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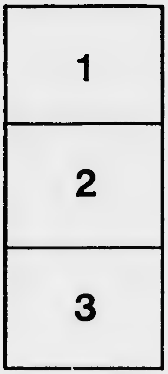
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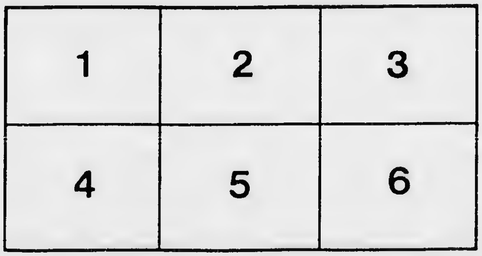
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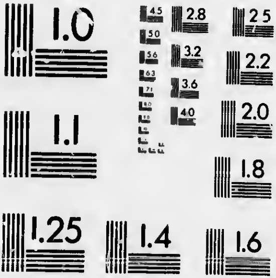

BULLETIN No 4

# The Construction and Internal division of Creameries.

PUBLISHED BY THE DEPARTMENT OF AGI CULTURE,
OF THE PROVINCE OF QUEBEC

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# The Construction and Internal Division of Creameries.

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GENERAL IDEAS. — CONSTRUCTION OF THE BUILDING. — PLACING THE MACHINES AND APPARATUS IN THE DIFFERENT APARTMENTS. — MACHINERY. — MAINTENANCE OF CREAMERIES.—GENERAL INFORMATION.

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## I.— GENERAL IDEAS.

**Object of this Bulletin.**— The object of this bulletin is to make known the rules to be followed in the construction and management of creameries ; as well as other important matters of which it is necessary to be informed for the proper selection and utilization of the machinery in these establishments.

The information contained in this chapter applies also to cheese factories.

**Choice of a plan.** — When a person, unacquainted with the milk industry, proposes to put up a creamery, the first thing he will do is to acquire all the information he can from the various manufacturers of his district. He will visit the different establishments to learn what is best in each of them, so as to combine in his own as complete a plan as possible.

Unfortunately all butter makers are not of one opinion as to the best methods to be adopted in establishing a creamery. Some prefer one way, some another, often without considering the reasons inducing their preference, which may be affected by mere local considerations, or from the fact that they have always worked in a creamery constructed in a certain way and that they have become accustomed to creameries of that kind.

Our future creamery owner, in view of the contradictory information which he has picked up right and left, often finds himself very little further advanced than he was at the beginning. Then along come numbers of agents selling machinery and other things used in creameries, each one boasting of the superiority of his own particular machines. Our man trusting to one or the other, makes his choice and adopts a system more or less complete. The construction once commenced, difficulties arise, which must be overcome by altering the original design; this gives rise to extras which have the effect of making the new establishment cost from one quarter to one third more than was anticipated, of causing useless expenditure; the final result being that the creamery by no means fulfils all the desired conditions.

Take now a butter maker, well up in his business, who wishes to put up a creamery. In adopting his design he often allows himself to be influenced by certain details of construction to which he has been accustomed and in which he has confidence. To carry out his own ideas, he neglects other important details and the new establishment may turn out to be defective in certain respects and may cost him more than was at all necessary.

To avoid all these difficulties, uncertainties and useless expenditures, it is advisable to collect the results of the experience of the last years in this province, and from these to fix or determine the method of construction. Once a standard style is accepted as doing good work, no person need have any further hesitation, what is to be expected will be known before hand, and the amount of money which it will be necessary to expend.

On the other hand the manufacturers of machinery and other materials for creameries and cheese factories, will make arrangements to manufacture only such machines and apparatus as will meet the accepted standard. In a general way the adoption, of such a plan as the above, would result in advantages too numerous to be mentioned here.

Great advantages would particularly result in the uniformity of manufacture: the machinery of the factories being in keeping with the method of work usually followed and *vice versa*. Great advantage would also result in the facility of instruction, in the inspection and concerning the competition between different creameries, a subject which will be treated of later on.

The standardization is a matter the enormous advantages of which have been recognized for some years in most other industries and the tendency of which is to spread more and more. It is an entirely modern idea and of American origin. The milk industry should not remain in the back ground in this respect.

But for a certain style of factory to be generally adopted as the regular or standard style, it must necessarily have originated from experience guided by science, that is, it must be practical, it must be in keeping with the regular methods of manufacture for the making of either butter or cheese; to a certain extent it must be adapted to the habits of the country and must be within the reach of the modest means of the class of persons who make the milk industry their occupation.

A standard style having been once adopted, improvements in detail may be made from year to year and in accordance and keeping with the progress reached in the milk industry.

The object of this bulletin is to collect all the information furnished by practice and relating to the construction of creameries.

**Importance of the buildings.**—It is calculated that a creamery receiving 5000 lbs of milk per day, during six months, leaves the maker of butter with nothing more than his wages. It is also calculated that the general cost of handling from 5000 to 7000 or 10,000 lbs of milk are about the same; as also for the handling of from 10,000, 15,000 or 18,000 lbs. There are factories on a small scale working only one separator and with a capacity of 5000 to 10,000 lbs per day, and creameries on a large scale with two separators able to handle from 10,000 to 15,000 lbs per day. These are the two sizes most generally used. There are some larger, but not many, as the herds of cows in the different centres have not yet reached their full developement and also because, where there is much milk, unfortunately strong competition immediately arises. Under present circumstances in this Province to risk capital in a very large creamery would be imprudent, except in very exceptional cases, this is matter for regret. The patrons of creameries, in their own interests, should always patronize the large establishments.

Cheese factories containing one, two or three vats are the most general in use. The first of small size can handle about 5,000 lbs of milk per day, the second, of medium size, as much as 10,000 lbs, and the third of large size as much as 15,000 lbs of milk per day. Larger factories are to be found, but for the reasons given above they are in limited numbers. A cheese factory, receiving 3,000 lbs of milk per day, only pays the wages of the manufacturer and his assistant. Consequently a non-working proprietor, owning a cheese factory, receiving less than this quantity of milk, could not expect to make any thing out of the business, not any more than the non-working proprietor of a creamery receiving less then 5,000 lbs. These are established facts derived from experience. . It is different when the proprietor is himself a manufacturer. Nevertheless it may be broadly stated that under 3,000 lbs for cheese factories and 5,000 lbs for creameries, the wages earned are not in keeping with the labor supplied : with a small supply of milk, the amount earned is entirely insufficient.

**Choice of situation and location of the factory.** — The factories should be located so that :

1. A sufficient quantity of milk may be secured : at least 3,000 lbs per day for a cheese factory and 5,000 for a creamery, as explained above ;

2. Good drainage may be secured. Bad drainage, as proved over and over again, produces serious mishaps in the manufacture, the causes for which are often sought for elsewhere, for example, in the milk furnished by the patrons of the establishment, when the milk is in no way to blame.

The following case is a striking example. On a farm at Axbridge, in England, near the village of Cheddar, in the original Cheddar cheese district, Miss Telley, the daughter of the proprietor, who had charge of the making of the cheese, had been unable, for some time, to regularly make good cheese : mishaps in the making occured almost every day. It was noticed that these mishaps took place more generally when the wind blew from a certain fixed quarter. After careful investigation, it was discovered that the internal surface of the underground pipe or conduit, through which the whey ran off into a vat in the farm yard, was covered with a coating of dried whey in a greater or lesser state of decomposition and consequently peopled with baccili of every kind. When the wind blew in the direction of the opening of the conduit, it forced back, into the cheese factory, the air charged with these injurious germs, which, falling into the milk, caused the mishaps in question. A remedy was effected, the mishaps ceased, and Miss Telley was able to make as good cheese as she had done in the past.

A factory should never be built in a hollow in the land, from which drainage will be difficult of either the discharges from the factory itself or from the flow of water from rain. If it is absolutely necessary to build on such a location, the hollow in the land should first be filled in.

3. An abundant supply of water of the best quality may be readily procurable at all times. What has already been stated about drainage, may be repeated in connection with the water supyly, for mishaps in the manufacture are sometimes due to the poor quality of the water used, not only for the watering of the cows but also of that used in the factory itself.

Another question of vast importance in connection with the location of the factory, which cannot be passed over in silence, is the question of overcrowding or competition : This is the question for all small factories.

If a factory is built in a place where there are already a sufficient number of the same kind, it must be expected that the supply of milk of such factory can only be had at the expense of the neighboring factories, and experience has shown that in such cases, not only the neighboring factories will suffer, but also the new factory itself. This question of small factories is of vital importance to the milk industry of this Province and it cannot be too strongly insisted upon. It is really strange that it is so little understood, for even the most short sighted must see the disadvantages of the multiplication of such factories.

Every body deplores what is commonly called *competition*, but notwithstanding this, numerous factories are opened and carried on every year, with the sole and avowed object of making competition.

Things have arrived at such a pass that many business men now, and with good reason too, will no longer risk their capital in creameries or cheese factories.

Three or four thousand dollars are invested in a factory, and any day this amount may be almost entirely lost, if another factory is established in the neighbourhood to run in competition.

At the present time numbers of persons having capital invested in creameries or cheese factories, do not know whether they will ever be able to draw their money out. The risk is considerable and out of proportion to the advantages to be hoped for. On the one hand a few dollars may be gained, and on the other ten times as many may be lost.

I do not wish here to speak of the baneful results following on the multiplication of factories, results which are now well known and which are still more hurtful to the patrons than to the proprietors, if we consider the amounts uselessly expended, although such competition is sometimes profitable to the new factory at the expense of the one already existing. But to put up a factory, without sufficient reason, where there is one already or where one is sufficient, is a dishonest action, because it is the causing of the loss, to the proprietor of the existing factory, of the whole or of a part of the capital which he has invested and of the profits which he anticipated when he organized his establishment.

In the case where the new factory is only started with the avowed object of competition and without any hope of the increase of the number of cows in the neighbourhood, the injustice is self apparent.

Competition is allowable, it is often useful, but the abuse of it is bad, and it must not be pushed to this point, for, in this particular case, the results of this competition to the bitter end, are so well known, so immediate and of such vast importance to every body, that it is impossible that consideration of it should be neglected.

Too much cannot be said upon this subject.

## II.—CONSTRUCTION OF THE BUILDINGS FOR CREAMERIES.

**General division of the building.**—In a well laid out creamery, are found many distinct apartments : (Fig. 1.)

1.—The boiler room ;

2.—The room for the separators ;

3.—The room for the ripening of the cream, for the churning and for the working of the butter ;

4.—The refrigerating room ;

5.—The ice house ;

6.—The store.

The relative positions and dimensions of these different apartments must be considered first of all. In studying this question one must be guided, 1. by economy in the construction of the building and in its solidity ; 2. by the nature of the work to be carried on in each of these apartments ; 3. by the convenience for work.

A rectangular building is in general the most economical and to be recommended in preference to others. Although the apartment where the boiler is placed does not require walls so proof against cold as the other rooms in the creamery, it should still be well closed in ; flooring is unnecessary. The boiler should not be placed in the same apartment as the separators, as it will give out too much heat in summer and also on account of the dust from the fire. It should be placed in a shed put up against the main building.

The skim-milk can be conveniently disposed of on the platform for the reception of the milk and it is generally unnecessary to make special arrangements to convey it to another part of the building · one platform will therefore be sufficient.

The cold room should be located as near as possible on the north or at least on the east side of the building.

The skimming room should be at the end of the building, opposite to that of the refrigerator. The room for ripening the cream and for the working of the butter should be between the skimming room and the refrigerator.

The ice house could advantageously be a separate building and could be built economically. The room for the working of the butter should be separate from that of the separators for two very important reasons : the first being that the temperature in which the cream is ripened and in which the butter is worked shoud be constant, while in the room of the separators the temperature is generally too high and too variable ; in the second place, the separators and other machines always give out bad odours from which it is better to remove to a distance, the cream and butter. A partition is not so costly an article as to oblige one to go without it.

The opinion has often been expressed that great advantage would arise from placing the room containing the separators and the room following it upon different levels so that the cream could run directly from the separators into the cream vat and from there into the churn ; but this arrangement, convenient, it is true, from certain points of view, generally increases the cost of the factory. It does not appear to have received the sanction of practice ; we will therefore not specially recommend it here. The cream is now generally received in cans and carried by hand to the cream vat. Place all the rooms therefore on the same level.

The elevation of the receiving platform, above the floor of the apartment containing the separators, should be sufficient to allow the milk to run from the receiving vat to the separator, after passing through the heater, and the cream to fall into the cans after passing through the cooler.

The highest separators are about 4 feet 4 inches in height, the platform should therefore be at least 5 feet high as it is better to raise the separator slightly above the floor on account of the cooler. This height will vary according to the machines that are employed. The tendency is always to reduce the height. It is better to slightly increase it. A height of at least 5 feet is therefore recommended.

When a heater, requiring a greater differenec between the level of the reception vat and the separator, is used, there need be no hesitation in increasing the elevation of the platform ; when a lower separator is used the elevation may be lessened ; this elevation therefore depends entirely upon the machines which are in use.

Whatever it may be, admitting that the height in question is from five to six feet, the height from the platform to the ceiling should be about six feet which would bring the full height of the apartment to 11 or 12 feet. In any case we would recommend at least 12 feet so as to have a sufficient height in the rooms above the refrigerators.

**Dimensions of the rooms** —The sizes of the rooms vary according to the importance of the creamery. They must be sufficiently large so that the machines will not inconvenience the butter maker in carrying on his work. The sizes of these apartment vary considerably according to the ideas of each individual. Nevertheless, based upon the dimensions most generally adopted, the following are recommended :

CREAMERY SMALL SIZE, 5,000 TO 10,000 LBS OF MILK PER DAY.

| | | | |
|---|---|---|---|
| Apartment for separators | 25' | x | 18' |
| Apartment for working the butter | 25' | x | 15' |
| Ice house | 18' | x | 20' |
| Refrigerating rooms | 10' | x | 20' |
| Boiler room | 10' | x | 15' |
| Height of the rooms | 12' | to | 14' |

CREAMERY LARGE SIZE, 10,000 TO 15,000 LBS OF MILK PER DAY.

| | | | |
|---|---|---|---|
| Apartment for separator | 30' | x | 20' |
| Apartment for working the butter | 30' | x | 20' |
| Ice house | 18' | x | 25' |
| Refrig[er]ators | 12' | x | 25' |
| Boile[r r]oom | 15' | x | 20' |
| Heig[ht] of the rooms | 12' | to | 14' |

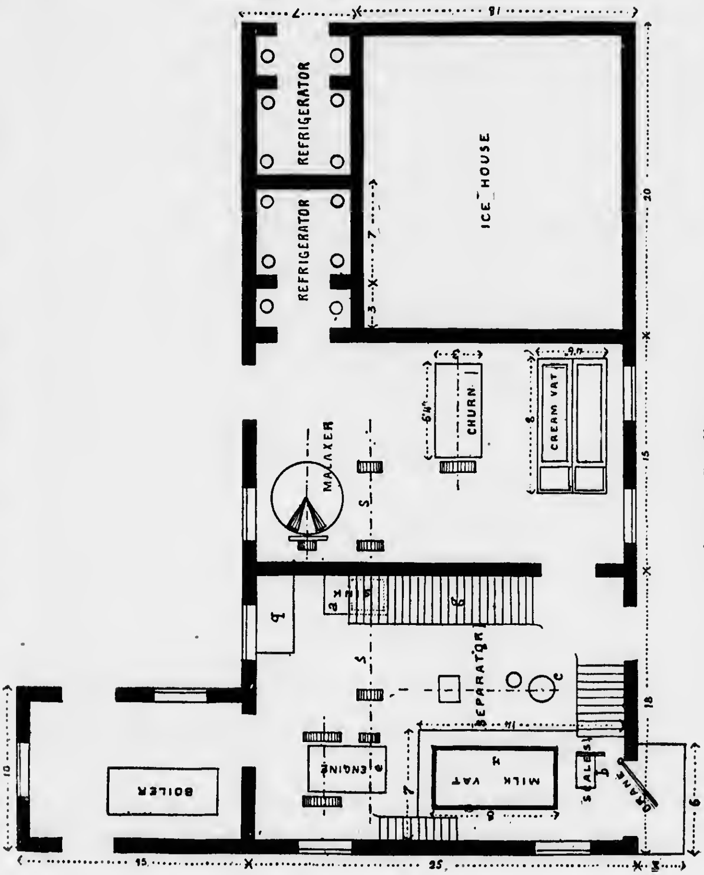


Fig. 1.— Small creamery

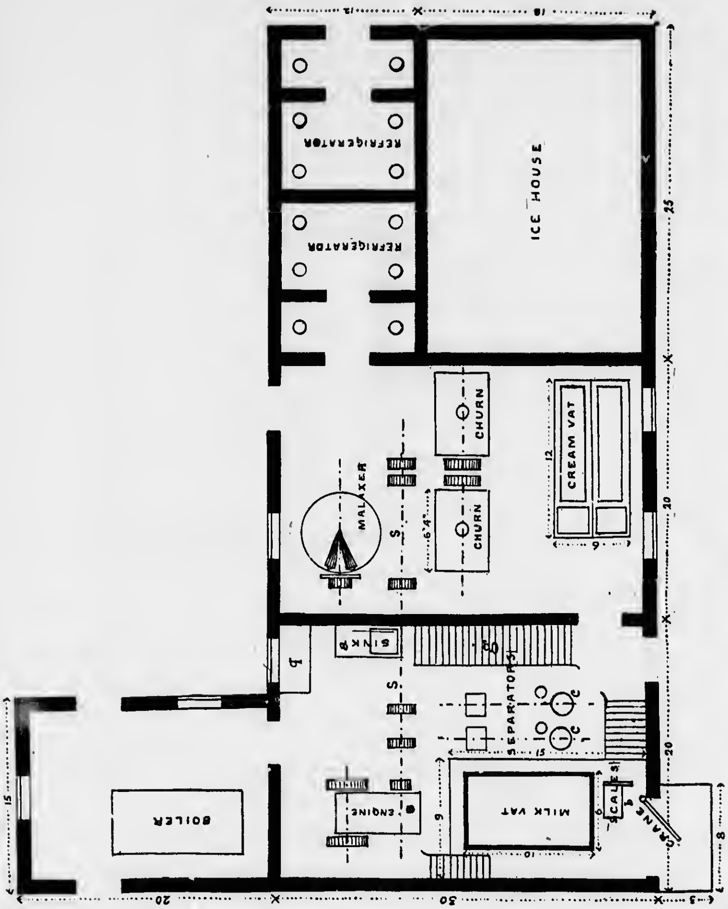


Fig. 2.—Plan of creamery, capacity 10,000 to 15,000 lbs of milk per day.

The refrigerators occupy two stories. The upper story comprises a room which communicates by a stairway on one side with the garret of the factory and on the other side by a door with the ice house. The cylinders in the lower rooms open into it. In this room the ice is broken up before being placed in the cylinders. This will be treated of later on.

For some time past, the tendency has been to completely separate the ice house from the main building of the factory and to build it as economically as possible; as ice houses fall into decay very rapidly and that repairs are more easily made when they are separate and because, being constructed economically, they cost less money, custom seems to have established this as a rule and I would call particular attention to it.

In this case the refrigerators are found at the end of the building as shown in fig. 3.

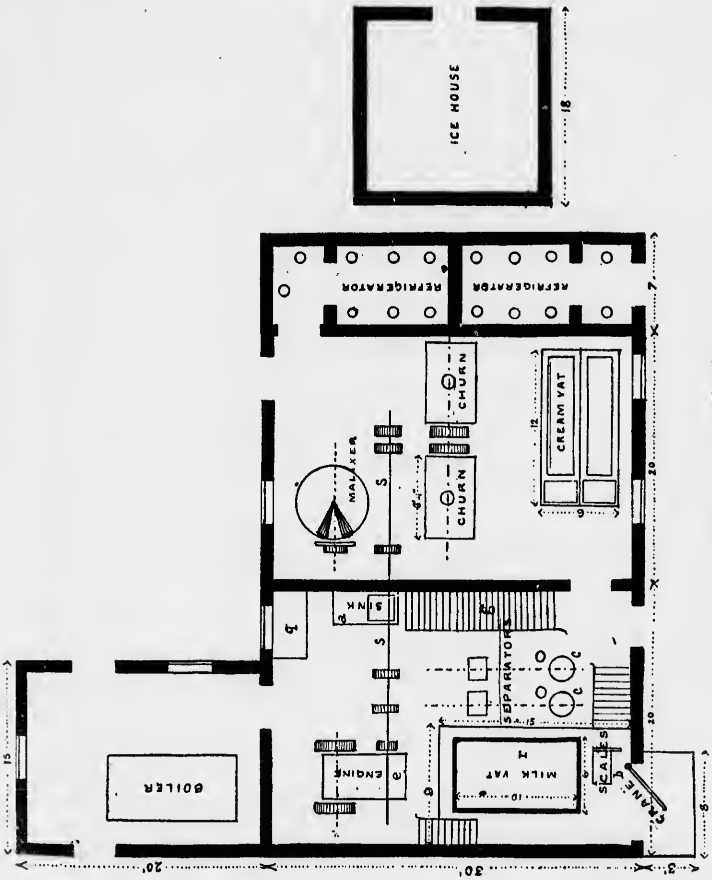


Fig. 3.—Plan of creamery with ice house apart.

In such case the following are the dimensions of the ice house:

Factory small size...... 18′ x 18′ by 12′ high
Factory large size....... 22′ x 22′ by 12′ high

In this case the upper story of the cold rooms should have a door opening in the end of the building to enable ice to be taken up with tackle.

**Mode of construction.**— As the temperatures of the different rooms must be different, as we have seen, their walls should be constructed differently. The lower and more regular the temperature required in an apartment, the greater the attention which must be given to the walls.

The boiler room should be carefully built but still the degrees of heat may vary considerably without any great inconvenience being experienced. What is necessary, is, that it does not freeze during the nights in the spring, and autumn, nor in the winter if the establishment is run during the winter. Next to be considered is the apartment containing the separators. This apartment should be built, so as to make it possible to maintain a good temperature during the cold spells of weather in the spring and autumn. The walls of the apartment in which the butter is worked should be so constructed as to make it possible easily to maintain at all times a temperature of about 62°. The walls of the ice house should be sufficient to preserve the ice, without too heavy a loss, through melting, during the great heats of the summer. If considerable quantities of saw dust can be procured, the walls of the ice house may be built very economically. Lastly the cold rooms require our attention, the walls must be very carefully looked after, for in these rooms it must be possible to maintain a temperature in the neighbourhood of 32° during the whole summer season.

The walls may be constructed in two different ways: either of grooved and tongued deals; or of studs covered with wood. This latter mode of construction is called a "balloon frame" and is the mode most generally employed.

Whether the building is put up on the first or second plan, the number of rows of boards and layers of paper to be used in the construction of the walls and the placing of these materials will remain the same. What follows, with respect to the number and the placing of these rows of boards and paper, will therefore apply equally to the two cases.

**Foundation.**—The building should always be set on a stone foundation, on wooden posts or on pillars of stone. In the two latter cases it should be carefully banked up with earth completely round.

Either in the stone foundation on in the embankment, spaces should be reserved for openings or small windows capable of being opened or closed at will.

These openings are intended for the ventilation of the lower part of the buildings, which is necessary from time to time to prevent the rotting of the sills and floors.

The elevation of the floor of the building above the ground should be sufficient to permit of the ready running off of drainage water. An elevation of two feet above the ground is generally sufficient.

**Construction of the walls, floors and ceilings.**—The following dimensions apply equally to small and large sized factories. The sill used for the exterior walls of the main building should be 8″ x 6″ and should be placed on the flat. The studs should be 2″ x 6″ and 16 inches apart. The corner posts should be 6″ x 6″ and 12 to 14 feet long.

For factories of small size; economy may be effected in the construction of the walls by the employment of a sill 6″ x 6″, studs 2″ x 4″ 16″ apart and corner posts of 4″ x 4″ from 12 to 14 feet long. This saving cannot be recommended in the construction of factories of large size, as after some years, the walls will become disjointed and cracked and will require continual repairs.

The interior wall or partition, separating the apartment containing the separators from that where the butter is worked should have a sill of 6″ x 6″ and studs of 2″ x 4″, 18″ apart. The same dimensions will apply to the dividing partition of the two refrigerators. The partition separating the ice house and the cold rooms from the room where the butter is worked as well as that separating the ice house from the two refrigerators should always have a sill and studs of the same dimensions as those of the outside walls. The cross partitions which divide each of the two refrigerators into two should be constructed of 2″ x 4″ lumber nailed to the cross beams of the floor and ceiling.

The shed or out building in which the boiler is placed, whatever the size of the building, should always be constructed with a sill of 6″ x 6″ and studs of 2″ x 4″, 18″ apart. The sill of this outbuilding need not be on the same level as that of the main building; a rough floor will answer for this apartment. An elevation of only a few inches above the ground will be sufficient for the sill of this building.

For this out building, the studs should be clap-hoarded on the outside and covered on the inside by boards planed and grooved.

The entire outside walls of the main building should be first covered with rough unplained boards, which however must be well jointed together. These boards should be nailed obliquely to the studs of the frame, so as to give greater solidity to the building. Upon this boarding two layers of building paper should be placed one over the other with the joinings covered. The whole may then be finished by clapboarding.

In the interior of the apartment containing the separators, a single thickness of planed boards, grooved and well jointed together, will be sufficient and this as well for the outside as for the inside walls.

For the room where the butter is worked and in the interior, rough 1 inch boards but well jointed together should be first fastened to the studs of the frame, the boards should be nailed obliquely to the studs, but inclining in an opposite direction to the rough boards nailed on the outside of the building. Upon these boards two layers of paper one over the other and with joinings covered, should be placed, when the whole should be finished by boards well planed and grooved. This method of construction should be followed for the interior of the four walls of this apartment.

For the ice house, to begin with rough well jointed boards should be first nailed to the interior of the four walls, on these boards two layers of paper should be placed one over the other with the joinings covered and the whole finished by a covering of well planed and grooved boards; that is to say that the walls of the ice house should be constructed similarly to the walls of the room where the working of the butter takes place.

For the two refrigerators, (figs. 1, 2 and 3.) the construction of the interior walls is slightly more complicated. In the first place, as stated above these apartments consist of two stories. In the upper story the four walls will be simply covered by 1 inch boards. In the lower story, which is 6½ feet high, work should be commenced in the interior,—and in each of the two compartments of each refrigerator—where the four walls should be covered by rough boards (fig. 4) nailed on obliquely if desired. Upon these boards there should be laid two layers of paper and over this paper another covering of boards well joined. Upon these boards laths or furring of two inches in width by one in thickness should be nailed parallel to one another and not more than from one foot and a half to two feet apart. Upon these laths should be nailed one thickness of rough one inch boards well jointed together. On these boards two layers of paper should be put one over the other with the joining covered and the whole should be finished with one thickness of grooved and planed boards, put up and nailed with care.

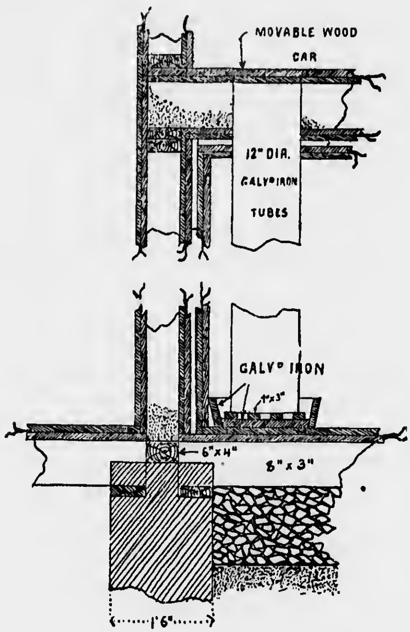


Fig. 4.—Section of the cold room showing position of cylinders.

The floor of the apartment, containing the separators and that of the room where the working of the butter takes place, should be supported by joists of 2½ x 10″, set two feet apart. These floors should be made of two inch hemlock deals, grooved and well nailed down.

The floor in the refrigerators should be supported by joists 2½ x 10 set two feet apart. It should be made of rough one inch boards with a layer of paper on top over which two inch grooved hemlock deals should be carefully nailed. All these floors should be as tight as possible.

The parts of the sills of the building, upon which the ends of the joists rest, should be strongly supported from underneath.

The floors of the two principal apartments should have a slant towards the interior wall which separates them. This slant or slope should be one inch in five feet: that is to say, in factories of small size, the joists, closest to the outside wall, should be raised 3½ inches and in factories of large size, it should be raised 4 inches. The other joists should be raised proportionately to their distance from the central wall. These joists should be laid parallel to the width of the building, and should be supported by a beam placed across the room.

The slant or slope of the floors of the two refrigerators should be from the central wall to the exterior doors and should also be 1 inch in 5 feet.

The bottom of the ice house should be formed of a bed of broken stone, of at least one foot in thickness, upon which six inches of sawdust should be spread.

The ceiling of the apartment containing the separators and of that for the working of the butter should be formed of joists of 10 x 2, 2½ feet apart covered on the upper side by an ordinary floor and on the lower side by grooved and tongued boards well joined together.

The ceiling of the cold rooms should be supported by joists of 8 x 2, 2 feet apart. On the lower side of the joists (fig. 4) it should be constructed in exactly the same way as the walls of these apartments, that is to say, it should be composed of two thicknesses of boards, separated by two layers of paper, of an open space of an inch between the laths, and below the laths of two other thicknesses of boards enclosing between them two layers of paper with the joinings well covered.

On the upper side of the joists is the floor of the room in which the ice is broken before being placed in the cylinders; this will be treated of later on. The floor should consist of two thicknesses of boards, separated by two layers of paper, the upper thickness of boards being two inches. This upper room will not have any ceiling. The ice house will have no ceiling either.

**Open spaces in the walls.**—The walls should not be filled in with saw dust. A layer of still air is the best isolator against heat. When freshly put in, saw dust gives satisfaction; but in the long run, it packs and cakes, and its efficacy is greatly diminished. It has also the disadvantage of attracting vermin.

To prevent the air inside the building from penetrating into these open spaces through the lower parts of the walls along the sills, a bed of dry sand of six inches in thickness should be placed inside on the sills at the base of each wall. Asbestos is still better for the purpose if it can be procured at a reasonable price.

**Laying of paper.**— The paper used should be felt paper of the finest quality. It should never be cut at the angles or corners of the wall, but bent, without solution of continuity, from the walls under the ceilings or on the floors, or from one face to another of the walls, so that these may be hermetically enclosed.

**Wood to be employed.**— In the construction of creameries, no odorous woods, such as pine, should be used, but only woods without harmful odours, such, for example as hemlock, white wood or white spruce. The wall should be as smoth as possible.

**Painting.** — All the inside walls of the apartment containing the separators, of that used for the working of the butter and of the refrigerators, should receive one coat of paint and two coats of varnish. The floors of these apartments should also receive two coats of oil. On the outside, the building should be carefully painted for the preservation of the wood.

**Drainage.**—There are two apartments to be drained: that of the separators and that for the working of the butter. The first will be drained by a gutter at the lowest part of the floor, that is along the wall dividing the two apartments; this gutter should be made of galvanized iron and should be constructed as shown in figure 4. The slope will be from 1 to 2 inches in five feet, the same as the floor..

The edge of the floor should not overhang the scupper but should be rounded off as shown in the figure. On the wall side, between the scupper and the wall, a slat should be nailed having a section in the form of a quarter of a circle with a radius of 2 inches.

In the other apartment the scupper will be against the same wall and should be constructed in the same way. It will have the same slope. The exit of the drainage water from the building will be by a hydraulic joint as shown in figure 5, so as to prevent any bad air from the discharges from penetrating the factory. The drainage water should be led off to a long distance

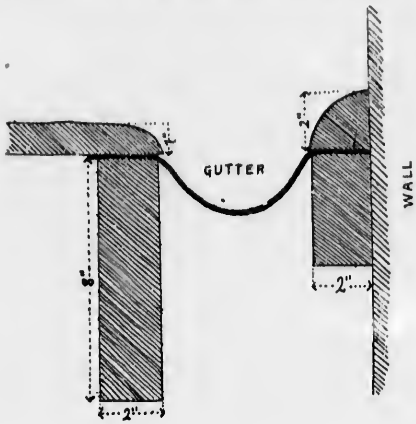


Fig. 5.—Gutter.

by underground drains, every precaution being taken that no bad air should be allowed to escape around the creamery, and the drains should be easily opened and cleaned.

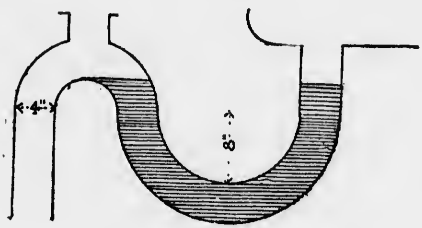


Fig. 6.—Hydraulic joint.

**Ventilation.**— The apartments to be ventilated are those containing the separators, that where the butter is worked and the boiler room.

The garret should also be ventilated.

The two first apartments should each be ventilated by a chimney of one foot square opening in the middle of and level with the ceiling. These chimnies should be furnished with a register, permitting of their opening or closing at will. These two chimnies should join at the summit of the roof in a ventilator of one foot and a half on each side.

The boiler room should be ventilated by a chimney of one foot square furnished with a register.

**Heating.**— The necessary means should be taken for the heating of of creameries which it is intented should be worked during the winter. This heating should be effected by steam pipes or steam radiators. The only apartments requiring heating are those containing the separators, and that where the butter is worked.

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## III.—LOCATING THE MACHINES, AND APPARATUS OF THE DIFFERENT APARTMENTS.

1. **Boiler room.**—This apartment, besides the boiler, should contain a bench with a vice and the tools necessary for making repairs, also a cupboard for the keeping of oils and other fixings for the boiler and engine. There should also be in it, a special place fer the piling of a certain amount of dry wood. There should be communication with the apartment containing the separators by means of a door and by another door with the yard of the creamery. There should be two windows, the one immediately above the bench and the other placed in such a position as to give plenty of light at the front of the boiler and on the controlling instruments, such as the water level and the steam guage.

2. **Apartment of the separators.** — In this apartment, will first be found (fig. 1 and 2) on the receiving platform, 1. the scales *b* and weighing can; 2. the receiving vat *r*; 3. the can to return the skim-milk; 4. close to the platform at *c c*, one two or three separators according to the size of the establishment; 5. between the receiving vat and the separator, a heater for warming the milk before skimming; 6. next to the separator a cooler to cool the cream after skimming; 7. next comes the engine at *e*; and at *s s* the shaft for the transmission of power; 9. against the wall at the end of the

apartment and in front of the window will be found a table with a babcock for testing the milk; 10. along the interior wall is seen the stairs *g* leading to the garret; 11. Under the stairs at the back is the sink for the washing water; 12. next to the separator there is also a pump for the raising of the whey.

The engine should be placed in such a way that the shaft will be parallel to the main front of the building, to avoid being obliged to pass the belts, running the churn and the butter worker, through the wall.

The engine and the separator should be in sight of the person who weighs the milk, so that he may easily superintend and regulate the working of these machines; two short stairs, one near the engine and the other near the separator, place the platform in communication with the rest of the apartment.

The machines and the apparatus must not be too crowded or close to one another, space must be left for easily moving round them for cleaning, regulating and keeping them in order.

Absolute cleanliness is imperative, therefore every part of the apartment should be easy of access. The disposition of the machines as pointed out (fig. 1 and 2) is certainly to be recommended. The discharge pipes of the separator should be on the side opposed to the intermediate and the heater should be placed above the belt and in such a manner as to leave easy access to the discharge tap of the milk vat.

This apartment has a door opening on the front face of the building. It is better that the opening for the receiving platform should also be on the same side of the building, because if placed on the other side the platform would require to be made so much larger that it would greatly diminish the open space in the apartment. A building with a width of from 25 to 30 feet is besides quite large enough to place the scales, the vat and the engine end to end as shewn in figures 1, 2 and 3. Further it may be seen that the milk vat is not flush with the side of the platform; in front of it is a small passage of from 8 inches to 1 foot in width to permit of the ready cleaning of this vat, which itself has a width of at least four feet. Between the wall and the vat there is a passage of from 1½ to 2 feet.

The skim milk is run off in the interior of the apartment on the platform, next to the scales, in the left hand corner, where the graduated can is placed. It may be returned to the patrons on the left side of the building. In such case a moveable wooden spout connects this can with the vehicles which turn the corner of the building after having delivered their milk and proceed to wait for the whey along this side of the building.

3. **Apartment where the butter is worked.**—In this apartment are found, 1. the cream vat. 2. the churn, 3. the butter-worker, 4. an ice chute. It is constructed of 1 inch boards 2′ by 1½′ and communicates with the interior of the ice house by three small doors placed one above the other which are usually kept closed. Each day the one nearest to the top of the ice pile is opened, the quantity of ice necessary for the day is thrown into the chute, after which the door is carefully closed. The floor at the foot of this chute should be covered by a piece of wood of at least two inches in thickness otherwise the pieces of ice, thrown down upon it, would soon make a hole in it; an opening at the base of this chute permits the removal of the ice.

The butter-worker and the churn are worked from the same shaft as the separators. In this apartment there are three doors, that communicating with the cold room and along side of this latter an outside door, which permits the loading of vehicles without passing through the apartment containing the separators.

**Refrigerators.** — There are two refrigerator rooms : one having no communication with the interior of the building and the other communicating with the room where the butter is worked. They are both constructed in precisely the same way. In creameries of small size, they have each 10′ x 10′ of floor surface and a height of from 6½ to 7′ feet. The first is intended for the preservation of perishable products which the patrons of the establishment desire to leave there, awaiting forwarding elsewhere, the other is for the butter. The size 10′ x 10′ and 6½ feet in height is amply sufficient for the product of 10,000 lbs of milk per day.

In creameries of large size, these rooms are 12′ x 12½ and 7 feet in height. They are built as small as possible so as to economize the ice, as the temperature must be maintained as near to 32 as possible.

Each of these rooms is furnished with ice cylinders or boxes of one foot in diameter constructed as shown in figure 6. They open in the upper room, in which the desired quantity of ice is put into them. These cylinders are also open at their lower ends and rest upon slats placed in the bottom of a longitudinal trough whih receives the water from the melting ice (fig. 7.) This water is conducted to the outside of the building by an S shaped pipe

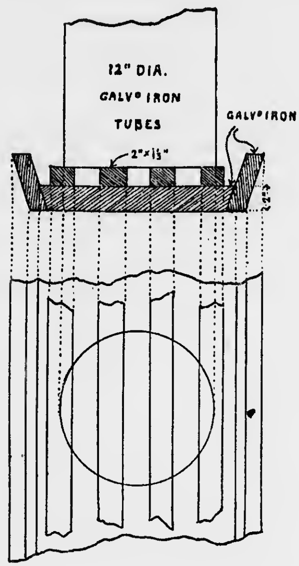


Fig. 7.—Details of cylinders and trough.

so that the outside air can in no way get into the rooms. The upper opening in these cylinders is closed by a well fitting cover.

These rooms have no chimney nor have they any communication with the ice house nor with the rooms above. As we have already seen, they are divided into two parts, the front part answers as a porch of 4 feet, in this two cylinders are placed. The doors of these rooms are most carefully constructed in the same way as the walls. They should close as hermetically as possible.

5. **Garret.** — In the garret is the vat for the skim-milk, which is situated above the reception platform ; it also answers as a store house for butter tubs, boxes, salt, etc. This garret is reached by a stair situated along side of the wall which separates the apartment containing the separator from that where the butter is worked, which has already been considered.

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## IV.—MACHINERY.

**List of apparatus used in creameries.**—1. A steam boiler from 12 to 18 horse power, complete, with pump or injector, safety valve, glass water level, 3 guage cocks, one steam guage, one tap for emptying the boiler, one check-valve for the pipe of the pump and one chimney.

2. An engine from 12 to 18 horse power.
3. Weighing can, of a capacity of about 500 lbs, with all accessories.
4. Scales for 800 lbs, with double lever, for the milk.
5. A vat, holding from 2500 to 5000 lbs for receiving the milk.
6. A large shaft with pulleys and belts.
7. A heater for warming the milk, of a capacity of from 3000 to 6000 lbs per hour.
8. One, two or three separators.
9. One cream cooler.
10. One pump for the skim-milk.
11. One vat for the skim-milk, capacity of 4000 to 5000 lbs.
12. A graduated can and spout to return the skim-milk.
13. One centrifugal pump for the water for the cream cooler.
14. Two cream vats of 3000 lbs each.
15. One or two churns of 300 gallons.
16. One butter-worker.
17. One cold water vat ; capacity 15 or 20 barrels.
18. One vat for butter milk.
19. One sink and a barrel for hot water.
20. One scale for weighing the butter.

21. One special scale for salt.

22. One steam babcock of 24 bottles and accessories.

23. One lactodensimeter of Quevenne and two or three creamometers.

24. Two or three thermometers.

25. One acidemeter.

26. One 8 ounce graduated glass for measuring color.

27. One butter tester.

28. Three tin cans for cream, two for water, one or two dippers, two floor brushes and one india rubber scraper, butter spades butter packers and butter slices.

29. A metal plate to mark the name of the establishment, a number of letters and figures and the brush to mark with.

30. Strainers for the reception vat, the cream vat and the churn ; a sieve for the butter milk.

31. A crane to lift the cans.

32. The piping for the steam and water and all necessary valves.

**Boiler** —The choice of a boiler is a most important question. There is always a strong temptation to take one which is too small. This is a great mistake, as when the boiler is weak it is very difficult to maintain a constant pressure. Each time that water is put in or the fire recharged,—the pressure is lowered. In such a case it is impossible to maintain a regular speed of the separator and the skimming also suffers.

In the case of a creamery receiving 10,000 lbs of milk per day : if only 2 lbs of fat per 1,000 of milk are left in the skim-milk, there is at once a daily loss of 20 lbs of butter, which, at 20cts a pound, amounts to $4.00. The variation of pressure in the boiler easily creates a loss of this importance.

Another disadvantage is, that when the boiler is too small to give the desired pressure, it becomes necessary to force the fire, which rapidly renders the boiler useless.

If hard water is used, it expands, the water gets into the engine and accidents may occur.

Again, for a boiler which is too small, a larger quantity of wood is consumed, for the same quantity of steam, than would be required for a larger boiler. Everything therefore is to be gained by increasing the power of this machine.

For a creamery, with one separator, a boiler of 12 to 15 horse power is required and for an establishment with two separators it is necessary to have a boiler of from 15 to 20 horse power.

It must not be forgotten that steam is required not only to run the separators but also for the heater, for the working of the churn and the butter worker, for washing purposes and for the heating of the building in the spring and autumn.

With reference to the make of boiler to be chosen, it is of little importance providing that it is strong enough. Still we would not recommend the use of vertical boilers as the wear and tear is more rapid and the cleaning more difficult, and again these boilers require shorter wood.

The most suitable boiler for a creamery is a boiler with a return fire. This should be placed in an oven made of brick. (Fig 8.)

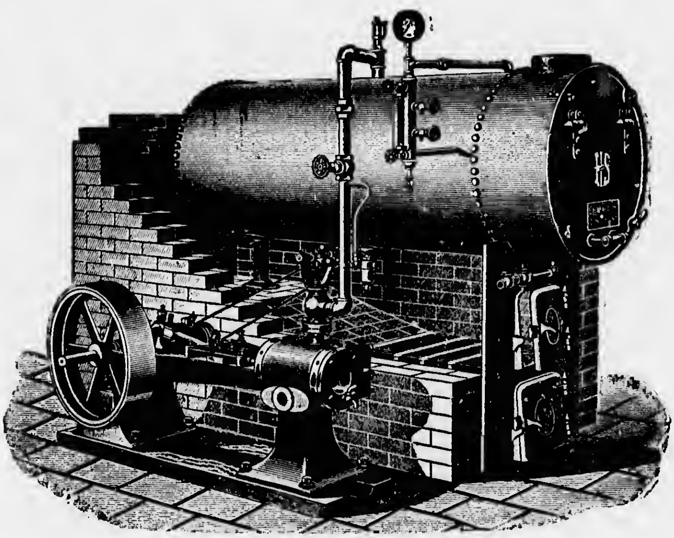

Fig. 8.—Boiler.

The grate should be at least 3 feet long if wood of 2½ feet is used and not less than 3½ feet if 3 foot wood is used.

As to the manner of constructing the oven, the advice of the maker of the boiler must be followed, because, when constructing a boiler, the maker calculates that the oven will be built in the way he points out to the purchaser, and it is not always wise to ignore his advice.

Every boiler should be provided with the following apparatus :

1. A glass water level and three guage cocks to indicate the level of the water, should the glass tube happen to get broken.

2. One safety valve.

3. One pressure or steam guage to mark the pressure.

4. One injector or feed pump.

5. One check valve between the boiler and the pump or injector and one valve between the check valve and the boiler.

6. One key in the chimney to regulate the fire.

To avoid explosions, the water in the boiler should never be allowed to be lower than the upper tubes, nor even than the highest points in the boiler to which the fire may reach. When such a thing occurs, the fire must be always reduced and the boiler allowed to cool before putting in more water. Statistics show that nine tenths of explosions occur from the non-observance of this rule.

The engine must not be run at too high pressure which strains the boiler. If the boiler has been tested up to 150 lbs to the square inch when cold, it should never be run beyond 80 or 100 lbs.

The steam or pressure guage which indicates the pressure, should do so exactly and should be verified from time to time.

The safety valse should work regularly. If it leaks so as to make it necessary to refil it, it must be repaired and adjusted. It should be examined from time to time to see that it is not blocked and that it rises well to the pressure at which it should work.

When the tubes of the boiler are covered on the inside with soot or ashes and when the boiler is dirty in the inside it takes much more wood to obtain the same amount of steam. The cleaning of the tubes and the boiler is therefore a matter of great importance. Besides this, deposits and incrustations in the interior of a boiler are often the causes of an explosion.

The tubes must be cleaned, as often as it is necessary, to keep them constantly clean.

To clear the boiler of these deposits, it should be blown out. It should never be blown at a high pressure. To prevent the disjointing of the tubes and the leakages which would result from a sudden change in the pressure and in consequence of the temperature in the interior, 20 or 30 lbs is a sufficient pressure for this operation.

When there is much mud in the water the boiler must be blown out every day, a few minutes immediately before commencing to work and when the pressure is on.

When these deposits adhere to the inside of the boiler and form incrustations, certain ingredients should be used in the inside of the boiler which will convert these incrustation into muddy deposits which are got rid of by blowing.

Potatoes are useful for this purpose. For example, one dozen may be used in a boiler of 10 horse power, each time it is blown out, caustic soda or lime often gives satisfactory results. 5 or 6 ounces of caustic soda or ½ a pound of lime may be used each time the boiler is completely blown out. There are also for sale certain special powders useful for the purpose which may be chosen according to the nature of the water which is in use. Coal oil or other ingredients which might spread bad smells through the factory should not be used for this purpose, neither should machine oil.

A question very frequently asked is, the manner of calculating the strength of a boiler. On account of the number of data entering into it, this calculation is of rather a complicated nature, if it is desired to make it exact.

The power of a boiler depends necessarily, and in the very first place, on the quantity of wood burned by the hour and consequently on the surface of the grate and on the draft, height and dimensions of the chimney. The higher the chimney and the greater its diameter, the more wood can be burned by the hour to the square foot of the grate.

Practically speaking, the power of a boiler is calculated according to the number and diameter of its tubes and the diameter and length of the boiler itself. This is not a regular manner of proceeding ; it is followed because it is presumed that the grate, the chimney and the oven have been constructed in accord with the boiler. But it is no less true, that if, for a boiler calculated to be of 12 horse power, according to the number and diameter of its tubes, a grate and a chimney a little weaker or a little stronger should be employed, the boiler would really be of less or greater than 12 horge power. If the grate and the chimney are too strong for the boiler, its work will be bad. As the makers of the boiler itself, furnish at the same time the grate and the chimney, it is sufficient here to point out the manner of calculating its power by the number of its tubes, its diameter and its length. The following rule is only approximate, but practically it is sufficient :

Twelve square feet of heating surface are calculated per steam horse power.

To find the heating surface of a horizontal tubular boiler, the following is the mode of procedure : The measurements should be taken in inches.

1. Multiply the two thirds of the exterior circumference of the boiler by its length. To obtain the exterior circumference, put a cord around it and measure the length of the cord, or it may be calculated by measuring its diameter, thus a boiler of 36 inches in diameter will have a circumference of $36 \times 3{,}1416 = 113''$; because to find the circumference of a circle its diameter must be multiplied by the number 3,1416. Now supposing the boiler to have a length of 6 feet $= 72''$, by multiplying $\frac{2}{3}$ of 113 by 72 the number 5424 is obtained.

2. Multiply the number of tubes by their diameter and by their common length and finally by the number 0,2618. Supposing for example that this boiler has 20 tubes of two inches, by making the preceding calculation we obtain $20 \times 2 \times 72 \times 0{,}2618 = 754$.

3. Take the two thirds of the surface of the tubular plates. To find the surface of a circle half the diameter multiplied by itself must be multiplied by the number 3,1416. Here half the diameter is 18 inches and 18 multiplied by itself gives 324 and $\frac{2}{3}$ of 324 are 216.

4. Add together the 3 numbers thus found : by the addition in our case, they come $5424 \times 754 \times 216 = 6394$.

5. To take the double sum of the sections of all the tubes. The tubes having 2 inches in diameter, their section is 4,43 square inches. As there are 20, the double sum of these sections is $2 \times 20 \times 4.43 = 177$ square inches.

6. Deduct this latter number from the former one. In our case it comes to 6394—177 = 6217.

7. Divide this latter number by 144 inches to obtain the heating surface in square feet 6217 : 144 = 43. The boiler therefore of which we are treating will have a heating surface of 43 square feet. As it requires 12 square feet per steam horse power, its power will therefore be 43 : 12 = 3½ horse power.

**Engine.**—When a single separator of large size is to be operated, an engine of at least from 8 to 10 horse power is required; for two separators an engine of 12 to 15 horse power is necessary. When the engines are run by a turbine wheel, an engine of at least from 6 to 8 horse power will be required for the butter worker and the churn.

When the separators are to be worked by the engine, it is better to select one working at the speed of the intermediate shaft than at a lesser speed. It is better that the engine should have a good rate of speed as there is less trouble in the choice of pulleys, and the slipping of the belts from the pulleys will be more readily prevented.

Regularity of movement in the engine is the most important matter to which to give attention. When the boiler is sufficiently powerful, this regularity is obtained by the employment of a good regulator or governor. The governor should always be in perfect order and well regulated, and the engine should always work with the admission valve wide open. The speed should neve. be regulated by this valve; but should always be maintened by the governor.

This point should be the more strongly insisted upon, because many skimmings are faulty and the patrons of the establishment suffer serious losses through this cause. Manufacturers should therefore give their fullest attention to the regulation of the governor, and if they are incapable of doing this themselves, they should have it done by a competent man.

One style of engine cannot be here recommanded in preference to another; there are thousands of different styles; still the attention of interested parties should be drawn to the fact that it is better to have an engine strongly expanding the steam, to one with a small expanding power, for apart from the economy in fuel a more regular speed is obtained in spite of the variation of pressure of the steam in the boiler.

The question of calculating the power of an engine is a very complicated one and cannot be here fully explained. Still the following rule will enable any one to realize approximately the power of engines used in creameries.

The interior diameter of the cylinder should be multiplied by itself and then by the pressure in square inches at the boiler, by the minute, and by the length of stroke of the piston and finally by a number comprised between 0,0000034 and 0,0000037 according to the extent of the expansion.

For creamery engines the average number 0,0000036 may be taken.

For example, take an engine of which the stroke of the piston is 8 inches, the interior diameter of the cylinder 6 inches, the number of revolutions 200 per second and the pressure at the boiler 80 lbs, the power of the engine under these conditions will be about 6 x 6 x 80 x 800 x 8 x 0,0000036 = 16½ horse power.

This formula is only approximative and can only be followed in connection with engines of the kind that are used in creameries and have an expansion of from ⅓ to ½, or if it is desired, one admission, comprised between 0,5 and 0,66 of the stroke. It will not apply to engines in which the expansion is more considerable.

**Shaft.**—To calculate the diameter of the shaft, one must rely upon the data derived from practice. The faster the revolutions of the shaft the smaller need be its diameter. Practically, it is recognized in the shops that a 1¾ inch shaft can transmit a power of 8, 6 horses, at a speed of 200 revolutions of 10,7 at 250 and of 12, 9 at 300 revolutions. A shaft of 2″ can transmit a power of 12,8 horses at 200 revolutions, of 16 at 250 and of 17,2 at 300. It is taken for granted in all these cases that the shaft is supported by bearings which must not be more than 8′ apart and that the pulleys are placed along side of these bearings.

For creameries, of both large and small size, a speed is recommended of not more than 200 revolutions, a diameter of 1¾″ and bearings every 8 feet at least, the pulleys being placed as near as possible along side of them. Besides with a smaller shaft the pulleys turn around the shaft. If the shaft does not revolve fast enough it becomes necessary to use a pulley of too great a diameter in proportion to the small pulley with which it is connected; this will result in considerable slipping of the belts which will diminish the speed of the separator; or if these slippings are to be avoided the belts must be very tightly stretched, which will cause them to wear out very rapidly. On the other hand, if the shaft turns too rapidly, it is difficult to work the churn, the butter worker and the pumps without a counter shaft.

2. **Calculation of pulleys.**—The pulley from which the movements originate is the controlling pulley, the one which receives the movement is the pulley controlled—Thus the pulley of the engine is the controlling and the one on the shaft in connection with it, is the pulley controlled. The small pulley on the intermediate is, with respect to the shaft, a controlled pulley and the pulley of the shaft which transmits the movement to it is a controlling pulley. To find the diameter of a controlled pulley, when the speed, it should have, is known, and the diameter and speed of the controlling pulley, the speed of the controlling pulley is divided by that of the controlled pulley, and the quotient of this division is multiplied by the diameter of the controlling pulley.

So, if the speed of the engine pulley is 180 revolutions to the minute, if that of the shaft be 200 revolutions and if the diameter of the engine pulley is 3 feet; to find the diameter of the pulley of the shaft, 180 should be divided by 200, giving 0,90, after which this quotient will be multiplied by 3 giving 2,70 feet or 2 feet 8½ inches, this result will then be diminished by ½ an inch to allow for the friction. A pulley of 32″ in diameter should therefore be used.

To calculate the diameter of a controlling pulley, when its speed is known, and also the speed and diameter of the pulley controlled, the speed of the controlled pulley is divided by that of the controlling pulley and the quotient of this division is multiplied by the diameter of the pulley controlled. This is the inverse of the preceding calculation.

Thus, supposing the diameter of the pulley on the intermediate to be 5 inches and its speed 915 revolutions and that the speed of the controlling shaft be 200 revolutions, to find the diameter of the controlling pulley 915 must be divided by 200; 4,578 is obtained and by multiplying this quotient by 5 the diameter of the small pulley, 22,875 inches are obtained as the diameter of the controlling pulley. In this case ½ an inch more will be taken to allow for friction, instead of ½ an inch less. The diameter of the controlling pulley should therefore be about 23½ inches.

This calculation applies to the pulleys which control the churn and the butter-worker when the speed of the intermediate shaft and the diameter and speed of the pulleys connected with these two instruments are known.

**Separators.**—What separator should be chosen? This question is often asked. The answer must be that among all the various kinds of separators good and bad ones are to be found. When a separator is purchased, it is always well to take it for some time on trial. It may also be remarked that a poor workman will make bad skimming with any separator.

There are many kinds of separators now in the market of which the principal ones are the Alpha, the Laval, the Tubular, the Alexandra, the U. S. etc. Following, the reader will find drawings of the Alpha (fig. 9 and 10), the Tubular (fig. 11), the Alexandra (fig. 12).

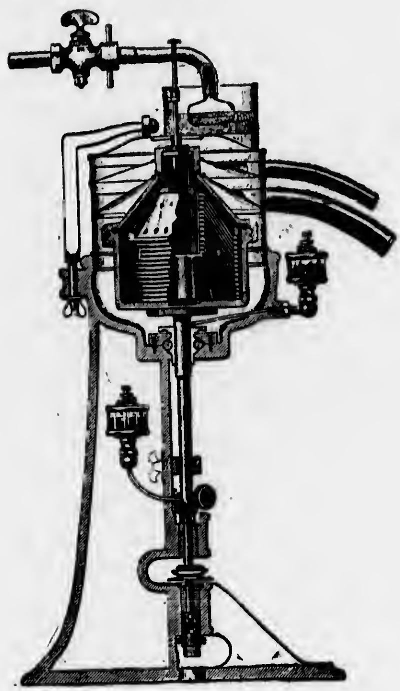

Fig. 9—The power separator "ALPHA."

When one of these machines is purchased, the seller generally gives all the information about the setting up and operating of the same. Still the following observations will be found applicable to all separators.

Fig. 10.—Turbine separator "ALPHA."

1. They must always be placed upon a foundation of stone, of brick or of cement, If set up on a floor which vibrates ever so little, the vibration produces heating which rapidly deteriorates the machine.

2. The revolving shaft should always be as vertical as possible.

3. It must be fastened to the foundation with strong bolts furnished with washers. To assure the verticalness of the shaft, iron and not wooden wedges should be used as the latter soon rot and crush down.

4. For oiling, nothing but perfectly clean oil of the finest quality should be used. Dirty oil causes the speedy wearing out of the machine.

Fig. 11.—Tubular Separator.

5. When the separator is cleaned each day, the necessary precautions must be taken to prevent the entry of water or other foreign substances into the valves.

6. The separator should be gradually brought up to its normal speed,

without attempting to reach it too rapidly. The moment of reaching this speed should be taken from an indicator and it should never be exceeded.

7. When the separator is stopped and the work finished, the engine should be cast off, and the machine allowed to slow down of itself.

Fig. 12.—ALEXANDRA Separator.

As to the question of the advantage of employing separators worked by turbines or those worked by belts, it may be stated that under the actual condition of things, practise has demonstrated that, where only one separator is used, a turbine is the proper motor, but where there are several separators in use, it is more economical to work them by belts. This arises from the fact that separators worked by turbine use up a little more steam than those worked by belts.

**Theory of skimming.**— When the bowl of the separator is revolving with great rapidity, the milk is held up against the sides of the vessel by a power which is known as *centrifugal force.* It is this power which overcomes the weight, as it is much more powerful than the latter. It is proportionate to the square of the number of revolutions, that is to say, that if the number of revolutions is doubled, it is four times as powerful ; if it is three times greater, it is 9 times stronger ; if it is four times greater, it is 16 times and so on. It is also proportionate to the diameter of the bowl ; that is to say that if the diameter of the bowl is doubled it is doubled ; if it is trebled, it is trebled also, and so on.

This shows that in order to increase the centrifugal force it is better to increase the number of revolutions than the diameter, and this is why there is an increasing tendency to build separators running at a very great rate of speed : The only limit to this is the difficulty of finding a machine that will not vibrate, and is not liable to wear out rapidly, nor to burst, for at this speed the interior pressure is considerable. Under the influence of centrifugal force the cream, which is the lighter, tends to rise to the surface of the milk, that is towards the axel of the bowl, while the skim-milk tends towards the sides. To facilitate this movement of the cream towards the center and of the skim-milk towards the exterior, various methods are employed : for example, a certain kind of dish, piled one above the other, the object of which is to prevent the currents of cream and of milk, which are going in opposite directions, from counteracting one another. This is the general idea of what takes place in the bowl during the skimming.

From this it is easy to understand, that the vibrations of the bowl may greatly interfere with the separation of the cream and that every necessary means must be taken to diminish them as much as possible.

Each system of separator presents special characteristics which it is impossible to mention in this bulletin : an examination of the various separators will readily show the characteristics of all of them.

**Vats.**—Vats should be made of tin of the best quality. Tin No 22 at the least should be employed, for when the tin is not sufficiently thick or is of poor quality it rapidly becomes full of holes.

The vat for the reception of the milk should be made like a cheese vat that is jacketed and with a jet of steam, so that the the milk in it may be partly warmed in the winter and autumn, before the warming is completed in the regular heater, immediately before skimming. This is important be-

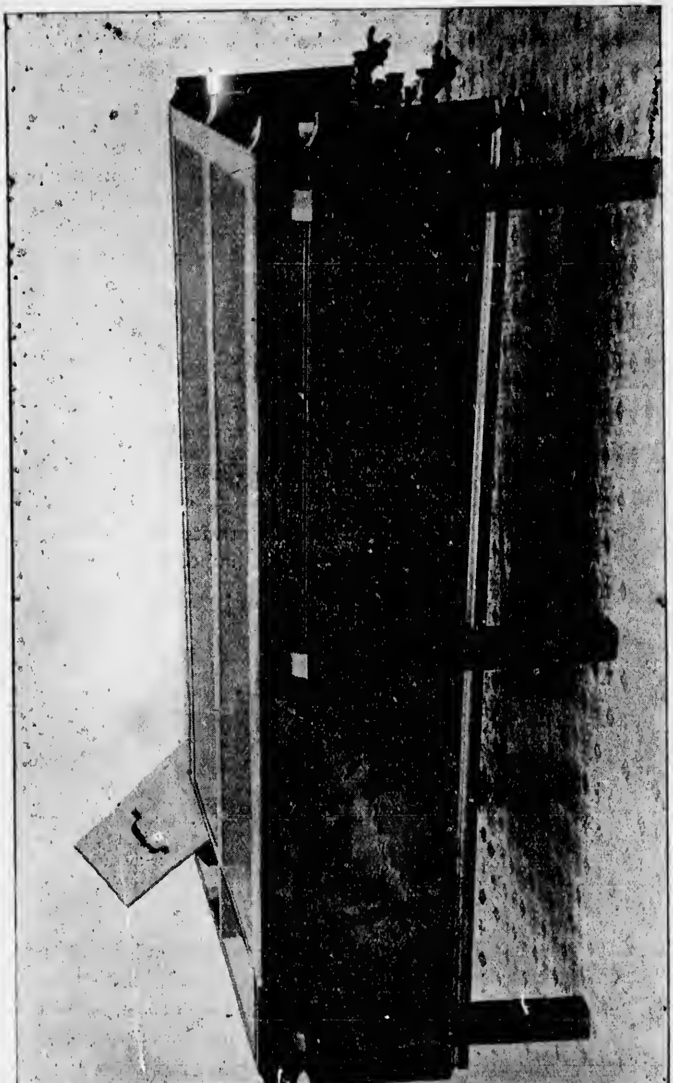

Fig. 13.—Cream vat.

cause if the milk is heated irregularly or too rapidly ; the skimming is affected. These vats should be capable of holding 2500 lbs in a creamery of small size and 6000 lbs in a large sized creamery.

The cream vat also ought to have a double bottom ; the space between the two bottoms being large enough to contain a sufficient quantity of water and ice and to allow of its being stirred about without difficulty. This double bottom should also be furnished with a steam pipe, so that the water may be warmed in case it should become necessary to raise the temperature of the cream.

**Churn.**— There are two systems of churns, simple churns and combined churns. In the first the butter is simply made and washed, besides this in the second the butter is worked.

The best system of the simple churn is a square one which is generally used in this Province, shown in fig. 14.

The combined churn is shewn in fig. 15. In the interior are found fluted cylinders which work the butter in the churn itself, once it is taken in grains. On leaving this churn it is ready to be immediately put into boxes.

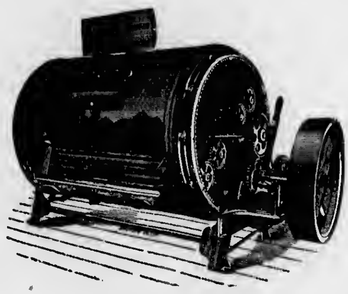

Fig. 15.—Combined churn.

Oak churns are the best, those made of pine rot very quickly. The churn should be so large as to never require to be more than half filled. The churns most generally used are those of a capacity of 300 gallons. One of these is sufficient for a creamery of small size, while two will be required for a creamery of large size.

In preparing the churn before using, it should be rinsed with boiling

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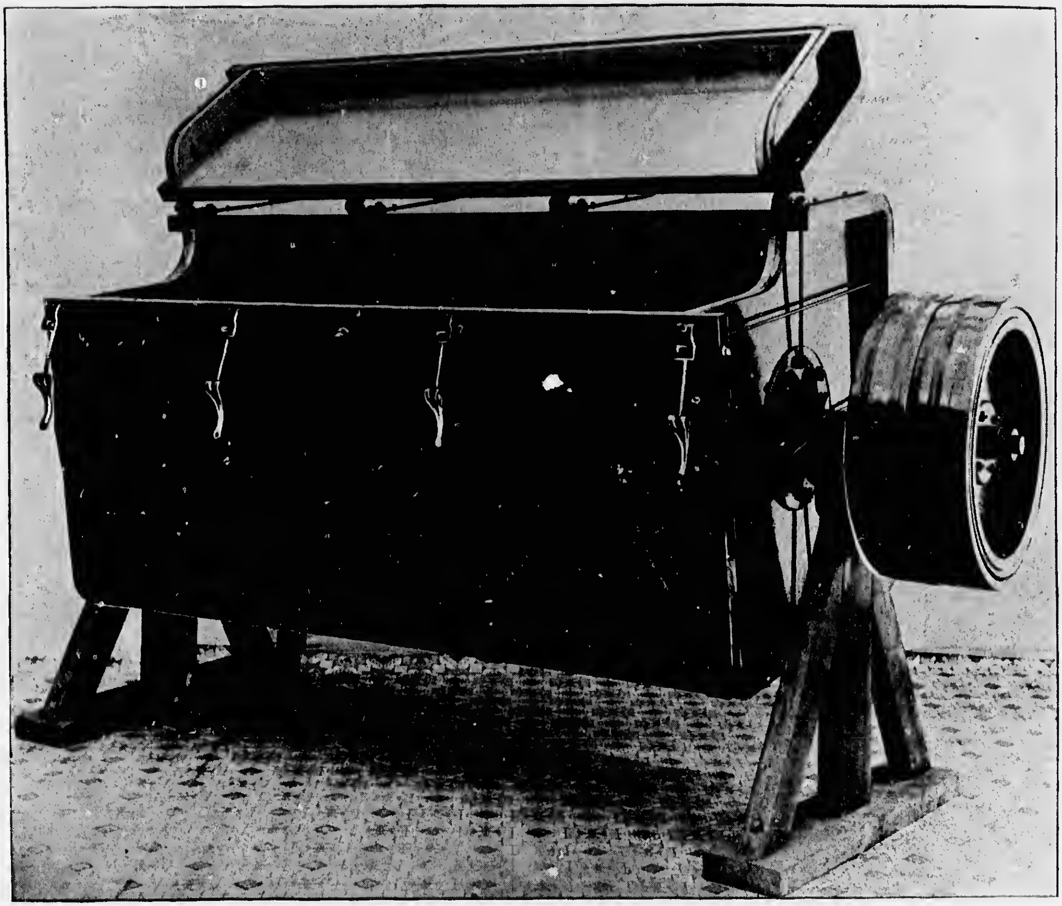

Fig. 14.—Churn.

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water, and afterwads, during the heats of summer, it should be again rinsed but with cold water, to cool it ; in the spring and autumn during cold weather this second rinsing is unnecessary, and the warmth in the churn assists in maintaining the cream at the desired temperature.

When the turning of the churn is commenced, certain gasses are given off by the cream, which must be allowed immediately to escape so that the interior pressure wh... they produce may not injure the churn.

After the churning, the first thing to be done is the washing of the churn with boiling water. All the interior iron work should be well rubbed with a clean cloth soaked in the hot water from the churn. This done the churn should be rinsed with an abundant quantity of water, after which a jet of steam should be turned on for five minutes for the purpose of destroying all germs and of rapidly drying it. When not in use it should be left open. If these precautions are taken the churn will always be in good condition and will not rot.

**Butter workers.**— In creameries, where combined churns are not employed, butter workers in form of a turn table are generally found in use. Figure 16 represents one of these machines. The butter is pressed upon the table by several rollers and the pressure of these rollers expels the butter milk, There are certain kinds ol butter workers in which the butter passes through cylinders placed one above the other or along side of one another, and more or less fluted, but these kinds are more adapted to the operation of mixing butter. For pressing the butter, butter workers in the shape of turn tables, are preferable.

When more than 150 lbsof butter per day have to be worked, it is better to employ a steam butter-worker, than one worked by hand, so that the work may be done more rapidly and before the butter has time again to heat.

The butter-worker is kept in order in the same way as the churn.

**Heaters, pasteurisers, coolers.**—These apparatus, although very dissimilar in appearance, are still all based on the same principle. These principal things are found in them : 1° a warm liquid, 2° a cold liquid and 3° between the two, to separate them, a very thin metal partition. Heat has always a tendency to transmit itself from a warm to a cold liquid. This transmission takes place all the faster when the difference of their temperature is considerable and the partition which separates them is very thin and therefore a better conductor of heat.

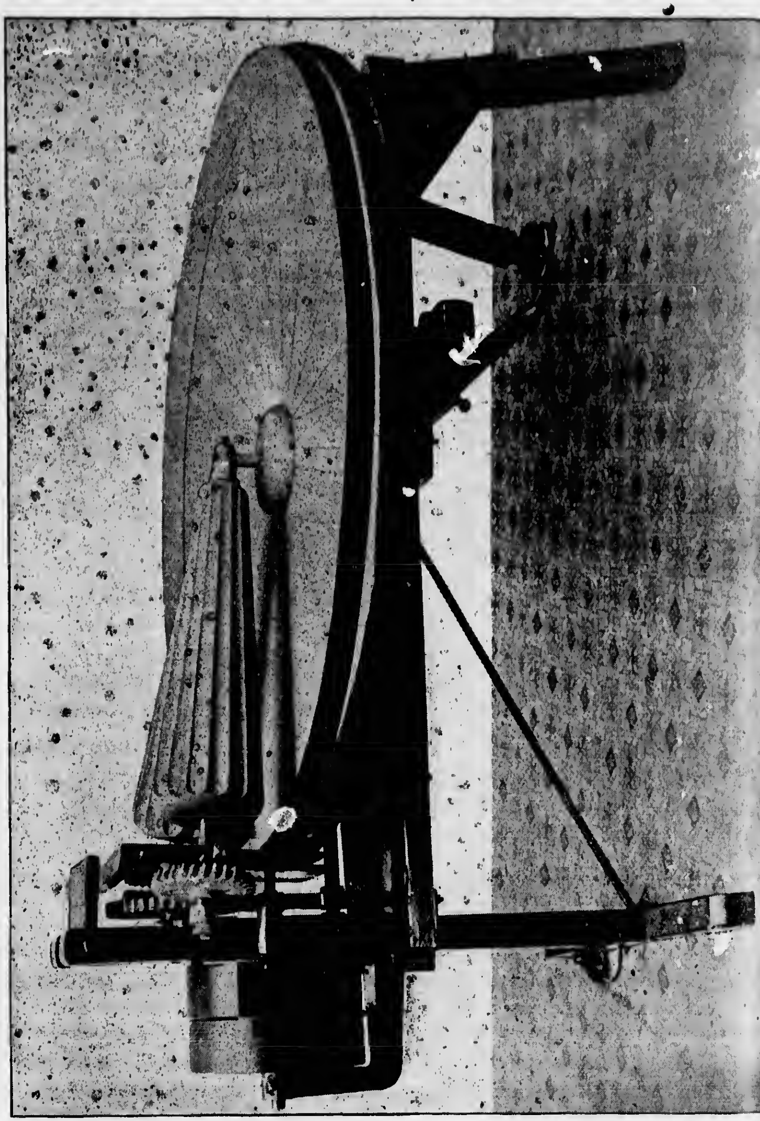

Fig. 16. Butter worker

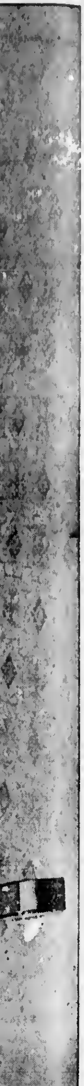

Fig. 16.—Butter worker.

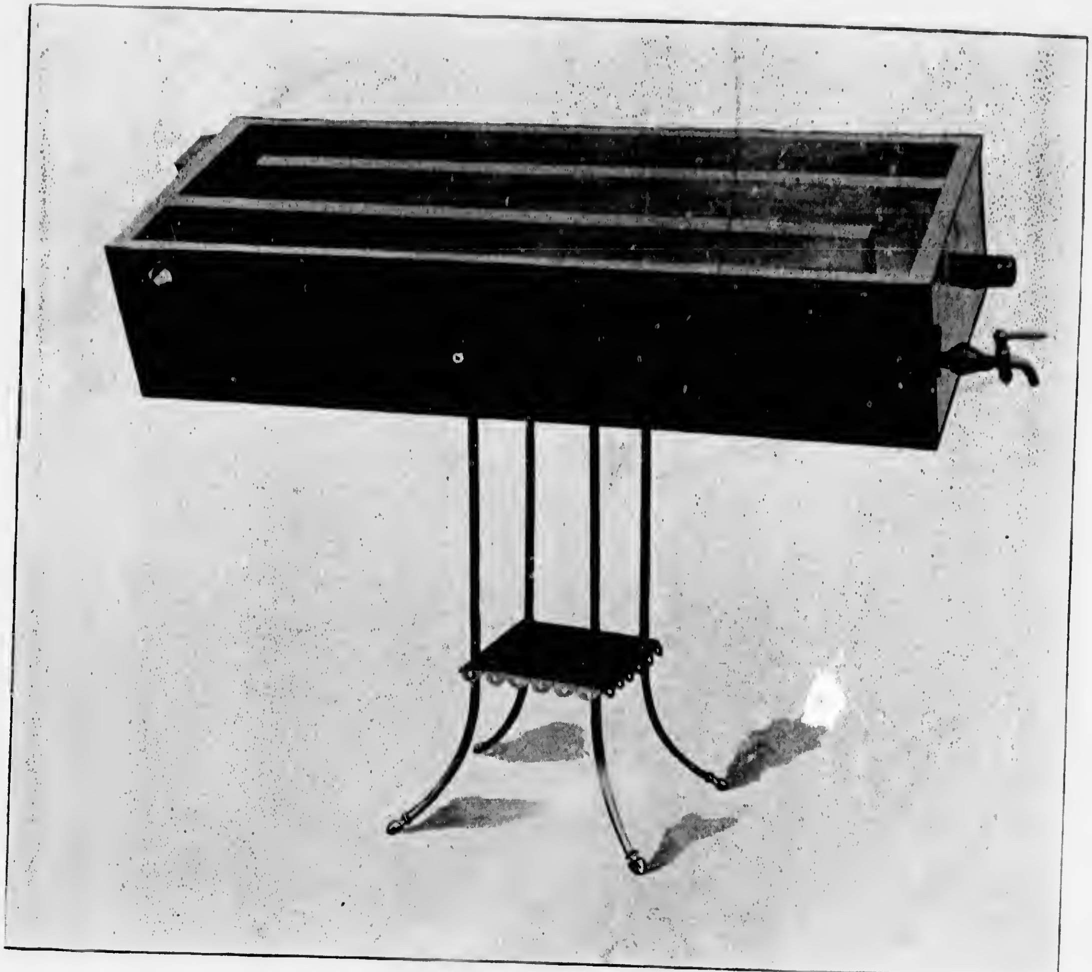

Fig. 17 —Heater.

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It also takes place the more rapidly in proportion as the liquids upon both sides of the partition are more or less stirred about.

When it is desired to heat up a cold liquid, it is done either by a heater or a pasteuriser ; if it is desired to cool a warm liquid, the apparatus used is a cooler. In the milk industry, the liquid which requires heating or cooling is always either milk or cream and the liquid which serves as the instrument of transmission of the heat is always either hot water or cold.

The following are some general rules in connection with these apparatus :

1. The transmitting partition must be as thin as possible ;

2. The two liquids on either side of the partition should be continually and rapidly stirred. This may be arranged for in many different ways, but the best way is to have it flowing in a thin layer. This rule is most important to insure the efficiency of the apparatus.

3. When it is necessary to heat milk or cream, neither water of too high a temperature nor should steam be used, because this will cause the milk or cream to coagulate on the transmitting partition and this thin coagulated coating will prevent the transmission of the heat from one liquid to the other and the apparatns will no longer operate.

4. Arrangements must be made to prevent air bubbles from interposing between the liquids and the transmitting partition, because air prevents the passage of heat. This condition takes place particularly in heaters of which the surface of the transmitter has not a sufficient incline.

5. In heaters, when the quantity of milk to be heated diminishes, unless the source of heat, that is the temperature, or the quantity of water on the other side of the transmitting partition, is diminished at the same time, the heat accumulates in the partition and a thin coating of milk coagulates upon its surface, preventing the apparatus from working in a normal way. Measures must therefore be taken to regulate the quantity and temperature of the hot water used.

6. When cream is cooled, especially if the cold water has a temperature in the neighbourhood of 32° and if the cream is thick, the partition becomes covered with a greasy coating which prevents the heat from going through it, the efficiousness of the machine is impaired. We would recommend that in these cream coolers the cream should be run on to a partition of slight

thickness and with as heavy an incline as possible : in this way the layer of cream will be very thin and will more quickly lose its heat.

7. If must not be forgotten in the consideration of these apparatus, that a partition can only transmit per square foot of surface and per hour a limited quantity of heat, in keeping with the differences of the temperatures of the two liquids and that a certain number of square feet of tranmitting surface is required to heat or cool by so many degrees a given quantity of milk. If the quantity of milk or cream to be heated or cooled by the hour is doubled or trebled the surface of the transmitter should also be doubled or trebled : If the number of degrees by which it is necessary to heat or to cool the milk is doubled or trebled, the surface must also be doubled or trebled, the difference of temperature being the same in the two cases. The same remarks will apply to refrigerators.

8. It is exceedingly difficult to point out the number of square feet necessary in the transmission surface to warm 1000 lbs of milk per hour or in the same time to cool 1000 lbs of cream, a certain number of degrees ; because this depends, not only on the number of degrees which they must be heated or cooled but above all on the stirring of the two liquids and on the nature of the partition of transmission.

9. It is however quite easy to calculate the quantity of ice necessary to cool a certain quantity of cream. This calculation shows that about 18 lbs of ice are required to cool 100 lbs of cream from 85° to 50°. For 300 lbs of cream taken from 2500 lbs of milk 54 lbs of ice would be required, that is about a cubic foot, for a cubic foot of ice weighs 55 lbs.

The quanfity of steam necessary to heat the milk can also be calculated, but this calculation is a matter of lesser importance.

With reference to the kind of heater to be recommended, all we can say is that the one shown in fig. 17, is generally considerd good.

There are not many kinds of cream coolers. It is matter of regret that these apparatus are not employed more largely, as their use permits of the cream being immediately cooled to the desired temperature without its being necessary to keep stirring it for a long time in the cream vat. Furthermore cream, quickly cooled in this way, more easely loses any bad smells it may contain.

A cooler, giving very good results has just been placed on the market. The subjoined shetch fig. 13, shows the way it works. The cream is sent over the outside of a very thin tin revolving cylinder, against the interior surface of the wall of this cylinder several jets of cold water are thrown. This water starts the movement of the cylinder by means of wings against which the water is projected.

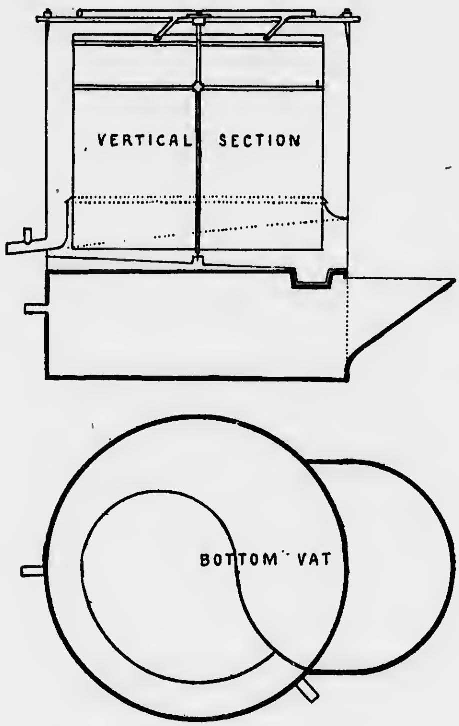


Fig. 18.—Refrigerator.

We have therefore on one side of the division a thin layer of warm cream and on the other a thin layer of cold water and the heat from the cream is transmitted to the water through and by means of the dividing partition. The cream is received in a slanting circular scupper and thence in the kettles and the water falls into a receptacle where it is recooled before being again pumped on to the wings. This kind of apparatus which is very simple and easily cleaned, can also be used as a heater.

## V.—MAINTENANCE OF CREAMERIES.

**Cleanliness of creameries.**—The first condition for the making of good butter, is the keeping of the creamery in the highest state of cleanliness.

1. The runs or scuppers should be cleaned every day with the greatest care. No spoiled milk or sweepings should be seen about.

2. All hollow places, which may be found in the sides of the engine or of the separators should also be cleaned each day, so that neither oil nor a mixture of oil, water and decaying milk may be allowed to accumulate. Every part of the machinery should be carefully wiped over every day.

3. The cans, vats and various other utensils, used for the milk or cream, should be sterilized after each using, by steam or boiling water: after working, particular attention should be given to the cleanliness of the vat for skim-milk.

4. The jackets in the cream or milk vats should be emptied and cleaned from time to time, otherwise the water becomes foul and emits evil odours through the building.

**Disinfection of creameries.**—Every year in the spring the establishment should be disinfected before the recommencement of manufacture. This is done in the following way:

1. The floors, walls, ceilings, doors and windows of the different apartments should be washed with caustic soda and soap and then thoroughly aired and dried. This done the whole building should be washed a second time with a sponge and a solution of from 1 to 2 p. ct, of chloride of zinc or formaline or of fluoride of sodium.

Chloride of zinc costs $ 1,00 per pound and a solution of ½ per cent will come to about 15c per gallon.

Formaline cost $1.15 and a solution of 1½ p.ct. will come to about 17c. per gallon Fluoride of sodium costs from $1. to $1.25 per pound and its solution at 1 p. ct. comes to between 10 c. and 12 c. per gallon. The first two articles are poisons, but mixed in solutions of 1½ per cent they will not injure the hands.

After having thus thoroughly washed over the walls, ceilings, floors and windows, the doors and shutters should be opened wide so as completely to renew the air; and they should be left open during a whole day. This operation should only be performed during fine weather.

If the disinfection of the air alone in the factory on in one of the apartments, is desired, this may be effected by the burning of sulphur, keeping the doors and windows properly closed ; these should be kept closed for several hours, after which the premises should receive a thorough ventilation. Instead of sulphur, formaline may be used ; a small quantity of which may be placed in saucers in the different apartments with the doors and windows closed for several hours.

But the disinfection of the interior of these establishments is not alone sufficient, above all it is necessary to attend to the surroundings which must be kept carefully clean. The spouts and ditches which receive the drainage water must be examined and emptied. Their slope must be sufficient to prevent the water from remaining in them, soaking into the soil and spreading foul odours around. The floors and spouts in the interior of the establishment must be kept water-tight. If there are cracks the places where the leakages occurred the previous year should be found and lime should be spread about ; the cracks must be carfully stopped.

In certain establishments it is sometimes impossible to make good butter : the reason of this may be the want of cleanliness in the building and a disinfection, which will not cost more than $4 or $5, will produce a marked improvement in the quality of the butter.

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## GENERAL INFORMATION.

The following information may prove useful to those desiring to construct and work a creamery.

The information comes from Mr. William R. Haven, a specialist in the book keeping of butter factories. It has been taken from books regularly kept for some years in a number of factories in this province and certainly deserves serious consideration.

There is no doubt that in many factories the cost of manufacture, might be reduced but this reduction must not be counted on, reliance should rather be placed on the figures given here, for in this case a mistake of too much is less harmful than a mistake of too little.

## VALUE OF A COMPLETE CREAMERY.

| —— | Small 3000 lbs of milk per day and under | Good ordinary 3000 to 5000 lbs per day, without skimming station | Ordinary with skimming station 8000 to 10000 lbs of milk per day | Ordinary with 2 skimming stations 10000 to 15000 lbs of milk per day |
|---|---|---|---|---|
| | $ | $ | $ | $ |
| Land | 75 00 | 125 00 | 165 00 | 210 00 |
| Buildings and foundations | 550 00 | 750 00 | 900 00 | 1050 00 |
| Well, Waterworks, ice-house, roads and fences | 100 00 | 125 00 | 165 00 | 210 00 |
| Machinery (separators engine and boiler) | 1 separator 550 00 | 2 separators 825 00 | 3 separators 1200 00 | 4 separators 1600 00 |
| Connection of machinery | 140 00 | 200 00 | 250 00 | 300 00 |
| Vats, churns, butter-workers, etc | 115 00 | 290 00 | 350 00 | 410 00 |
| Cans, scales, laboratory, office, etc. | 105 00 | 175 00 | 235 00 | 300 00 |
| Cartage | | | 100 00 | 175 00 |
| Unforseen costs of installation and opening | 10% 165 00 | 10% 250 00 | 15% 500 00 | 15% 640 00 |
| Totals | $1800 00 | $2740 00 | $3865 00 | $ 4985 00 |

## VALUE OF A SKIMMING STATION

| | |
|---|---|
| Land | $ 40 00 |
| Buildings | 200 00 |
| Wells, waterworks, roads and fences | 50 00 |
| Machinery | 400 00 |
| Connections | 50 00 |
| Materials | 75 00 |
| Moveables | 60 00 |
| Cartage | 100 00 |
| Unforseen 10% | 100 00 |
| | $ 1075 00 |

There figures are only averages liable to vary with circumstances, but when it is proposed to establish a butter factory or a skimming station, they may be considered as a hasis of calculation. It is much to be desired that every proprietor of an establishment, connected with the butter industry, would take the trouble, as a simple precaution, to follow the preceding financial outline and enter under each article, inventorising and taking note, most exactly and without forgetting anything, of every thing he buys, changes, pays out owes or expends, even his own time and personal expenses, besides all other charges, trips, freights, expressage, telegrams, correspondence, day's work, cartages, journeys, etc, etc, necessitated by and for the complete and finished installation ; he will thus have the figures of the real gross cost of capital expense, made or to be made without any mistake or loss, and this information will often be of great value to him.

## DETAILS OF THE COST OF CARRYING ON A CREAMERY.

These charges are hased upon the average expenditures of 14 establishments during the 4 years 1896, 1897, 1898 and 1899 added together and averaged.

The unit chosen is one pound of butter net. By multiplying the cost of making one pound of butter by the return in butter from one hundred pounds of milk we arrive at the exact cost of handling the other unit of 100 lbs of milk.

Column 1.— Small establishment 449,596 lbs of milk per year, return 4.457%.

Column 2.— An ordinary good establishment 1040.119 lbs of milk per year, return 4,569%.

Column 3.— Good establishment with one skimming station 1423.446 lbs of milk per year, return 4,702%.

Column 4.— Very good ordinary establishment with 2 skimming stations 2.056.313 lbs of milk per pear, return 4,397%.

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | C | C | C | C |
| Labor.—Maker, assistant skimmer, if there is a skimming sta., inspection | 1.087 | 0.791 | 0.986 | 0.973 |
| Repairs.— Buildings, machines, material and rolling stock .......... | 0.251 | 0.258 | 0.307 | 0.263 |
| Heating with washing, lighting, greasing and oil ................... | 0.293 | 0.259 | 0.223 | 0.182 |
| Ice, water and testing with babcock. | 0.289 | 0.141 | 0.113 | 0.098 |
| Boxes, tubs, paper, salt and colouring matter ........................ | 0.652 | 0.514 | 0.493 | 0.486 |
| Transport, butter milk, journeys, freight, express (and cream if there is a skimming station) ........... | 0.169 | 0.168 | 0.303 | 0.256 |
| Rent, Insurance, taxes and interest at 7% ........................ | 0.779 | 0.468 | 0.467 | 0.454 |
| General charges in pay, sales, and for the office of the secretary and accounts ...... ...... ...... ...... | 0.271 | 0.189 | 0.229 | 0.157 |
| Unforseen and bad workmanship.... | 0.089 | 0.095 | 0.094 | 0.084 |
| Total annual expense per lb of butter. | C 3.880 | C 2.883 | C 3.215 | C 2.953 |
| If to this is added a sinking fund for the capital from 10 to 15%, a very necessary charge since all industrial establishments are liable to the wearing of material, to fire, accidents, etc., and that this is only a value dependant upon all conditions favorable or the reverse, say...... | 10% 0.905 | 10% 0.577 | 15% 0.867 | 15% 0.812 |
| A true total of the cost of manufacture by the lb of butter will be found.......... .......... | C 4.785 | C 3.460 | C 4.082 | C 3.765 |

The following results from the above :

A small establishment No 1 cannot be run unless the patrons pay at least 4c per lb of butter and 4½c with sinking fund.

An establishment such as No 2 alone seems able to cover all expenses.

An establishment with skimming station (one or more) is only possible if the patrons pay 3½c or about 20 0/0 of the gross price of the butter. At 3c and still less at 2¾c, such an establishment is barely possible, even with the strictest economy, because every thing necessary must be there, without stint.

Many proprietors of establishments wrongly consider interest charged at 7 p. c.—as an advantage—and then it is not charged as an expense. This is a very grave error both in fact and in account keeping, the nature of the sinking fund is general ignored, thus producing errors of calculation, losses, &c.

In any case the figures given above are only averages, they may however be said to be just and exact from a continous series of years. These charges increase proportionately per lb of butter, if the total quantity of butter, made during the season, diminishes, per contra the charges diminish proportionately per lb of butter, if the quantity of milk and butter is increased.

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## DETAILS OF THE COST OF WORKING A SKIMMING STATION.

These figures represent the cost of manufacture of one pound of butter. By multiplying these figures by the average return in butter of one hundred pounds of milk, the cost of handling the other unit of 100 lbs of milk is obtained.

The details of the charges are established by an average of expenses during the 4 years from 1896 to 1899 added together and averaged.

Finally a skimming station will only be advantageously connected with a central establisment, when the cost of such station does not exceed 2 cents per lb of butter or about 9 cents per 100 lbs of milk.

Column 1.—Small ordinary skimming station, milk per year 243,182 lbs return 4,513 0/0.

Column 2.—Good skimming station, milk per year 484,944 lbs, return : 4,425o/o.

| — | 1 | 2 |
|---|---|---|
| | C | C |
| Labor | 0.583 | 0.541 |
| Repairs, buildings, machinery, materials and rolling stock | 0.211 | 0.144 |
| Heating, light, washing, oiling and oils | 0.268 | 0.234 |
| Ice, water, testing Babcock | 0.040 | 0.041 |
| Cartage of cream | 0.559 | 0.531 |
| Freights, express, cartage and journeys | 0.044 | 0.036 |
| Rent, Insurance, taxes and interest at 7% | 0.322 | 0.376 |
| General charges for payment of patrons, of the office, of accounts, of the secretary | 0.223 | 0.153 |
| Unforseen, and bad workmanahip | 0.056 | 0.047 |
| Sinking fund 10 to 15% | mem. | mem |
| Totals | C 2.306 per lb of butter or 10.107 per 100 lbs of milk | C 2.103 per lb of butter or 9.306 per 100 lbs of milk |

## DIFFERENCE BETWEEN THE WEIGHT OF BUTTER MADE AND THE WEIGHT OF THE SAME WHEN SOLD.

| — | Minimum per 100 lb of butter made | Maximum per 100 lb of butter made | Average per 100 lbs of butter made |
|---|---|---|---|
| Difference between the gross weight of butter made and valued and the net weight weighed and sold. | lb | lb | lb |
| 1897 .......................... | 0. 32 | 1. 86 | 0. 86 |
| 1898 .......................... | 0. 38 | 1. 36 | 0. 76 |
| 1899 .......................... | 0. 20 | 1. 72 | 0. 68 |
| | lb | lb | lb |
| | 0. 29 | 1. 68 | 0. 76 |

Therefore on an average when a manufacturer states and proves that he has made 100 lbs of butter—only 99 $\frac{24}{100}$ lbs will be in reality sold and paid for.

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## RESULTS OF AVERAGE CURRENT PRICES OF SALES OF BUTTER WHOLESALE.—MONTREAL MARKET.

| —— | 1894 | 1895 | 1896 | 1897 | 1898 | 1899 | Reun. |
|---|---|---|---|---|---|---|---|
| | C | C | C | C | C | C | C |
| May ............ lbs. | 18.25 | 14.67 | 15.50 | 16.12 | 16.00 | 15.75 | 15.89 |
| June .................. | 18.88 | 16.58 | 16.11 | 16.89 | 16.50 | 17.69 | 16.94 |
| July .................. | 18.50 | 17.88 | 16.60 | 17.00 | 16.50 | 18.63 | 17.34 |
| August .................. | 19.00 | 18.00 | 18.00 | 18.25 | 17.69 | 20.75 | 18.43 |
| September .............. | 20.50 | 18.42 | 19.00 | 17.25 | 18.50 | 22.75 | 19.21 |
| October ............ | 21.75 | 20.75 | 19.35 | 17.50 | 18.00 | 20.83 | 19.50 |
| November ............ | 22.00 | 19.00 | 18.50 | 17.50 | 19.50 | 20.00 | 19.23 |
| Average totals ......... | C 19.55 | C 17.37 | C 17.26 | C 17.34 | C 17.51 | C 19.71 | C 18.12 |
| Cost of manufacture per lb at 20 pct, 18 pct, 17½ pct, or 3c. 3½ or 4 cents per lb. ...... | C 4.000 | C 3.675 | C 3.154 | C 3.274 | C 3.218 | C 3.461 | C 3.324 |
| Net return of butter lbs per patron .......... | C 15.550 | C 13.69 | C 14.105 | C 14.066 | C 14.292 | C 16.249 | C 14.796 |
| Average return from milk ............... | 4.519 | 4.625 | 4.600 | 4.465 | 4.523 | 4.481 | 4.511 |
| Average price for 100 lbs of milk to the patrons .. ...... ...... | C 70.270 | C 63.339 | C 64.888 | C 62.805 | C 64.643 | C 72.812 | C 66.745 |

As a general principle three things are necessary to cause 100 lbs of milk, to return a good price to the producer :

The first and most essential is the return of the milk in butter without any loss, either is quality or in weight.

The second is, a good paying price, which price is but the consequence of the return.

The third and last is the reduction, the utmost possible reduction of the proper and necessary cost of manufacture, without any meanness, for in this as in everything else one receives no more than he pays for; and a return once obtained should always rather increase than diminish, for what has been done once can be done again.

## AVERAGE DATA RELATING TO CREAMERIES AND TO SKIMMING STATIONS.

### CREAMERIES AND THEIR SKIMMING STATIONS.

| | minimum | maximum | average |
|---|---|---|---|
| lbs. OF MILK PER DAY | | | |
| 1897............ | 2597 | 11209 | 5746 |
| 1898............ | 2793 | 13471 | 6460 |
| 1899............ | 3304 | 15186 | 7842 |
| Averages.. ...... | 2892 | 13265 | 6485 |
| PATRONS PER FACTORY | | | |
| 1897............ | 23 | 106 | 76 |
| 1898............ | 21 | 103 | 74 |
| 1899............ | 38 | 135 | 88 |
| Averages........ | 27 | 115 | 79 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **DAILY MILK PER PATRON (IN lbs)** | | lbs | | lbs | | lbs |
| 1897 ............ | | 58.61 | | 101.76 | | 75.87 |
| 1898 ............ | | 80.20 | | 114.50 | | 91.29 |
| 1899 ............ | | 081.02 | | 104.96 | | 92.15 |
| Averages ........ | | 72.93 | | 105.25 | | 86.07 |
| **SEASONS MILK PER PATRON (IN lbs)** | | | | | | |
| 1897 ............ | | 9196 | | 16415 | | 11104 |
| 1898 ............ | | 10731 | | 17060 | | 13379 |
| 1899 ............ | | 11824 | | 16442 | | 13848 |
| Averages ........ | | 10551 | | 16881 | | 12777 |
| Ordinary length of season from May to the middle of November. | | | | | | |
| 1897 days | | 133 | | 161 | | 146 |
| 1898 days | | 140 | | 163 | | 153 |
| 1899 days | | 136 | | 176 | | 156 |
| | | 136 | | 167 | | 152 |
| NUMBER of cows to each establishment<br>1° number to each patron ;<br>2° Daily milk per cow in lbs | | | | | | |
| 1897 ............ | 5. | 11.72 | 6. | 14.57 | $5\frac{1}{2}$ | 13.79 |
| 1898 ............ | 6. | 12.38 | 8. | 1490 | $6\frac{2}{3}$ | 13.83 |
| 1899 ............ | $5\frac{3}{4}$ | 12.22 | 8. | 1434 | $6\frac{1}{2}$ | 13.74 |
| Averages ......... | $5\frac{3}{5}$ | 12.13 | $7\frac{1}{3}$ | 14.61 | $6\frac{1}{7}$ | 13.77 |

| | | | |
|---|---|---|---|
| AVERAGE BABCOCK test | | | |
| 1897 ............ | 3.698 | 4.217 | 4.005 |
| 1898 ............ | 3.995 | 4.146 | 4.064 |
| 1899 ............ | 3.971 | 4.198 | 4.074 |
| Averages........ | 3.871 | 4.176 | 4.034 |
| RETURN OF lbs OF BUTTER PER 100 lbs OF FAT | | | |
| 1897 ............ | 106.71 | 11490 | 11154 |
| 1898 ............ | 108.13 | 11393 | 11157 |
| 1899 ............ | 105.38 | 11273 | 10999 |
| Averages ........ | 101.66. | 113.42 | 111.31 |
| This return, which the Babcock testing should control, is small; for 100 lbs of fat should produce in butter a minimum of 114 lbs or a maximum of 126.67 an average of 118.75. | | | |
| RETURN OF lbs OF BUTTER PER 100 lbs OF MILK | | | |
| 1897 ............ | 4.020 | 4.710 | 4.465 |
| 1898 ............ | 4.370 | 4.668 | 4.523 |
| 1899 ............ | 4.383 | 4.620 | 4.481 |
| Averages ........ | 4.245 | 4.653 | 4.490 |
| This return also enables us to know the average quantity of butter made each day, per establishment, by the season, per patron and per cow....... | | | |

## SKIMMING STATIONS.

SPECIAL RETURNS COLLECTED FROM ALL ESTABLISHMENTS

| | Minimum | Maximum | Average |
|---|---|---|---|
| **Milk per day (lbs)** | | | |
| 1897 ............ | 1217 | 3568 | 2661 |
| 1898 ............ | 1993 | 3522 | 2455 |
| 1899 ............ | 1514 | 3300 | 2433 |
| Averages ........ | 1559 | 3428 | 2488 |
| **Patrons per station** | | | |
| 1897 ............ | 23 | 35 | 30 |
| 1898 ............ | 21 | 32 | 26 |
| 1899 ............ | 14 | 33 | 25 |
| Averages ........ | 19 | 33 | 27 |
| **Daily milk per patron (lbs)** | | | |
| 1897 ............ | 58.61 | 164.15 | 84.75 |
| 1898 ............ | 80.20 | 170.60 | 97.19 |
| 1899 ............ | 76.60 | 144.73 | 102.64 |
| Averages ........ | 71.08 | 158.23 | 96.70 |
| **Season's milk per patron (lbs)** | | | |
| 1897 ............ | 3239 | 16415 | 10527 |
| 1898 ............ | 10731 | 17060 | 13890 |
| 1899 ............ | 11174 | 16942 | 13790 |
| Averages ........ | 8280 | 16638 | 12900 |

| | | | |
|---|---|---|---|
| LENGTH OF THE SEASON (*day*) | | | |
| 1897............ | 62 | 161 | 119 |
| 1898............ | 140 | 155 | 149 |
| 1899............ | 129 | 159 | 143 |
| Averages ........ | 103 | 149 | 138 |
| Cows, number per patron and daily milk per cow | | | |
| 1897............ | 5. 11.72 | 6. 14.57 | 5⅓ 13.93 |
| 1898............ | 6. 13.36 | 8. 14.90 | 7⅙ 14.11 |
| 1899............ | 6. 12.34 | 8. 14.63 | 7½ 14.00 |
| Averages ........ | 5⅔ 12.35 | 7⅓ 14.77 | 63¾ 13.88 |
| TESTS | | | |
| 1897............ | 4.064 | 4.193 | 4.107 |
| 1898............ | 4.013 | 4.154 | 4.093 |
| 1899............ | 3.960 | 4.185 | 4.067 |
| Averages .... .... | 4.016 | 4.169 | 4.078 |

NOTE.—All the above information may at first appear superfluous, still it presents many points of interest. Supposing a patron, knowing that he can secure the milk from 55 patrons, desires to build a creamery. He wishes to find out exactly how much his establishment will cost him. With these tables it is easy for him to see that this creamery will receive an average of from 3000 to 4000 ℔s of milk per day and will cost him about $2,700 and that he will have to expend 2.88c daily for cost of manufacture and this without the cost of a sinking fund and with a sinking fund 3.46 c. With this information and much more that these tables will furnish him, he can organize his business upon a solid foundation because he can rely upon these figures: if there is any mistake it will be in an overcharge of costs. With these figures he has no chances of a serious mistake. He can strike off the charges which are not necessary in his particular case, but in any case he has a complete list of all those which may arise, which must always be of great advantage to him.

Quebec, 28th May 1900.

GABRIEL HENRY, C. E.