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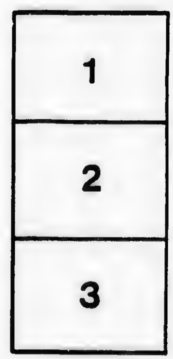

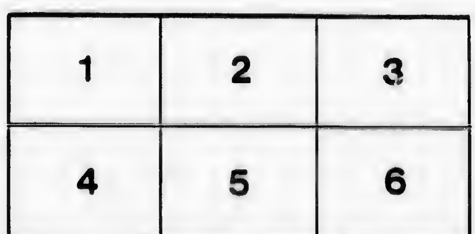

PROVINCE OF QUEBEC
DEPARTMENT OF AGRICULTURE

CURING-ROOMS
IN
CHEESE-FACTORIES

PREMIUMS
OFFERED BY THE GOVERNMENT
TO ENCOURAGE THEIR IMPROVEMENT.

DUSSAULT & PROULX, PRINTERS
1899

PROVINCE OF QUEBEC.

DEPARTMENT OF AGRICULTURE

RULES TO BE FOLLOWED FOR THE CONSTRUCTION OR IMPROVEMENT OF CHEESE FACTORIES

The experience of the past few years has clearly demonstrated that one of the great obstacles to the improvement of the cheese of the Province of Quebec and to the enhancement of its price consists in the want of good curing rooms and in the putting upon the market of unripe or badly cured cheese, whereby we lose in part the benefit of the efforts made to secure careful manufacture.

Further, the English market offers much better prices for properly ripened cheese, while it shows a tendency to refuse all cheese which does not possess a mild flavor and a rich body.

As competition is daily becoming keener in all the markets upon which the cheese of the province is offered for sale, the evil results of these defects are constantly manifesting themselves with ever increasing intensity.

To remedy this state of things, the Honorable Commissioner of Agriculture at Quebec has decided to make a grant to all associations or individuals owning or desiring to erect cheese factories, who, having applied for the same, consent to submit to the conditions hereinafter mentioned.

These conditions are divided into four categories :

1 Conditions relative to the construction of the factory and to that of the curing room in particular ;

2 Those relating to the ventilation of these rooms, to their cooling in summer and their warming in the spring and fall ;

3 Those which concern the general laying out of the factory ;

4 Those which relate to the manufacture and to other questions.

The grant in question shall be payable in two instalments. The first when the conditions of the two first categories shall have been fulfilled, and the second when the conditions specified in the two last categories shall have been equally complied with.

The object of the grant is not to secure a mere half measure of improvement in the factories, but the establishment, in different parts of the province, of factories that may, as far as possible, in all respects be regarded as models and that may be able to supply to all engaged in the cheese-making industry reliable information in regard to the cost, working and advantages of such installations

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I.—CONDITIONS

RELATIVE TO THE CONSTRUCTION OF THE FACTORY AND THAT OF THE CURING ROOM IN PARTICULAR.

As a grant may be given to existing factories as well as to factories in course of construction, we shall consider the two cases separately.

1.—EXISTING FACTORIES

GENERAL AIM OF THE IMPROVEMENTS

All the improvements must be made with the view especially of rendering the curing room as impervious as possible to heat and air.

LOCATION OF THE CURING ROOM

As far as possible, it should be located on the ground floor or first story. No grant will be given for a curing room placed immediately under the roof.

As far as possible, too, its ends should face the north and south and its sides the east and west.

Its size should be at least 400 square floor space, feet or the equivalent of 20 × 20 feet, while the quantity of milk received should not exceed 5,000 lbs per day in the height of the summer.

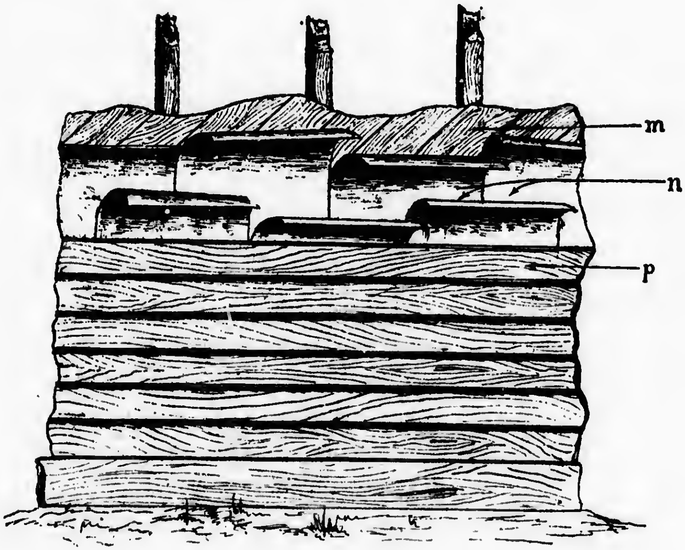

Fig. 1

Outer surface of the walls of the curing room.

For a quantity of milk ranging between 5,000 lbs and 8,000 lbs, the floor space should be at least 700 square feet and for a quantity ranging between 8,000 and 12,000 lbs, its floor space should cover at least 1,000 square feet.

WALLS—(*Fig. 1. 2, 4 and 5*)

The walls of an existing factory may be constructed of either of timber, deals or studding. In all cases, if not already so, the deals or the studding should be first lined, inside and outside and reciprocally, with a double thickness of rough one inch boards *m* well nailed and well jointed together.

Preferentially, these boards should be nailed on obliquely (fig. 1) to the direction of the studding or the deals.

Over the double outer lining of boards, two layers of first quality felt or building paper should be well laid *n* (fig. 1) in broken joint fashion and without creases, while over the paper there should be another double clap-boarding *p* carefully placed and nailed.

Over the double inner lining of rough boards (*a*, fig. 2) one layer of felt, paper should be first applied and, on the paper, furrings or strips (*f*) two inches wide and one inch thick should be nailed parallel to each other at a distance apart not exceeding one foot and a half to two feet. Transversely to these strips and in the spaces or hollows between them, others (*l*) should be laid at intervals of three feet (fig. 2) so as to form over the entire surface of the wall a series of hollows of 1 inch deep, 1 ½ foot to 2 feet wide and 3 feet high.

When the spaces between the furrings are not cut in this manner and extend without breaks from the bottom to the top of the building, the air in them, under the influence of the heat passing through the wall, has a greater tendency to whirl and to thus increase by convection the conductivity of the wall as regards heat.

The second series of strips will also be useful in holding the paper better to the surface of the wall.

If desired, the strips may be nailed on obliquely so as to form spaces in diagonal shape.

Over the strips, a double thickness of one inch rough boards (*c*) should be nailed (fig. 2); they should be well joined and over them again should be laid two layers of felt paper *e*, finishing up with a double thickness of planed boards, well grooved-and-tongued, and carefully nailed and put on.

This mode of construction will be also required as well in the case of the inner walls separating the curing from the working and other rooms in the factory as in that of the outer walls.

FLOOR—(*Fig. 5*)

The floor of the curing room must have no tendency to sag or sink in the long run under the weight of the cheese. The beams *s* (fig. 3) upon which it rests should be strengthened and supported so as to give to it a resistance equal at least to that of a floor constructed with beams of 8″ × 3 inches, laid at 18 inches apart from centre to centre and having a length of 10 feet.

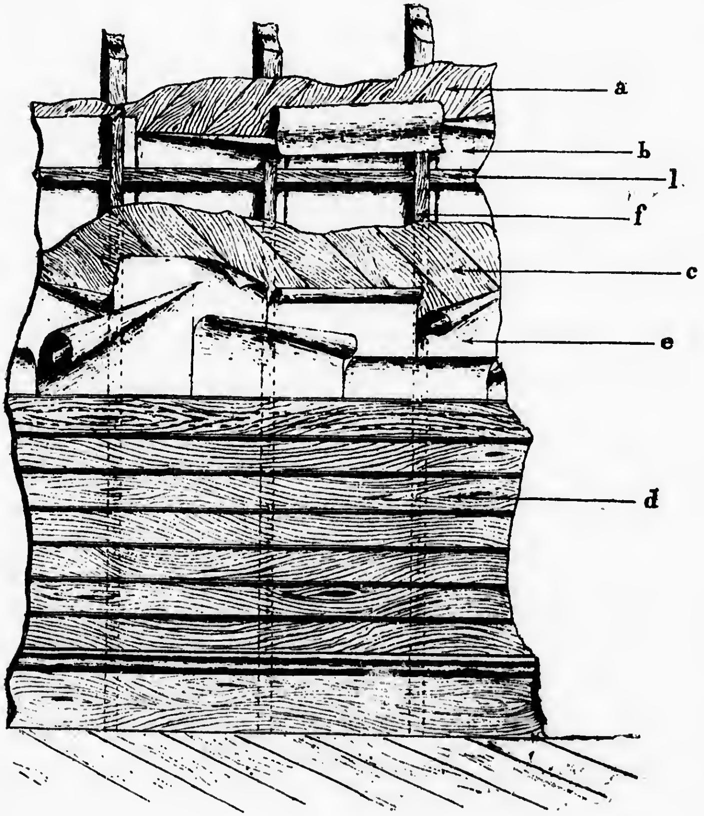

Fig. 2

Surface of the inner walls of the curing room.

If it consists only of one thickness *r* of boards, it should be sheathed with two layers, *qq*, of felt paper laid on carefully as on the walls and above that there should be placed a thickness *t* of 1½ inch boards, grooved and tongued and planed, well put together and nailed. The first lining of boards may be laid diagonally to the beams.

The floor of the working room must be water-tight, so that the waste water may in no case soak through under the building and engender and spread bad smells.

CEILING—(*Fig. 5*)

If the joists carrying the ceiling are not strong enough because they are too far apart or too slight, the whole should be first strengthened by inserting between them other joists of the same size and, if necessary, of greater thickness. The ceiling may also be supported by a cross beam. This ceiling should in all cases have a resistance equal at least to that of one carried on joists of 10″ x 2 inches, 2½ feet apart from centre to centre and of a maximum length of 12 feet.

If the under face of the joists be not already lined with 1 inch boards *u* (fig. 5), this boarding should be put on at once, only grooved-and-tongued boards being used and these may be laid on obliquely to the direction of the joists, if preferred. But the boards must be thoroughly well joined together.

On this lining, furrings or strips *v* of 1 inch in thickness and 2 in width, as in the case of the walls, should be nailed at intervals of 1½ feet to 2 feet apart. It is needless to cut these, as in the case of the walls, by other strips, as in this case the empty spaces are horizontal and the air has not the same tendency to whirl in them.

Under the strips, a layer of paper *g* should be placed supported by a lining of 1 inch boards *j* grooved, tongued and planed, well joined and nailed. On the upper face of the joists, when the factory is to have no upper story, it is not necessary to lay down a floor, but between the joists and on the ceiling a layer of sawdust (hemlock or spruce) or of very dry fine sand, at least 2 inches deep should be spread. To exclude vermin, slaked lime is sometimes mixed with the sawdust; but this mixture is dangerous, as it may cause fire.

Several instances of fires occasioned by the use of mixed lime and sawdust are known. Instead of lime, ashes may be used. This mixture is less dangerous.

LAYING THE PAPER

The paper used should be first quality felt paper.

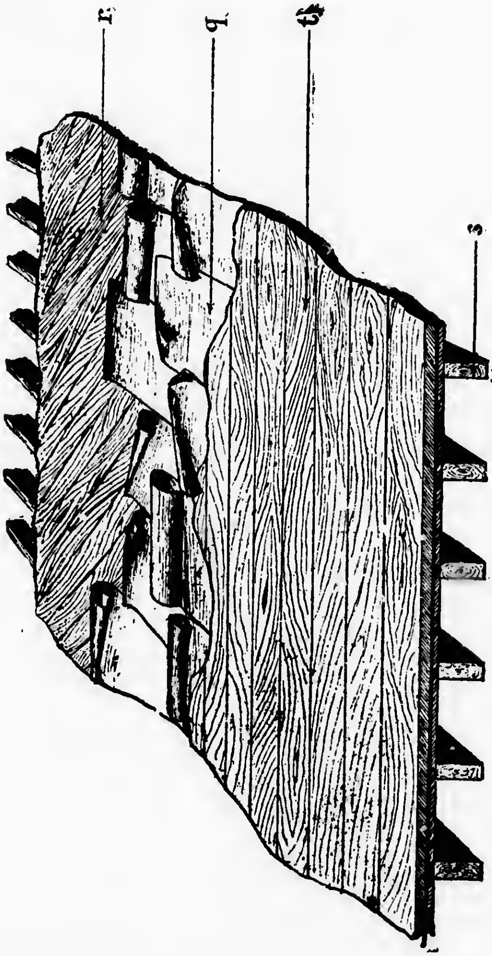

Fig. 3
Floor

It should never be cut at the angles and according to the edges of the walls, but folded or lapped over without breaking the continuity of the walls under the ceiling or on the floor or from one side to the other of the room, so that the latter shall be hermetically sheathed.

Whenever there are holes in the paper, these should be covered by nailing patches over them.

HOLLOW SPACES IN THE WALLS

The hollow spaces in the walls should not be filled with sawdust. A layer of *still* air is the best insulator against heat. At the outset, sawdust gives good results, but in the long run it packs and forms into lumps, when its value becomes much impaired. It has also the drawback of attracting vermin.

In order that the air from the outside may not get into these spaces along the base of the walls, they should be filled at the bottom all around the curing room with mineral wool or fine dry sand to a depth of six inches *i* (fig. 6.)

DOOR AND PORCH (Fig. 7)

Wherever possible, the door should be placed in an angle of the curing room and doubled inside and outside with two thicknesses of boards separated by two doubles of paper. The double boards resting on the studding may be nailed to advantage diagonally and be of rough 1 inch ungrooved boards. But the outer boards should be of 1 inch planed stuff grooved-and-tongued.

The edges of the door frame should be bevelled so that it may shut hermetically as in the case of cold storage rooms for butter (fig. 7). It should open from the inside of the curing room outward.

It should have an inside porch *t* at least 3 feet wide by 5 long, placed inside the room and constructed of studs of 2″ x 4, spaced 1½ to 2 feet apart and lined both inside and outside with 1 inch boards planed, 9 grooved-and tongued and well nailed.

The door of this porch may be of a single thickness of boards, but should close well. It should open into the curing room, so that when the maker is putting in the cheese, he will only have to push it before him.

These two doors should be supplied with weights or hung in such a way that they will be always self-closing.

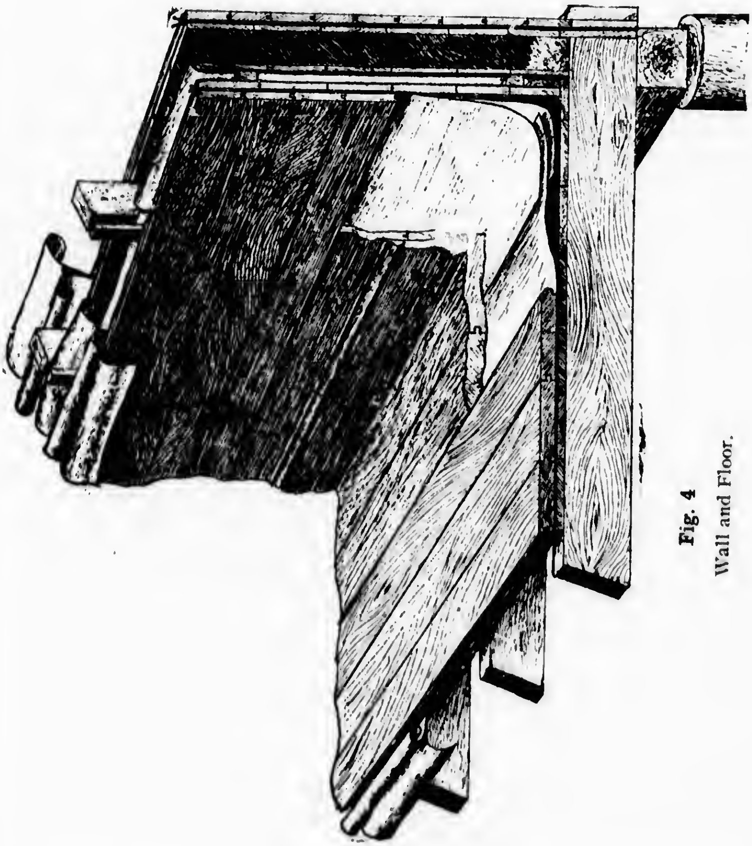

Fig. 4
Wall and Floor.

The door frame should be carefully put in with tight joints between the wood of the wall and in order that the air may not penetrate either into the wall spaces or into the curing room by any fissure around the frame, the latter should be well packed all round with tow or rags.

WINDOWS—(*Fig. 6 and 7.*)

The room should be sufficiently lighted, but the total window space must be kept between $\frac{1}{15}$th and $\frac{1}{20}$th of the floor space of the room. When the room is long, it may go as far as $\frac{1}{15}$.

Too large and too many windows are a serious obstacle to the maintenance of the coolness of the room.

The windows should be supplied with double sashes so placed as to close them hermetically and to completely prevent the air from finding admission in this way. The use of two thicknesses of glass is also recommended.

The windows should be opened only in the spring when the room is cleaned out and disinfected before resuming the work of manufacture. Ventilation to be always supplied by means of the ventilator hereinafter described.

They should be provided with outside shutters V (fig. 7) that may be shut down over their openings and thus close them more or less when more or less obscurity is desired in the room or when it is necessary to prevent the rays of the sun from penetrating into it. These shutters should be worked from outside and, as far as possible, the windows should face the north.

As in the case of the door, the frames of the windows should be put in with the greatest care and the joints between them and the woodwork of the walls packed as tightly as possible to prevent all circulation of the air around them. This point is most important for the proper insulation of the room.

WOOD TO BE USED

In the construction or improvement of curing rooms, no strong-smelling wood, such as pine, should be used. Only woods without injurious odor such as hemlock, bass-wood, white spruce, &c., should be employed.

PAINTING

The walls of the curing room should be painted white both inside and outside. White not only imparts an air of cleanliness to the room and at once

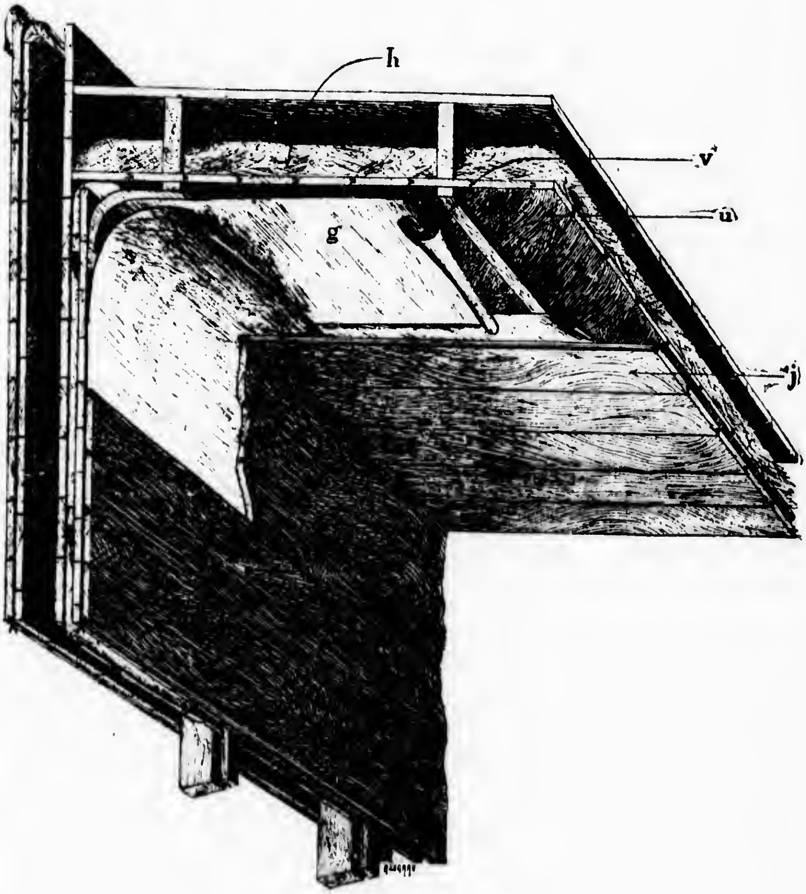

Fig. 5

Ceiling and floor

reveals the want of cleanliness in the factory, but it has the further immense advantage of partly preventing the outer radiating heat from penetrating the wall and radiating towards the interior of the room.

BANKING UP

The curing room should be thoroughly banked up with earth all around.

In the banking up, however, care must be taken to leave openings or air holes to ventilate the space beneath the flooring from time to time in summer. But most of the time these openings must be hermetically closed so as to prevent all circulation and all whirling of the air underneath the flooring, which would quicken the transmission of heat in one way or the other, by convection and by conductivity, through the latter.

When the temperature of the room is warmer than the outside as in summer, at night for instance, these air holes may be advantageously opened and a circulation of air under the building thus established which will not only help to cool the room, but to preserve the flooring.

2. FACTORIES TO BE BUILT

GENERAL OBJECT AIMED AT

The entire structure should be built so as to render the curing room as impervious as possible to heat and air and the working room should be sufficiently closed so that cheese may be made therein without difficulty even in the cold weather of the spring and fall.

LOCATION OF THE CURING ROOM

The curing room should be always located on the ground floor and the factory should be so placed as far as possible that the longer sides of the room in question shall face the east and west. A situation to the north of the working-room should be preferred.

DIMENSIONS

Every factory to be constructed hereafter, for which a grant may be asked, must have a curing room of at least 700 square feet floor space and a working room of at least 400 square feet. In no case, shall the width of such factory be less than 24 feet. No grant shall be made to any factory of less dimensions built after the publication of this bulletin.

When, in the height of the summer, the factory receives upwards of 8000 lbs of milk per day, the curing room must have a floor space of at least 1000 square feet with a minimum width of 28 feet for the factory.

The height of the curing room must be at least 10 feet between floor and ceiling.

In the case of all new factories applying for the grant, it is advised that the boiler should be placed in a separate room of at least 12 feet × 12 feet attached to the main building.

WALLS

The factory walls may be constructed of timber, deals or balloon-framing.

When timber is used, the deals should not be less than three inches thick. When studding is used, pieces of 2″ × 4″ may be employed so long as the square of the building does not exceed 12 feet in height and 40 in length. If the square be more than 12 feet high or more than 40 feet long, studs of 2″ x 6″ must be used. These studs should be spaced 2 to 3 feet apart at the furthest.

A thickness of 1 inch rough boards well joined should be first laid on the deals or studs, both inside and outside, and the walls should be finished as in the case of already existing factories (Fig. 1, 2, 4, 5.)

This method of construction should apply to the inside walls separating the curing from the working and other rooms, as well as to the outer walls but for the partition walls, studs of 2″ × 4″ may be used in all cases.

For the walls of the working room or for those of the other rooms, as for the boiler building, it will not be required to lay on the studs or deals, inside, more than one thickness of boards grooved-and-tongued and planed and on the outside more than one thickness of clap-boarding.

FLOORS

The building should be divided into two equal parts in the direction of its length by a longitudinal beam *V* (fig. 6 and 8) of 10″ × 8 inches well supported to carry the sleepers of the floor, while the extremities rest on the wall sill around the building.

Sleepers of 8″ × 3 inches laid at 18 inches apart from the centrè line should be used for a building of 24 to 26 feet in width and of 10″ × 3 inches spaced at 20 inches apart for a factory of 26 to 30 feet in width, the real length of these joists on account of the beam in the centre thus not exceding 13 feet in the first case and 15 in the second.

The floors to be constructed as in the case of already existing cheese factories (see preceding fig. 3 and 4).

CEILING

For the ceiling as for the floor, the building should be divided in the direction of its length by a longitudinal beam *S* (fig. 8 and 6) of 10″ × 8 inches, resting on the walls at its extremities and on posts in the interior of the building, this beam being intended to support the joists of the ceiling in the middle and to shorten their bearing.

For the ceiling joists, timbers of 10″ × 2 inches should in all cases be used for factories 24 to 30 feet wide. They should be laid at intervals of 2½ feet apart from centre to centre for a factory 24 feet wide, of 2 feet for a width of 24 to 28 to 30 feet. The ceiling should be constructed precisely as in the case of already existing factories (see fig. 5 above).

FLOOR AND CEILING OF WORKING ROOM

In the working room, the floor and ceiling should be carried on joists of the same dimensions and set in the same way as in the curing room.

For the floor, a double thickness of 1½ inch boards, planed and grooved and tongued, will suffice. It should be perfectly water-tight and for the ceiling a double thickness of 1 inch planed and grooved-and-tongued boards should be used.

A slope of at least 1 ¾ to 2 inches per 10 feet should be given to the floor of the working room towards a gutter to carry off the waste water. The bottom of this gutter should have a slope of at least 2 inches per 10 feet towards its extremity and this gutter should in no case be placed against a a wall.

For the location and construction of the door of the curing room and of the porch inside this door, for the location, construction and putting in of the windows and shutters, for the laying of the paper, for the sawdust and mineral wool at the bottom of the walls, for the kind of wood to be used, for the painting and for the banking up, the rules laid down with respect to existing factories should be strictly followed (see figures 4, 6, 7 and 8 above).

But, in the case of new factories the earthing or banking up should be done as well around the working as around the curing room.

II.—VENTILATION

COOLING AND HEATING OF THE CURING ROOM. MAINTENANCE OF HUMIDITY

When a curing room is well constructed, air should not be able to penetrate into it to any appreciable extent any more than heat: the room is then said to be completely insulated. This is the end which should be first sought and, until it is completely attained, it is very difficult to regulate its temperature while renewing the air in it and maintaining a suitable degree of humidity. To attain it, a large quantity of ice is requisite. With well constructed walls and an air-tight room, on the other hand, the quantity of ice needful is much smaller.

But, in ripening, the cheese in the room emits certain odors and certain gases, which may prevent the curing from proceeding in normal fashion. Provision must therefore be made for renewing the air. As in summer the air outside is warmer than it is inside, the introduction into the room of a certain volume of the outer air, which has not been cooled, would warm it on hot days and cool it on cool days and during the cold weather in the spring and fall, it is essential to provide the curing room with apparatus intended:

1. To introduce air into it;

2. To expel the foul air;

3. To cool the air introduced when it is too warm or to directly cool the room;

4. To warm the room;

5. To maintain in it the desired degree of humidity.

I. APPARATUS FOR INTRODUCING AIR (Fig. 6)

The air should not find admission through any opening or fissure at the base of the room or around the door communicating with the working room or around the windows, through the door or the windows themselves. Air drawn from the ground level is never pure enough any more than is the air from the working room.

The air should be derived from a chimney or shaft *C.* (fig 6) capped with a ventilator *A* in the shape of a funnel (fig. 6) revolving on a vertical axis and supplied in rear with a vane sufficiently long and wide to keep the mouth of the funnel constantly turned to the quarter from which the wind blows.

The wind thus taken in will penetrate into the curing room and the air taken from such a height will be as pure as possible. The ventilator shaft should be provided at the bottom with a register *R.* by which it may be shut or opened at will and as much as may be desired (fig. 6 and 9).

For a curing room of 400 square feet, the ventilator shaft should be at least 10″ × 10 inches inside and the smallest diameter of the orifice of the ventilator should be at least 10 inches inside, while the greatest diameter of that opening should be a least 24 inches. For a curing room with a floor space of 100 square feet, the ventilator shaft inside should be at least 14″ × 14 inches and the smallest diameter of the mouth of the ventilator should be at least 14 inches inside, the largest being not less than 36 inches.

For rooms of dimensions between these, the ventilators should be in proportion.

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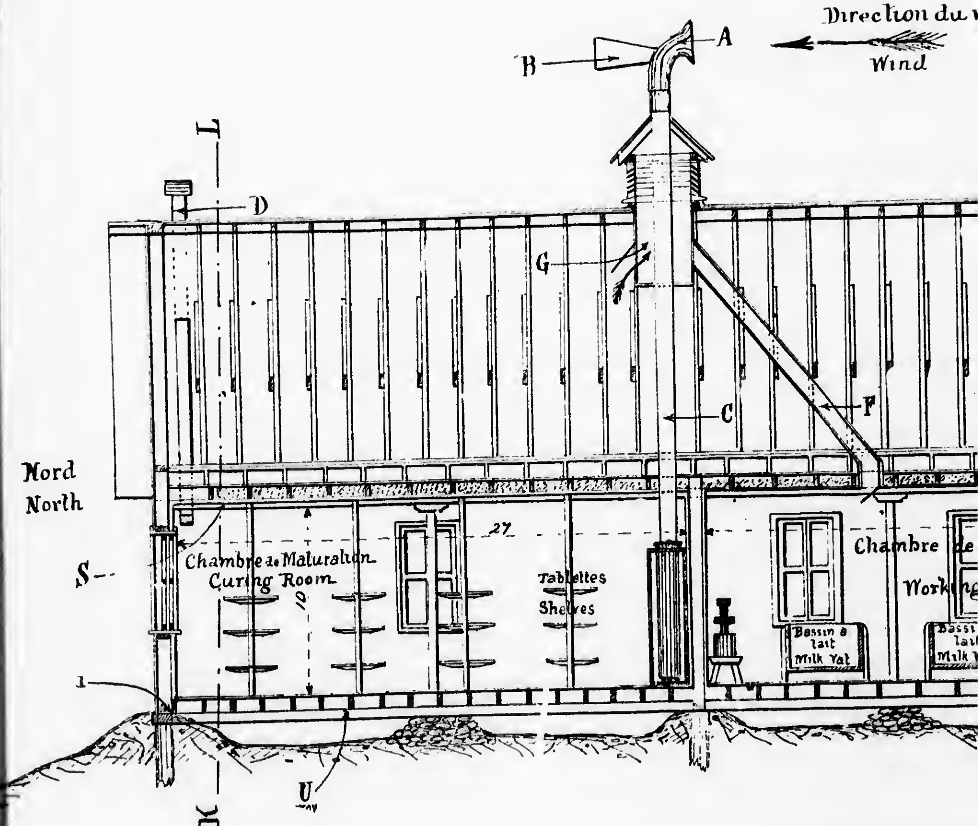
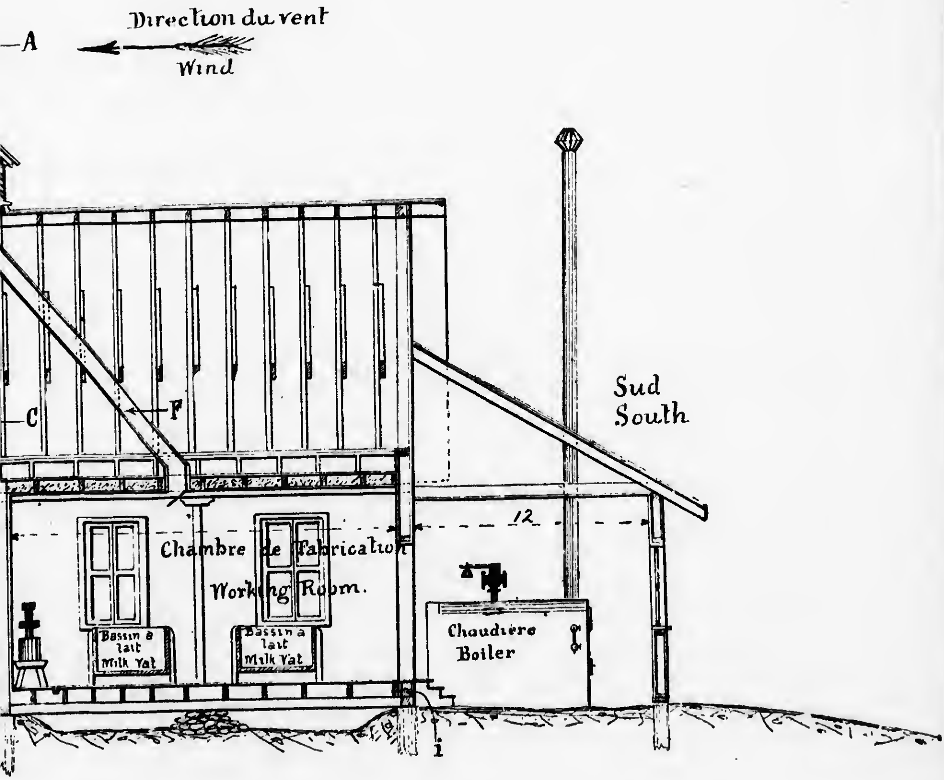


Fig. 6

Longitudinal section showing position of ventilator



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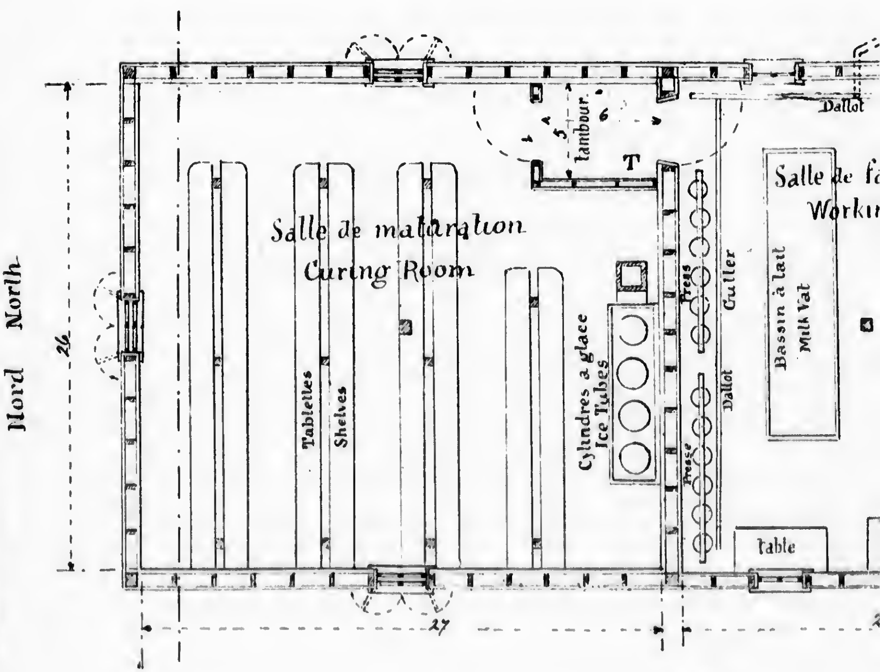

Fig. 7

Plan of building

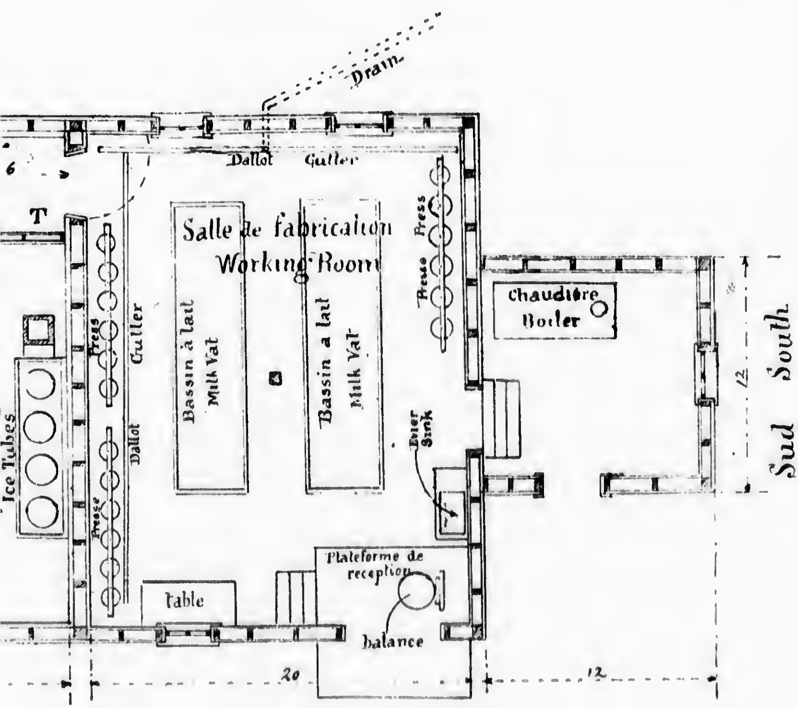

Fig. 7

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3. REMARKS C

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In all cases, the aperture of the ventilator must rise above the ridge of the roof at least four feet.

2 APPARATUS INTENDED TO EXPEL THE FOUL AIR (Fig. 6 and 8)

It is composed of one or more wooden shafts rising directly from the ceiling of the curing room to above the roof. These shafts should exceed the ridge of the roof by at least 1 foot. If only one is used, it should be placed at the end of the room opposite to that occupied by the ventilator. It should be at least 10 inches × 10 inches in the inside for a curing room of 400 square feet of floor space, 14 inches × 14 inches for a room of 1000 square feet of floor space, and intermediate dimensions for rooms of intermediate dimensions.

If two are used, one should be placed in each of the corners opposite to the end of the room where the ventilator is, (fig. 6 and 8). In the first case, they should be 7 inches × 7 inches inside and in the second 10 inches × 10 inches inside and for rooms of intermediate dimensions apparatus of intermediate dimensions should be employed, but the aggregate of their sections should always be equal at least to that of the ventilator shaft.

In all cases, the ventilator should be placed at the end of the room facing the quarter from which the prevailing wind blows during the summer months and the escape shafts at the other end. The latter should never rise above the roof to the same height as the mouth of the ventilator, so that the escaping air will have less tendency to be carried by the wind towards the opening of the latter. The aerating shafts, as well as that of the ventilator, should rise directly from the curing room to above the roof without communication with other rooms or shafts.

3. REMARKS ON THE WORKING OF THE VENTILATOR AND THE SHAFTS

One or more simple shafts, without ventilator, would have no effect during the summer in renewing the air of a very close curing room, because, the air being cooler inside than outside, they would have no draught. The outer air would on the contrary have a tendency to descend into them, if the cold air of the room could escape through cracks or openings at the bottom of the room. In cold weather, on the other hand, they would have a certain draught, if the cold outer air could get into the room through the same openings or cracks. But as, on principle, there should be no opening at the bottom of the building, by employing a ventilator such as has been just described, the pure air cannot penetrate at all times but by the force of the wind into the room and the foul air will escape through the opposite shaft or shafts.

It is seldom that there is not sufficient wind for the working of these ventilators, if they be of the proper size and the intervals of calm are relatively brief. A wind with a velocity of 1½ foot to 2 feet to the second, that is to say, barely noticeable, would suffice to ventilate the room, if the dimensions indicated be observed.

At the Quebec Observatory, the mean velocity of the wind during the summer of 1898 was 13 miles an hour (1$\frac{9}{10}$ foot to the second, about.)

During the same summer in

MAY

There were only 11 hours without wind and not more than 4 hours at a time; in

JUNE

There were only 12 hours without wind, one hour each time; in

JULY

13 hours without wind, not more than three hours at a time; in

AUGUST

7 hours, not more than 4 hours at a time; in

OCTOBER

7 hours, not more than 3 hours at a time.

As will be seen, the register would rather have to be kept partly closed all the time.

On the other hand, where there is no wind, the convection being less outside the building, the heat would have a lesser tendency to penetrate into the walls, so that the relative coolness of the room would be easily maintained during these brief intervals of dead calm.

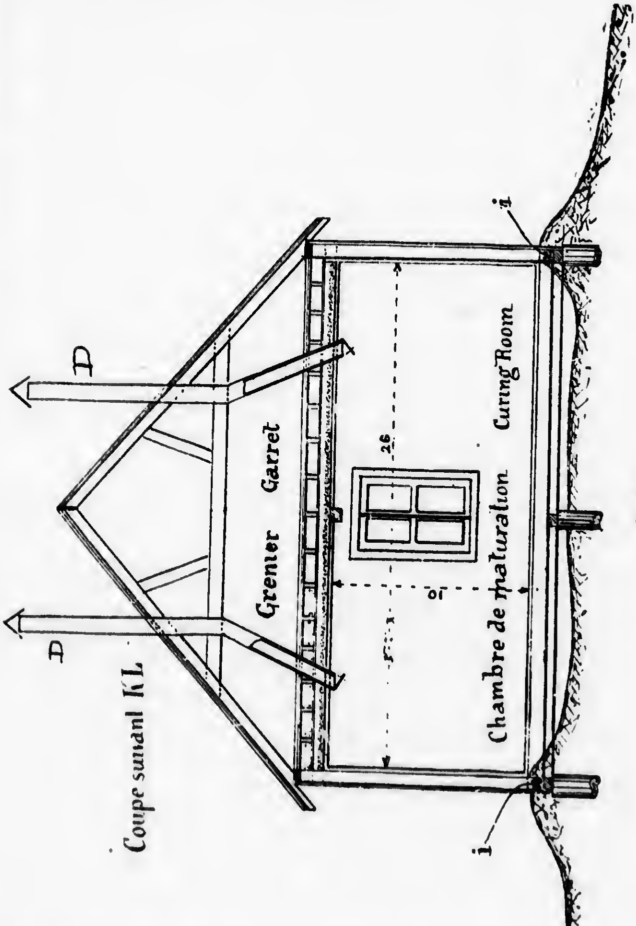


Fig. 8

Vertical section through figure 6 at "K L" showing the arrangement of the escape shafts

In cold weather, the ventilator may be used to air the room and, in that case, it will help the draught of the shafts, which will tend to take place in the right direction.

4. APPARATUS FOR COOLING THE AIR—(*Fig. 9, 10, 11 and 12*)

To cool the room, one or other of the following methods may be employed :

The first method is the " *direct* " method. It consists in placing at one or several points of the room, cylinders of galvanized iron No 22, which are filled with ice or a mixture of ice and salt.

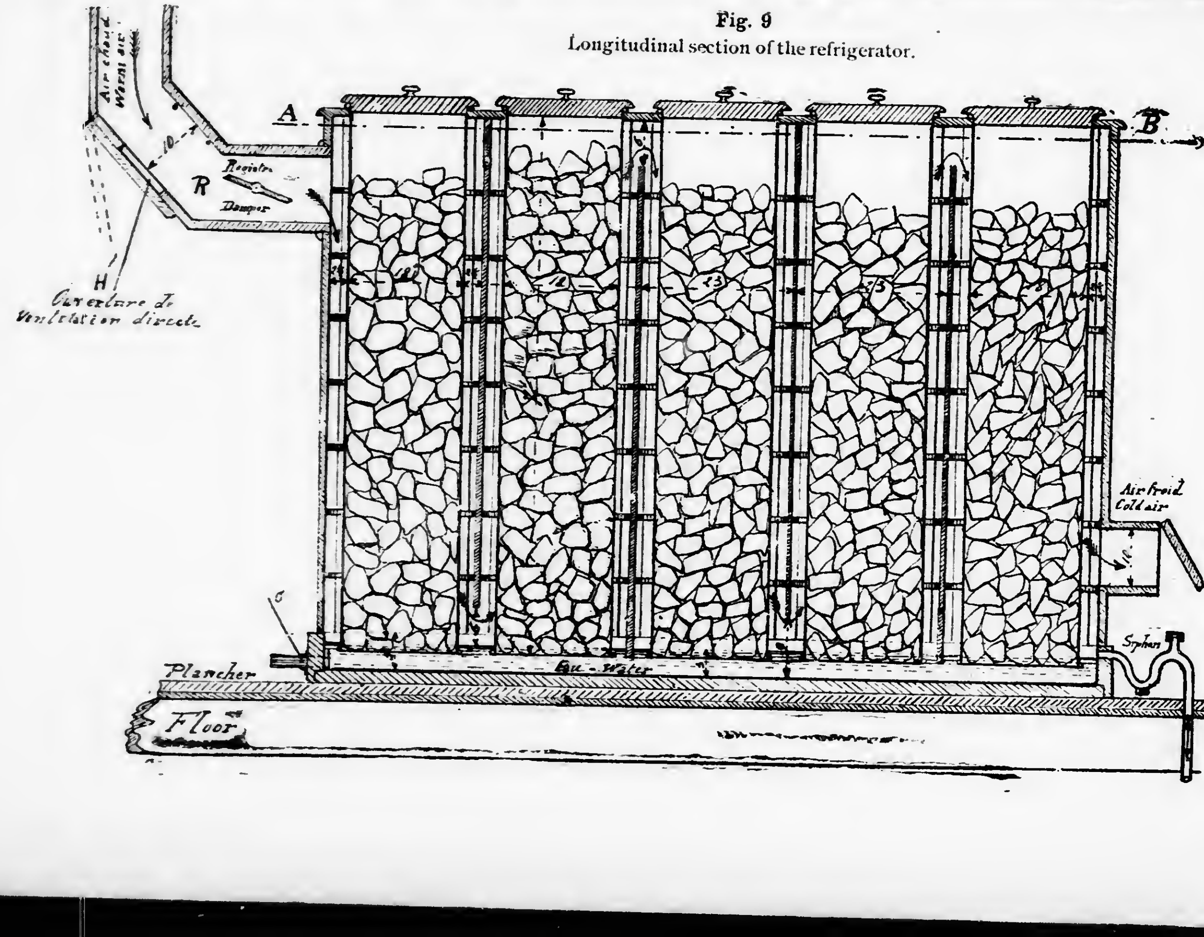
These cylinders should be without bottoms and should rest on slats of 2 inches × 2 inches and about 2 inches apart nailed to the bottom of a water tight wooden trough lined with galvanized iron intended to collect the water from the melting ice. This trough should have a slight slope towards one of its ends in which is the hole, stopped with a wooden plug, to clean it out. At ordinary times, the water from the melting ice will flow off through a 1 inch iron pipe bent in the form of a siphon, starting from one of its extremities, passing through the floor and communicating with the drain of the factory. This pipe is bent in the form of a siphon to prevent the foul air from the drain getting in. Where it passes through the floor, it should for the same reason be well packed around with tow or mineral wool.

These cylinders should be closed above with a good wooden cover. They will spread coolness through the room. This first method should only be used in the sections of the province where the temperature is cool during the summer, in certain parts along the Lower St-Lawrence, for instance, and in that case more care than ever should be bestowed on the construction of the walls. To increase the refrigerating power of the cylinders, it would be preferable to employ the following *indirect* cooling method.

This second method consists in placing the cylinders in a wooden cupboard (fig. 9, 10, 11, 12) situated at the bottom of the ventilator shaft. The mouths of the cylinders should rise above the upper shelf of the cupboard, so that they may be filled with ice without opening the latter. They should have no bottom and rest, as in the former case, on slats of 2 inches apart nailed at the bottom of a water-tight wooden trough lined with galvanized iron.

This trough should be placed on the floor in the bottom of the cupboard with a slight slope towards one of its ends, as in the direct method, and the water from the melted ice will flow off through an iron siphon.

Fig. 9
Longitudinal section of the refrigerator.



The cylinders should be separated from each other by vertical wooden partitions, which will force the air to circulate successively around each of them.

For example, if the air comes in at the upper left corner of the cupboard (fig. 9) the partition separating the first cylinder from the second should be carried to the upper shelf of the cupboard in order to force the air to descend along the first cylinder. It will descend to a sufficient distance from the *bottom of the trough* so that the orifice thus formed below, between the level of the water and the bottom of the partition, shall have an equal section to that of the shaft. This distance should be 7 inches for small and 11 inches for large factories.

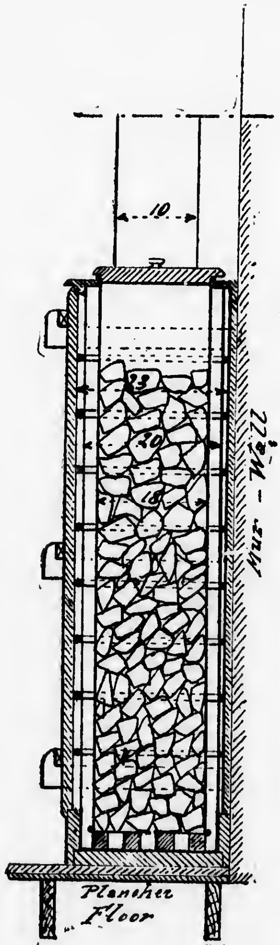
The partition separating the second from the third cylinder should go down to within 2 inches from the bottom of the trough to allow the water from the melted ice to flow to the end of the trough.

The mouth of the siphon should rise 3 inches above the bottom of the trough, so that there may be always 3 inches of water in the latter. In this way, the air cannot pass below the second to the third cylinder. This will further have the advantage of depositing the sawdust and mud from the ice used in the bottom of the trough and thus preventing it from choking the siphon. This second partition should not extend to the upper shelf of the cupboard, but leave for the passage of the air an opening of equal section to that of the shaft. This opening should be 4 inches for small and 8 inches for large factories. The same thing should be done with the other cylinders, the passage of the air being alternately above and below.

The aperture by which the air escapes from the cupboard should have a section equal to that of the shaft, that is to say, 10 × 10 for small and 14 × 14 for large factories.

For the siphon, 1 inch pipe at least should be used. In the event of its becoming choked with sawdust or mud, the best way to clear it is to run a rapid current of water through it, in any manner whatsoever.

The cylinders should have a diameter of 1½ foot and be 7 feet high. They should be set apart 24 inches from axis to axis, so as to leave a space of 6 inches between them. The inside depth of the cupboard should be 23 inches so that there may be a space of 2½ inches between the cylinders and the back of the cupboard and a similar space between them and its front. For a curing room of 400 square feet of floor space, three of 1 ½ foot diameter



Transversal section of Refrigerator

by 7 feet high should be used and for a curing room of 1000 square feet about 6 would be needed. For a room of 700 square feet, intermediate size an intermediate number should be employed. The rule is that the total surface of the cylinders should be about 1/16 of the aggregate of the inside surfaces of the walls, floor and ceiling.

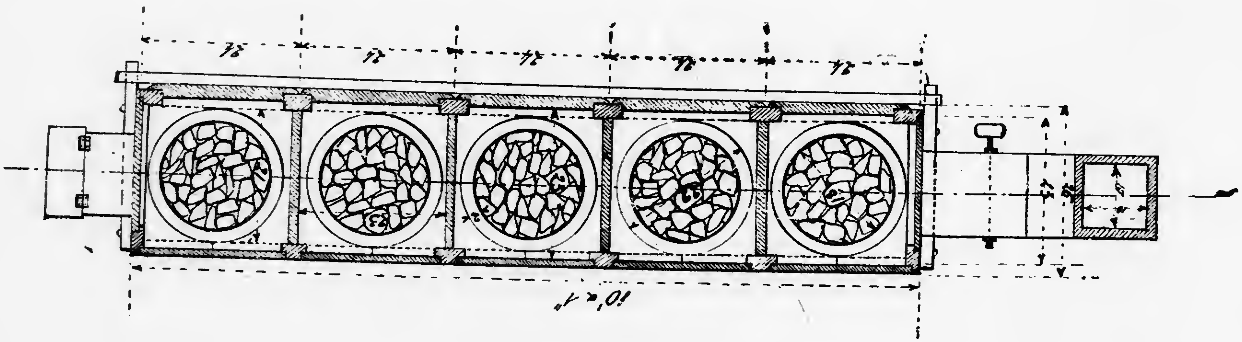
Thus, for a room of 24 × 16 and 10 in height, the total surface should be $(2 \times 24 + 2 \times 16)\ 10 + 2 \times 24 \times 16 = 1568$. The $\frac{1}{16}$th of 1568 is 98 square feet. If the cylinders have a diameter of 1 ½ foot and are 7 feet high, each of them will have an exterior surface of 33 square feet. Three such cylinders would give together 99 square feet, the surface needed. If cylinders of smaller diameter are used, it will necessarily take a greater number of them calculated as above.

Pieces of wood cut as indicated in figure 12 should be nailed inside against the partitions and around the cylinders so as to leave between them and the cylinders a circular void of 2 inches. These pieces should be put on from top to bottom of the cupboard at distances of about 10 inches apart and are intended to make the air whirl against the cylinders and to increase the convection and consequently the efficiency of the refrigerating surfaces.

The cupboard should be closed in front with a single or double door hung on hinges or removable, but in all cases shutting very hermetically. As, under the influence of the humidity, large panels would have a tendency to warp, it would be preferable to employ small removable panels, one to each cylinder and attached on the front of the cupboard one alongside the other as indicated in figures 10 and 11.

When the number of cylinders is 6, three may be placed to the right of the ventilating shaft and three to its left. But, in that case, the inner section of the openings for the circulation of the air must be reduced by half, in each of the two groups. Less than three, one after the other, should never be placed in each group.

Cylinders of a diameter of 1 ½ foot will contain a large quantity of ice and they should be kept filled to the top in order that their refrigerating surface may have its full effect. If it be not desired to handle so large a quantity, hollow wooden boxes of 6 ½ feet high with a section of 8 inches × 8 inches, closed at both ends may be used, for example, to reduce their contents. One of these boxes may be placed vertically at the axis of each cylinder.



Horizontal section of the Refrigerator

5. OBSERVATIONS ON THE USE OF THIS APPARATUS

In the direct method, when the cylinders are not enclosed in a cupboard such as that just described, they can only transmit cold to the room by radiation. The convection by the circulation of the air along their sides being due only to the differences of temperature which they cause in their neighborhood, is very weak in that case and consequently the changes of temperature are greatly diminished. If, on the other hand, the air is forced to circulate around them as in the indirect process above described, the convection is much increased and the cold transmitted per hour by the cylinders is much more considerable.

But a good circulation of air in the room can only be secured by introducing into it a certain volume of the outer air and by driving out an equivalent volume. Under these conditions, the outer air which is warmer than the air inside brings with it heat which joins that passing through the walls by conductivity. And the more the outer air is introduced per hour, the more is the room warmed. It will be seen therefore that when there is no renewal of the air around the cylinders, the convection is weak ; but the only heat that finds admission is what passes through the walls by conductivity; if, on the other hand, the outer air be introduced, the warming of the room is accelerated, but the convection around the cylinders is at the same time increased and so also is their refrigerating effect. But the quantity of heat brought in by the air increases much more quickly than the favorable effect of the convection on the cylinders when the quantity introduced per hour attains a certain limit and when that limit is exceeded, the room grows warm instead of cool, no matter what may be done.

With apparatus of the form and dimensions above indicated, it is with a wind of 1 foot to the second (a wind that can scarcely be felt) that the room stands the best chance of keeping cool during hot weather outside.

These apparatus are calculated for an outer temperature of 90° and an inside temperature of 60°.

When the heat is great outside, and the wind can be felt, the register of the shafts must be partly closed to maintain the renewal of the air within proper bounds.

When the temperature outside is less high, the cylinders should no longer be filled to the top, so as to reduce the refrigerating surface or the

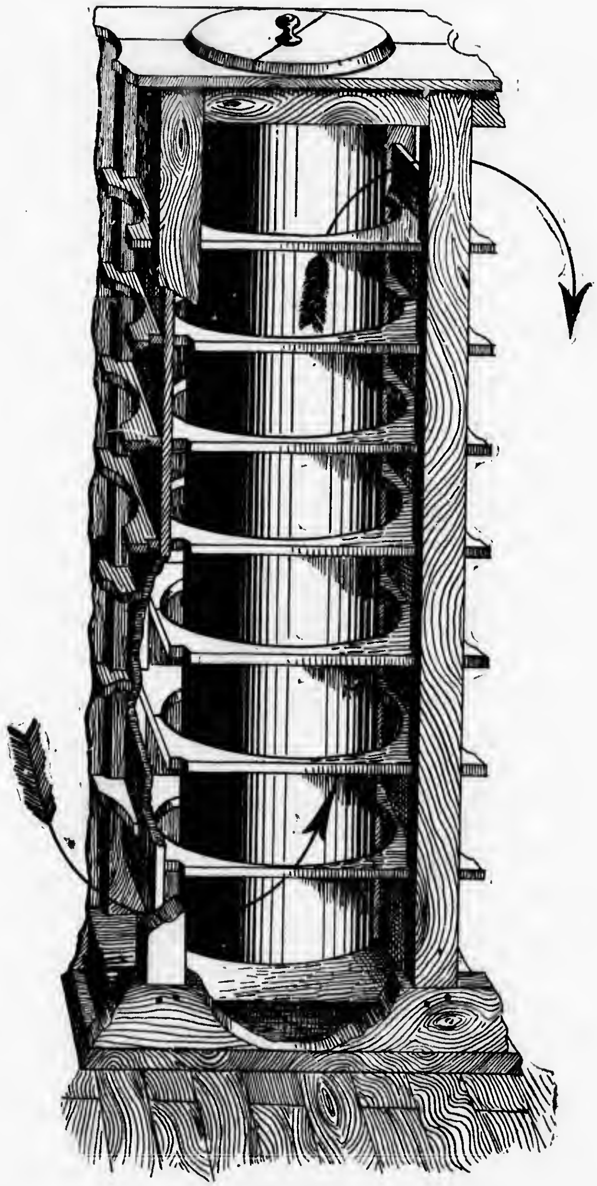


Fig. 12
Showing the arrangement of the cylinders in the cupboard.

register of the ventilator should be completely closed. When it is desired to cool the room without ventilating it, the front of the cupboard should be opened and the registers of the shafts should be completely closed. This cannot be advantageously done except when the outside temperature is very little higher than the inside temperature, at night, for instance.

In a general way when the outside temperature is not too warm during the day and remains cool during the night, it will suffice to ventilate at night and to shut all the registers and all the openings well during the day in order to keep the room cool. It will only be necessary to use the apparatus above mentioned in warm weather; about 40 days during the year.

With a little practice with these apparatus, a manufacturer will soon get to ventilate his curing room, while maintaining in it a low and constant temperature.

According to figures supplied by Mr. Smith, director of the Quebec Observatory, the month of July is the hottest month, generally speaking.

The temperature only went over 80° nineteen times during the summer of 1898, of which 6 were consecutive days. It exceeded 90° only two or three times. The mean outside temperature during six months of the summer of 1898 was:

June	60.9°
July	67.5
August	64.6
September	56.1
October	44.5

During great heats, the temperature always falls about 10° at night.

All these temperatures were taken in the shade.

At first sight the apparatus, being calculated for 90° outside and 60° inside, may seem excessive, but it must not be forgotten that in the sun the temperature may rise to 140° and that, consequently, instead of reckoning on a difference of 30° in the temperature, allowance must be made for a difference of 80° on the sides of the room exposed to the sun, that is to say, for more than double. And the sunny days are numerous. In 1898, during the summer at Quebec, there were in

May	17	days with sun.
June	16	"
July	13	"
August	16	"
September	17	"

It must also be reckoned that the wind greatly increases the convection on the faces of the building.

Consequently, the transmission of heat through the walls will be much greater than if the building were entirely sheltered from the sun and wind.

Lastly, the manufacturer cannot be expected continually keep the cylinders filled with ice to the top.

Further, the surface of the cylinders will not always become entirely coated with ice and they give out cold much less easily when their surface is bright than when they have an icy coating.

To remedy these drawbacks, it is recommended :

1. To place as far as possible the curing room to the north of the working room ;

2. To give as much as possible an east-west exposure to the longer sides of the curing room, as already explained ;

3. To plant trees around the factory to throw shade upon the walls and to break the force of the wind ;

4. To give the preference to cylinders of large diameter, 1½ foot, as above explained.

If there be no trees around the factory, branches of balsam fir may be laid against its sides exposed to the sun and wind.

In fine, if it be seen that the cylinders are not coated with frost, they may be painted black outside.

With these precautions, the transmission of heat through the walls will be greatly lessened and the efficiency of the apparatus increased.

For a small factory, with an outside temperature of 90°, an inside temperature of 60° and a renewal of the inside air to the extent of 833 cubic feet to the hour (velocity of the wind outside about 1 ½ foot to the second that is to say, which scarcily can be felt) about 40 lbs of ice will be used per hour. If the wind is very strong, the convection on the outer faces of the building will be increased and it will take a little more. In that case, care must be taken to close the register so as to keep the renewal of the air in the room within proper bounds.

For a large factory under the same conditions as to temperature, with apparatus of the dimensions indicated and an inside renewal of air to the extent of 1692 cubic feet per hour, it will require about 85 lbs of ice per hour.

If the ventilation be increased, the bulk of ice melted per hour will at the same time be increased and the cooling of the room will be decreased. If the register be completely closed, the quantity of ice consumed per hour will be greatly diminished, but the temperature of the room will be raised, if the temperature outside be high. But such great heats seldom last long. It will be seen therefore that the quantity of ice to be used during a summer will not be large.

If it be too warm, in spite of all, to maintain the coolness of the room, a mixture may be used of one part in weight of salt to two parts of ice. Salt may be always used to economize ice.

6. APPARATUS TO WARM THE ROOM

When the temperature outside is cold, in the fall, it will be necessary to warm the curing room.

A stove may be used for the purpose ; but, in such case, it must be surrounded with galvanized iron which should be raised about 6 inches above the floor to prevent the direct radiation of the heat upon the cheese. The screen must rise at least a foot higher than the stove.

It is advised to heat the room preferentially by steam pipes fed from the boiler and it would be well also to place before these radiators a galvanized iron screen raised above the floor about 6 inches for the same reason as above.

The ventilator and the aerating shafts should be used at the same time to ventilate the room.

7 HOW TO REGULATE THE HUMIDITY OF THE AIR IN THE CURING ROOM

When the outside air is damp, in rainy weather for instance, ventilation will suffice to maintain the required degree of humidity. For dry weather, there should always be a steam-pipe, the end of which should be flush with the inside surface of the wall and have a small valve. In dry weather this valve should be slightly opened so as to diffuse the necessary humidity. This valve should not be placed directly on the radiator because it would be necessary to heat the radiator at the same time. It might however be put on the steam-pipe of the radiator but in front of the valve on the latter and in that case, the steam-pipe above mentioned would not be necessary.

According to the observations made at the Quebec Observatory, the hu, midity of the atmosphere is always greater in the morning than at might and less toward the middle of the day.

The degree of humidity has nothing to do with the temperature but the direction of the wind has a great deal of influence. At Quebec the north-east wind increases and the west wind diminishes it.

During the summer of 1898, the mean was as follows :

MONTH	MORNING	3 p. m.	EVENING	MEAN
May	73	60	67	67
June	82	68	75	75
July	83	67	78	76
August	88	71	79	79
September	82	63	72	72
October	83	67	75	75

Mean for the summer 76½. This is a good average for ripening cheese.

These figures also show that if humidity be not desired, ventilation must be avoided as much as possible in the morning, in the evening and during the night and also during damp winds.

It must also be borne in mind that the ice cylinders dry the air when covered with ice.

8. ICE HOUSE.

The factory should be provided with an economical ice house $10 \times 10 \times 10$ feet.

III.—Conditions

RESPECTING THE CONSTRUCTION OF THE FACTORY GENERALLY.

The factory should not be built on low land whereon rain-water may collect and stagnate. If it be already on such a site, the soil under the factory should be raised to prevent water remaining on it. Ditches should be dug to carry the rain-water far off.

The drainage of the perfecthould be factory s and the drainage waters be carried far off by an underground drain with a sufficient slope to prevent their stagnating. This drain should be so made that it can easily be cleaned at any time if it should happen to be stopped; it should communicate with the factory by means of a pipe bent to form a trap.

The working-room should be ventilated by a ventilating shaft of at least a foot and a half by one foot, different from that of the curing-room.

The attic of the factory should itself be ventilated by a shaft of at least a foot and a half by one foot. The shaft in both the working-room and the attic might connect; but above the point of junction the total section of the shaft should be equal to the aggregate of the sections of both shafts that unite in it. It should therefore be at least 1 foot 8 inches by 1 foot 8 inches.

The whey vat should not in any case be underneath the factory. It should be lined inside with tin.

It is recommended that it be raised sufficiently to allow the whey to flow out of the tap as the milk does in creameries and it should be so arranged that it may be properly cleaned every day.

The plant should be sufficiently good to permit of the manufacture of first quality cheese.

IV.—CONDITIONS

RESPECTING THE MANUFACTURE AND OTHER POINTS

To obtain a subsidy it is necessary :

1. That the factory should, if possible, belong to a syndicate if there be one in the region wherein it is situated. If there be none, the person in charge of the factory shall submit to its being inspected whenever the Government requires ;

2. It shall bind itsetf not to ship any cheese which has been less than a fortnight in the curing-room ;

3. The manufacturer shall bind himself to wash out the whey-vat every day ;

4. He shall keep a record of the temperature on blank forms to be supplied him by the Department of Agriculture ;

5. The water used shall be as pure as possible.

V.—METHOD OF OBTAINING THE SUBSIDY

In order to obtain the grant, application must be made in writing to the Department of Agriculture, Quebec.

The Department of Agriculture will supply the necessary forms and such forms shall be signed by the proprietor, the manufacturer and two of the principal patrons of the factory, *as witnesses* and returned to the Department.

By their signature so given, the proprietor and the manufacturer shall bind themselves, each in so far as he is concerned, with the view of obtaining the premium, to fulfil all the conditions indicatedin the blank forms. The conditions are those set forth in the present bulletin.

When the improvements are completed, an inspector shall be sent to report thereon to the Government. The inspector shall forward a sketch of the factory with his report. A special form will be supplied him for this report. The blank form shall be signed by him and by the contractor who has done the work and also by two of the principal patrons.

By such signature the inspector shall certify that, as far as he can ascertain, the work has been done in accordance with the conditions required by the Government ; and by their signature, the contractor and the patrons shall certify that the walls, floors and ceilings have been made in accordance with the rules laid down and that the materials used are of good quality. On receipt of that report, the Government will pay the first part of the subsidy.

Should all the conditions of the first and second categories not be fulfilled at the date of the inspection, the subsidy shall be kept back until they are.

At the end of the second season of manufacture, the inspector appointed to inspect the factory shall make his report and if all the conditions of the third and fourth categories be fulfilled, the second part of the subsidy shall be granted.

APPROXIMATE COST OF THE IMPROVEMENTS

The cost of the improvements will vary considerably according to the state of the factory that has to be improved, the cost of lumber, the skill of the workmen and the various other conditions of the undertaking.

In the case of an existing establishment, the walls of which are lined inside and outside with boards, the average cost of the improvements indicated in the bulletin will be about as follows ;

A factory whose curing room will have 400 square feet of floor space $180.00 ;

A factory whose curing room will have 700 square feet of floor space $230.00 ;

A factory whose curing room will have 1000 square feet of floor space $280.00.

The cost of the ice cylinders will be about as follows :

A cylinder 7 feet high, 18 inches diamater, galvanized iron No. 22, $4.50.
" " 6 " " 12 " " " " " " 2.50.

A rotary cap for ventilator made of galvanized iron No. 24, 14 inches in diameter at the base, complete, will cost about $7.00.

A rotary cap for ventilator, of galvanized iron No. 23, 12 inches in diameter at the base, will cost about $5.50.

VII.—CONTRIBUTION BY THE GOVERNMENT OF THE PROVINCE OF QUEBEC.

The subsidy which the Honorable Commissioner of Agriculture has decided to grant will amount to the following :

For a curing room with a floor space of from 400 to 700 square feet—$100.00.

This subsidy of $100.00 will be granted merely to factories already in existence. No subsidy will be granted to new factories built subsequently to the publication of this bulletin, whose curing-rooms have a floor space of less than 700 square feet.

For a curing-room of from 700 to 1000 square feet, it will be $150.00.

For a curing room of 1000 square feet and over, it will be $200.00.

VIII.—GENERAL CONSIDERATIONS

ON THE NECESSITY OF THE IMPROVEMENT OF THE CURING ROOMS, THE ADVANTAGES AND DIFFICULTIES PRESENTED BY SUCH IMPROVEMENT AND THE EXPENSES IT ENTAILS

The expenses entailed by these improvements may, at first sight, seem exaggerated and but little in proportion to the benefits that one may hope to derive from them. But the experience of those who have made the experiment proves the contrary.

Here is a summary of the results hitherto obtained in the United States, where experiments on an extensive scale have been made in that direction.

The New York Produce Review and American Creamery says :

" We may sum up the results by saying that cheese cured at a temperature of about 69° shrank over 1% more in weight as compared with those cured at 60° and the experts who examined them pronounced the cheese cured at 60° worth from ½ to 1 cent a pound more money. The chief differences were in the flavor and texture of the cheese.

"The flavor was much more pleasant and the texture more silky in those cured at the lower temperature.

"To make a practical application of these results to factory work, we may assume that a factory making 100 tons of cheese in a season would increase the value of the cheese by one quarter of a cent by having proper control of the temperature. This would mean a gain of $500.00 on the 100 tons.

"A saving of 1% in the shrinkage would be a saving of one ton of cheese which, valued at 8 cents per pound, would be $100.00."

The fact that these statements are based on experience gives them weight and it must be added that if the English market could with increasing facility obtain cheese cured at 60°, it would probably not take any other. We must therefore keep ourselves prepared to meet this new requirement and the improvement of curing-rooms is a vital necessity.

But, it may be said: "We admit this; still could not the temperature of those rooms be controlled by employing more economical methods than those pointed out to us?"

It is easy to answer this. So long as it is a question of maintaining an inside temperature of from 65° to 70°, inexpensive methods may be resorted to. This is generally the sole object in view here and has lead to believing that the problem was an easy one. But when it is necessary to maintain, even in the greatest heat, a temperature in the vicinity of 60° in a curing room, an object which must unavoidably be attained, the problem is very different and very difficult.

A great many means have been suggested and employed in every direction and the result of all these trials has shown that if we really wish a sufficient control of the temperature up to 60°, there must be no stinginess in the cost of the improvements. These trials have also proved that the benefits to be derived are proportionately much more considerable with an expenditure of $200.00 for a factory of any great size than with an expenditure of $100.00.

The most important point in the improvement of the curing rooms is the impermeability of the walls to heat and air. To this point every attention must be devoted because when once the cost of good walls is incurred, the

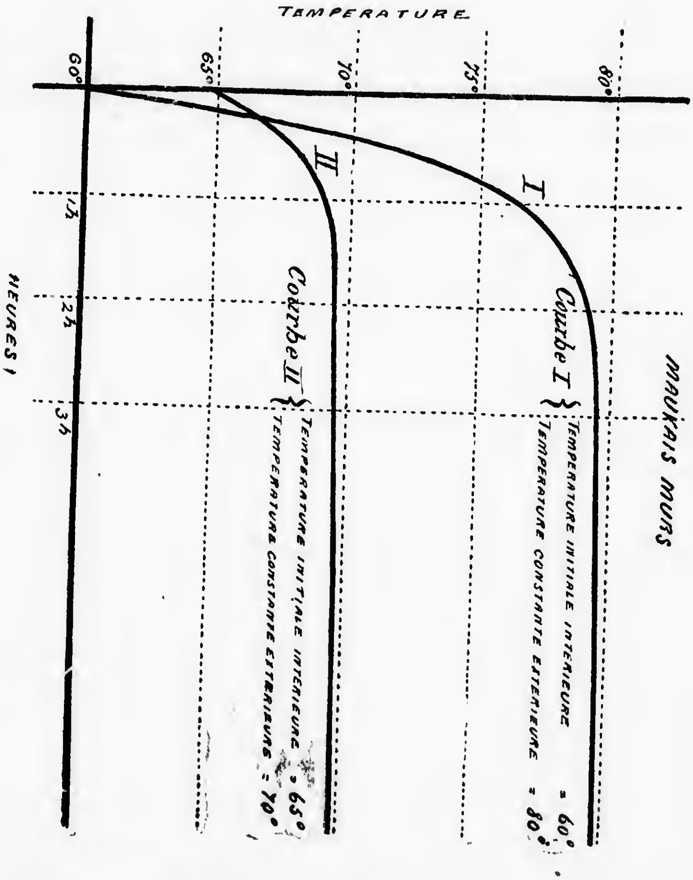


Fig. 13

result will be felt for many years and the quantity of ice to be used each year for completing the effect produced by the walls, will be slight. On the contrary, with bad walls, it will be necessary every season to employ a considerable quantity of ice and inthis case the refrigerating apparatus will also need to be much more powerful and consequently much more costly, to attain the same end.

In fact these apparatus should be looked upon merely as auxiliary to the walls and not as the basis of the cooling of the curing-room.

The walls of these rooms,owing to the manner in which they have hitherto been built, allow much more heat to pass than is generally imagined, owing to their conductivity.

Let us take for instance a curing room of 26 × 27 × 10 feet, the walls of which are built in the usual way. Let us admit that at a given moment the inside temperature of this room is 60° and the outside temperature 80°. Then even supposing the room to be completely air-proof, it will not take more than three hours to raise the temperature to about 80° as will be seen by the curved line in figure 13.

If the initial inside temperature of that room were 65° and the outside temperature maintained itself at 70°, the inside temperature would take about the same time to reach the vicinity of 70° (curved line II fig. 13).

To maintain the temperature of this room at 60° in the first case, 25 ℔s of ice per hour would be needed and to maintain it at 65° in the second, about 6 ℔s per hour would be needed.

If the walls of that room were twice as impermeable to heat, it would take about 6 hours to raise the temperature from 60° to the neigborhood of 80° (curved line III fig. 14) and it would take about the same time to raise it from 65° to 70° if the outside temperature remained at 70°.

In the first case of the second experiment, only 15 ℔s of ice would be needed to maintain the temperature at 60° and 3½ ℔s to maintain it at 65° in the second case. This saving of ice shows that the quantity required to maintain a low temperature is in an inverse ratio to the impermeability of the walls and in proportion to the difference of temperature inside and outside.

But the outside temperature generally rises from the morning until about 2 P. M.; then it remains stationary for some time and falls again. Thus it will be seen that if it remains at 80° for about two or three hours

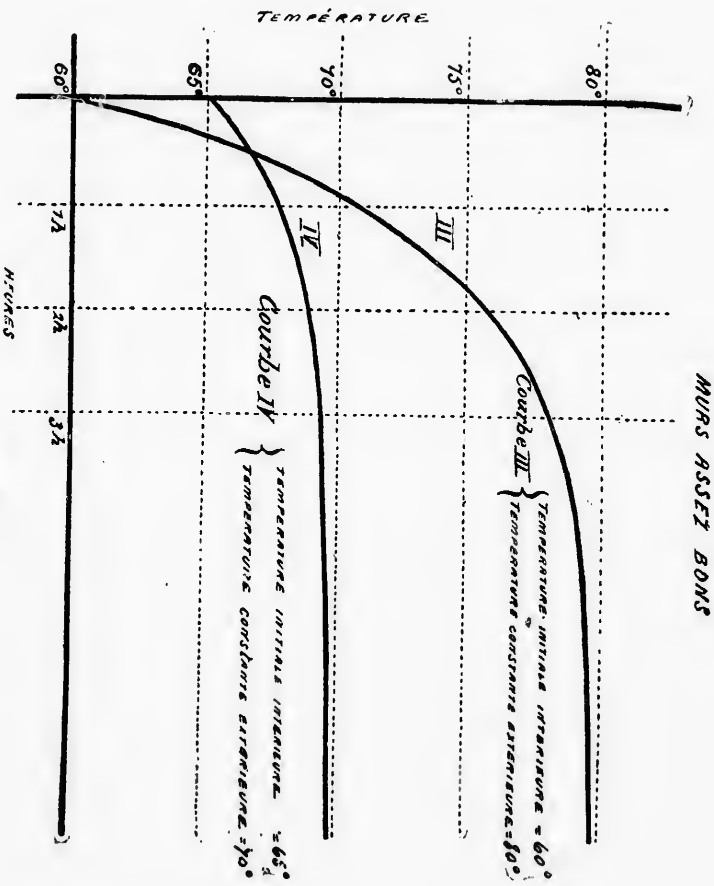


Fig. 14

after dinner, a curing-room with bad walls would have time to reach that temperature while one with good walls would not have time, since in the latter case it would require 5 or 6 hours to reach it.

With good walls the variations of the inside temperature, if much slighter than with bad walls, are nevertheless still more considerable than is generally imagined and to do away with them completely, it is necessary to have walls built in a rational manner and with the greatest care.

As a rule, it may be said that with bad walls, the inside will follow the outside temperature pretty closely, especially when the latter is high, while, with good walls, the variations are much slighter. And in the latter case, if the outside temperature remains in the vicinity of 70° during the day and falls below 60° during the night, it will be possible, by ventilating at night, to dispense with ice during the day. With good walls it will be necessary to use ice only during hot weather and when two or more days elapse without the outside temperature going below 60° at night.

All that has just been said presumes that the hot air outside cannot penetrate into the inside of the room by any fissure and the ventilation can be throughly regulated at will. If such be not the case, the variations of the outer temperature will be much greater still and a much larger quantity of ice will have to be used.

Refrigerating apparatus may be divided into two categories : 1 Those working chiefly by *radiation of cold* ; 2. Those working chiefly by *convection* that is to say by the *circulation of the air to be cooled over the refrigerating surfaces.*

The former require a great development of cold surface if ice be used. If a refrigerating mixture be used, their surface may be considerably reduced. Some might be made in which a mixture of salt and ice could be used. But apparatus of this kind have not yet been sufficiently studied with respect to the refrigeration of curing rooms, in which case they must not be costly.

The latter require a smaller cold surface but call for a rather rapid circulation of air over that suface.

The air of the room itself might be made to circulate over it without taking any from outside. This would effect a great saving in ice. But such a circulation would require mechanical appliances which, as a rule, are too costly for cases such as those now before us and the air of a curing room must be renewed from time to time.

It has been found more economical to cause air from outside to circulate. This has the advantage of renewing the air inside the room but the disadvantage of bringing much heat with it, which increases the consumption of ice. But as, in this case, the circulating apparatus — which generally consists of a cap on the top of a shaft as described in this bulletin — is inexpensive and requires but little supervision, this method is likely to be preferred to the others. It may be said, in general, that for curing-rooms and as matters stand at present, the apparatus of the first category are preferable in districts where the outside temperature remains comparatively low during the summer. In districts where it is subject to great variations and rises very high, those of the second category should be preferred.

Of the latter category that which seems to be most used at present in the United States is the system of subearth ducts, tried for the first time in Wisconsin 3 or 4 years ago. The Honorable Commissioner of the Province of Quebec sent some one to examine it a year and a half ago and on the first December 1897, caused a bulletin to be published on the subject.

In that bulletin, the theory of the appartus was fully explained and every practical information connected with it was given.

This system has the advantage of not requiring ice and gives fairly good results but it is costly and cannot be adopted everywhere; for instance, where the sub-soil is rocky at a depth of 2 or 3 feet from the surface.

The system recommended by this bulletin is quite new. It will cost less and will be surer. It will further have the immense advantage of being able to be used either as an apparatus of the first category when the outside temperature remains in the neighborhood of from 65° to 70°, or as an apparatus of the second category when the outside temperature rises to 80° and even to 90°. In this bulletin it is calculated for an outside temperature of 90°. With it a mixture of salt and ice (1 part, in weight, of salt to 2 parts in weight, of rcushed ice) will give very good results.

The maintenance of the temperature of a curing room at 60° at all times, even with a high outside temperature is therefore a problem an economical solution whereof is more difficult to find than is imagined at first sight and which necessarily calls for rather costly improvements which are however compensated for by the benefits to be derived.

For all additional information, apply to the Department of Agriculture, Quebec.

Quebec, 12th March, 1898.

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