38
						AUGUST.								
6-7	87·94	12·06	3·12	2·63	·35	5·30	·66	6·59	·39	·54	40·80	59·20	28·91	2·25
7-8	87·94	12·06	3·20	2·65	·33	5·20	·68	6·52	·35	·57	40·40	59·60	28·78	2·40
8-9	87·76	12·24	3·25	2·84	·35	5·14	·66	6·62	·34	·54	41·40	58·60	29·00	2·30
9-10	87·78	12·22	3·26	2·73	·34	5·23	·66	6·58	·33	·55	40·80	59·20	28·98	2·35
0-11	87·80	12·20	3·20	2·90	·33	5·09	·68	6·52	·37	·54	41·10	58·90	28·50	2·30
1-12	87·94	12·06	3·08	2·86	·35	5·07	·70	6·72	·35	·56	41·60	58·40	28·42	2·30
verage	87·86	12·14	3·19	2·77	·34	5·17	·67	6·59	·35	·55	41·02	58·98	28·76	2·32
						SEPTEMBER.								
3-4	87·36	12·64	3·69	2·99	·34	4·94	·68	6·73	·38	·55	40·80	59·20	29·07	2·30
4-5	87·34	12·66	3·62	2·96	·36	5·06	·66	6·77	·45	·53	41·40	58·60	29·00	2·25
5-6	87·60	12·40	3·41	2·97	·38	4·98	·66	6·69	·36	·56	41·25	58·75	28·32	2·35
6-7	87·64	12·36	3·37	2·92	·36	5·01	·70	6·81	·37	·55	40·75	59·25	27·98	2·30
7-8	87·34	12·66	3·62	2·98	·36	5·02	·68	6·76	·39	·54	40·60	59·40	29·07	2·35
8-9	87·54	12·46	3·46	2·90	·35	5·07	·68	6·75	·39	·54	40·95	59·05	30·78	2·30
verage	87·47	12·53	3·53	2·95	·36	5·01	·68	6·75	·39	·54	40·96	59·04	29·04	2·31

RECORD OF OBSERVATIONS MADE AT THE BATH AND WEST

1	2	3	4	5	6	7	9		10	11
	RELATING TO EVENING'S MILK.									
			At Night.				In Morning.			
Day of Month.	Name of Fields.	Volume of Milk.	Time.	Temp. of Dairy.	Temp. of Milk.	Acidity.	Temp. of Dairy.		Temp. of Milk.	Acidity.
		galls.	P.M.				min.	max.		
1–2	Common Mead, Horses .	36	5.15	63	83	·18	57	63	63	·19
2–3	Ditto	37	6.20	63	85	·19	57	65	65	·20
3–4	Ditto	41	6.5	62	84	·18	57	63	64	·20
4–5	Ditto	40	6.15	60	85	·19	57	63	62	·20
5–6*	Ditto	38	6.22	62	83	·19	57	65	68	·20
6–7	Ditto	35	6.12	62	85	·19	57	60	66	·20
Average		38	..	62	84	·19	57	63	65	·20

* This was an Experimental Cheese, and in calculating the Averages, the figures relating the are discarded.

	24	25	26	27	28	29	30	31	32	33	34	34a	35
						Temp. of Scald.				RELATING TO WHEY.			
Day of Month.	Time when Curd cut.	Acidity of Whey before breaking.	Time of breaking.	Acidity of Whey put aside.	Time Scalding commences.	1st	2nd	Time taken in stirring.	Time in Scald.	Temp. when drawn.	Acidity.	Volume.	Acidity of draining from piled Curd.
	A.M.		A.M.		A.M.			min.	h. m.			galls.	
1–2	8.50	·12	9.15	·13	10 3	88	92	42	1 22	90	·21	82	·29
2–3	8.38	·12	9.5	·13	9.53	88	92	50	1 32	90	·21	74	·30
3–4	8.33	·12	9.5	·13	9·54	88	92	37	1 29	90	·22	78	·30
4–5	8.38	·13	9.2	·13	9.50	88	92	30	1 30	91	·21	76	·29
5–6	8.30	..	8.40	·12	9.56	96	106	30	0 56	102	·13	72	·15
6–7	8.31	·12	9.0	·12	9.51	88	92	30	1 29	92	·15	71	·18
Average ..		·12	..	·13	..	88	92	36	1 28	90	·20	75	·27

OF ENGLAND SOCIETY'S CHEESE SCHOOL, OCTOBER, 1893.

12	13	14	15	16	17	18	19	20	21	22	23
MORNING'S MILK.			Total Vol. of Milk.	MILK HEATED.		STALE WHEY.		MIXED MILK, &c.			
Name of Field.	Vol. of Milk.	Acidity.		Quantity.	To Temp.	Vol.	Acidity.	Acidity before Renneting.	Time of Renneting.	Rennet Added. Vol.	Rennet Added. Proportion by Volume.
	galls.		galls.	galls.					A.M.	ounces.	
Common Mead, Horses . . .	53	·20	89	33	89	2	·37	·20	7.55	1·61	8845
Ditto	44	·19	81	28	90	2	·39	·20	7.40	1·47	8816
Ditto	46	·19	87	35	85	2	·39	·20	7.43	1·58	8810
Ditto	43	·19	83	30	87	2	·40	·20	7.46	1·50	8853
Ditto	44	·20	82	35	87	none	..	·20	7.42	1·88	6979
Ditto	42	·19	77	32	84	2	·18	·20	7.43	1·40	8800
	45	·19	83	..	..	..	·35	·20	7.45	1·51	8825

36	37	38	39	40	41	42	43	44	45	46	47	48	49	
			ACIDITY OF WHEY DURING TREATMENT OF CURD.								SALT ADDED.		Temp. of Dairy.	
Time Curd remains piled	Time Curd was taken from Tub.	Temp. of Curd when taken from Tub.	When taken to Cooler.	After 1st Cutting.	After 2nd Cutting.	After 1st Turning.	After 2nd Turning.	After 3rd Turning.	After 4th Turning.	Acidity of Curd when Milled.	Weight	Percentage.		
min.	P.M.										lbs. oz.		min.	max.
30	12.26	91	·47	·59	·77	·89	..	..	..	..	2 4	2·10	58	68
25	12.15	92	·48	·63	·78	·86	·93	1·03	..	..	2 2	2·05	59	66
28	12.15	91	·46	·58	·73	·84	·95	..	..	..	2 3	2·01	60	65
30	12.15	93	·48	·63	·72	·92	..	..	..	..	2 2	2·02	58	67
10	11.15	105	·15*	..	..	..	..	..	..	..	2 2	2·10	59	67
35	12.20	92	33	·52	·71	·86	·92	..	..	..	2 0	2·06	58	66
..	12.18	92	..	..	..	..	..	..	..	..	2 2	2·06	59	66

RECORD OF OBSERVATIONS, OCTOBER, 1893—*continued.*

	50	51	52	53	54	55	56		57		58		59		(
	Relating to Curd.			Relating to Cheeses.											W
							Temp. of Cheese Room.				Hygrometer Reading.				Cl
Day of Month.	Temp. in Vat.	Weight when Vatted.	Time of Vatting.	Acidity of Liquid from Press.	Weight taken to Cheese Room.	Loss in Press.	Morning. Min	Morning. Max.	Evening. Min.	Evening. Max.	Morning. Min.	Morning. Max.	Evening. Min.	Evening. Max.	w s
		lbs.	P.M.		lbs.	lbs.									
1–2	76	107	4.0	·90	100	7	59	63	59	62	59	62	58	61	[illegible]
2–3	74	103½	4.45	1·01	98½	5	59	61	59	60	58	61	59	61	[illegible]
3–4	74	108½	3.45	·97	101½	7	58	60	58	61	57	60	58	61	[illegible]
4–5	77	105½	3.25	·93	99	6½	56	59	57	60	56	59	58	60	[illegible]
5–6	71	101	8.30	·77	92	9	58	59	58	61	57	59	58	60	[illegible]
6–7	73	97	4.10	·95	88½	8½	57	58	57	60	57	59	57	60	[illegible]
Average	74	104	4.1	·95	97	7	58	60	58	61	57	60	58	60	[illegible]

RECORD OF ANALYSES, OCTOBER, 1893.

	Composition of Milk.							Composition of Whey.			Composition of Curd.			
Day of Month.	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	A
1–2	86 60	13·40	4·24	3·32	·51	4·65	·68	6·64	·43	·56	40·80	59·20	29·72	2
2–3	86·38	13·62	4·27	3·35	·46	4·88	·66	6·73	·44	·54	41·20	58·80	29·29	2
3–4	86·60	13·40	4·28	3·20	·43	4·81	·68	6·62	·43	·54	40·45	59·55	29·96	2
4–5	86·52	13·48	4·25	3·19	·45	4·91	·68	6·85	·47	·56	40·95	59·05	31·13	2
5–6	85·96	14·04	4·75	2·91	·46	5·26	·66	6·93	·52	·54	41·40	58·60	29·54	2
6-7	87·00	13·00	4·01	2·90	·43	5·00	·66	6·82	·39	·55	40·50	59·50	29·56	2
Average	86·51	13·49	4·30	3·14	·46	4·92	·67	6·76	·45	·55	40·88	59·12	29·87	2

No explanation of the preceding tables is necessary, the results being obtained in an exactly similar manner to that described in detail in previous Reports.

THE RECORD OF ANALYSES OF MILK, &c.

Last year, great difficulty was found, for many days during the season, in making the analysis of the milk; fortunately there was no difficulty this year, so that the records during the months of April and May are complete.

ANALYSES OF THE CHEESES.

A very large number of analyses have been made of the cheeses when ready for sale, the results of which are given in the following table:—

COMPOSITION OF CHEESES.

Made.	Sampled.	Water.	Fat.	Casein, &c.	Mineral Matter.
April 5	July 17	34·55	32·48	29·42	3·55
„ 14	„ 17	35·05	32·49	28·76	3·70
„ 18	„ 17	36·40	30·80	29·20	3·60
„ 21	„ 17	35·95	31·08	29·57	3·40
May 4	August 15 ..	35·50	29·15	31·05	4·30
„ 10	„ 15 ..	35·50	32·20	28·25	4·05
„ 17	„ 15 ..	34·35	31·32	30·23	4·10
„ 26	„ 15 ..	36·15	29·94	29·81	4·10
June 3	September 17 ..	35·65	30·47	29·98	3·90
„ 8	„ 17 ..	34·15	31·53	30·37	3·95
„ 16	„ 17 ..	33·35	30·76	31·89	4·00
„ 22	„ 17 ..	32·95	34·65	28·45	3·95
July 4	September 17 ..	33·80	31·27	31·03	3·90
„ 12	„ 17 ..	33·55	31·03	31·32	4·10
„ 19	„ 17 ..	32·85	31·32	31·73	4·10
„ 26	„ 17 ..	34·65	29·70	31·60	4·05
August 4 ..	November 17 ..	36·65	24·00	35·10	4·25
„ 11 ..	„ 17 ..	34·90	28·80	31·90	4·40
„ 18 ..	„ 17 ..	36·45	27·64	31·66	4·25
„ 24 ..	„ 17 ..	35·80	25·76	34·24	4·20
September 1A ..	November 29 ..	35·15	30·26	30·14	4·45
„ 1B ..	„ 29 ..	35·05	28·08	32·82	4·05
„ 2 ..	„ 29 ..	36·10	27·68	31·62	4·60
„ 6 ..	„ 29 ..	36·45	29·38	29·82	4·35
„ 14 ..	„ 22 ..	37·50	26·40	31·90	4·20
„ 15 ..	„ 29 ..	37·15	30·36	28·19	4·30
„ 22 ..	„ 29 ..	37·20	31·58	26·82	4·40
October 2 ..	December 28 ..	37·73	30·80	27·94	3·53
„ 6 ..	„ 28 ..	36·40	31·20	28·20	4·20
„ 14 ..	„ 28 ..	36·73	34·64	22·77	3·86
„ 20 ..	„ 28 ..	37·40	33·44	25·46	3·70

III.—THE BACTERIOLOGICAL INVESTIGATION.

After writing my Report for the Journal last year, the Board of Agriculture asked me to furnish a special Report upon the bacteriological work done in connection with these experiments. This was published in the "Report on Grants to Agricultural and Dairy Schools, &c.," and those who are interested in this work should read that portion of the Report.

The work done this year has been most laborious, and it is to be regretted that it is not possible to set forth the results of such work in terms which can be easily understood by those who are not acquainted with bacteriology. I must therefore confine my remarks to a very simple statement of facts, and try and point out their practical bearing for the cheese-maker.

During April and May the milk showed no very special peculiarity, only those organisms being found in it which have been found on previous occasions. The cheeses were good, and no very special difficulty presented itself; but towards the end of May, the milk began to change, and the curd lost that sweetness which it had had before. From that time to the end of the season the curd produced was in no single instance of that quality and flavour which, for the most part, characterised the curd made at Vallis in 1891, and at Axbridge in 1892. One result of this has been most annoying. It prevented any experiment being made in which the milk should be inoculated with a pure culture of bacteria in order to see if similar results could be produced artificially as were produced naturally. The defects of the curd—for it is not until the curd is taken out of the tub that the presence of some taints is distinctly noticeable—may be stated to be three in number. First, as being the one which was almost constant, was a fæcal smell, which, though very faint at first, became quite strong before the curd was vatted, and was so unpleasant on some occasions that it made one feel quite sick to be near the curd for any length of time.

When this peculiar smell was present, Miss Cannon informed me that it was most difficult to know whether the curd had attained sufficient acidity for grinding or not. The acidity apparatus was found of very great advantage in helping to determine this most important point. Miss Cannon takes so much interest in the observations that it was not possible to prevent her seeing the results obtained by the chemical test for acidity, and therefore it soon became evident to her that the best results were obtained when the acidity was high.

As illustrating the difficulty of judging the acidity when this taint was present, it may be mentioned that upon one such occasion Mr. Cannon happened to visit the dairy. I asked him if in his opinion the curd was fit to grind. After examining it carefully, he said that it was; but, judging from the acidity test, it was not. However, I thought it would be a good experiment to have it ground then, and to try, when the cheese was ripe for sale, whether he was right or not. This cheese was made on the 25th June, and was tasted by Mr. Hill, Mr. Cannon himself, and Mr. Gibbons on the 17th September. The result was a very inferior cheese.

The second taint was one which I have met on a few previous occasions, and is similar to the smell of an out-of-the-way chemical compound 'aldehyde.' When present, the curd sours very rapidly, and requires to be closely attended to. Such was the cheese made on the 27th of April, which was put away at 2.6 P.M., although the average time of vatting for the month was 4.34 P.M.; it will also be noticed that though the acidity of the whey coming from the curd after second cutting was only 94 per cent., yet the acidity of the whey, or liquid, from press was 1·12, which is very high. On the 16th and 21st of May, similar rapid development of acidity took place; in the one instance the cheese being vatted at 12.55, and in the other at 2.10, although the average of the month was as late as 4.57.

The third taint was that which is well known to cheese-makers, and is the cause of a spongy curd. It was noticed upon several such occasions that the whey had during the night fermented to such an extent that in the morning it was all blistered and frothy. Upon examination under the microscope this whey cream was found to be teeming with bacteria.

Samples of milk, curd, and whey have been examined in dozens of instances when these taints were present, and the number of bacteria found and their variety have given me an enormous amount of work. It may be possible some day to present readers of this Journal with photographs of these bacteria, but at present it would be useless, for it has not yet been possible to prove which are the particular organisms that produce the mischief in each case. Indeed, it may take some years to prove this, for it will be necessary to preserve the various organisms, and to make cheese from milk into which each has been placed.

In the spongy curd alone no less than five distinct organisms have been found, and some idea of the work which has yet to be done may thus be obtained.

One organism in particular has been found so frequently that I am bound to consider that it has much to do with the condition of the milk. It is in every respect, so far as I have been able to make out, exactly similar in its appearance, and growth, and

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in the various forms which it assumes to organisms previously described, but not in connection with the manufacture of cheese.

But the question of most practical importance is, whence do these bacteria come?

In all my former work, the organisms found in the milk have been chiefly impurities gathered from the air. In some instances where they have been of a special character I have been able to trace their source. And in other cases it has been proved that they have no hurtful influence upon the cheese. But every endeavour to trace certain of the organisms present this season has failed. Some I was able to trace; thus, one variety I felt sure was due to sores on the teats of the cows, and, upon examining the strainer over which the milk is passed before it enters the tub, I found a small scab therein, which upon careful microscopical examination was found to contain similar organisms. This trouble with the cows was frequent throughout the season, and invariably the same bacteria were found. They were chains of spherical organisms, and are known as streptococci. Another source of bacteria getting into milk were the flies; these at times were very troublesome. Many will get into the milk during the period of milking, more especially at certain times of the year, and particularly during a very dry and hot season such as the last. Probably milkers take very little heed whether the flies get into the milk or not; but I am certain that it is necessary to prevent this as much as possible. One knows how flies settle upon any dung in a field, they take some of this upon their bodies or feet, and carry it to the cows or any other article upon which they next settle. Now, having examined the bacteria in the dung of cows and horses, I find certain forms present which are not generally, and should not be, in milk. As I found one most characteristic of these in the milk on several occasions, I came to the conclusion that the cows were not being kept as clean as they should be. I inspected the cows, but did not find this supposition borne out by their appearance. The cows were well looked after. The conclusion that I finally arrived at was that the bacteria were carried to the milk by flies. Many investigations were made, and these proved, without doubt, that when flies were very numerous in the milk, bacteria were also numerous.

It has been mentioned, in the beginning of this Report, that the dairy was low and whitewashed. Now whitewash in very warm weather appears to attract flies, hence they were numerous in the dairy during the great heat of the summer, and during that period the milk was more tainted than later on. Again, I noticed that the whey never fermented so badly as when there were large numbers of flies in it.*

It is an accepted fact that milk as it comes from the cow is free from bacteria. Hence the bacteria which get into it before it enters the dairy must come—1st. From the air which it passes through in its passage to the pail. 2nd. From the pail itself. 3rd. From the hands of the milkers. Or 4th. From the teats of the cow. I have already referred to the possibilities of contamination from the teats. The pails were so carefully cleansed that in this instance I do not believe they were the means of introducing bacteria into the milk. One word as to the hands of the milkers. Probably care was taken, certainly careful instructions were frequently given as to the necessity of care in this respect. But man is but mortal, and in hot weather cider is refreshing. Now cider, especially old cider, is very full of bacteria, some of which have certainly been found in the milk, and always will be, if cider is drunk immediately before or during milking. The rapid souring of the curd previously referred to might be brought about by a little cider finding its way into the milk. For this rapid souring is accompanied with a smell more like that of acetic acid than of lactic acid.

Lastly, as to contaminations from the atmosphere, and this undoubtedly is the chief source of trouble. It is at the present day almost, if not quite, impossible to say what organisms can or cannot come from the atmosphere. Fortunately, being consulted by dairy farmers in all parts of the country, it soon came to my knowledge that the troubles which were being felt at the Cheese School were also being met with in other parts of the country. Thus, a cheese-maker in the Midlands sent a sample of milk giving trouble which I submitted to microscopical and bacteriological examination. In it were found exactly the same organisms as were giving so much trouble at the Cheese School, and which I associated throughout with the tainted curd, although as yet there has been no opportunity of proving the assumption correct. Similar results were obtained with milk received from Buckinghamshire, and also from Essex. Enquiries soon brought the information that fermenting curd, and a difficulty in making good cheese, was being found in many places, even by those who were making upon totally different systems. But upon enquiry I was informed that no such difficulty had been met with by the Cheddar Cheesemakers in the West of Scotland. It will be known to most of

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* Referring to former Reports it has been mentioned that taints were most frequent in the past at about hay time. This is usually a time when flies are very troublesome, and that may account for the observed facts.

my readers that the season in the West of Scotland was entirely different to that of the West of England.

Now, if a tainted or peculiar condition of milk appears over a large district, or part of the country, and does not appear in another part, and the only difference that we can find between these localities is a climatic difference, are we not justified in assuming that this had something to do with the presence or absence of the taints in the milk? Though this may not be the only possible explanation, as we know little about the geographical distribution of bacteria.

But we have strong grounds in support of this reasoning if we may judge by analogy. It is a well-known fact that certain diseases are produced by bacteria, that these diseases will at times be prevalent over large areas, and for a certain time, while not present in other parts, and that they will disappear as suddenly as they came. We say that there is an epidemic of a disease. Is it not possible that there are epidemics of diseases or taints which affect milk, brought about by bacteria, just as there are epidemics of diseases among men? This, at least, is the only possible explanation which I can find that will satisfactorily account for the facts which have been very briefly stated in this Report. Even if further work may prove that it is not a tenable hypothesis, I cannot but think that it will be very serviceable as a working hypothesis for guidance in future investigations. It points, however, to the necessity for this research work being extended, and not confined to one part of the country only. Had it not been for what one may almost call mere accident, I should not have been aware of the prevalence of this trouble amongst cheese-makers generally.

With all these various troubles to contend against, the wonder is that Miss Cannon was able to make cheese of such good quality, and the question arises how was this brought about? A careful examination of very many of the cheeses has revealed the fact, that, of the organisms which caused the various taints, only a few varieties survived in the cheeses, and these only in some few of them. What is the explanation of this fact? It is the same as has been given before and emphasised by me in previous Reports, namely:—that sufficient acidity was produced in the curd before it was vatted to ensure the destruction of the invading organism. When the cheese was put up with too little acidity, the taint was more or less perceptible in the cheese. On the other hand, if too much acidity were produced, then the cheese, though it would not be a good one, was at least free from any taint. I shall have to refer to this subject again when speaking of the few experiments which were made during the year.

The Cheeses.—A very large number of cheeses have been most carefully examined in the manner described in my Report of last year. I shall now summarise the facts which have been obtained from this work and from preceding observations. The old theory was, that the ripening of cheese is brought about by the presence of certain bacteria known as the butyric acid bacillus, or Bacillus Amylobacter. To quote the words of no less an authority than De Bary, "the butyric acid fermentation is essential to the ripening of cheese." At least two organisms received this name. The organism which was considered the Bacillus Amylobacter by the earlier writers is, in my opinion, not this organism at all, but is one form of the Oidium Lactis referred to briefly in my Report for 1892. I have only found this organism in one single cheese, and never in a good one. I found it this year for the first time in a cheese which was of very inferior make, cracked, and suffering from the cheese fly. In this it was abundant; hence it is quite possible that it may be abundant in many of the foreign cheeses, which have hitherto been mainly the subject of investigation.

Prazmowski, however, has described a Bacillus Amylobacter which is entirely different to that of the older writers. And this organism I have found in very many of the cheeses, though not in all. It is seldom present in large numbers, and for one of the Bacillus Amylobacter there will be hundreds of other organisms present. It is, therefore, very evident that for cheese of the description made by Miss Cannon, which may be described as moderately quick ripening cheese, the Bacillus Amylobacter plays a very secondary part. What then are the bacteria present in such large numbers? I am not quite prepared to dogmatise upon this point, but the results hitherto obtained all point in one direction, namely, that it is the lactic acid bacillus. In a cheese examined soon after it is made, the bacilli are possessed of all the properties which characterise the Bacillus Acidi Lactici as obtained from milk, but in course of time they seem to lose these properties, as they grow under different conditions. Thus, if a minute portion of new cheese be placed in some sterile milk, the milk curdles within a couple of days. If we keep the cheese, and from time to time place a little in some sterile milk, it will be seen that the power of curdling the milk is slowly being lost. At last it seems to entirely disappear. Yet place some of this same cheese in some milk from which the air is excluded, and the milk will be curdled. Although for a long time it will be possible to obtain a growth of this lactic acid bacillus on gelatine, yet after a time even this is most difficult, and nothing will grow upon a plate culture. The long confinement of the organism apart from the atmosphere appears to change its nature, and causes it to lose its most characteristic property. But the fact remains that it is this lactic acid ferment which has brought about whatever changes have taken place in the cheese, which we describe as "ripening" without exactly knowing what that ripening means.

The deductions which may be drawn from this work are important and conclusive. In the first place it is certain that for the manufacture of the best cheddar cheese, one and only one organism appears to be necessary, namely, the Bacillus Acidi Lactici: all other organisms are unnecessary, and some are detrimental. It is also certain that taints, fermentation, sponginess, a too rapid souring of the curd or a want of sufficient acidity, while generally promoted by careless manipulation, are all due either to the presence of injurious bacteria, or to the absence of those which are essential for the production of a good cheese. We know further that while, by careful manipulation, the Bacillus Acidi Lactici can be encouraged and its growth in sufficient quantity assured, on the other hand the presence of injurious bacteria can be to a large extent prevented by cleanliness. And lastly, while it is not possible to say at present whence come the injurious bacteria, which are occasionally found in milk, yet, by careful manipulation in the manufacture of the cheese, their evil influence may, to a large, extent be counteracted.

IV.—THE EXPERIMENTS AND EXPERIMENTAL CHEESES.

One of the difficulties which the cheese-maker has to contend against, especially in the spring of the year, is the low acidity of the milk, and the slow development of acidity in the process of cheese-making. I am convinced that, sooner or later, science will come to the aid of the cheese-maker in this respect, and my first experiment was directed to this end.

1*st Experiment.* 18th April.—One gallon of whey, the acidity of which was ·35 per cent., was added to the evening's milk at 6.15 P.M., the volume of milk being 52 gallons. The acidity of the remaining sour whey was next morning ·42 per cent. But the acidity of the milk, which in the evening was only ·19, was in the morning ·66 per cent., hence the whole of it was a solid mass of curd. The rennet present in the whey may have had something to do with this result, but the main cause would undoubtedly be the high temperature of the milk, and, as a consequence, the much more rapid development of acidity. A number of experiments were subsequently made with small quantities of whey upon a definite quantity of milk kept at a constant temperature in the incubator. The results are tabulated below, being first calculated to 1000 volumes of milk, so as to make them easier of comparison:—

RESULTS of EXPERIMENTS on the RIPENING of MILK, by addition of WHEY taken from the tub after BREAKING the CURD.

Volume of Milk.	Volume of Whey.	Temp. at which kept.	Milk curdled.	Acidity of the curdled Milk.
				per cent.
1000	10·0	75–85	Before 13 hours	·64
"	5·0	"	"	·62
"	2·5	"	"	·57
"	10·0	67–77	After 15 and before 23 hours	·70
"	5·0	"	" "	·70
"	2·5	"	" "	·69
"	2·0	64–72	19 hours 20 min. after	·65
"	1·0	65-72	22 hours after	·65
"	·5	65–72	22 hours 50 min. after	·64

It will be very evident that the action of sour whey upon the milk is both powerful and uncertain. Therefore it is quite impracticable to use sour whey in the manner I had first thought possible, to raise the acidity of the evening's milk during the early and late months of the cheese-making season. The influence of temperature was also strongly shown in the results obtained. Thus, while 10 parts of whey per 1000 of milk caused the milk to curdle within 13 hours and to show ·64 per cent. of acid, at a temperature of from 75–85° Fahr., the same amount of whey in 1000 of milk kept at from 67–77° Fahr. produced only ·33 per cent. of acid in 13 hours.

We thus see the imperative necessity of keeping the milk and dairy warm at night, during cold weather, if we wish to ensure sufficient ripeness in the milk by the morning.

2nd Experiment.—This was made on the 30th April, the object being to see whether more rapid development of acidity could be obtained, and the value of the cheese enhanced, by adding the whey cream from the previous days' make to the milk in the warmer, so as to get it well mixed with the milk before renneting. The quantity of whey cream was ½ gallon. Very little difference was manifested during the making of the cheese, except that the whey had on its surface an oily appearance, and had a slightly strong smell. By reference to the tables, it will be seen that the addition of the whey cream prompted the souring of the curd; while the fat did not come out again in the whey but enriched the curd. The experiment will have to be repeated, and the value of the practice will have to be judged when the conditions are less favourable to the development of acidity than they were last season. Meantime, where whey butter has but little sale or only at a low price, I think the practice of putting the whey cream back into the next day's milk may be advantageously practised, especially in the early months of the season.

3rd Experiment. 16th June.—For some time the difficulty of getting sufficient acidity in the curd had been very great, so that it was not vatted until late at night. This experiment was made to see if a better result could be obtained by keeping the curd in scald until as much acidity was present in the whey as was present in the milk before renneting.* So slow was the development of acidity that the curd had to be stirred in scald for 1 hour 45 minutes. Even after that, the further development of acidity was very slow, and as I was determined to get the desired acidity, the cheese was not vatted until 10.10 P.M. But the result was worth all the trouble, for when the cheeses were sold this was declared to be "of good flavour and texture, and the best cheese of the month."

This result strongly confirms the conclusions set forth in the Reports for the past two seasons, conclusions which are supported by the results obtained this year, and of which the most important is, that a good cheese will result, even under most unfavourable conditions, provided sufficient acidity be obtained in the curd before it is vatted. It is because, by means of the test for acidity, this condition can be estimated with accuracy and certainty, that I have been able to produce experimental cheeses of good quality, although possessing very little skill in the practice of Cheddar cheese-making. If the use of the test for acidity were learned by young cheese-makers, and its valuable aid utilised in cases of difficulty, we should soon find a marked improvement in the cheese of the County of Somerset.

May I suggest that the use of this apparatus † might be taught in the schools of the county, in connection with the teaching of chemistry.

4th and 5th Experiments. 30th and 31st August.—The milk from Mr. Bethell's cows was kept separate from that of Mr. Hunt's each day, and cheeses were made,—one by Miss Cannon and one by myself,—in an exactly similar manner, in order to determine whether any difference existed between the two milk supplies.

The results were curious. Both the cheeses made on the 30th were poor and tainted, that from Mr. Hunt's milk being the worse. But both the cheeses made on the 31st were very good, that from Mr. Hunt's milk being if anything the better.

* The reasons for this course are fully stated in the Report for 1892.

† See 'Journal,' vol. iii. p. 179.

The fact that the milk supply to the School was from two sources has added considerably to the difficulty of finding out the origin of the taints. I most strongly urge the necessity in all future investigations of confining the source of milk supply to one farm only.

6th Experiment.—The milk on the 1st September was divided in half, Miss Cannon took one-half and made the cheese on her system, and I took the other half and made the cheese on Candy's system, so far as I then understood it. The point which I desired to test was this. In Candy's system the curd is exposed to the air while on the rack, but in Cannon's system it is kept encased in cloths, and with a weight on it. Now, would there be any difference in the two methods as regards the peculiar taint which the curd developed at this stage? The result was most interesting. When Miss Cannon's curd was vatted at 5 P.M. it had the fœtid smell strongly developed, but was otherwise a good curd. In the curd made on Candy's system, the smell was perceptible but not nearly so strong. When the cheeses were cut for sale, no trace of the taint could be found in either, and Miss Cannon's cheese was the better of the two. The superiority of this cheese is easily accounted for, by the fact that cheeses made on Mr. Candy's system are not ready for market so soon as those made on Miss Cannon's system. Hence the cheese, though good, had not then the flavour which would be developed with longer ripening.

The *7th and 8th Experimental Cheeses* were made on 2nd and 14th September respectively, in order to determine some minor details. Upon these no comment is needed. The information yielded will be incorporated subsequently with that from other sources.

V.—OBSERVATIONS ON THE METHOD OF MAKING CHEDDAR CHEESE ADOPTED BY MR. T. C. CANDY.

In 1892 some experiments were made to try the effect of a high scald, and I determined this season to further study a system of Cheddar Cheese-making which depended upon a high scald. The best known of these is Candy's system. To make sure that I understood it, I wrote out a description and sent it to Mr. Candy, whom I have the pleasure of knowing. He returned it in due course, with the information that it was not a sufficiently accurate description of his system in some of the details, and that he thought it would be better for me to come to his place and study the system there. This I did on the 3rd, 4th, and 5th October. On the last day I made the cheese so far as possible myself, Mr. Candy watching me and pointing out and correcting all errors in my manipulation. I have prevailed upon Mr. Candy to give the members of the Society the advantage of a full description of his method of cheese-making (see ('B. and W. of E. Journal,' vol. iv. p. 127), which is, I believe, now published for the first time.

Mr. Candy informed me that, working from purely theoretical premises, I had, in making some of the experimental cheeses of 1892, very closely followed his system without being aware of it. The conclusions to which I came from those experiments were, that in Cannon's system the whey was pressed from the curd mainly by means of acidity, but that in Candy's system the whey would be expelled mainly by means of heat. I may here state that Mr. Candy, in order that I might see how his system was varied to meet different degrees of acidity or ripeness in the milk, was kind enough to take the trouble to obtain the milk each day in a different stage of ripeness. The following table shows the acidity developed in the various stages of manufacture at Mr. Candy's:—

TABLE OF ACIDITIES AT MR. CANDY'S.

—	3rd Oct.	4th Oct.	5th Oct.
Mixed milk before renneting	·20	·205	·21
Whey before breaking	·12	·12	·13
Whey when drawn	·13	·13	·14
Draining from piled curd	·17	·15	·15
First drainings on cooler	·17	·16	·15
Second " "	·21	·19	·17
Third " "	·24	..	..
First draining after cutting	..	..	·22
Second " " "	·33	·30	·31
Third and last draining after cutting	·33	·30	..
Liquid from press	·83	·92	..

If we compare the above figures with the acidities obtained on Cannon's system, it will be at once seen how very slow is the development of acidity in Candy's system.

There can be little doubt that we have here a complete confirmation of the deductions drawn in my last Report, namely, that while Cannon seeks to obtain the necessary dryness of the curd before grinding by means of acidity, Candy obtains that dryness by means of heat. Further, we obtain an insight, for the first time, into what may be considered the principle common to the two systems, namely, to obtain a curd before vatting which shall contain only a certain amount of whey, and that whey possessing a certain acidity.

Unfortunately, I was not able to make analyses of the various products at Mr. Candy's, but I hope in the future an opportunity may be given me of studying his system more thoroughly.

I went direct from Mr. Candy's to the School at Butleigh, and there on the 6th October made a cheese upon his system. The results of the analyses, as well as the facts connected with that cheese, are given in the tables, and it will be seen that the amount of moisture in the curd was almost identical with that which Miss Cannon obtains in her curd. For some reason or another, the acidity did not develop in the curd before grinding so far as I could have wished, the acidity of the liquid from press being only ·77 per cent. Hence, when this cheese was tasted by Mr. Hill on the 28th December, he pronounced it "of good flavour, but not firm enough." But it is only right to state that Mr. Candy informed me cheese made upon his system required longer to ripen than three months, while this experimental cheese was not three months old when tasted. This statement of Mr. Candy's, which it may be taken for granted is based upon experience, is a confirmation of the opinion which I gave as the result of last year's work, namely, "that a cheese made with low acidity requires longer to ripen, and probably a higher temperature, than a cheese with high acidity."

An impression seems to have arisen, from my experiments at the Cheese School, that I am trying to determine the relative merits of Cannon's and Candy's systems. I have no such object. My aim, as a scientific observer, is to try and discover what laws of nature each utilises, and what results each obtains. At the same time I, naturally, compared the two methods and the results obtained therefrom. The conclusion I have come to is, that from the same milk as good a cheese can be made by the one method as by the other. And I have come to another conclusion,—one of far more importance to cheese-makers generally,—that makers who will not endeavour to understand the system they now adopt, and who do not bring cleanliness, forethought, experience, and skill to bear upon their work, will not be able to make a better cheese by the one system than by the other, and will never make excellent cheese by either.

VI.—THE SCOURING LAND OF SOMERSET.

My attention was naturally drawn to these peculiar soils, which are well known, and form one of the remarkable features of Somerset. The scouring land appears to crop up here and there only, and runs in tracts mainly on the higher land, and far less frequently in the hollows. I have given no particular study to this land, but there are one or two points in connection therewith which have an immediate bearing upon the cheese-making, hence my introducing the subject here.

My first attempt was, if possible, to see whether analyses would throw any light upon the cause of their action. Two samples of soil were obtained from typical scouring land, and analysed with the following results:—

ANALYSES OF SOILS (SCOURING LAND).

——	Hutchings.	Bludgeley.
*Organic matter and loss on heating ..	14·40	17·65
Oxide of Iron	10·02	9·55
Alumina	6·83	6·93
Lime	3·20	3·20
Magnesia	1·20	1·00
Potash	·60	·68
Soda	·90	·10
Phosphoric acid	·40	·42
Sulphuric acid	·15	·10
Carbonic acid, &c.	..	·42
Insoluble	62·30	59·95
	100·00	100·00
*Containing nitrogen	·55	·58
Equal to ammonia	·66	·69

My first thought was that the amount of magnesia in the land might account for the herbage grown thereon having a scouring effect. But if we compare these analyses with the analyses made by Dr. Voelcker of the soils in the valley, we see that they are very similar; moreover, the amount of magnesia is not greater than that in the soils of the fields at Axbridge, nor even so great. They show only one peculiarity, an abnormally high percentage of nitrogen. Land containing a high proportion of nitrogen has a very rapid and forcing effect upon vegetation. But this high proportion of nitrogen is as difficult to account for as the scouring effect of the land; so we must leave this problem for the future, and merely point out that if any young chemist desires a good subject for research here is one.

Now, in 1891, I observed that the change of food, when the cows were first given cake, was productive of a taint in the milk. As is well known, a change of diet is productive of a certain amount of scouring, though it may only last a day or two. A similar effect was noted at Axbridge in 1892, and in 1893 it is universally stated by the cheese-makers that it is impossible to make good cheese off "scouring" land.

We may, perhaps, learn one simple lesson from these facts, namely, that no matter where the cows may be, anything which causes them to scour will spoil or deteriorate the cheese. It will introduce fœcal organisms into the milk, and will cause a fœcal smell in the curd, such as was present so frequently at Butleigh, and only the very greatest care will enable the cheese-maker to produce good cheese under such circumstances.

There may be, then, some truth in the notion that upon certain soils it is far more difficult to make good cheese than upon others. The cause, it would seem probable, is not that any peculiar plants form part of the herbage, nor that the composition of the soil is very exceptional, but that several conditions combine to promote a rapid growth of plant life upon a soil rich in magnesia. Salts of magnesia thus enter the plant and have a scouring effect upon the cattle. Even when not marked it might be sufficient to cause a constant effect, which would soon appear so natural as to escape notice. The only remedy that can be suggested at present is scrupulous cleanliness, which, though necessary at all times, is indispensable upon soils of this nature.

VII.—CONCLUSION.

The results of this year's work confirm in every particular the conclusions which have been come to in previous Reports. It is scarcely necessary to reiterate the conclusions come to in this Report.

The work of the three years may be summarised as follows:—

To make Cheddar Cheese of excellent quality, one, and one single organism only is necessary in the milk, that is the Bacillus Acidi Lactici; every other organism present will tend to make the work more difficult. Hence, it is imperative that scrupulous cleanliness be the primary consideration of the farmer and of the cheese-maker, as of all those who have in the least possible respect to deal with the cows, the milk, or the apparatus employed.

Secondly. No matter what system of manufacture be adopted, two things are necessary—two results must be obtained. The one is that the whey be separated from the curd so that when the curd is ground it shall contain not less than 40 per cent. of water, nor more than 43 per cent.; and the other is that the whey left in the curd shall contain developed in it before the curd is put in the press at least 1·0 per cent. of lactic acid, if the cheese is required for sale within four months, and not less than ·8 per cent. of lactic acid, if the cheese is to be kept ripening for a longer period.

Lastly, the quality of the cheeses which comply with the foregoing standards will vary according to the quality of the milk from which they have been made, and, proportionately, to the amount of fat present in that milk. The fat is the constituent which most affects the quality of the cheeses, hence it is not possible to expect the same quality of cheese to be made from land which yields large quantities of poor milk as from land which yields small quantities of rich milk. But, with due care, the larger yield of cheese which can be obtained from the poorer milk should balance in value that of the higher quality which can be made from the richer milk-yielding pastures.

VIII.—FUTURE WORK.

That there is much yet to be learnt must be apparent to all. 1st. It is necessary to still further study the influence of soil upon the yield and quality of milk, and its value for cheese-making.

2ndly. It is necessary to see if there is any reason why so many systems of cheese-making should be adopted, and whether it would not be possible and advantageous to reduce the systems so that the best might be more widely adopted. At present the systems adopted in adjacent dairies are often so distinct that the makers can give little help to one another in time of trouble. This does not tend to improve the method of any of them, while if they were all making upon the same system, there would be common ground of interest and a friendly rivalry which would greatly help to improve the general make throughout the county.

Meantime, science should be at work, trying to solve the problems which arise each year, and in each district. If the cheese-makers themselves would only realise that this work is being done for their good and in order to help them to earn their living; and if they would utilise the School as a centre from which they might gain some little scientific, if not practical, assistance, they would not only help on a good work, but might derive some personal advantage from laying before me the difficulties they had to contend with in their cheese-making.

Mr. Oswald Hewitt assisted me again in the work during the whole period.

I cannot close this Report without thanking Mr. Neville Grenville for the very great personal kindness shown to me, and the material assistance which he rendered in the work. Every one was willing to lend me a helping hand, and to supply any information I required. If in my desire to seek out facts, and get at the root of everything I have at times appeared too inquisitive or been too troublesome, my excuse must be the deep interest I take in striving to conquer the difficulties which are met with by those who manufacture Cheddar Cheese.

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BATH AND WEST AND SOUTHERN COUNTIES SOCIETY.

INSTRUCTION IN CHEESE-MAKING.

Under an arrangement with the Somerset County Council the Society has opened a School, for instruction in Cheddar Cheese-making, at Mark House, Mark, near Highbridge, Somerset, for a period of Six Months, commencing from April 5th last.

The Teacher is Miss Cannon, of Milton Clevedon, Evercreech.

The fee (payable in advance) to Residents in Somerset for a complete course of four consecutive weeks' instruction is £6, which includes board and lodging, the charge to Non-Residents in the County being £8 8*s*.

The following are the rates for shorter periods:—

	Residents in Somerset. £ *s.* *d.*		Non-Residents. £ *s.* *d.*
For the first week (with board and lodging)	2 0 0	..	3 3 0
" second " " "	1 10 0	..	2 2 0
" third " " "	1 10 0	..	1 11 6
" fourth " " "	1 7 6	..	1 11 6
" one day (with board)	1 1 0	..	1 1 0

Day Students are admitted only when the class for longer periods is not full.

If more persons apply to be admitted as Students than can be instructed at any one time, preference is given to the wives, sons, or daughters of dairy farmers and dairymen; the families of Members of the Society having priority.

The number of Students to be instructed at one time is, as a general rule, limited to five, but under exceptional circumstances this number may be exceeded.

Cheese-making commences each morning at seven o'clock, and is carried on all through the week, but it is optional to Students to attend, or not, on Sundays.

Applications to join the School must be made to the Society's Secretary,

THOS. F. PLOWMAN,

April, 1894. 4, *Terrace Walk, Bath.*

BATH AND WEST AND SOUTHERN COUNTIES SOCIETY

FOR THE

Encouragement of Agriculture, Arts, Manufactures and Commerce.

TERMS OF MEMBERSHIP.

ANNUAL SUBSCRIPTIONS.

Governors, who are eligible for election as President or Vice-President, not less than	£2
Ordinary Members, not less than	£1
Tenant farmers, the rateable value of whose holdings does not exceed £200 a-year, not less than	10/-

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Governors may compound for their Subscriptions for future years by payment, in advance, of £20; and Members by payment, in advance, of £10.

Governors and Members who have subscribed for not less than twenty years, may become Life-Members on payment of half these amounts.

Any person desirous of joining the Society can be proposed by a Member, or by the Secretary (THOS. F. PLOWMAN, 4, Terrace Walk, Bath).

SUMMARY OF PRIVILEGES.

GOVERNORS AND ORDINARY MEMBERS.

1. To receive the Society's *Annual Journal* free of expense.
2. To obtain opinions and analyses with regard to Manures, Soils, Feeding Stuffs, &c., at very low rates.
3. To obtain reports and results of examinations of Seeds and Plants at very low rates.
4. To make an unlimited number of Stock and other Entries at the Society's Annual Exhibitions at reduced fees.
5. To be admitted free during *the whole time* of the Annual Exhibition, and to the Reserved Seats in the Grand Stand and the Working Dairy.
6. To use the Special Pavilion for Reading, Writing, &c., provided for Governors and Members attending the Annual Exhibitions.
7. To take part in the Society's Experiments on Crops, &c., and to receive reports thereon.
8. To be admitted free to witness the Teaching and Competitions at any of the Society's Dairy Schools.

10/- MEMBERS.

Members subscribing less than £1 are entitled to all the above-named privileges except No. 4; and, in the case of No. 5, the Ticket is available for *one day only*, instead of the whole time of the Exhibition.

GOVERNORS' SPECIAL PRIVILEGES.

Governors are entitled, in addition to the privileges already mentioned, to an Extra Season Ticket for the Annual Exhibition and for the Reserved Seats in the Grand Stand and the Working Dairy. Governors subscribing more than £2 are entitled to a further Ticket for every additional £1 subscribed.

OBSERVATIONS

ON

CHEDDAR CHEESE-MAKING.

REPORT FOR 1894.

By F. J. LLOYD, F.I.C., F.C.S.

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OBSERVATIONS

ON

CHEDDAR CHEESE-MAKING.

REPORT FOR 1894.

PURSUING the policy which has guided the Society for the past few years with respect to the locality of its Cheese School, a site was selected in 1894 where, according to local tradition, it was not possible to make good cheese. Such a site was found in the parish of Mark, about four miles from Highbridge. To use the words of a local man who spoke to me on the subject, the common opinion was "that no good cheese had been made in Mark for thirty years." Nothing is more striking to an observer of local beliefs than the strong hold which they obtain upon the general inhabitants of a district. It would be difficult to account for them even were they founded on facts over which the inhabitants had no control, but when, as is generally discovered upon investigation, they are mainly founded upon superstition, one feels that no language can be too strong in which to denounce such folly.

So far as can be judged from hearsay, the people in certain parts of Somerset have to a certain extent lost the art of making good Cheddar cheese. There may have been some special causes tending towards this end, included among them being, perhaps, certain difficulties intimately associated with the district, such as a bad water supply, or the dying out of those inhabitants who possessed special skill in the manufacture of cheese, and who were looked upon as guides in all cases of difficulty. From these, and perhaps other causes, the quality of cheese may materially decline in a particular district. After a few years the inhabitants begin to consider it a matter of course that the cheese which they produce will be of poor quality, and they do not seem to attempt to improve it, or to seek for the cause of its inferiority. If they do, then with that perversity characteristic of human nature, they seek for a cause outside themselves, and, as a rule, partly perhaps from their inability to think of any other cause, but partly I fear from interested motives, they put the blame upon the land. Such a tradition had become firmly rooted in the parish of Mark. The land was universally declared to be unsuitable for making cheese, and it was held that no good cheese could be made there.

For three consecutive years the Society's Cheese School has been located in a district where it was said good cheese could not be made, and always because of the nature of the land. On each of these occasions the soils have been analysed by Dr. Voelcker, and in no single instance has he been able to detect the presence of any chemical constituent which would be injurious to the milk or to the cheese made therefrom, or would in any way prevent good cheese being made off such land. The pastures have been carefully examined by the Society's botanist, Mr. Carruthers, and he too has in all cases reported that in these pastures he has been unable to find any weed or plant which would cause the slightest taint in the milk, or which could in any way be considered as even remotely likely to injure the milk, or cause the pasture to be the source of any taint in the cheese. In view of this accumulated evidence, it is devoutly to be hoped that we shall hear less in the future of lands upon which, according to tradition, it is not possible to make good cheese. The sooner this superstition of the West is as dead and buried as is the belief in demons, once so prevalent in the same districts, the better. The belief that the cause of bad cheese lies in the soil is as pernicious as a belief in the evil influence of some supernatural presence; it is a veritable demon destroying all hope of improvement, and preventing all attempts to overcome the difficulties which undoubtedly exist. Let this Somerset tradition die as quickly as possible. It has already been the ruin of far too many people and of the peace of far too many households. It is founded upon superstition, and there is not one jot nor tittle of evidence in support of it. I shall hope to prove in this Report, beyond any possibility of doubt, that the real cause of these failures is not the land. I shall also endeavour to show what they are due to, and to point out the way by which in the future we may hope to obtain sufficient knowledge to enable us to cope with them.

I.—THE CONDITIONS UNDER WHICH THE CHEESES WERE MADE.

THE FARM AND SOIL.

The north-west of the county of Somerset consists of low-lying lands bounded by the Bristol Channel on the one side, on the north-east by the high range of the Mendip hills, and on the south-west by a range of hills, the Quantocks, which run almost parallel to the Mendips. Between these two hills lies a valley exceptionally flat and level, and at the head of the valley inland is the town of Glastonbury. From there the valley gradually widens, and very gently slopes down to the sea, where it ends in a long stretch of low lying land, reaching from Weston on the north to Bridgwater on the south. The parish of Mark is situated in the broad part of this valley, about five miles from the seashore, and almost half-way between Weston and Bridgwater.

The Farm selected for the School was that of Mr. John Peters, of Mark House. The accommodation for the pupils was ample, and a room was also found for the laboratory in which to conduct the scientific work now to be reported upon. The dairy was rather dark and small as compared with some of those which the School has previously had. This would have been a disadvantage in carrying on the experimental work had not every assistance been given me by Mrs. Peters, who placed her warming apparatus at my disposal, so that, in spite of the small size of the dairy, I was able to make more experimental cheeses than usual.

The farm, or rather that portion of it devoted to milch cows, consisted of eight fields, of which two were in the moor, and at some considerable distance off, while the others were close to the house.

In order to maintain, so far as possible, uniformity in the reports on the Cheese School, Mr. Carruthers, the Society's botanist, was asked to visit the farm and inspect the fields This he did on the 7th of August, and has reported thereon as follows :—

REPORT OF MR. WM. CARRUTHERS, F.R.S., ON THE VEGETATION OF THE FARM AT MARK.

The soil is a rich alluvium, and supports a vigorous vegetation. There is great similarity in the elements of the pastures in the various fields. The principal grasses are Cocksfoot (*Dactylis glomerata*), Rye-grass (*Lolium perenne*), Dogstail (*Cynosurus cristatus*), and Squirrel grass (*Hordeum pratense*). These four grasses exist throughout the farm in nearly equal proportions. Cocksfoot is one of the best grasses. It is deep-rooted, and consequently draws its food from a larger and deeper mass of soil than many other grasses, and therefore grows rapidly, producing a large amount of nutritious and palatable food. Rye-grass and Dogstail occupy a lower platform, supplying a lesser quantity of good food; as, however, the bents in pastures consist, to so large an extent, of the seeding heads of these two grasses, they cannot be considered as favourite food of stock. Squirrel tail is a very inferior grass, which in ordinary pastures runs rapidly to seed. But on a rich soil like that at Mark, this grass produces a large amount of nutritious food. Sheep and cattle prosper on some pastures in Somerset where Squirrel tail is, by a long way, the predominant grass. Early in the season it produces a considerable quantity of foliage, which is eaten down in such rich pastures, though when it flowers the long sharp awns which bristle round the head prevent the stock from touching it.

There were in the pastures at Mark also the following grasses: Timothy (*Phleum pratense*), Fiorin (*Agrostis alba*), and Yorkshire fog (*Holcus lanatus*), though in much less quantity than the four grasses already named. Occasional plants of Golden oat-grass (*Avena flavescens*), Brome grass (*Bromus mollis*), and Meadow Fescue (*Festuca pratensis*), were found in the pastures.

All the fields had a thick bottom of White Clover (*Trifolium repens*), and there were throughout some Red Clover (*Trifolium pratense*).

A little Yarrow (*Achillœa Millefolium*) was met with in all the pastures.

As I have already stated, there was very little variation in the different fields. In the three divisions of "Church path ground" there was a larger proportion of Cocksfoot and Yarrow, and the Cocksfoot was somewhat more abundant in the "ten" and "twelve acre" fields.

Excepting the Buttercup, which is seldom touched by the cattle, there was no weed in the fields which could injuriously affect the milk.

The vegetation was vigorous, so that even the inferior grasses supplied a nutritious food to the cows.

(Signed) WM. CARRUTHERS.

It was remarkable how closely the soils in all the fields approached one another in character, so much so that I at first hesitated as to whether it was necessary to send more than one sample to the Society's Consulting Chemist for analysis. I decided, however, to select the two most dissimilar samples, and these were forwarded to Dr. Voelcker, who reported upon them as follows:—

REPORT OF DR. VOELCKER ON THE SOILS.

The soils are very similar in appearance, and they give, moreover, very similar results upon analysis. Indeed, there is no difference between them which calls for special comment.

In appearance the soils were of a greyish-brown to black-brown colour, and they seemed to be somewhat heavy loams of rich nature.

The analytical results were as follows:—

SOILS DRIED AT 212° FAHRENHEIT.

——	Butlake.	Crib House.
*Organic matter and loss on heating	20·11	18·64
Ferrous Oxide	1·10	1·24
Ferric Oxide	4·21	4·05
Alumina	8·28	7·76
Lime	1·43	1·23
Magnesia	1·23	1·13
Potash	1·02	·88
Soda	·66	·62
Phosphoric acid	·26	·24
Sulphuric acid	·13	·11
Insoluble silicates and sand	61·57	64·10
	100·00	100·00
*Containing nitrogen	·83	·78
Nitric acid	·0055	·005
Chlorine	trace	trace

It will be at once seen, by anyone conversant with chemical analysis, that the above results represent soils of great richness. In character they are rather heavy, but their mechanical condition (judging at least from the small samples sent me), is excellent, the rootlets radiating in every direction and keeping the earth open and friable. The samples are very rich in organic vegetable matter, the accumulation, probably, of long continued pasture growth, and they contain much nitrogenous matter derived therefrom.

In phosphoric acid they are also very rich, they have plenty of lime, without the defects of soils too rich in that material, and they are exceedingly well supplied with potash.

(Signed) J. AUGUSTUS VOELCKER.

THE STOCK AND YIELD OF MILK.

The spring of 1894 was exceptionally warm and early, so that when the work of the School commenced on the 1st of April the cows, then only twenty-two in number, were out on the pastures, and remained out during the whole seven months covered by the observations.

The herd was not a special one, the cows, including those subsequently bought by Mr. Peters, being ordinary dairy cows, mainly of shorthorn character. With these purchases the herd numbered fifty-three. From the 1st to the 21st of April they remained in the fields near the house; on the 22nd of April they were sent down to "The Moor."

If we consider the nature of the soil, as shown by Dr. Voelcker's Report, the nature of the herbage, as shown by Mr. Carruthers' Report, and the well-known fact that the year 1894 was exceptionally favourable to growth, we shall at once realise that upon this farm all the conditions were favourable to the production of a large yield of milk.

The table opposite shows the average yield of milk and of cheese therefrom, made during each month of the past four years.

It is a somewhat remarkable fact that the average daily yield of milk per cow at Butleigh, from 1st of May to the end of October in 1893, in spite of the exceptionally unfavourable season, was 27 lbs., and that exactly the same quantity, viz. 27 lbs., was the average daily yield at Mark from the first of May to the end of October, 1894, during a season when food was abundant.

But, while the average quantity of milk yielded daily was exactly the same both at Butleigh and Mark, the composition of that milk was very different. The milk at Mark was of exceptional quality, so that the proportion of cheese made from each gallon of milk was far higher at Mark than at Butleigh. Indeed,

AVERAGE OF RESULTS OBTAINED DAILY FROM 1891 TO 1894.

Month.	Vallis, 1891.					Axbridge, 1892.				
	Vol. of Milk.	Cheese taken from Press.	Cheese when sold.	Shrinkage in ripening.	Cheese from one gallon of Milk.	Vol. of Milk.	Cheese taken from Press.	Cheese when sold.	Shrinkage in ripening.	Cheese from one gallon of Milk.
	galls.	lbs.	lbs.	lbs.	lbs.	galls.	lbs.	lbs.	lbs.	lbs.
April	81	73	69	4	·85	79	70	66	4	·83
May	119	117	111	6	·93	109	102	94	8	·86
June	132	132	123	9	·93	127	122	113	9	·90
July	112	114	107	7	·96	116	115	108	7	·93
August	91	99	91	8	1·00	100	102½	94	8½	·94
September ..	79	87½	82	5½	1·04	84	91	85	6	1·01
October	52	64	59½	4½	1·14	58	68	62	6	1·07

Month.	Butleigh, 1893.					Mark, 1894.					
	Vol. of Milk.	Cheese taken from Press.	Cheese when sold.	Shrinkage in ripening.	Cheese from one gallon of Milk.	Vol. of Milk.	Cheese taken from Press.	Cheese when sold.	Shrinkage in ripening.	Cheese from one gallon of Milk.	Average No. of Cows.
	galls.	lbs.	lbs.	lbs.	lbs.	galls.	lbs.	lbs.	lbs.	lbs.	
April.. ..	106	96	89	7	·84	103	101	96	5	·93	33
May	149	142	132	10	·88	148	148	140	8	·94	50
June	141	130	121½	8½	·85	140	141	132	9	·94	51
July	134	129	122	7	·91	129	131	124	7	·96	52
August ..	134	131½	124	7½	·92	112	118	112	6	1·00	52
September..	102½	109½	104	5½	1·02	100	112	106	6	1·06	53
October ..	68	80	77	3	1·13	74	87	81	6	1·09	53

it was as high as it has been during the past four years, and is almost identical with the yield obtained from the cows fed on the rich hill pastures of Vallis.

It is often asserted that the quality of the food has no influence upon the composition of a cow's milk. I believe such a theory to be utterly opposed to the universal experience of all practical men, and of all properly conducted experiments. And the facts above stated afford perhaps the most striking evidence that has been obtained for some years past of the influence of food upon the quality of milk. The difference in the composition of the milk yielded at Mark as compared with that yielded at Butleigh in 1893, and at Axbridge in 1892, is well shown in the following table:—

AVERAGE COMPOSITION OF MILK for each MONTH during the YEARS 1891–2–3–4.

——			Total Solids.	Fat.	Casein.
April	1892.	Axbridge	11·75	3·06	2·35
	1893.	Butleigh	11·89	3·09	2·43
	1894.	Mark	12·31	3·29	2·42
May	1892.	Axbridge	12·04	3·12	2·55
	1893.	Butleigh	12·01	3·05	2·59
	1894.	Mark	12·51	3·35	2·73
June	1892.	Axbridge	12·20	3·17	2·65
	1893.	Butleigh *	12·03	3·08	2·65
	1894.	Mark	12·52	3·40	2·69
July	1892.	Axbridge	12·20	3·21	2·66
	1893.	Butleigh *	12·14	3·20	2·49
	1894.	Mark	12·52	3·47	2·64
August	1891.	Vallis	12·61	3·87	2·76
	1892.	Axbridge	12·28	3·38	2·65
	1893.	Butleigh *	12·14	3·19	2·77
	1894.	Mark	12·78	3·70	2·76
September	1891.	Vallis	13·00	4·13	2·99
	1892.	Axbridge	12·56	3·57	2·87
	1893.	Butleigh *	12·53	3·53	2·95
	1894.	Mark	13·05	3·93	2·83
October	1891.	Vallis	13·81	4·75	3·21
	1892.	Axbridge	13·13	4·00	3·08
	1893.	Butleigh *	13·49	4·30	3·14
	1894.	Mark	13·46	4·39	2·95

* For first week in month only.

II.—THE RECORD OF OBSERVATIONS.

A complete record of observations was, with but few exceptions, kept by my assistant, Mr. James McCreath, for every week-day of the seven months during which the School was open. This record was identical in form with that made in preceding years, and consisted of sixty observations, and complete analyses of the milk, whey, and curd each day.

The first of the following tables gives a summary of these observations for the seven months, and the second gives the average results of the analyses made during these seven months.

MONTHLY AVERAGES OF RESULTS OF OBSERVATIONS.

	3	5	6	7	9		10	11	13	14	15	19	20	23	25	27	34	34a	35		51	53	54	55	60
Month.	Relating to Evening's Milk.								Morning's Milk.		Total Volume of Milk.	Acidity of Stale Whey.	Mixed Milk, &c.		Acidity of Whey before breaking	Acidity of Whey put aside.	Acidity of Whey when drawn.	Volume of Whey.	Acidity of drainings from piled Curd.	Acidity of drainings from Curd before grinding.	Weight of Curd when vatted.	Acidity of Liquid from Press.	Weight of Cheese taken to cheese room.	Loss in Press.	Weight of Cheese when sold.
	Volume of Milk.	At night.			In morning.																				
		Temp. of Dairy.	Temp. of Milk.	Acidity.	Temp. of Dairy.		Temp. of Milk.	Acidity.	Volume.	Acidity.			Acidity.	Proportion of Rennet added.											
	galls.				min.	max.			galls.		galls.							galls.			lbs.		lbs.	lbs.	lbs.
April . . .	51	58	83	·21	56	59	68	·22	55	·21	103	·40	·22	9006	·15	·16	·19	88	·25	·82	109	1·05	101	8	96
May . .	70	60	81	·22	58	60	68	·23	78	·22	148	·39	·22	9011	·15	·16	·20	142	·28	1·00	162	1·08	148	14	140
June . . .	67	64	82	·21	62	64	69	·22	72	·21	140	·37	·22	8939	·14	·15	·18	135	·27	·92	153	·99	141	12	132
July . .	63	66	84	·21	64	67	70	·22	65	·20	129	·39	·22	8940	·15	·15	·18	124	·27	·93	141	1·02	131	10	124
August . .	55	65	82	·22	64	66	70	·22	58	·20	112	·36	·22	8821	·14	·15	·17	108	·23	·90	128	1·04	118	10	112
September . .	48	63	83	·22	62	64	69	23	52	·22	100	·34	·23	8024	·15	·16	·19	97	·23	·90	120	1·02	112	8	106
October . . .	34	64	79	·22	61	66	70	·22	40	·22	74	·36	·22	6880	·14	·15	·18	67	·24	·94	94	1·04	87	7	81

MONTHLY AVERAGES OF RESULTS OF ANALYSES.

Month.	Composition of Mixed Milk.							Composition of Whey.			Composition of Curd.			
	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	Ash.
April. . .	87·69	12·31	3·29	2·42	·41	5·52	·67	7·08	·24	·44	40·03	59·97	28·28	2·45
May . . .	87·49	12·51	3·35	2·73	·40	5·33	·70	7·05	·17	·46	40·28	59·72	27·53	2·59
June . . .	87·48	12·52	3·40	2·69	·40	5·31	·72	7·28	·21	·52	40·12	59·88	29·62	2·41
July . . .	87·48	12·52	3·47	2·64	·39	5·30	·72	7·15	·23	·49	40·38	59·62	31·45	2·28
August . .	87·22	12·78	3·70	2·76	·40	5·17	·75	7·13	·22	·46	40·33	59·67	30·06	2·26
September .	86·95	13·05	3·93	2·83	·42	5·07	·80	7·21	·23	·47	40·94	59·06	29·81	2·20
October . .	86·54	13·46	4·39	2·95	·44	4·85	·83	7·27	·21	·45	40·58	59·42	30·19	2·25

Subsequently, as occasion may require, I shall quote from the individual results where they throw any light upon my subject matter.

The determinations of acidity were made with the apparatus described in former Reports, and I understand that the demand for this apparatus has become sufficiently great to induce two of the leading manufacturers of chemical apparatus to place it upon the market.

A certain number of the cheeses when ripe were sampled and analyses made, the results of which are shown in the following table:—

COMPOSITION OF CHEESES.

	Moisture.	Fat.	Casein, &c.	Mineral Matter.
April 10	35·51	30·61	29·39	4·49
„ 16	34·50	30·50	30·80	4·20
„ 17	34·84	32·09	28·82	4·25
„ 18	35·02	28·80	31·89	4·29
„ 21	35·87	29·09	31·02	4·02
„ 27	35·13	28·96	31·64	4·27
May 4	35·02	31·29	29·27	4·42
„ 14	35·14	30·42	30·31	4·13
„ 25	34·24	30·79	31·02	3·95
„ 30	36·39	29·59	29·93	4·09
June 4	37·56	26·59	31·81	4·04
„ 12	35·11	29·43	31·16	4·30
„ 23	31·64	30·16	34·26	3·94
„ 28	34·48	26·82	34·40	4·30
July 4 L	28·61	30·99	35·96	4·44
„ 4 C	33·97	29·32	32·47	4·24
„ 17 L	32·96	30·89	32·33	3·82
„ 17 C	33·79	30·76	31·90	3·55
„ 18 L	32·92	27·66	35·40	4·02
„ 18 C	34·51	28·75	32·81	3·93
„ 20 L	34·41	31·72	30·44	3·43
„ 20 C	31·76	30·13	33·62	4·49
August 27	32·65	31·20	32·15	4·00
September 17	34·00	36·21	25·99	3·80
„ 27	34·65	34·32	26·48	4·55
October 2	35·05	31·32	29·68	3·95
„ 9	34·90	31·20	29·85	4·05
„ 15	36·10	31·68	27·92	4·30
„ 22	33·05	33·04	29·76	4·15
Average, 1894	34·27	30·49	31·12	4·12
„ 1893	35·52	30·33	30·10	4·05
„ 1892	36·44	32·27	27·62	3 67

III.—THE EXPERIMENTAL CHEESES.

The Scotch system of making Cheddar cheese, as carried on in the Stewartry of Kirkcudbright, possesses certain distinct peculiarities which so far affect the principles that underlie cheese-making that I decided to make some experimental cheese on this system.

First, it will be well to briefly describe the Scotch system.

SCOTCH SYSTEM OF CHEDDAR CHEESE-MAKING.

The first consideration with the Scotch maker is to obtain the evening's milk of sufficient ripeness by the morning. This ripeness he tests by means of the rennet test, which will be described in due course. If the milk, after the whole of it has been brought to the right temperature for renneting, should not be of sufficient ripeness as indicated by the test, then it is covered up and left to ripen; on no account would the rennet be added to the milk until it was sufficiently ripe.

The rennet is next added, in the proportion of 1 oz. to 27 gallons of milk, or one part of rennet to 4,320 parts of milk. This is the second striking point about the Scotch system, the amount of rennet used being about twice the quantity employed by the West of England cheese-makers. The curd is allowed to set for one hour, and is then cut by means of American curd knives. These knives consist of an oblong frame, in which are set, at distances of about half-an-inch apart, very sharp knives running the whole length of the frame. Two such frames have to be used, each capable of reaching to the bottom of the cheese vat. In one the knives are set vertically, and in the other horizontally. By means of these knives the curd is cut three times in different directions until it is divided into small half-inch cubes. The advantage of using the American knives is that the curd is cut much more finely than with the old shovel-breaker; and, when the knives are carefully used, the amount of fat left in the whey is less than that which is present when the shovel-breaker is used. But there is one disadvantage which, unless care is taken, may more than counterbalance all the advantages. In order to use the knives with ease the curd must be firm, more so than is necessary with the old shovel-breaker. There can be little doubt but that this has gradually brought about the custom of using more and more rennet, until at last, as already shown, it has become double the amount generally used in the West of England. This excess of rennet is detrimental to the manufacture of cheese of the finest quality.

The curd is scalded to 97° Fahr. The cheese being made in jacketed tubs, this scald is produced gradually, taking about 45 minutes. The curd is then stirred for 25 minutes, allowed to settle, the whey drawn, and the curd taken out of the tub and placed upon a cloth over a rack in the cooler. The curd when taken out of the tub on to the cloth is crumbled up into fine particles, and the whey taken up with it passes away through the cloth. Having been thoroughly broken up and the excess of whey allowed to drain off, the curd is covered with cloths and allowed to rest 30 minutes. It is then turned, and again broken up, but not so fine as before. It now gradually solidifies, and is next cut into blocks about 1 ft. square on the surface, and about 3 or 4 in. in thickness. These are piled together, turned occasionally, and finally ground. The curd is then spread over the cooler, and when sufficiently cool is salted and put into the vat.

In the early stages of the manufacture of this cheese, the system adopted is very similar to that of Mr. Candy (see the 'Journal,' vol. iv., p. 171); but it has one distinct peculiarity, namely, the crumbling of the curd into small fragments when it is taken from the tub to the cooler. The effect of this crumbling process is to admit the air into the curd in a manner and to an extent which does not happen in any other system with which I am acquainted. And the result of this aeration is to promote the active development of the bacteria present in the curd, especially of the lactic acid organism. Owing to this the development of acidity is rapid, and sufficient acidity is obtained in the curd before vatting, although this takes place about 2 P.M. Hence the saving of time by this method of cheese-making, as compared with either that of Mr. Candy or of Miss Cannon as carried out at the School, is considerable. The determinations of acidity which I made in Scotland showed that fairly uniform results were obtained, and about the same amount of acidity was developed as in the English systems. Thus, in one instance, which will suffice for quotation, the acidities were as follows:—Mixed milk, ·22 per cent.; whey, when curd taken to cooler, ·30 per cent.; drainings from curd when it was considered fit to grind, ·67 per cent.; liquid from press, 1·03 per cent. The difference in the acidity of the liquid coming from the curd when it was considered fit to grind, and that of the liquid from the press is explained by the fact, that the curd after being ground is spread out to cool for some time, as in the Candy system, and air gains access to the curd and promotes the growth of the acid-forming organisms. The same result was found and stated when Mr. Candy's system was reported on. Indeed, we are forced to the conclusion that it is this development of acidity during the time the curd is cooling, after being ground, which takes place unnoticed by the maker, but at the same time constitutes one of the essential conditions of a good cheese, that enables many people to make a good cheese by this system who are unable to make it by the system of Miss Cannon, where the amount of acidity in the curd has to be determined by the sense and experience of the maker before the curd is ground and put away. As I have pointed out again and again, the system of Miss Cannon in the latter stages demands very particular care and very considerable natural gifts, coupled with experience—qualities which, though necessary for the manufacture of a good cheese by any system, are not so much called into play by the system of Mr. Candy, and still less by the Scotch system above described.

TESTING RIPENESS OF MILK BY RENNET.

This system of testing the ripeness of the milk is based upon the fact that the time which a given quantity of rennet takes to curdle a given quantity of milk at a definite temperature depends upon the acidity of the milk. To obtain accurate results, it is essential that the rennet should be from the same source for every test, and that the volume of milk and of rennet and the temperature of the milk should always be the same, and be most accurately determined.

The test is made as follows:—4 oz. of milk at 84° Fahr. are poured into a vessel, which can be placed in another vessel containing water at 84° Fahr. A few minute pieces of cork or straw-skin are floated on the milk; 3·55 c.c. (1 drachm) of rennet (some use 1 teaspoonful) are now accurately measured and delivered into the milk rapidly. The watch, which must have a second-hand, is held in the left hand, and the time the rennet is added must be accurately noticed. Stir the milk rapidly in a circular direction, and remove the stirring-rod at the end of 10 seconds. The straws or cork will revolve with the milk. But suddenly they will stop, which indicates that the milk has curdled. Time the moment they stop—to the second. The number of seconds which the rennet takes to curdle the milk shows the ripeness. Each maker knows by experience the standard he wishes to work up to. About 19 to 22 seconds is usually the time taken.

My first experimental cheeses were made upon the Scotch system, with the view of discovering the cause for the cheese being made in so comparatively short a time, while obtaining that amount of acidity in the curd which has been shown to be essential to a good cheddar, whatever way it may be made.

Experimental Cheese, No. 1, on Scotch system. Acidity of milk, ·22.—To obtain this acidity great care had been taken in the ripening of the evening's milk, for it was obviously necessary to obtain it if rapid results were to be secured. On the other hand, being convinced that the use of an excessive amount of rennet was detrimental to the manufacture of a good cheese, only one part was added to 7,000 of milk. In all other respects the cheese was made on the Scotch system. The acidity of the liquid from the curd rose rapidly after it was taken to the cooler. The curd was ground at 1.30 P.M., left to cool, and vatted at 3.30 P.M. The acidity of the liquid from the press was 1·00 per cent. The cheese was good, but not so good as the best English Cheddar cheese, being rather too dry. However, it compared very favourably with the best Scotch cheeses. The chief peculiarity of the cheeses made on this system is their dryness—in my opinion, the main cause why they do not take a higher position in competitions among cheddar cheeses of various makes. The analysis of the curd showed that it contained only 37·60 per cent. of water, whereas the average composition of the cheese made in the same month at the School showed 40·12 per cent. of water. Similar results have been obtained with samples of curd sent from Scotland; they all contain less water than should be present in a curd which will ripen into an excellent cheese. As pointed out in previous Reports, the amount of water in the curd when vatted should be from 38 to 42 per cent., and the higher the moisture between these limits the better the cheese, as a rule. However, as regards the chief point which I desired to investigate—namely, how to make a cheese in reasonable time—this experiment was satisfactory.

Experimental Cheese, No. 2.—My next experiment was an endeavour to discover what were the conditions which led to this rapid attainment of the desired end. From past work, I knew that ordinarily a rapid cheese could not be made unless the milk was ripe to start with. I determined to ascertain if this held true of the Scotch system also? The second cheese was therefore made when the milk showed less acidity. The result was that the cheese took as long to make as did a cheese made from the other half of the milk by Miss Cannon on her system; neither of the cheeses being vatted until 7.40 P.M., and both showing almost identical results as to the amount of acid present in the curd. The liquid from the press of that on the Scotch system yielded 1·03 per cent. of acidity; of that made by Miss Cannon, 1·02 per cent. of acidity.

These experiments conclusively show that the value of the Scotch system, so far as its rapidity goes, depends primarily upon obtaining sufficient ripeness in the milk to start with, and that, failing this, it is as long a process as Miss Cannon's. How far the peculiarity of opening up the curd by crumbling it when it first comes from the tub may accelerate the cheese, provided this ripeness is first present in the milk, it is not yet possible for me to say. When ripe, the cheese made on the Scotch system, compared with that made by Miss Cannon, showed the peculiar dryness which had characterised the preceding experimental cheese.

In the preceding remarks upon the Scotch system of making cheese, it has been stated that opening up the curd and leaving it in a fine state exposed to the air immediately after taking from the tub, and, again, for cooling before vatting, ensures the development of acidity. It may not unnaturally be asked, upon what grounds is such a statement made. It is based upon a number of observations and determinations of acidity, and is conclusively proved by the next experiment.

Experimental Cheese, No. 3.—The cheese was being made by Miss Cannon in the usual way, as has been described in the 'Journal,' vol. ii., p. 136. When the curd was removed from the tub it was divided into two parts, each of which was subsequently treated in a similar manner. Half the curd was ground and spread out to cool, the other half was wrapped up in cloths, as usual, to keep the heat in the curd and promote ripening. The acidity of the liquid, which came from both halves just before the first was ground, was ·78 per cent. The second half, after remaining wrapped up for half an hour, was ground and salted, and the cooled and uncooled portions were vatted within a few minutes of each other. The acidity of the liquid coming from the press containing the curd which had been opened up to cool was 1·14 per cent.; the acidity of the liquid coming from the press containing the curd which had been wrapped up was only 1·09 per cent., although the temperature of the latter was, when in the vat, 8° Fahr. higher than that of the cooled portion. This experiment affords very conclusive evidence of the effect of opening up the curd to the atmosphere, and proves that the development of lactic acid is promoted more by the free access of air than by mere temperature.

The object of this third experiment was to discover whether putting the curd into the vat at a high temperature had any especial effect upon the ripening of the cheese. For it is held by many makers that it is not advisable to vat the curd at a higher temperature than 70° Fahr. The experiment failed, as experiments have a habit of doing, from unforeseen causes; the proportion of acidity which had been developed in each of the curds, and which subsequently developed in the cheeses, being too high and rendering them both too acid. However, so far as can be judged by a careful examination of the records of observations, putting the curd away at a high temperature has not had the effect of producing a bad cheese; some of the best cheeses being the product of curd vatted at as high a temperature as 77°–80° Fahr.

Experimental Cheese, No. 4.—One reason which has been given to me by Scotch makers for the large amount of rennet used is that it helps to ripen the cheese more rapidly. An experiment was therefore made to test this point. The milk was divided equally between Miss Cannon and myself. She used one part of rennet to 9,000 parts of milk; I used one part of rennet to 4,500 of milk. So far as possible the cheeses were made alike; but it was found that Miss Cannon's curd made with less rennet contained less acidity than the curd made with the large proportion of rennet. Hence the result cannot be relied upon as due solely to the action of rennet, and the experiment will have to be repeated. When ripe, the cheese made with most rennet showed more fat, and was slightly the better cheese.

Experimental Cheese, No. 5, was made to test the effect upon the cheese of certain land, which had the reputation of being scouring land and bad for cheese-making. The cows had been divided into two lots some time previously: one lot, 21 in number, being on the scouring land (in all 24 acres), yielded 53 gallons of milk. The other lot, 33 cows, on the old pastures, yielded 51 gallons.

During the making, and even at the time of vatting, the two curds showed very little difference in quality; if anything, that from the scouring land being not quite so good as the other. The cheeses when ripe showed, however, far more difference in quality: that from the milk off the scouring land being of very poor quality, while the other cheese was much better, though not of good quality.

There can be no doubt that upon this scouring land it is more difficult to keep the cows clean and therefore to obtain clean milk, and the difficulty increases the longer the cows are kept upon such land. I had pointed out the great necessity of care to insure the cows being clean, and doubtless this was, to a certain extent, observed. But the result shows how necessary scrupulous cleanliness is on the part of those who are unfortunate enough to possess scouring land.

The other experimental cheeses will be described in the portion of this Report dealing with the bacteriological observations and experiments.

IV.—THE BACTERIOLOGICAL OBSERVATIONS.

After the writing of my Report on the work of 1893, the further study of the bacteria then found engaged my attention. The results being of a purely scientific nature need not be here entered into. But it may be as well once more to draw attention to the conclusions which it was hoped these bacteriological studies would in time enable me to arrive at. In the first place, it was believed that the peculiar and desirable properties of a good cheese were due to the growth in that cheese of special bacteria, and it was decided, if possible, to discover these, isolate them, and so be enabled by putting them into the milk to make at will a cheese of any desired quality.

To attain this end, my first work was the study of the organisms found in milk. It soon became evident, as may be seen from the Reports on the observations carried out in former years, that the number of bacteria present in the milk was legion, that they varied considerably, both in number and variety, and that the same microbes were not found every year, nor even in any one year at all periods of that year. It was also found that during the process of manufacture, owing to the development of acidity in the whey, many of the organisms present in the milk were destroyed by the time the curd was fit for grinding. Hence, during 1894 attention was paid mainly to those organisms which were present in the curd when it was fit for grinding.

The object of this research work is to get a complete list of the organisms which are found in milk, whey, curd, or cheese: to compare the organisms found each year with those found in preceding years; to study the effect produced upon the curd or cheese by their presence; to ascertain their source, and, if they are injurious, what means must be taken to prevent them finding their way into the milk, and how best to deal with the milk when they are present.

THE METHOD OF STUDYING BACTERIA.

When a sample of milk, whey, or curd is to be examined, a drop of the sample, if a liquid, or a small piece, if a solid, is taken with the greatest care on a sterile needle, and placed in some sterile salt solution to dilute it. Subsequently a drop of this dilute solution is taken upon a sterile needle and placed in some beef broth gelatine, which for the time is kept at a temperature of about 90° Fahr., so that it is liquid. The liquid gelatine is next poured into a sterile flat dish placed on a level surface, and allowed to cool to the temperature of the atmosphere. When cool the gelatine is solid, and the micro-organisms which were contained in the substance placed in this gelatine are now fixed, so that they cannot move about. This "plate culture" is placed in an incubator, and kept at a uniform temperature. Most micro-organisms are capable of living and multiplying in this gelatine, and each one rapidly increases in number until it has produced so many that a little "colony" of these bacteria is formed which may be seen with the naked eye. On the opposite page is reproduced a photograph of such a plate, showing the colonies and their different appearance. When the plate has been kept in an incubator for about seven or ten days, the colonies will be sufficiently large to enable the next step in their study to be taken. By means of a sterile needle, a minute quantity is removed from one of these colonies, and the needle drawn along the surface, or thrust into some nutritive gelatine contained in a test-tube. Here the bacteria will in the course of from seven to ten days have grown so considerably as to form a more or less definite streak of growth on or in the gelatine. Should the plate have several colonies, which from their appearance may be considered the growth of different organisms, then as many cultures in test-tubes are made as there are different colonies on the plate. With due care each of these test-tube cultures will contain only one variety of bacteria, and this is called a "pure culture." The reproduced photograph opposite shows how differently various organisms grow in these test-tubes. A small portion is taken from a pure culture and a slide made, so that the organisms may be examined under the microscope. Subsequently, pure cultures are started from this first one in or upon other substances, more especially milk, beef broth, agar, &c. By carefully noting the aspect of the colony on the plate, and of the growth in various substances, one is able to compare the results with the work of other observers, and so find out whether the organism has been found before, and, if so, when and where. Meantime, each organism has to be indicated by a number in default of a name.

In this way during the past year, thirty-three different substances were examined—four of milk, three of whey, nineteen of curd, and seven of likely sources of contamination. From these plates ninety-six pure cultures of bacteria were obtained, which have up to the present been found to consist of no less than forty-seven different varieties of bacteria. These are still under investigation, as well as those that have been found in the cheeses when ripe.

THE RESULTS OBTAINED.

The first fact worthy of note is that some of the organisms which were found in preceding years were not found once in

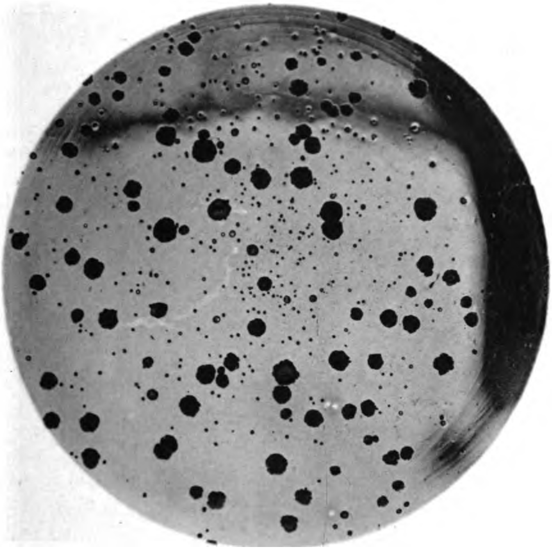


Fig. I.—Plate Culture.

Fig. II.—Pure Cultures.

The Graphotone Co., Art Printers, Bush Hill Park, Enfield.

1894. On the other hand, some have been found which to me are entirely new, and have not been previously met with.

There can be little doubt that the organisms present in milk are, for the most part, those present in the atmosphere where the cows are milked, hence the only conclusion that can be come to is that the atmosphere itself differs materially each year as regards the organisms which it contains. Whether this difference is due to the change in locality of the School, or would be found irrespective of locality, remains yet to be proved.

Then again, it has been noticeable that at different times of the year different organisms make their appearance, and subsequently disappear. Thus of sixteen liquefying organisms —*i.e.* those which have the power of causing the solid nutrient gelatine upon which they are grown to be converted into a liquid—three were found in April, four in May, and nine in June. Some of these were again found in the months of July and August, but subsequently it was very rare to obtain a liquefying organism.

There is still another fact which appears to be worth recording. The principal shapes which bacteria possess are spherical (cocci), or rod-shaped (bacilli). In my work I have noticed that many of the organisms met with are neither true cocci nor yet can they be called rod-shaped. Hence, for the purpose of classification and identification, I have divided these into a separate class, and I term them micro-ova, so designating all organisms which are not more than twice as long as broad. Such is the lactic acid bacillus, see photograph, facing p. 25. It is a rather remarkable fact that of the forty-seven organisms at present isolated from the milk, whey, and curd, only eleven are really bacilli, while twenty-one are micro-ova, remarkably similar in appearance to the Bacillus Acidi Lactici. Hence it is, that a mere microscopical examination of the micro-organisms in a sample of milk or curd affords no guide to the purity of that milk or curd.

For some years past, however, my work has been directed mainly to find out, if possible, the origin and cause of taints in milk, curd, and cheese. By far the greatest difficulty that the cheese-maker of the present day has to contend with, and one which he is totally unable to account for, and little knows how to contend against, is the occurrence—sometimes only for two or three days at a time, but sometimes for long periods—of distinct taints in the curd, which the cheese-maker knows full well will more or less deteriorate the resulting cheese. Sometimes they arise, one knows not how, in the dairies of the very best cheese-makers, disappear in a day or two as suddenly as they come, and with no more apparent cause for their disappearance than there was for their appearance. From time immemorial they have baffled all cheese-makers; in some parts of the country they have rendered cheese-making almost impossible, certainly unprofitable.

As was the case less than half a century ago with very many of the diseases to which man is liable, the origin of these taints, which may be looked upon as diseases of curd, has been vaguely supposed in some way to be connected with dirt. The diseases of man were thought to be more prevalent in certain districts, or upon certain soils; and a similar impression has prevailed with regard to the diseases, or taints, of curd. Hence there has arisen a widespread belief that upon such soils good cheese cannot be made.

The progress of science has within comparatively recent years proved beyond doubt that these diseases which had baffled the wisest physicians to account for, are the result, not of dirt, as generally understood, nor yet of any peculiar locality, but are due to the presence in the human being of infinitely minute vegetable organisms known as bacteria. Those who in studying science in connection with dairying have watched these discoveries, have been drawn to the conclusion that, in all probability, the diseases of curd might also be due to bacteria, and not necessarily to what is ordinarily termed dirt, nor yet to any special peculiarity connected with soil or locality. Such conclusion, however, was founded mainly upon theory, and was supported by very little, if any, direct evidence. There had been a certain amount of negative evidence forthcoming, such as has been reported from year to year in the account of these observations. Thus, although the School had been located in places where it was well known difficulties arose, which also arose at the School when located in those districts, yet no satisfactory cause could be found for them. The local belief that it was due to the soil or to the herbage had, by the analyses of the soil by the Society's Consulting Chemist, Dr. Voelcker, and by the careful examination of the herbage by the Society's Consulting Botanist, Mr. Carruthers, been proved to have no foundation. For in no case was any substance or plant found which could possibly give rise to the taint present in the curd and peculiar to the district. This negative evidence had materially strengthened my belief that, in course of time and by continued investigations, it would be proved that the taints of cheese, like the diseases of man, were produced by bacteria. Hence the considerable amount of work which has been done each year in this direction, and now, at the end of four years of observations, I am able to announce that one taint is undoubtedly produced by the presence of a particular organism in the milk.

For four years we have been groping, so to speak, in the dark; now—having conclusively proved that the taint, commonly known as "spongy curd," is the result of a micro-organism growing in the curd—we have found the key to all the difficulties and taints which curd and cheese are liable to, and, in course of time, we shall be able to isolate and describe, and, I hope, find the source of, if not the remedy for, those bacteria, which, it is almost certain, will be found to be the cause of other taints.

Medical men tell us, and have conclusively proved, that the various diseases to which men are liable, such, for instance, as diphtheria, pneumonia, or tubercle, are each the result of the growth of a special organism in the human body. The farmer knows that the same is true of many of the worst diseases to which his herds are liable; it is only necessary to mention pleuro-pneumonia among cattle, and swine fever among pigs. We know that diseases produced by such micro-organisms are frequently contagious; that it is merely necessary for a perfectly healthy animal to come into contact with, or sometimes only into the neighbourhood of, animals so diseased, in order to become themselves contaminated with the bacteria, and thus to contract the disease which the organisms produce. Such knowledge teaches us a lesson, and points to the necessity of certain precautions being carefully observed by the cheese-maker, should he by any accident get into his dairy a diseased curd—by which I mean a curd containing any taint. Let him remember that the mere contact of his hands with such curd is sufficient to convey the bacteria which cause that taint to the surface of any utensil which he may subsequently handle. It is therefore imperative when any taint arises to get that curd out of the dairy, so far as possible, before the evening's milk comes in. On no account should any of the whey which has come from the tainted curd be used in the next day's cheese. In fact, the whole of the whey should be got out of the dairy as quickly and as thoroughly as possible, and every utensil should be cleaned with, if possible, more than usual care; but especially *the handle of the breaker* with which that cheese was made.

Before proceeding further, let me anticipate a question which the cheese-maker would naturally ask, viz.—if I am not to use any whey in the next day's cheese, what am I to do in order to obtain the requisite acidity? Some experiments have been made in order to ascertain how this difficulty may best be overcome. Fairly successful results were obtained by placing about 10 gallons of the evening's milk in a small warmer, heating this to 98° Fahr., and keeping it on the top of the heating apparatus overnight, lightly covered with a thick cloth to prevent dirt entering the milk and to retain the temperature. In this way the milk ripens very rapidly, and if in the morning the whole of the evening's milk is warmed as far as it may be, and this ripened milk put into it, the ripening process continues, and the absence of sour whey is, to a large extent, made up for.

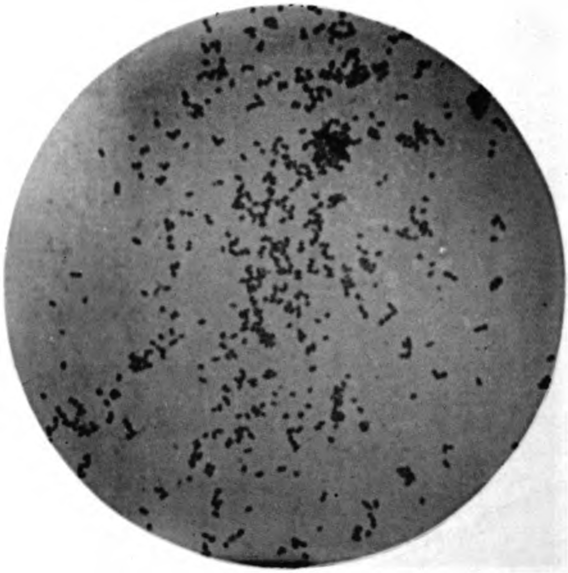
The taints which were most prevalent at Mark were of three kinds. During the first few months the curd soured rapidly, and had an unpleasant vinegar smell. This subsequently disappeared, and was followed by the peculiar fæcal taint which was so noticeable in the curd at Butleigh; and later on the curd was particularly spongy, and had that characteristic odour which invariably accompanies a spongy curd. For a large portion of the time the two latter taints were more or less frequent.

The frequent presence of these taints has, unfortunately, caused many of my experiments to be failures, as will be understood by a short explanation of the method of experimenting adopted.

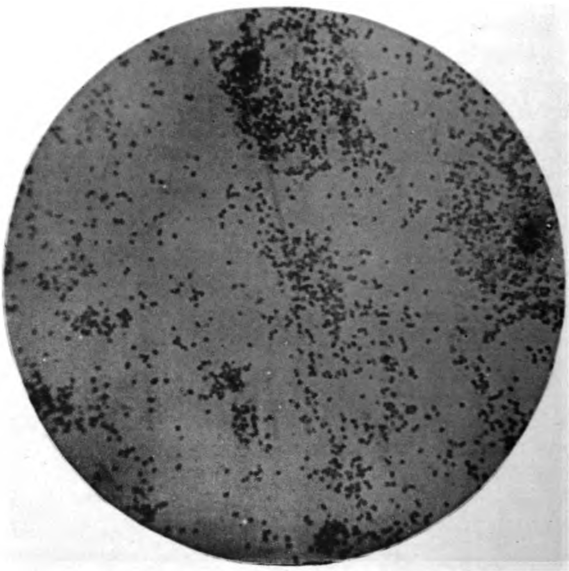
Having obtained an organism whose frequent presence, or my previous experience, led me to suspect that it had some connection with a taint, I separated it from every other organism, and obtained a pure culture in the manner already described. From this pure culture a small quantity was transferred to some sterilised milk in a flask, and in this the organisms were allowed to develop until the day arrived for making the experimental cheese. As a rule, from seven to ten days was found a sufficient time. The evening's milk was then divided into two portions; one-half being placed in a tub for Miss Cannon's use, and the other half in a tub for the experimental cheese. As soon as the milk was in this tub, the contents of the flask were poured into it and the milk was well stirred, the stirring being repeated two or three times during the evening. The morning's milk, as it came in, was divided equally between the two tubs. The cheeses were then made simultaneously and, so far as possible, in every respect similarly. Thus the special effect of the organism which had been placed in the evening's milk could be distinctly noticed, provided that the milk was originally free from taint. But when, as unfortunately happened too frequently, the cheese made by Miss Cannon proved to contain a taint, it was impossible for me to determine what particular effect the organism being experimented with had produced.

SPONGY CURD.

Experimental Cheese, No. 6.—Among the organisms present on several occasions when there was a taint in the cheese was one which attracted my attention in 1893, and was found again in



Bacillus Acidi Lactici × 1000.



Bacillus of Spongy Curd × 1000.

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1894 in some tainted curd. Pure cultures were obtained, and the evening's milk was inoculated, as has just been described, with a flask containing this organism. The curd which Miss Cannon made out of the one-half of the milk was of very good quality. The curd which was made out of the inoculated milk was a perfect sponge. Never had I seen such a curd, nor had any one at the School ever seen one like it. It contained myriads of minute holes blown in the curd, apparently by the production of gas. What this gas is I have not had time to discover; but it will be an interesting subject of investigation for some one to take up, and also to ascertain, if possible, what substance is utilised for the production of the gas.

The organism which produces this effect is, as may be seen from the annexed photograph, what I term a Micro-ovum. In shape it is almost identical with the Bacillus Acidi Lactici, as is well seen by comparing the two photographs. These reproductions are from photographs taken by me from slides prepared in the ordinary routine work of the observations, and are the best I have been able to obtain with the apparatus and time at my disposal. The organism grows on gelatine, sometimes in a thick-raised moist streak, sometimes as a broad streak with very irregular edges. When grown in milk, at a temperature of 65° Fahr., the milk curdles in about twelve to fourteen days. Its growth on agar is very similar to that on gelatine. Whence it comes I have not yet been able to prove, but have some reason to think that it is obtained from fæcal matter, which may be that of the cows or that of man.

Experimental Cheese, No. 7.—Having obtained this result it was necessary to repeat it, so as to make quite sure that the sponginess was really due to this micro-organism, No. 21, and not to any other cause. Special cultures were therefore started from the original culture, and, in due course, another cheese was made from milk inoculated with the organism. The same result followed as in the previous experiment. The curd was a spongy mass. The power these minute organisms have to produce gas is almost incredible. This gas does not form until the curd is removed from the tub to the cooler. Here, although the curd is wrapped up in cloths, covered with a tin, and pressed with a 56 lb. weight, the action of the organism rapidly becomes noticeable, and the curd is as easily blown into a sponge as if there had been no weight at all upon it.

The development of acidity in the curd was very slow as compared with that in the curd made by Miss Cannon from the remainder of the milk. And although the curd was not put away until sufficient acidity had been developed, yet this seemed to have no effect on the organism. These cheeses when ripe were of very inferior quality. In spite of the weight they had been subjected to in the press they still cut slightly holey. They had a most disagreeable flavour and aroma.

Many other experimental cheeses were made with milk inoculated with organisms which I desired to test. In only one of these were results obtained which indicated that the organism had a detrimental effect upon the curd. With this particular organism (No. 11) no less than three experimental cheeses were made, and in each case the result was a curd having a distinctly fæcal taint. Unfortunately the cheese made by Miss Cannon was not on any one of these occasions quite free from taint, so that it is not possible to say for certain whether this organism is the producer of a fæcal taint or not. Further experiments will be made with it this year.

THE ORIGIN OF TAINTS.

In previous Reports I have pointed out certain sources which, in my opinion, are likely to give rise to taints in the milk. Among others may be again mentioned the hands of the milkers. dirty utensils, impure atmosphere where the cows are milked, and dirt upon the teats and udders of the cows. There are two other sources of taints to which my attention has been drawn in 1894.

Spans.—It is the custom in Somerset to span the cows when milking, that is to tie the legs together. The span used is generally made of rope, which is a very absorbent substance. Now, should a cow dung when being milked, it is highly probable that some of this dung would splash on to the span. As soon as one cow is milked, the milker takes off the span and places it upon the next cow to be milked. In doing so his hands become contaminated with the material upon the span, and as soon as he commences milking this material passes into the milk. Judging from the foul condition which the span gets into in the course of only a few days, I am quite convinced that this is probably the cause of much trouble, and of some at least of the taints present in the curd.*

Drinking Water.—One other source of trouble is, I believe, the drinking water. In many parts of the country, the cows drink from dykes or ditches. The banks of these are so high and steep that it is necessary to make special slopes down to the water for the cattle to obtain it. Yet how persistently the cows will try and find some other place to get at the water. Why?

* In support of this assertion, it may be well to state that I had all the spans steamed on several occasions, and this was always followed by an improvement in the milk.

In my opinion it is because the water at these drinking places becomes contaminated with the droppings of the cows, and, as is well known, there is nothing which cattle will so avoid. The contaminated water at these drinking places, during the very hot weather when the cows will stand in the water, if not at other times, gets splashed on to the teats, dries there, and when the cows are milked some of this dirt gets into the milk. Is it not found by long experience that nowhere is so much difficulty in cheese-making found as in those parts which have a bad or sluggish water supply? Unfortunately such water is liable to be contaminated not only by cattle, but by the drainage of cottages on the banks of the stream. In many such parts it would be money well spent to put up drinking troughs for the cattle, and pump the water into these as required. In my experience, where the cattle have been supplied with water in troughs there has been far less trouble in the cheese-making than where they drink from a stream or pond, into which they can get.

RESULTS OF OBSERVATIONS.

When the cheeses were ripe, I took the opportunity of tasting as many as possible, and of obtaining the opinion of Mr. Hill and Mr. Cannon upon those which were of most importance, and likely to throw some light upon the problems under investigation. These opinions were carefully recorded at the time. At the end of the season, particulars of the various acidities, data, and chemical constituents of each cheese, were very precisely tabulated, in order to see if any answer could be supplied to that most difficult question—Why are some cheeses better than others?

These tabulated figures showed that all those cheeses which were made with milk, into which a micro-organism capable of producing a taint had been placed, were bad. Of the cheeses made by Miss Cannon and pronounced "inferior," "of poor quality," or "deficient," 75 per cent. were made from milk which was not pure, the curd having been pronounced on the day of making to contain a taint. We may legitimately draw from these facts a most important conclusion, namely, that the large majority of bad cheeses made in the country are due to the milk not being pure, and to its being contaminated before the cheese-making commences. Moreover, these investigations warrant the assertion that this contamination is for the most part, if not entirely, brought about by the presence in the milk of micro-organisms or bacteria.

The following, among various other causes, may account for the other 25 per cent. not coming up to the mark, viz.:—

want of sufficient acidity, coupled with the presence of a large proportion of moisture in the curd; a slight excess of acidity; and want of sufficient moisture or water in the curd.

In the next place, I endeavoured to ascertain what were the conditions under which the best cheeses were produced. It would appear that this result can be assigned to no one cause. As a rule, the better cheeses are generally found to be rich in fat, as compared with those of poorer quality. The acidity of the curd, as estimated by the acidity of the liquid from the press, varies considerably, as also the proportion of water in the curd. But there seems to be an intimate relation between the acidity and the amount of water in the curd. Taking the average amount of water which should be in the curd at 40 per cent., then, if the curd contains much water, *i.e.* above the average, a good cheese only results when the acidity is high; a poor cheese almost invariably when the acidity is low. On the other hand, if the proportion of water in the curd is low, it is better to err on the side of having slightly too low—rather than too high—a proportion of acid present; for in the latter case the cheeses always appear too acid when ripe. Hence, I would advise cheese-makers to bear these two rules well in mind. *In a dry curd do not develop too much acidity. In a wet curd strive to develop acidity.* As a rule, there should be about 1 per cent. of lactic acid in the liquid from the press.

In previous Reports, the conditions which would appear from the observations to be necessary for the *rapid* manufacture of a good cheese, have received attention, as also some of the causes of inferior cheeses. In this Report, I have endeavoured to supplement that information with some account of the conditions necessary to insure a good cheese.

We may summarise these conditions as follows:—First, pure milk, free from bacteria capable of injuring the cheese. Secondly, careful determination of the acidity produced at all stages of the manufacture. Thirdly, the necessary skill, to enable one to obtain a sufficiently dry, while yet a sufficiently acid, curd. Lastly, that experience which alone can enable a cheese-maker to know when these conditions are obtained.

By far the greater number of inferior cheeses made at the present day are due to the absence of the first of these requisites —in other words, to want of sufficient cleanliness during the in-gathering of the milk. Next to this, the chief cause of failure is the inability of makers to estimate the amount of acid present in the milk, whey, or curd at the different stages in the manufacture of the cheese. I am convinced that this difficulty will never be overcome by many until they learn to use a reliable test for acidity, such as that which has enabled me during the past few years to throw so much light upon the science of cheese-making. A few failures are due to want of sufficient skill in estimating the dryness of the curd; and yet a few, but, I believe, comparatively very few, may be due to want of sufficient skill in carrying out the necessary processes or manipulations characteristic of Cheddar cheese-making.

As to the work of the future, very little need be said. Having proved that of the inferior cheeses made by an expert maker 75 per cent. are due to taints in the milk, it becomes of paramount importance to discover the cause and source of such taints. The cause of one such taint has been discovered, and shown to be a particular variety of Bacteria. This fact, the practical cheese-maker could never have discovered without the aid of science. It is then in the direction indicated by this work that we must proceed in the future. We must try to discover the origin of other taints, the sources whence they arise, and how best to prevent, or to modify, their harmful influence.

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BATH AND WEST AND SOUTHERN COUNTIES SOCIETY.

CHEESE SCHOOL.

Arrangements have been made by the Technical Education Committee of the Somerset County Council with the Bath and West and Southern Counties Society to open a School for instruction in Cheddar Cheese-making at the Manor Farm, Hazelbury, near Crewkerne.

The farm is the property of Viscount Portman, and is in the occupation of Mr. G. D. Templeman. There is ample provision at the commodious residence attached to the farm for the comfortable accommodation of Students.

The School will open on Wednesday, April 3rd, 1895, for a period of six months.

Miss Cannon, of Milton Clevedon, Evercreech, has been engaged as Teacher. Over £2,000 have been awarded in prizes for Cheese made by Miss Cannon and her mother.

The fee (payable in advance) to Residents in Somerset for a complete course of four consecutive weeks' instruction is £5, which includes board and lodging, the charge to Non-Residents in the County being £8 8*s*.

The following are the rates for shorter periods:—

	Residents in Somerset.				Non-Residents.		
	£	*s.*	*d.*		£	*s.*	*d.*
For the first week (with board and lodging)	1	10	0	..	3	3	0
" second " " "	1	7	6	..	2	2	0
" third " " "	1	2	6	..	1	11	6
" fourth " " "	1	0	0	..	1	11	6
" one day (with board)	1	0	0	..	1	1	0

Day Students will be admitted only when the class for longer periods is not full.

If more persons apply to be admitted as Students than can be instructed at any one time, preference will be given to the wives, sons, or daughters of dairy farmers and dairymen; the families of Members of the Society having priority.

The number of Students to be instructed at one time will, as a general rule, be limited to five, but under exceptional circumstances this number may be exceeded.

Cheese-making will commence each morning at seven o'clock, and will be carried on all through the week, but it is optional to Students to attend, or not, on Sundays.

Applications to join the School must be made to the Secretary, and the fee must accompany the application.

THOS. F. PLOWMAN,

March, 1895. 4, *Terrace Walk, Bath.*

BATH AND WEST AND SOUTHERN COUNTIES SOCIETY

FOR THE

Encouragement of Agriculture, Arts, Manufactures and Commerce.

TERMS OF MEMBERSHIP.

ANNUAL SUBSCRIPTIONS.

Ordinary Members, not less than £1
Tenant farmers, the rateable value of whose holdings does not exceed £200 a-year, not less than 10/-

Governors, who are eligible for election as President or Vice-President, and who subscribe not less than £2, are entitled, in addition to the privileges below stated, to an extra Season Ticket for the Annual Exhibition, the Grand Stand, &c. Governors subscribing more than £2 are entitled to a further Ticket for every additional £1 subscribed.

Members subscribing less than £1 are entitled to all the privileges of Membership except that of entering Stock at reduced fees, and their admission Ticket for the Annual Show is available for *one day only*, instead of for the whole time of the Exhibition.

LIFE COMPOSITIONS.

Governors may compound for their Subscriptions for future years by payment, in advance, of £20; and Members by payment, in advance, of £10. Governors and Members who have subscribed for twenty years may become Life-Members on payment of half these amounts.

SUMMARY OF MEMBERS' PRIVILEGES.

a. To receive annually the Society's *Journal* free of expense.
b. To obtain, at low rates, opinions and analyses with regard to Manures, Soils, Feeding Stuffs, &c., from the Society's Consulting Chemist.
c. To obtain, at low rates, reports upon and results of examinations of Seeds and Plants, from the Society's Consulting Botanist.
d. To make, at reduced fees, an unlimited number of Stock and other Entries at the Society's Annual Exhibition.
e. To receive free an Admission Ticket to the Annual Exhibition (including also the Grand Stand and the Working Dairy) available for the whole term.
f. To use the Reading and Writing Room provided for Governors and Members attending the Annual Exhibition.
g. To take part in the Society's Experiments on Crops, &c., and to receive reports thereon.
h. To be admitted free to witness the Teaching and Competitions at any of the Society's Technical Education Schools.

Any person desirous of joining the Society can be proposed by a Member, or by the Secretary (Thos. F. Plowman, 4, Terrace Walk, Bath).

OBSERVATIONS

ON

CHEDDAR CHEESE-MAKING.

REPORT FOR 1895.

By F. J. LLOYD, F.I.C., F.C.S.

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OBSERVATIONS

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CHEDDAR CHEESE-MAKING.

REPORT FOR 1896.

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INTRODUCTION.

WHEN in the summer of 1891, I was asked by the Bath and West and Southern Counties Society to carry out observations on the manufacture of Cheddar Cheese, it was decided that the first object of such experiments should be—

(*a*) "The formulating of a complete scheme of investigation of the science which underlies the existing practice of the best cheese-makers."

I was also instructed to ascertain the :—

(*b*) Variations in quality of milk from cows feeding in different pastures.

(*c*) Causes of defects in cheese-making from quality of milk, &c.

(*d*) Effect of temperature in ripening of cheese.

It is only necessary to recall these stated objects of study to show that at the time only one thought was dominant in the minds of those who prompted the investigation, namely, that the problems to be solved were all of a purely chemical nature. As time has gone on and the facts ascertained by these observations have increased in number, it has been clearly seen that the science of cheese-making deals not merely with chemical questions, but also, to a large extent, with bacteriological questions. By degrees the most important chemical points were cleared up. The influence of the proper development of lactic acid, commonly known as "acidity," in each and every stage of the process of manufacture, was demonstrated, and a method of rapidly and accurately estimating this acidity was introduced. This apparatus has slowly come into use, not merely among makers of Cheddar Cheese, but also among those who are producing other varieties.

The almost universal belief that the soil and herbage of certain localities rendered cheese-making practically impossible in such localities was investigated. Soils were analysed by the Society's Consulting Chemist, Dr. Voelcker, and the pastures most thoroughly investigated by the Society's Consulting Botanist, Mr. Carruthers, F.R.S.; but invariably without any explanation being found for the firm and widespread conviction that such soils and pastures were not suited for cheese-making.

Then, when the third object of investigation began to receive attention, it was found that defects in cheese-making would arise, now and again, in dairies presided over by the most skilled and careful makers. Thus while on one day a cheese of excellent quality would be produced, on the next day there might be one of very inferior quality. And this by the same maker, with milk the quality of which (chemically speaking) was similar to that of the former day, while the temperatures, system of making, development of acidity, and every other condition, so far as could be determined, were identical for the two cheeses. Investigation soon proved that there were other than chemical agents at work during the making of a cheese, whose influence for good or harm might be quite as powerful as, if not more powerful than, the skill of the maker.

Bacteria, those infinitely minute vegetable growths which are now being found to play so important a part in both the welfare and ills of mankind, were not absent from the milk and dairy, and were fighting either for or against the skill and intelligence of the cheese-maker. The study of these bacteria therefore received attention; some which played an injurious part in the manufacture of cheese were gradually discovered, and one or two of these were traced to their source. Thus it was ascertained that trouble invariably resulted from contamination of the milk with dirt prior to its reaching the dairy, and that inferior cheeses were frequently due, not to any want of skill on the part of the cheese-maker, but to want of cleanliness on the part of the milkers. Dirty hands to milk with, and dirty cows to milk, cause more inferior cheese of every description than all other causes put together.

Such, briefly, had been the outcome of the work done when my last Report was written. Thus the examination of the bacteria in milk was forcing itself prominently forward as the line along which future progress must be looked for. There still remained, however, some few points in connection with the chemistry of cheese-making to investigate, *e.g.* the chemistry of the ripening of cheese, and to these subjects attention was given in 1896.

The experiments were carried on at the Somerset Cheese School of the Bath and West and Southern Counties Society. It has been the custom for some years past to have the School located in a different part of the county each year. The desirability of a permanent School was brought before the Somerset County Council; but they decided not to have such a School for the present, a decision which, in my opinion, is not calculated to best promote the cheese industry of the county.

I.—CONDITIONS UNDER WHICH THE CHEESES WERE MADE.

(*a*.) THE FARM AND DAIRY.

The dairy of Mr. Tucker, of Trivett's Farm, Cossington, near Bridgwater, was selected as the site of the School in 1896. Cossington is said to be a place in which it is difficult to make good cheese, and certainly if the troubles met with at the School are such as are common to the district, Cossington well deserves its reputation. However, it is satisfactory to know that, in spite of these troubles, Miss Cannon's skill in the manufacture of Cheddar Cheese enabled her to produce an article which fetched very good prices throughout the season.

The village of Cossington is situate upon comparatively high ground, on one of those outcrops of the blue Lias formation which rise here and there from the flat valleys or moors of the north-west of Somerset. The fields on which the cattle feed are mainly down on the moor where the soil is clay, and where peat abounds, or is intermingled with the soil. The fields on the higher level are few and comparatively small, and here the soil partakes of the blue Lias character, and the herbage is what is known as "teart," or "scouring." The cows were on one or more of six fields during the season, which fields, for sake of future reference, may be numbered 1 to 6 :—

No.		Name.
1	.. ..	Home.
2	.. ..	Newlands.
3	.. ..	Stubclose.
4	.. ..	Hatches.
5	.. ..	Holywell.
6	.. ..	At Farm.

Water was supplied to the cattle by means of dykes or ditches running through the fields, the water in which came from a spring in the higher ground of Cossington. In spite of the drought there was always sufficient water, though, as might be expected, it was not plentiful.

The dairy was a room in one corner of the house, two sides of which were formed by outside walls facing north and west, and each having a small window. Both of these windows opened on to a part of the farmyard, which was surrounded by horse boxes, cattle stalls, piggeries, &c., though the latter were not used during the time of the cheese-making season. It is most extraordinary that any farm should be so planned that no breath of air can come into the dairy without passing over horses, cattle, or pigs, and their droppings.

The air in the pig-styes was carefully examined and found to contain organisms which have been proved to be detrimental to cheese-making. Last year I showed that even the droppings of fowls, if allowed to dry and become disseminated in the air, would give trouble, and the same may be said of all fæcal matter. It is indeed remarkable that landlords, who ought to know better, both allow farm-houses, where cheese-making will be the staple industry, to be built which are utterly unsuited to the purpose for which they are intended, and neglect to improve such buildings when they exist.

Unfortunately the dairy was small, so that it was not possible to make two cheeses in it simultaneously. Another room was intended for the making of experimental cheeses, but it was not found suited to the purpose, so that fewer experimental cheeses were made than would otherwise have been the case. It will be essential to remedy this in the future, for further progress must depend very largely upon the results of experimental cheeses. Moreover, it is scarcely necessary to point out that unless such cheeses are made under conditions favourable to their production, it would not be just to compare the results so obtained with cheeses made under the most favourable conditions.

(b.) THE STOCK AND YIELD OF MILK.

The work of the School commenced on the 1st of April, and there were then fifty-one cows in-milk.

These were already out on the pastures, thirty in Newlands, receiving hay in addition, and twenty-one on Stubclose receiving, owing to the shortness of keep there, not only hay but also cotton-cake (about 6 lbs. each per day).

The number of cows were increased by 14th of May to fifty-eight, and in the meantime had been changed into other fields. On the 9th of June there were sixty-two cows in-milk. This number continued in-milk up to 21st of September, when ten of the cows were milked only once a day; and on October 4th the number in-milk dropped to forty-nine,

On 27th of August there were ten feeding on "aftermath" and receiving cake; and on 12th of September there were twenty cows cake-fed. Thus, owing to the drought, some of the cows had to be fed on cake during the greater portion of the season.

Milk Yield.—The greatest amount of milk yielded was on the 4th of May, when fifty-five cows gave 175 gallons, or an average of 3·18 gallons per cow. Even when the number of cows had risen to sixty-two on the 9th of June, the maximum volume of milk obtained was only 163 gallons. Comparing these figures with the 1895 results, it is interesting to note that in that year the maximum yield was given twelve days later, on 16th of May, and only reached 3 gallons per cow. We thus see how early was the season of 1896.

Quality of the Milk.—The following table shows the average composition of the milk which was yielded at Cossington, and enables us to compare it with that produced in preceding years. The analyses were made during the first ten days of each month.

It will be seen from the table opposite that the milk at Cossington was exceptionally rich in fat during the whole season, and that the casein in the milk, while normal during April, May, and June, fell during the months of July, August, and September below the normal. A careful study of these results will show that the solids other than fat in the milk also fell during these later months below the normal. I have found this to be a somewhat characteristic result of an exceptional drought and scarcity of food, especially with individual cows, some appearing to be affected far more than others.

AVERAGE COMPOSITION OF MILK for each MONTH during the YEARS 1891–96.

Month.	Year.	Locality.	Total Solids.	Fat.	Casein.
			per cent.	per cent.	per cent.
April	1892	Axbridge	11·75	3·06	2·35
	1893	Butleigh	11·89	3·09	2·43
	1894	Mark	12·31	3·29	2·42
	1895	Haselbury*	12·65	3·70	2·43
	1896	Cossington	12·75	3·83	2·43
May	1892	Axbridge	12·04	3·12	2·55
	1893	Butleigh	12·01	3·05	2·59
	1894	Mark	12·51	3·35	2·73
	1895	Haselbury*	12·58	3·39	2·60
	1896	Cossington	12·78	3·70	2·64
June	1892	Axbridge	12·20	3·17	2·65
	1893	Butleigh†	12·03	3·08	2·65
	1894	Mark	12·52	3·40	2·69
	1895	Haselbury*	12·56	3·51	2·58
	1896	Cossington	12·59	3·57	2·64
July	1892	Axbridge	12·20	3·21	2·66
	1893	Butleigh†	12·14	3·20	2·49
	1894	Mark	12·52	3·47	2·64
	1895	Haselbury*	12·68	3·60	2·67
	1896	Cossington	12·61	3·66	2·58
August	1891	Vallis	12·61	3·87	2·76
	1892	Axbridge	12·28	3·38	2·65
	1893	Butleigh†	12·14	3·19	2·77
	1894	Mark	12·78	3·70	2·76
	1895	Haselbury†	12·82	3·80	2·68
	1896	Cossington	12·73	3·83	2·66
September	1891	Vallis	13·00	4·13	2·99
	1892	Axbridge	12·56	3·57	2·87
	1893	Butleigh†	12·53	3·53	2·95
	1894	Mark	13·05	3·93	2·83
	1895	Haselbury*	13·03	3·94	2·91
	1896	Cossington	13·19	4·31	2·71
October	1891	Vallis	13·81	4·75	3·21
	1892	Axbridge	13·13	4·00	3·08
	1893	Butleigh†	13·49	4·30	3·14
	1894	Mark	13·46	4·39	2·95
	1895	Haselbury*	13·70	4·55	2·92
	1896	Cossington	13·38	4·41	2·85

* For first and third weeks in month. † For first week in month only.

(c.) COMPARISON OF RESULTS OBTAINED, 1891–96.

The following table gives an epitome of the results which have been obtained during the past six years:—

AVERAGE RESULTS OBTAINED, 1891–96.

Month.	Vallis, 1891.				
	Vol. of Milk.	Cheese taken from Press.	Cheese when sold.	Shrinkage in ripening.	Cheese from one gallon of Milk.
	galls.	lbs.	lbs.	lbs.	lbs.
April	81	73	69	4	·85
May	119	117	111	6	·93
June	132	132	123	9	·93
July	112	114	107	7	·96
August	91	99	91	8	1·00
September	79	87½	82	5½	1·04
October	52	64	59½	4½	1·14

Month.	Axbridge, 1892.				
	Vol. of Milk.	Cheese taken from Press.	Cheese when sold.	Shrinkage in ripening.	Cheese from one gallon of Milk.
	galls.	lbs.	lbs.	lbs.	lbs.
April	79	70	66	4	·83
May	109	102	94	8	·86
June	127	122	113	9	·90
July	116	115	108	7	·93
August	100	102½	94	8½	·94
September	84	91	85	6	1·01
October	58	68	62	6	1·07

Month.	Butleigh, 1893.				
	Vol. of Milk.	Cheese taken from Press.	Cheese when sold.	Shrinkage in ripening.	Cheese from one gallon of Milk.
	galls.	lbs.	lbs.	lbs.	lbs.
April	106	96	89	7	·84
May	149	142	132	10	·88
June	141	130	121½	8½	·85
July	134	129	122	7	·91
August	134	131½	124	7½	·92
September	102½	109½	104	5½	1·02
October	68	80	77	3	1·13

AVERAGE RESULTS OBTAINED, 1891–96.

Month.	Mark, 1894.						
	Vol. of Milk.	Cheese taken from Press.	Cheese when sold.	Shrinkage in ripening.	Cheese from one gallon of Milk.	Average No. of Cows.	Average yield of Milk per head per day.
	galls.	lbs.	lbs.	lbs.	lbs.		galls.
April	103	101	96	5	·93	33	3·12
May	148	148	140	8	·94	50	2·96
June	140	141	132	9	·94	51	2·74
July	129	131	124	7	·96	52	2·48
August	112	118	112	6	1·00	52	2·15
September	100	112	106	6	1·06	53	1·89
October..	74	87	81	6	1·09	53	1·40

Month.	Haselbury, 1895.						
	Vol. of Milk.	Cheese taken from Press.	Cheese when sold.	Shrinkage in ripening.*	Cheese from one gallon of Milk.	Average No. of Cows.	Average yield of Milk per head per day.
	galls.	lbs.	lbs.	lbs.	lbs.		galls.
April	126	126	118	8	·94	46	2·74
May	175	167	159	8	·91	61	2·87
June	183	168	159	9	·87	70	2·61
July	146	148	138	10	·95	70	2·09
August	139	152	138	14	·99	70	1·99
September	113	124	119	5	1·05	69	1·64
October..	76	90	87	3	1·14	65	1·17

Month.	Cossington, 1896.						
	Vol. of Milk.	Curd taken from Press.	Cheese when sold.	Shrinkage in ripening.	Cheese from one gallon of Milk.	Average No. of Cows.	Average yield of Milk per head per day.
	galls.	lbs.	lbs.	lbs.	lbs.		galls.
April	163	136	130	6	·80	51	3·19
May	166	164	157	7	·94	56	3·00
June	153	152	142	10	·93	59	2·6
July	137	139	131	8	·96	60	2·3
August	107	114	110	4	1·03	60	1·8
September	77	86	80	6	1·04	60	1·3
October..	56	66	61½	4½	1·10	50	1·1

* This was excessive in April, July, and August, partly owing to the heat of the season, partly to the cheese not being sold so soon as in former years.

II.—THE RECORD OF OBSERVATIONS.

In order to carry on the research work entailed by these observations, it has become quite impossible to devote every day to that recording of mere facts which in the past formed the main feature of the work. The record, therefore—which entails sixty observations and fourteen analytical determinations per day—was only kept during the first ten days of each month. The average results obtained are given in the annexed table, page 13.

(*a.*) SOME GENERAL CONCLUSIONS.

These observations have now been made for five years, and the results tabulated each year. The principal conclusions which could be deduced from these observations have been noticed in previous Reports, and have been many and important. In fact, I am of opinion that the chemistry of cheese-making has been very completely laid bare by this work. It is only necessary to study the results obtained during that period to be convinced that the one paramount secret of success is to obtain the right amount of acidity in the milk, whey, and curd at the critical points in cheese-making, viz. before adding the rennet, before drawing the whey, and before grinding the curd. And the test of the accuracy with which this is accomplished may be found in the acidity of the liquid from the press. No figures can be more instructive to the would-be scientific cheese-maker than the average acidity of the liquid from the press given in this table. It is not as though these averages covered wide divergences. I have looked carefully through the figures for every day in the season, and find that, during a whole month, the acidities of the liquid from the press would only vary within 0·1 per cent. of the average.*

In view, then, of the great uniformity of these results over a period of five years, I have come to the conclusion that but little more light is likely to be thrown upon the problems of cheese-making by continuing these laborious observations month after month.

There may, indeed almost certainly will, occur times when, from some special difficulty arising, it will be necessary to go through the whole set of observations in order, if possible, to find the cause of such troubles. Moreover, as a foundation for the systematic study of any system of cheese-making, similar observations would be invaluable, and, so far as my experience goes, it is impossible to suggest any necessary addition thereto,

* This is the secret of how to obtain cheese of uniform quality.

MONTHLY AVERAGES OF RESULTS OF OBSERVATIONS, DURING FIRST 10 DAYS OF EACH MONTH.

Month.	Relating to Evening's Milk. Volume of Milk.	At night. Temp. of Dairy.	At night. Temp. of Milk.	At night. Acidity.	In morning. Temp. of Dairy.		In morning. Temp. of Milk.	In morning. Acidity.	Morning's Milk. Volume.	Morning's Milk. Acidity.	Total Volume of Milk.	Mixed Milk. Acidity.	Mixed Milk. Proportion of Rennet added.	Acidity of Whey before breaking.	Acidity of Whey put aside.	Acidity of Whey when drawn.	Acidity of drainings from piled Curd.	Acidity of drainings from Curd before grinding.	Weight of Curd when vatted.	Acidity of Liquid from Press.*	Weight of Curd taken to Cheese Room.	Loss in Press.	Weight of Cheese when sold.
	3	5	6	7	9		10	11	13	14	15	20	23	25	27	34	35		51	53	54	55	60
	galls.	° F.	° F.	Per cent.	° F. min.	° F. max.	° F.	Per cent.	galls.	Per cent.	galls.	Per cent.	1 of Rennet to	Per cent.		Per cent.	Per cent.	Per cent.	lbs.	Per cent.	lbs.	lbs.	lbs.
April	62	62	81	·184	61	69	75	·194	69	·181	131	·190	8000	·132	—	·169	·247	·90	134	1·01	126	8	118
May	77	66	87	·186	63	66	71	·199	89	·177	166	·189	8000	·137	—	·207	·301	·92	175	1·01	164	11	157
June	72	68	88	·172	66	69	73	·185	85	·166	157	·175	8000	·140	—	·223	·329	·85	167	·96	155	12	145
July	73	68	87	·196	67	69	72	·208	69	·190	142	·198	8000	·146	—	·203	·304	·93	153	1·00	142	11	137
August	62	68	86	·182	66	68	72	·196	57	·177	119	·185	8000	·138	—	·178	·228	·99	134	·96	124	10	119
September	36	67	83	·180	66	67	74	·192	46	·177	82	·185	8000	·134	—	·201	·318	·93	97	1·01	90	7	83
October	27	65	80	·185	63	66	71	·200	37	·181	64	·189	8000	·139	—	·199	·271	·99	79	·90	74	5	70

* This determination was made every day, and the average given is that of the whole month.

MONTHLY AVERAGES OF RESULTS OF ANALYSES.

Month.	Composition of Mixed Milk.							Composition of Whey.			Composition of Curd.			
	Water.	Solids.	Fat.	Casein.	Albumin.	Sugar.	Ash.	Solids.	Fat.	Ash.	Water.	Solids.	Fat.	Ash.
April	87·25	12·75	3·83	2·43	·39	5·46	·64	7·48	·32	·45	40·66	59·34	32·05	1·78
May	87·22	12·78	3·70	2·64	·36	5·41	·67	7·21	·25	·48	40·72	59·28	30·64	2·05
June	87·41	12·59	3·57	2·64	·35	5·36	·67	7·12	·21	·44	41·33	58·67	29·88	1·83
July	87·39	12·61	3·66	2·58	·34	5·34	·69	7·17	·25	·49	42·07	57·93	30·87	2·01
August	87·27	12·73	3·83	2·66	·36	5·17	·71	7·00	·34	·50	41·65	58·35	31·09	1·93
September	86·81	13·19	4·31	2·71	·38	5·06	·73	7·03	·34	·54	40·57	59·43	32·85	1·88
October	86·62	13·38	4·41	2·85	·40	5·02	·70	7·13	·33	·51	41·40	58·60	31·69	2·05

though slight modifications would be needed for other systems of cheese-making.

I am convinced that, in the majority of cases, the chemical composition of the milk has very little influence upon the quality of the resulting cheese. In other words, whether a cheese will be bad or good will not depend upon the chemical composition of the milk. Moreover, I have been surprised to find that it is not necessarily milk rich in fat that makes a "fat" * cheese. The cause of this "fat" cheese is due to changes produced in ripening, which have yet to be studied. But that rich milk, *i.e.* milk rich in fat, will, other things being equal, make a richer cheese than poor milk hardly need be stated. Hence, it is foolish to abstract fat from milk which is to be used for cheese-making.

(*b.*) RENNET.

It will be noticeable that the proportion of rennet used at Cossington has been constant from the 1st of April to the 10th of October. It has been measured, in every case, in one of the rennet measures which were made specially for the purpose in 1892. The introduction of these measures, which are now placed upon the market by Messrs. Townson and Mercer, of Bishopsgate Street, London, may be said to be one of the practical results arising from the cheese observations. If, remembering this constant proportion of rennet, we study the average composition of the milk, we find that the proportion has not needed altering, even though the milk has varied considerably in composition, containing in April 3·83 per cent. of fat and only 2·43 per cent. of casein; in June, 3·57 per cent. of fat, and 2·64 per cent. of casein; and again in October, 4·41 per cent. of fat, and 2·85 per cent. of casein. These figures afford fairly conclusive evidence that the quantity of rennet necessary depends more on the strength of the rennet than on the composition of the milk, and that where it is found necessary to materially alter the quantity of rennet used, it is probably due to some change in the rennet which causes it to lose its strength.

(*c.*) DETERMINATIONS OF ACIDITY.

In my last Report I stated that some experiments had been made with a view of trying to estimate more precisely the acidity of the milk, &c. This year, in order to determine whether such tests would throw any light upon some of the

* A technical term, used to denote a cheese which cuts with somewhat the consistency of butter.

more delicate changes which take place in the milk, the acidity determinations have been made with a solution only one-fifth of the strength of that ordinarily used. After special experiments had been made on the subject, this was found to be the best strength to use; it has thus been possible to estimate the acidity to $\frac{1}{50}$th part of 1 per cent. And the results obtained show very clearly the difference between the evening's milk when brought into the dairy and after standing through the night.

But the use of such a solution is attended with difficulty, and cannot be recommended to anyone except a trained chemist. Only after considerable experience can a perfectly uniform tint be regularly obtained in the substance tested. The difficulty of obtaining this tint led to an investigation into the influence of the strength of the phenolphthalein solution, or "indicator," on the results obtained. This was found to be considerable, and the best results were obtained only when an indicator was used containing 0·2 grammes of phenolphthalein to the 100 c.c. of solution. I mention this owing to a growing demand which there now is for the acidity apparatus, so that those who provide the solutions may make the indicator of this strength, for even when using the ordinary solution of soda, the strength of the indicator will slightly affect the results obtained.

ACIDITY GOING BACK.

On comparing the figures, which show the average acidity of the drainings from the curd before grinding with those of the acidity of liquid from the press, it may be seen that during the months of August and October the acidity of the liquid from the press was less than the acidity of the last drainings from the curd when on the cooler. Now this is exceptional. It has been noticed on isolated occasions in former years, but never to such an extent as to affect the averages. Numerous attempts have been made to discover the reason for this, but up to the present without success. It is almost invariably associated with a taint in the curd, so that it is probably the result of bacterial changes. Its practical importance is this, that when such taint arises it is necessary to develop in the curd before vatting apparently *more acidity than is desired in the liquid from the press,* otherwise the cheese will be tainted and inferior.

(*d.*) THE ACIDITY OF CURD.

From time to time cheese-makers have said to me, "What we want is some instrument that will tell us the acidity of the curd."

Now, it has been pointed out in previous Reports that the acidity of the liquid from the press seemed to afford sufficient indication of the acidity of the curd for all practical purposes. At the same time I could not forget that in my early work (see Reports for 1892 and 1893), when attempting to obtain tests of the acidity of the curd, neither uniform results nor figures which lent themselves to any explanation could be obtained. The subject was left in obeyance, owing to more urgent questions having to be settled. But now, wishing to clear up all chemical problems relating to the manufacture of cheese, the question once more arose in my mind, is there an acidity or acid condition of the curd, independent of and different to the acidity of the liquid, by which that curd is impregnated?

Experiments were made to determine the acidity of the curd by the following four methods:—

a. Two grammes of curd were cut up into fine pieces, placed in a flask with distilled water, and allowed to stand in a warm place, or gently heated, and after standing for twelve hours the acidity of the liquid was determined.

b. Thinking that the warmth employed in method "*a*" might cause the production of lactic acid, 2 grammes were treated similarly to the above, but the solution immediately boiled so as to destroy the bacillus acidi lactici.

c. Two grammes of curd were rubbed up in a mortar with distilled water into fine particles, and the acidity thereof immediately determined.

d. Two grammes of curd were cut into fine pieces, placed in a flask with water, and an excess of caustic potash solution, and the liquid boiled. Subsequently the free potash was determined, so that the amount of potash consumed showed the acidity of the curd, soluble in alkali.

The following table gives some few examples of the results obtained, and also the acidity of the liquid from press on the same dates.

DATE.	Acidity by "*a*."	Acidity by "*b*."	Acidity by "*c*."	Acidity of Liquid from Press.	Acidity by "*d*."	Acidity due to Curd.
1896.						
June 6	·85	·87	·89	·88	6·05	5·16
" 24	..	·90	·97	·95	5·37	4·40
" 26	·94	·95	·99	·99	5·37	4·38
July 1	1·04	1·04	1·05	1·04	5·30	4·25

From these results, which have been confirmed by numerous other experiments, we learn that method "*a*" does not succeed in obtaining all the acid liquid out of the curd. That method "*b*," while it improves the results, owing probably to the contraction of the curd by heat expelling its acid contents more thoroughly, still fails to give quite so high results as method "*c*," which has consequently been adopted throughout the season. It is, fortunately, more simple and more rapid than either "*a*" or "*b*."

Comparing the results obtained by method "*c*" with the acidity of the liquid from the press, it will be seen that they are practically identical, so that this method of analysis appears to give us merely the same acidity as that of the liquid which is in the curd. As the curd contains only 50 per cent. of liquid at most, we might expect the figures to be one-half those of the liquid from the press. Why they are identical with the liquid from the press, I am as yet unable to explain. It has been noticed that after estimating the acidity by method "*c*" there is a secondary reaction, which takes place slowly, and is more difficult to determine, but which gives almost constant results. So far as I am able to judge at present, this is due to acid salts present in the curd.

The result obtained by method "*d*" is very different. Here, in addition to the acidity soluble in water, we have an acidity which we must assume to be due to the solid substance of the curd insoluble in water. By deducting from this total acidity the acidity due to the soluble portion, we should obtain the true acidity of the insoluble portion or casein.

The acidity of the casein, as determined by method "*d*," fluctuates from day to day in a most remarkable manner. This will be seen by reference to the following table. These results do not correspond in any way with the acidity of the liquid by which the curd is surrounded. Neither are they in proportion to the amount of pure casein present in the curd. The fat in the curd would, by being saponified, use some of the potash; but again we find no relation between the fat and this supposed acidity of the casein.

DATE.	True Acidity of Curd.	Acidity of Liquid from Press.	Percentage of Casein present in Curd.	Percentage of Fat present in Curd.
1896.				
July 2	5·45	·89	24·58	30·42
„ 3	3·42	1·06	24·85	31·05
„ 4	4·25	·98	25·54	29·96
„ 5	3·73	1·02	24·93	31·07
„ 6	4·32	1·03	24·94	32·76

The determination with which the results obtained seem mostly to accord is that of the acidity of the liquid from the press. But, without quoting figures, it may be stated that, though very numerous experiments have been made to try and discover if there were any relation, no *constant* relation could be discovered between these two determinations.

Tabulating the figures (which we may term "casein acidities") obtained this year, and comparing them with results obtained in 1892—the only year for which the necessary data exist—we obtain the following results:—

TABLE SHOWING AVERAGE "CASEIN ACIDITY" OF CURD DURING THE FIRST 10 DAYS OF EACH MONTH.

——	1892.	1896.
June	4·27	4·39
July	3·77	4·06
August	3·33	3·39
September	3·62	3·43
October	3·16	3·47

These results are of sufficient interest to warrant further investigation. They seem to prove beyond doubt that curd when vatted is an acid solid, surrounded by an acid pickle. Also, that the acidity of this solid varies not only from day to day, but in different months, decreasing during July and August, but increasing subsequently. How far the acidity of the solid, as distinct from the liquid, may affect the ripening or quality of the cheese remains to be determined.

Curd is one of those complex organic substances about which chemists know very little. In 1892 I showed that, during the process of cheese-making, a large quantity of lime was extracted from the curd not only in the whey and in each of the drainings from the curd on the cooler while it is developing acidity, but also from the curd when finally placed in the press. Now, as this lime would exist in the milk, either in solution or in combination with the casein, if in solution it would be present in the whey, while if in combination it would be present in the curd. The analyses of whey show that only about two-thirds of the mineral matter of the milk are present in it, so we must conclude that the remainder is in the curd. From a series of analyses made of the liquid from the press and of the curd, I find 0·5 per cent. of lime in the former, and nearly 1 per cent. in the latter. The only possible supposition is that it is combined with the casein. It would, therefore, appear that casein is an acid substance, is combined with the lime in curd, and as lactic acid is produced in the curd it takes away this lime and leaves an acid casein behind. If this be the right explanation, then it is evident that curd, in addition to the acidity which it possessed from the lactic acid it contained, would have an acidity of its own, proportionate to the amount of lime which had been taken away from the casein. Otherwise it would have a constant acidity in proportion to the quantity of pure casein present. As it is found not to have a constant acidity, the results of the above quoted experiments lead to the first assumption, so that the practical cheese-maker is justified in his request for an instrument that will test *the acidity of the curd.*

(e.) LIQUID FROM PRESS.

Complete analyses were made of six samples of this liquid taken at different periods. The average of the six analyses is as follows :—

Water..		82·23
Fat	3·48	
Lactic Acid	·99	
Albumin	·76	
Sugar	3·38	
Mineral matter (mainly Salt) ..	9·16	
		17·77
		100·00

The percentages of lactic acid, of albumin, and of mineral matter fluctuate but slightly. The percentage of fat is liable to greater fluctuation, while that of sugar is the most irregular.

(f.) THE COMPOSITION OF THE CHEESES.

The cheeses when sold have been found in the past to vary in composition so slightly that it was not deemed necessary to make very many analyses in 1896. The chief fluctuations, between different years, depend upon the quality of the milk, and upon the time which elapses between the making and selling of the cheese. The following table gives the results of the analyses.

PERCENTAGE COMPOSITION OF CHEESES WHEN SOLD. 1896.

——	Moisture.	Fat.	Casein, &c.	Mineral Matter.
April 23	36·05	29·52	30·53	3·90
" 24	36·35	30·45	29·35	3·85
" 27	36·65	27·01	31·89	4·45
May 7	33·60	32·20	30·30	3·90
" 18	35·70	33·28	27·22	3·80
" 20	35·40	30·52	30·28	3·80
June 6	35·00	29·97	31·33	3·70
" 11	34·30	33·32	28·68	3·70
" 20	34·70	32·49	28·91	3·90
July 2	37·40	32·40	26·30	3·90
" 8	35·80	32·94	27·46	3·80
" 14	35·90	33 32	26·48	4·30
" 22	36·00	32·67	27·23	4·10
August 7..	36 80	33·04	26·16	4·00
" 9..	37·40	32·13	26·47	4·00
" 14..	38·40	32·20	25·70	3·70
" 25..	38·50	32·73	25·17	3·60
September 4	35·30	31·92	29·28	3·50
" 9	35·80	34·29	26·51	3·40
" 23	36·00	35·10	25·40	3·50
October 2	36·00	33 00	27·50	3·50
" 10	36·60	32·45	27·55	3·40

(g.) THE FAT OF WHEY AND CHEESE.

In trying to clear up all the problems connected with the acidity of milk, whey, curd, &c., the question arose in my mind—does the fat ever exhibit an acid reaction? In all the estimations of fat this substance is isolated and weighed in little glass flasks. Experiments were made, first by mixing it with hot water, to dissolve out any acid soluble in water that might be present; but only a trace could be found. Then the fat was treated with alcohol, to dissolve out any acid soluble in alcohol, and the acidity of the solution was estimated. Both in the fat of whey and in that of curd an appreciable amount of acid substance was found. I have calculated the acidity present as oleic acid, and the following table gives the average results obtained from about ten determinations made each month in both whey and curd:—

PERCENTAGE OF OLEIC ACID IN FAT FROM WHEY AND CURD.

—	Whey.	Curd.
May	..	4·10
June	30·74	8·84
July	31·20	6·94
August	16·18	3·10
September	17·79	3·55
October	19·08	3·94

The results vary with each cheese in a somewhat remarkable manner, for which fact an explanation has yet to be sought. One experiment has been made by determining the acidity or oleic acid in the fat from a cheese when ripe to compare with that found in the curd at the time of vatting. The results are as follows:—

	Per cent. Oleic acid.
On Sept. 7th, in curd	1·98
On Nov. 25th, in cheese	2·23
On Jan. 28th, 1897, in ripe cheese	2·23

Practically no change seems to be produced in the fat by ripening, which confirms results to be subsequently referred to.

I am unable to trace any relation between the acidities produced during cheese-making and these oleic acid determinations, so that it would appear that the fat in the original milk varied in nature from day to day; a subject which will receive attention in the future.

III.—THE RIPENING OF CURD.

One of the original objects of the Experiments was to discover, if possible, what changes take place during the ripening of curd and its conversion into cheese. Every one knows how very different in texture and flavour newly-made curd is from ripe cheese. Moreover, it is generally known that a good curd will result in a good cheese, while a tainted curd will result in a cheese of poor flavour. It has been shown by the observations in former years that while some taints diminish during the ripening of the curd, others are augmented. I have found this year that while, during the first three months of the ripening of the curd, some taints appear to be overcome or checked by the changes taking place, they subsequently find in the ripe cheese a new stimulus to growth, and in a month or two after being ripe the cheese is unfit for consumption. There is every reason to suppose that the ripening of cheese depends on the growth and chemical changes produced by bacteria. For it is well known that if a cheese is kept at a low temperature, such as retards the growth of bacteria, ripening takes place slowly. On the other hand, when a cheese is kept at a higher temperature, more favourable to the growth of bacteria, ripening takes place rapidly. Hence the investigation divides itself into two parts, first, what bacteria are at work in the ripening of a cheese, and secondly, what chemical changes are brought about by their growth?

The first of these questions had received my attention to a certain extent in each preceding year, and the result of my observations was that, among bacteria, the bacillus acidi lactici played the most important part, judging from the number which were found in every cheese, their invariable presence, and my inability to discover any other organism which was always present. That this work is still incomplete I fully recognise. That other organisms are present in cheese is undoubted, and what part these may play in the ripening process remains to be discovered, as also the effect of those organisms which, during ripening, produce various well-known taints.

The second subject, namely, what chemical changes take place in the ripening of curd, having received no previous attention, it was decided to commence work in this direction.

Only those who have studied chemistry can at all appreciate the difficulties of such an investigation, and it is far from an easy task to clearly explain the work which has been done. Curd when taken to the cheese-room consists of water, fat, a small amount of milk sugar, lactic acid, albumin, and mineral matter (including the salt added to the curd), and lastly, "curd" itself, or the "casein" of the milk in a solid and insoluble form.

That cheese when ripe had lost moisture and become dry was evident. Some workers said that the fat was increased, others denied this, while the changes which had taken place in the casein were but little understood.

My first object was to devise a method of analysis which might throw some light on the changes that had taken place. The primary question was, did the ripening of the cheese render the casein or any other substance soluble in water?

Every one knows the striking difference in appearance between the white solid interior and the yellow semi-liquid exterior of a half-ripe Camembert Cheese. Such a cheese affords a striking example of change due to ripeness, and my first experiments were made therewith. As difficulties were met with and overcome, the system of analysis was extended, and at last a complete system of examination has been drawn up. But owing to the small sample of cheese which can be obtained from a boring, and the minute amount of substances to be estimated, it was not always possible to carry out the complete scheme, nor yet to check figures which seemed doubtful. In spite of these drawbacks and the incompleteness of the results, I think they throw sufficient light upon the subject of ripening to justify publication. In the future I hope to obtain more perfect and complete results.

The analytical data are given in the table on page 24. For the information of those who may wish to apply this method of investigation to other cheeses, I will briefly describe the process adopted. In order to obtain accurate results, all other work must be put aside, and the various determinations must be made with the utmost rapidity compatible with accuracy. The solutions undergo rapid change, after which the results would be useless, and misleading. All the chemical solutions and apparatus must be scrupulously accurate and tested specially before commencing work.

The sample of cheese is cut up on a porcelain slab into minute fragments; these must be well mixed together and portions taken for each determination. As regards the first six estimations, the methods by which these are made are well known. No. 7 is obtained by rubbing up 1 gramme in a mortar with water, and the acidity is estimated as previously described for curd.

The soluble constituents are estimated as follows: 5 grammes of the sample are taken, rubbed to a thin paste with a little water in a porcelain mortar, and then transferred to a graduated glass cylinder (stoppered), and the mixture made up to 104 cubic centimeters. This will yield 100 cubic centimeters of solution. After repeated shakings, the mixture is allowed to stand until next morning, when it is filtered, and the determinations are immediately made in the filtered liquid. In these determinations the acidity is first estimated as usual, the portion taken for this estimation being then evaporated to dryness for the solids. I find that unless precaution is taken to first neutralise the solution there is a loss during evaporation.

No. 13 is estimated by Kjeldahl's method.

No. 14 by distillation, after making slightly alkaline.

No. 15 by titrating with standard sulphuric acid, using methyl orange as indicator.

No. 16 by distilling the solution used for No. 15 estimation.

After repeated investigations no fat has been found in the soluble constituents.

Some of the nitrogenous constituents are soluble in ether after the sample has been dried. Thus an attempt to estimate the fat in the cheese by drying with gypsum and then extracting

Table Showing the Composition of Cheese at Various Stages of Ripeness.

No.	—	Camembert Cheese.		Cheddar Cheese of April 22.*			Cheddar Cheese of June 4.†			Cheddar Cheese of Sept. 7.	
		Unripe.	Ripe.	On April 22.	On July 7.	On Aug. 17.	On June 4.	On Aug. 5.	On Aug. 31.	On Sept. 16.	On Jan. 25, 1897.
1	Water	52·70	54·15	39·95	36·55	35·45	39·90	34·40	36·15	37·75	34·65
2	Solids	47·30	48·80	60·05	63·45	64·55	60·10	65·60	63·85	62·25	65·35
	Containing :—										
3	Fat	21·87	22·52	30·78	31·20	31·75	30·80	30·60	30·75	33·16	34·54
4	(*a*) Casein, &c., by difference	21·93	22·88	26·57	29·30	29·15	27·30	30·95	29·15	24·14	26·76
5	(*b*) Mineral matter	3·50	3·45	2·70	2·95	3·65	2·00	4·05	3·95	3·95	4·05
6	In (*a*) Casein by estimation of $N \times 6\frac{1}{4}$	..	..	24·06	26·31	26·35	25·81	28·06	27·74	23·56	25·11
7	Total acidity calculated as Lactic Acid	..	..	·95	3·78	3·15	1·03	2·50	3·24	1·53	2·07
8	In (*b*) Lime	..	..	1·00	..	1·00	1·03	..	..	..	1·04
	Soluble constituents—										
9	Total solids	..	..	7·65	15·27	14·40	7·96	13·43	14·80	8·80	13·60
10	Acidity calculated as Lactic Acid	·72	1·08	1·44	2·16	2·16	1·80	2·34	2·52	·81	·85
11	Mineral matter	..	..	2·26	2·27	..	·96	..	..	..	3·40
12	Containing Lime	..	..	·67	..	..	·45	..	..	..	·89
13	Casein, by estimation of $N \times 6\frac{1}{4}$	15·44	23·00	4·18	8·69	8·81	4·21	9·61	14·25	4·00	9·30
14	Ammonia Volatile	·54	·65	..	..	..	·14	·24	..	·09	..
15	Neutralising power estimated as Ammonia	·17	·44	·27	·41	·60	·34	·47	·60	·30	·34
16	Volatile acids estimated as Butyric Acid	·61	·72	..	·53	..	..	..	..	..	..

* This Cheese was tainted, and subsequently became unfit for food. † Very good Cheese, in perfect condition on August 31st.

with ether in a Soxhlet apparatus, has yielded abnormally high fat results, while the estimation of the nitrogen in the extracted residue gives abnormally low casein (nitrogen) results.

Let us now turn to the results obtained. It is evident that, during ripening, practically no change takes place in the fat. It is not increased in quantity, and it is not rendered soluble. The most marked change is the gradual increase in the amount of solids rendered soluble (No. 9), while this soluble matter is seen to consist mainly of nitrogenous substances (No. 13). Side by side with this change, we have a constant increase in both the acidity of the cheese and in the soluble acids, and it is highly probable that this increase in acidity is the primary cause of the increase in solubility of the nitrogenous matter. In other words, that the principal factors in the ripening of cheese are the continued production of lactic acid, side by side with an increase in the solubility of the casein, or nitrogenous compounds. But this is not all. As the casein is rendered soluble, we find an increase in the amount of ammonia (No. 14), and also of substances like ammonia, having a basic action (No. 15). There can be little doubt but that these substances are products of the decomposition of casein, and, so far as my experiments go at present, the main portion of the casein appears to have been converted into peptones. I have not been able to find any soluble albumins.

Now, if we examine the figures relating to the cheese of 22nd April, we shall find on 17th August, when the cheese had commenced to go off, that, while the soluble acidity (No. 10) had not increased since July, the actual acidity of the cheese (No. 7) had decreased. The formation of lactic acid had ceased, and fermentation of the soluble constituents—in other words, decomposition—had set in. The germs of taint not yet destroyed in the curd, but apparently kept in check by the activity of the lactic acid bacillus, so long as that organism was at work, now, having the field clear, commenced anew their evil influence.

The very small quantities of butyric acid found, show that the conclusion at which I arrived from microscopical examination of the cheeses is correct, and that the butyric ferment plays practically no part in the ripening of Cheddar cheese.

On the other hand, the very considerable increase in the percentage of lactic acid in the cheese lends additional proof to my conclusion that it is the development of this acid which plays the most important part in the process of ripening.

Thus we get some slight idea as to the processes which are taking place during ripening, and their practical bearing is both interesting and important. So long as lactic acid is being developed in the curd, so long is the cheese ripening. When the maximum acidity has been attained, it then begins to gradually diminish, decomposition sets in, and the taints, or rather the bacteria of taints, which up to this period seem to have been compelled to lie dormant, now re-assert their sway.

The process of ripening is followed by that of decay, the rapidity of which will depend mainly upon the impurity of the original milk and curd. Thus we understand why it is that cheeses which become ripe rapidly will not keep, while those made to ripen slowly do keep. We also understand why it is that cheeses which, if examined during the period of ripening, are found of fair quality, when kept over that period "go off," diminish materially in value, and become in time absolutely valueless.

Unless my facts or arguments are wrong, it is impossible to study these results without feeling that this question of the rapid ripening of cheese and its consequent results needs, indeed demands, serious consideration. Has not rapid ripening been carried too far? While, on the one hand, it is not imperative to make a cheese that requires a twelvemonth in which to ripen, is it desirable to make one which is ripe three months after it is made, and commences to show signs of decomposition a month later?

This first attempt to investigate the changes which take place during ripening only touches the fringe of the subject, yet already its practical bearing is evident, and I shall hope next season to make a further and more complete study thereof.

IV.—THE BACTERIOLOGICAL OBSERVATIONS.

THE MICRO-ORGANISMS IN MILK.

The importance of bacteria in dairying, especially in cheese-making, does not depend upon their size, but upon their number, and upon the rapidity of their increase. Thus the morning's milk of the 2nd of May, about three to four hours after it was drawn from the cow, that is soon after it came into the dairy, contained over 750,000 bacteria in one cubic inch. The number of bacteria in the evening's milk was not estimated, though practically this is of more importance, for it is mainly upon the increase in the number of these bacteria during the night that the next day's cheese-making will depend. How rapid this increase is, and how greatly the number of bacteria varies in the mixed morning's and evening's milk just before the rennet is added, can be seen from the following table. It contains the only three estimations made, and not merely a few selected from a number. To indicate the importance and influence of these bacteria on the manufacture of the cheese, a few of the ordinary observations as to times and acidities are also given.

DATE.	Bacteria in one cubic inch of mixed Milk.	Acidity of Whey.	Acidity of liquid from piled Curd.	Increase in acidity while Curd piled.	Time Curd remained piled.	Acidity of liquid from Press.	Time Curd vatted (P.M.).
		per cent.	per cent.	per cent.	min.	per cent.	H. M.
Sept. 2, '96 ..	11,500,000	·205	·270	·065	25	·97	7 10
Sept. 10, '96..	57,700,000	·205	·300	·095	10	·91*	2 10
April 10, '96..	87,000,000	·185	·325	·140	5	1·02	1 4

* This curd, if it had been left some time longer before grinding, say 30 minutes, would probably have had about the same acidity as the other two.

It will be seen that the time of vatting and the development of acidity in the piled curd are dependent upon the number of bacteria originally present in the milk.

It may be asked, how came these differences in the number of bacteria? The causes are several, but one of the principal is temperature. This is shown by the following figures:—

On the night of	Temp. of Dairy.	Temp. of Milk in morning.
1st to 2nd September	65–66	72
9th to 10th September	67–68	74
9th to 10th April	65–73	74

In face of these figures, it is scarcely necessary to point out how important it is to keep the evening's milk at a moderate temperature, in order to prevent the cheese-making on the following day being unnecessarily protracted.

They also enable us to understand why it is that the Cheddar cheese-makers in Scotland, who ripen the milk up to a fixed standard before renneting, succeed, as a rule, in finishing cheese-making early in the afternoon. And, if only a fixed standard of acidity were obtained in the mixed milk before renneting, cheese-making would be more regular.

The Bacillus Acidi Lactici.—Such is the name of the organism which has been most active in producing the results above referred to. It is to insure that these organisms shall produce a sufficient quantity of lactic acid in the curd that all the care as to temperatures of scald, &c., on the part of the cheese-maker is directed. But, in previous Reports, I have several times drawn attention to the fact that bacteriological examination has shown the Bacillus acidi lactici to be also the organism present in greatest number in the ripe cheeses. In this respect, the work of 1896 confirms that of the past.

Moreover, the investigation during the past season into the ripening of cheese, from a chemical point of view, has strengthened the evidence in support of the assumption, that the ripening of Cheddar cheese is brought about mainly by the lactic acid bacillus. In making this statement, what organism do I refer to?

It is only necessary to have a mere smattering of bacteriology to know that many organisms have been described by various writers as lactic acid organisms, or such as are capable of producing lactic acid by the fermentation of milk sugar.

Of these the organisms most frequently referred to are as follows:—

1. Bacillus acidi lactici. Hüppe.
2. Bacterium acidi lactici. Grotenfeldt.
3. Bacterium limbatum acidi lactici. Marpmann.
4. Micrococcus acidi lactici. Marpmann.
5. Sphaerococcus acidi lactici. Marpmann.
6. Micrococcus acidi lactis liquefaciens. Krueger.
7. Pediococcus acidi lactici. Lindner.
8. Streptococcus acidi lactici. Grotenfeldt.

Putting aside, for the moment, No. 6, which has the characteristic property of liquefying gelatine, let us examine the information available concerning the others. They do not liquefy gelatine. They, one and all, are described as forming on gelatine plate-cultures, small circular colonies, white, porcelain white, grey, or tinged with yellow, while all are described as colonies having a smooth glittering appearance.

I can only find a statement of the time which they take to curdle milk for Nos. 3, 4, and 5, and these all require twenty-four hours. Here let me state that, according to Krueger, his Micrococcus acidi lactis liquefaciens takes no less than five days to curdle milk, so that it cannot be compared with any of the other organisms, and does not need our further attention.

For six years I have been constantly seeking to find these various lactic acid organisms and have failed to do so. During that time hundreds of cultures have been started, and every possible attempt has been made to obtain these organisms. At times I have thought that I had secured two or more varieties of lactic acid bacteria. But when cultures of these were made simultaneously in or on the same media and kept under similar conditions as to temperature, &c., I have invariably found that my assumed varieties were in every respect identical. I am, therefore, forced to the conclusion that there is only one true lactic acid organism, which may be termed the Bacillus acidi lactici, ordinarily met with.

I have previously described this organism and the appearance of its cultures, but may now refer once more to these points. In shape it is slightly pointed at either end, and being only about one and a half times as long as it is broad, it does not really appear to be a bacillus, nor yet a coccus, which should be perfectly spherical. There ought to be some word to designate an organism so shaped; the word micro-ovum, which I applied to it some time since, has been stigmatised as neither Greek nor Latin, and a better substitute has been suggested in the word micröon.

This egg-shaped bacillus or micröon varies greatly in size, according, so far as I can judge, to the food which it is growing in or on, the age of the culture, and probably the number of bacteria present. Thus, in a young and vigorous growth it is quite large and distinctly bacillus shaped. With increasing age it diminishes in size, and in an old growth can scarcely be distinguished from a coccus. This is the form it mostly assumes in milk cultures, especially after they have curdled, also in cheese. Indeed, so very varied is it both in size and form that I have frequently felt certain of having obtained two distinct organisms, only, however, to be disappointed on further investigation.

In recently-made cultures it takes all the ordinary stains readily; but in old cultures it is more difficult to stain, and the stain is readily washed out. It will not retain the stain when subjected to Gram's method.

Not only does the organism itself vary in size, as above described, but a similar variation is noticeable in colonies of the Bacillus acidi lactici when growing on gelatine plate cultures. Two plates were inocculated from a pure culture of the bacillus, similar nutrient gelatine being used for each plate, and both being kept at the same temperature. The only difference was in the number of bacteria with which each plate was inoculated; in one case there were but few, in the other many, organisms. During the whole period of their growth the colonies on these plates were but slightly similar. Those few in number grew rapidly and attained considerable size, while the numerous colonies grew slowly, were minute, and never attained one-fifth the size of the other colonies. It would seem that in their growth, even on the solid gelatine, they either exhaust the material around them of its nutriment, or else poison it, though in milk the influence of the lactic acid produced might account for their less vigorous growth. Yet how this can take place on a solid nutriment is difficult to understand.

It has, indeed, always been a puzzle to me how the bacteria in a colony on a plate obtain their nutriment at all. I have seen colonies of bacteria rising one millimètre * above the surface of the gelatine, so that the food which supplies the organisms on the top of such a colony is one thousand times their own length away from them. How does it reach them?

However, putting aside these interesting problems, let us return to the Bacillus acidi lactici.

A colony on the plate is identical in appearance with the description given by other observers of several of the previously mentioned varieties. It is a small, white, circular smooth growth, very rarely larger than a pin's head, though occasionally it will spread over the surface, and a thin circular disc, about one-tenth of an inch in diameter, be formed. When growing in the gelatine the colonies are spheres, or at times lemon-shaped, both forms being present. The colonies, sometimes mere specks, sometimes nearly as large as a pin's head, are rarely one millimètre in diameter.

A stab culture in gelatine produces a very thin growth of isolated colonies.

A surface culture on gelatine produces a delicate growth under one-eighth of an inch wide, made up of isolated colonies in places, but mainly consisting of a fairly uniform thin streak. On agar and on potato the culture is similar to that on gelatine, but not so vigorous.

When milk is inoculated with the organism it is coagulated into a solid mass in forty-eight hours at a temperature of 70° Fahr.

Such is a description of the only lactic acid-producing organism, in any way similar to the eight previously mentioned, that I have been able to find.

A Strepto-bacillus Acidi Lactici.—There is, however, one lactic acid-producing and milk-curdling organism which has occurred from time to time among the bacteria in milk, and which I have sometimes found in cream; a bacillus which grows together in long chains—*i.e.* a strepto-bacillus.

I am even inclined to think that there are two varieties of this strepto-bacillus, one taking only twenty-four to thirty hours to curdle milk, the other taking three to four days at a temperature of 70° Fahr.

* A millimètre is about $\frac{1}{25}$th of an inch.

The individual bacilli are about one and a half to two μ long, with pointed ends, which give them an oval appearance.

Growing on a plate (gelatine) culture, the colonies cannot be distinguished from those of the ordinary Bacillus acidi lactici, being round on the surface, spherical or lemon-shaped when growing in the interior, white and small.

The streak culture on gelatine shows more marked difference. It is slower of growth, and forms a very thin streak, seldom one thirty-second of an inch wide, and it is made up of numerous, for the most part disconnected, colonies, whereas in Bacillus acidi lactici, as a rule, the colonies coalesce to form a uniform surface growth.

This strepto-bacillus appears to have a remarkable power of producing lactic acid, for, in several instances, milk was coagulated by it in from twenty-four to thirty hours. Here it may be well to explain the word "coagulated." When the milk sets in a solid mass, in which the whole of the water of the milk is contained, I term it coagulated. The true lactic acid-forming bacteria always produce this effect. There are other organisms which have the power of *curdling* milk, but they separate or precipitate the curd from a more or less clear whey. This distinction between the Bacillus acidi lactici and other organisms is very marked.

Cheeses were made from milk inoculated with this organism, and in these cheeses when ripe I was able to find the strepto-bacillus, as well as the ordinary Bacillus acidi lactici.

Overcoming Taints.—It has been stated that the milk at Cossington was frequently tainted. Three experimental cheeses were made with this strepto-bacillus, by placing a pure culture in the evening's milk.

The development of acidity by the morning was marked, and proceeded rapidly during the manufacture of the cheese. There is no method by which this development can be so well gauged as by comparing the acidity of the whey with that of the liquid coming from the piled curd after drawing the whey. The latter will, as a rule, show from 0·07 to 0·10 per cent. more acid than the whey, while in the case where the milk had been inoculated with the strepto-bacillus the difference was 0·17 per cent. or more.

All these three cheeses were pronounced to be of "very good" quality.

Another experimental cheese was made by inoculating the evening's milk with the ordinary Bacillus acidi lactici; but the result was not so satisfactory, owing to the milk on that occasion being badly tainted.

These experiments were generally made at a time when there was a taint in the milk, the object being to see whether any improvement could be brought about. The results would point to a considerable improvement being due to the introduction of the strepto-bacillus.

A Yeast.—During the continuation of these experiments there has been found in the milk, curd and ripe cheeses an organism which, from its immense size as compared with bacteria, I have designated a yeast. Noticing that this organism appeared to be frequently present in "very good" cheeses and not so frequently in inferior cheeses, I determined to make some inoculation experiments.

The organism is perfectly spherical; only rarely can a budding cell be observed. The cells do not show the variations of shape so frequently seen in most yeasts, nor do they remain united in chains or bunches. On plate (gelatine) cultures the colonies are mostly on the surface, being round, white, somewhat raised, and having a dull crinkled surface. Streak cultures on gelatine grow rapidly, and produce a thick white streak one-eighth of an inch wide, with dull and wrinkled surface, as if drawn up into folds. So far as I can judge from the description given by Duclaux, this yeast appears to be very similar to his *levure de lactose.**

Three times experimental cheeses were made with this organism. Unfortunately, on the first occasion the milk proved to be highly tainted, the curd had a very strong fæcal smell, and the cheese, though "fairly good," was not "very good." On the second occasion, the curd again had a slight taint, and the cheese, though good, was not of the best. On the third occasion the curd was not very good, though no marked taint was present; but the cheese was "excellent, with rich flavour, and mellow."

There thus appears to be some hope that this yeast improves the flavour of cheese, but it is evident, owing to the conditions having proved unfavourable for the experiments, that any conclusion would be premature.

I have also found a yeast very similar to the preceding, except that its cultures have a smooth and somewhat shining surface instead of the dry appearance of the above. Three experimental cheeses were made with this yeast, and all three were pronounced "very good" by the experts who examined them, though in two of the experiments the curd showed a taint when vatted.

Such were the ten inoculation experiments made with the object of trying to discover the bacteria or organisms which

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* Ann. de l'Institut Pasteur, 1887.

produce the highly desired combination of flavour and aroma characteristic of an excellent Cheddar.

In addition, experiments have been made with the view of determining the organisms injurious to the production of a good cheese.

The Vinegar Taint.—In 1894, when the School was located at Mark, I obtained certain organisms, somewhat characteristic cocci, which were also found at Cossington in the early part of 1896. They had not been present at Crewkerne in 1895. One of the taints which occasionally arose at Mark was distinguished as the "Vinegar" taint, the curd and whey possessing the smell of vinegar.

I was thus led to pay some attention to this coccus. It is exceptionally large, does not form chains, but is frequently found in pairs; the adjacent sides of the two cocci being so flattened that they look like one large organism with a dividing line * separating it into two rounded end cones.

Growing on the plate (gelatine) culture the colony is very small and perfectly spherical. In course of time, growth being very slow, a pit-like cavity of liquefied gelatine is noticed, at the bottom of which lies the little colony. Examined under the microscope at this stage it is seen to have partly lost its clear circular edge, which is now slightly irregular. The colony is opaque, no internal structure is visible, and it possesses a slight yellow colour. Later on, it seems to burst, and particles float out into the liquid gelatine. It is one of the most slowly liquefying organisms I have met with. It retains stain by Gram's method.

A stab culture in gelatine, after some time, begins to show liquefaction, which at the surface gradually extends to the sides of the tube, and the liquefied portion takes the shape of a sac, at the bottom of which is a white or slightly yellow deposit, while the liquid gelatine is slightly cloudy.

The organism when grown in milk slowly produces a curdling effect, and the precipitated curd takes a characteristic pinkish tinge.

On agar an ochre-coloured growth is formed, and on potatoes a light ochre-coloured growth. Experiments were made with this organism in the usual manner, and the vinegar taint was obtained. The cheese when ripe was not good, and had a wrong flavour.

A second experiment was made, the milk being divided into two parts, one inoculated, one not inoculated; and again the

* This under the microscope is a clear unstained space, the organisms being deeply stained.

inoculated milk produced an inferior cheese to the milk not inoculated.

As to the origin of this micro-coccus. Fortunately, owing to its power of retaining a stain when treated by Gram's method, which by far the greater number of organisms found in milk are not able to do, it was comparatively easy to examine various probable sources of contamination. The coccus was soon found in cow's dung, and so long as it gave trouble in the dairy it was always to be found in this material. Then came a period when the coccus was no longer found in the curd. Again the cow's dung was examined from time to time, but none of the cocci could be discovered. Towards the end of the season the organism again made its appearance in the curd. Once more the dung was examined, and again the coccus was found in it. There can be little doubt but that its presence in the milk and curd was accounted for, as several other organisms may be, by want of cleanliness, and the remedy is evident. But from a scientific point of view this subject raises another and more interesting problem, how came the micro-organism into the dung?

Ropey Milk Bacteria.—The season was characteristic, bacteriologically, for many reasons. Among others, for the frequent presence of organisms which when grown in milk give it a slimy consistency, or produce what is known as "ropey" milk.

The organism which possessed this power to the greatest extent was a coccus, which grows mostly in pairs, diplo-cocci, and does not retain stain by Gram's method. On gelatine plate cultures the colonies are fairly large, circular, dirty-white in colour, and opaque. A streak culture on gelatine produces a rapid growth, white, thick, and with smooth shining surface.

This organism when grown in milk causes the latter to thicken and become slimy, and subsequently a glutinous material appears to settle out of the milk.

An experimental cheese was made with milk inoculated with this organism. The curd was good, and the cheese very good. It is thus satisfactory to know that one of the slime-producing organisms causes no injurious effect on the cheese. Indeed, though it was not possible to make further experiments, there appears no reason to suppose that any of the slime-producing organisms found had an injurious effect.

Needless to say, the work entailed in preparing the cultures for the experimental cheeses enumerated above was considerable. In addition to this, regular bacteriological observations have been made throughout the seven months of the cheese-making season. And, as each month's cheese has been sold, there has been a bacteriological examination of some of the principal cheeses. The results of the examination of the cheeses simply confirm those which have been obtained in former years.

Apart from this work on the cheeses, forty-eight plate cultures were made at Cossington, from which eighty-six pure cultures were obtained and studied.

These may be classified as follows :—

Cocci	liquefying	16
	non-liquefying	21
Bacilli	liquefying	8
	non-liquefying	31
Yeasts, &c.		10
	Total	86

Season and Locality.—As in former years, so in 1896, nearly all the liquefying organisms were found during the early part of the season, that is during April and May, in which months eighteen of the twenty-four liquefying organisms were obtained. The persistence of this peculiarity year after year seems to point to the fact that the variation is due to some unexplained peculiarity of the season.

On the other hand, the organisms which were most abundant in 1895—the varieties of Coli communis—though present, more especially towards the latter part of the season, *i.e.* from August to October, were on the whole not nearly so frequently found as in 1895. Other organisms which were not found at all in 1895, were far more prominent. But many of these were very similar to, if not identical with, organisms found at Mark in 1894.

Now the farm at Mark is only five miles, as the crow flies, from the farm at Cossington. The cows at Mark, or some portion of them, feed in the low-lying marsh or moor land which stretches away continuously till it merges in the moor land or marshes on which many of the cows supplying the milk at Cossington were kept. The thought naturally arises, can there be any common cause which accounts for the bacteria found in 1894 and 1896 being so similar?

Are certain bacteria found in certain districts and not in others? Is it locality or is it season which causes these strange fluctuations in the varieties of bacteria present each year during the cheese-making season?

Until this question is settled, we cannot hope to make much further progress. It is a large question, and one most difficult to solve. It brings us once more face to face with the common belief among cheese-makers that to make good cheese on some soils and in some districts is not possible, or at best can only be attained with considerable difficulty.

Spans.—Many causes exist by which milk, before ever it enters the dairy, may become more or less contaminated with bacteria injurious to cheese-making. Some of these causes have yet to be discovered, and others, though known, are difficult to get rid of. But while these problems have to be solved by future investigation, the cheese-maker should meanwhile utilise the information already obtained. It has been shown that there is no source of trouble in the cheese-dairy equal to that due to the introduction of cows' droppings into the milk. The use of "spans" is an absolutely certain method of so contaminating milk, especially as there seems to be a strong dislike on the part of the milkers to having them cleaned. Why so many of the cheese-makers of Somerset persist in employing them, when over the greater part of England they are unknown, passes my comprehension. No amount of care can prevent their becoming soiled, and through them the hands of the milkers are also soiled, and thus the milk is contaminated. My advice is, get rid of spans! It may not be possible to do so at once, but by degrees it can be accomplished, and once done farmers will wonder why on earth they used them so long.

V.—CONCLUSION.

I have endeavoured to summarise in as simple language as possible the results of these observations and experiments, which year by year become more scientific. At the same time, I have endeavoured to indicate the nature of the work which yet remains to be carried out. Briefly, the four most important problems remaining are:—

(*a.*) What hidden chemical changes are taking place in the curd during the manufacture of a cheese?

(*b.*) What changes take place during the ripening of a cheese?

(*c.*) Will it be possible, by artificially introducing bacteria into milk, to improve the quality of cheese?

(*d.*) Whence come those taint-producing organisms which are the cause of such an enormous loss of money to the cheese-makers of this country?

The amount of work which was entailed by these investigations has been exceptional, and could not have been carried out had not my chief assistant, Mr. Alexander Cameron, willingly undertaken to spend the seven months at Cossington and conduct there, under special difficulties, the very delicate tests involved.

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