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CREAM RAISING

BY THE

CENTRIFUGAL

AND OTHER SYSTEMS

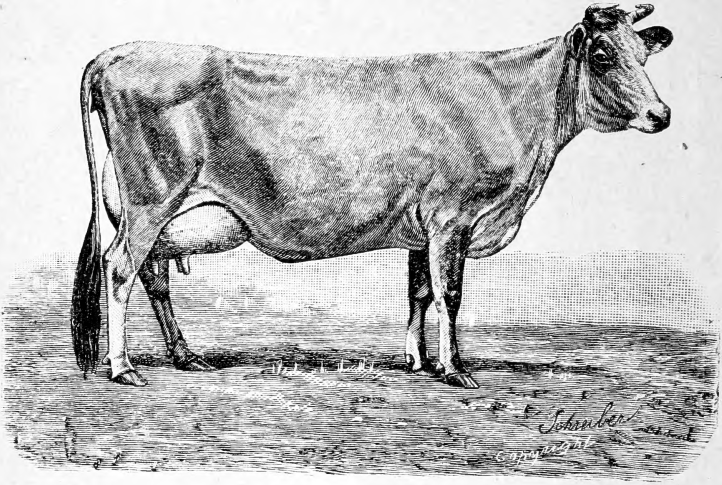
COMPARED AND EXPLAINED

WITH A FULL DESCRIPTION OF THE PLANT REQUIRED AND HOW TO USE IT, AND A CHAPTER ON THE CONSTRUCTION OF ICE HOUSES, ROOMS AND CELLARS FOR COLD STORAGE

Illustrated with 55 engravings

BY S. M. BARRÉ
Professor of Dairying Guelph Agricultural College, Ont.

PRINTED AT LE TRAVAILLEUR OFFICE,
WORCESTER MASS.



MARY ANN,

OF ST. LAMBERT.

This extraordinary Jersey cow, owned by Mr V. E. Fuller, of Hamilton, Ontario, gave 36 lbs. and 12 ounces of butter in 7 days, and 867 lbs. and 14 ounces in 11 months and five days.

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E. Ch. May 21/12

INTRODUCTION.

This pamphlet has been written to meet not only the requirements of dairy men, but also of the general public. For this reason we have been at considerable pains to make it as clear and comprehensive as possible.

There is no doubt that with the new and improved methods, coming into general use, the butter industry is destined to great development. Capitalists and dairy investors will find it to their advantage to have a book by means of which it is possible to form an accurate idea of the present state of the industry. From the numerous tables given in this work, it will be easy to determine the different yields of different methods, and ascertain which to use in given circumstances.

This work is divided into five parts.

The first part defines and classifies the different methods. It contains a description of the plant necessary for each, with instructions how to use it.—The second compares the different systems and contains remarks on their relative value.—The third is devoted to the centrifugal and contains a mass of practical information difficult to obtain elsewhere.—The fourth treats of what to do with the skim milk.—The fifth treats of the construction of ice houses, rooms, and cellars for cold storage and freezers, and of the storing and keeping of ice or snow.

We cannot conclude without offering our sincere thanks to Messrs. H. C. Petersen & Co. of Copenhagen, J. D. Fredericksen of Littlefalls, N. Y., Henry Wade, Secretary of the Agricultural Bureau of Ontario, the Knickerbocker Ice Co. of Philadelphia and W. G. Walton of Hamilton, Ont. who have kindly placed the material collected by them at our disposal.

Cream Raising by the Centrifugal and other systems.

MILK.

"Milk is a fluid in which float about numbers of globules: these consist of fat. When milk is suffered to remain at rest some hours, a large proportion of the fat globules collect at the surface into a layer of cream." (1)

CREAM.

The cream or butter globules come to the surface, because they are lighter than the watery fluid in which they float.

HEAVY MILK.

Heavy milk is milk in which the cream rises but very slowly, and in which a large proportion of the cream does not come to the surface at all. The cream from such milk is very thin, and there is no distinctly marked line between it and the skim milk. It is not to be wondered at, that such skim milk, does not look blue, there is often a larger quantity of cream mixed with it than has risen to the surface. In some cases as much as 75 o/o of the cream of heavy milk remains in the skim milk.

Heavy milk is generally obtained from cows that have calved since a long time, or that are running dry through being in calf, or through other causes.

Milk always becomes "heavy" though in a lesser degree, when it is allowed to cool before setting.

WHOLE MILK.

This is milk from which the cream has not been extracted.

(1) Fowne's Elementary Chemistry.

SKIMMING.

In every 100 lbs. of milk there is on average $3\frac{3}{4}$ lbs. of butter fat. (1) The great art of skimming consists in being able to extract from the milk all the butter fat, or any proportion desired, and this without injuring its quality in the least.

METHODS.

Many different methods are recommended by dairymen, but all can be classified under two distinct heads: 1o. The natural; 2o. The mechanical.

THE NATURAL PROCESS.

This process consists in employing changes of temperature, to hasten and complete the separation of cream from milk. It is an admitted fact, that the cream rises while the temperature of the milk is falling.

The greater the fall of temperature, the greater the quantity of cream which rises.

The one point upon which dairymen are unanimous, is that milk should be set as soon as possible after the milking (that is when it is still at blood heat), and then cooled down. There is a difference of opinion as to the temperature to which it should be cooled, but the best practical butter makers agree, that it should be just short of the freezing point, 32o Fahrt.

RULE.

Set the milk as soon after milking as possible, and cool it down just short of 32° Fahrt.

(1) We say butter fat designedly. If we were to say cream, it would be necessary to make a distinction between thick and thin cream.

REQUISITES OF THE NATURAL METHOD OF SKIMMING.

The requisites of this method are:
1o. Milk vessels.
2o. Refrigerating tanks.
3o. Ice, or ordinary spring or well water.

DESCRIPTION OF THESE REQUISITES.

1ST MILK VESSELS.

They are divided into two classes: shallow pans, and deep cans.

SHALLOW PANS.

The shallow pans, as the name indicates, are shallow vessels from 4 to 6 inches deep. They are made of any length and breadth to suit the requirements of the dairyman.

The newest of these are, in reality, double pans between which water is constantly allowed to flow.

DEEP CANS.

There are many good utensils of this form in the market, but we recommend a round or oval shaped deep can, such as can be had at a low price, at any tin shop, and upon which there is no royalty whatever to be paid. They are of different sizes.

DIMENSIONS OF DEEP CANS GENERALLY USED.

OVAL SHAPED.

Table No. 1.

Contents.	Height.	Length.	Width.
40 lbs.	17 inches.	16 inches.	6 inches.
50 "	21 "	15 "	5½ "
60 "	18 "	18½ "	6½ "
65 "	27 "	15½ "	7 "
80 "	20½ "	20 "	7 "

I recommend for small dairies, 1st. the oval 40 lbs. can; 2nd the 50 lbs. 20 inches high by 8 inches diameter, round shaped. Both these cans are easily handled.

They should be made of strong material, have only one smoothly soldered seam in order to facilitate washing. The bottom of these cans rests on a perforated iron hoop, to allow the water or ice to penetrate underneath.

The oval can is the most effective. It offers a larger cooling surface. It is estimated that an oval can will cool 70 lbs. of milk, in the same time that a round can would take to cool only 50 lbs.

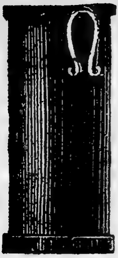


Fig. 1.—The deep round can.

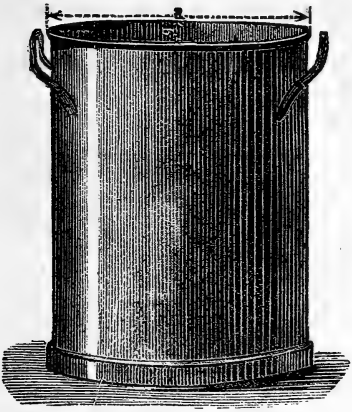


Fig. 2.—The deep oval can.

The deep can used in Denmark has neither covers nor taps. (1) Skimming from the bottom with a tap is not practised in Denmark. A can having no faucet or tap is easier to clean. A tap, placed in a position so as not to hinder the easy cleaning of the milk vessel, is not strictly objectionable.

(1) A cover in not objectionable when the manner of using it is properly understood.

THE STRAINERS.

The strainers are of wire cloth, and made to fit the cans. (See figs. 3, 4 and 5.)

Fig. 3.

Fig. 4.

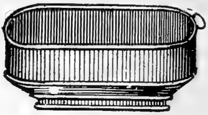


Fig. 5.

REFRIGERATING TANKS.

We give below a description with wood cuts, of such tanks or refrigerators.

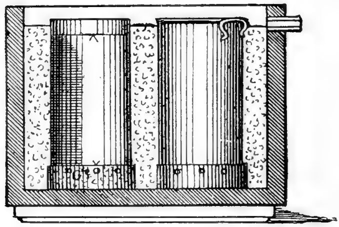


Fig. 6.

Fig. 6 represents a smal size cooling tank containing milk cans set in ice.

DIRECTIONS FOR MAKING COOLING TANKS.

These tanks may be made of wood with double sides, and 2 or 3 inches of space left between the sides, filled with charcoal, cut straw, saw dust or chaff. Charcoal is the best. If straw be used, it is necessary that the tank be water tight, or damp proof, because if the water were to leak through, it would soon cause a disagreable smell.

Otherwise make a water tight box. Bind and steady the angles with iron plates. Line with zinc or tin if convenient. If you do not line, a coat of varnish or paint, should be given inside, as is done with brewer's vats. This precaution makes them easier to clean.

Tanks No. 7 and 8, could also be adapted to the use of running water, and are provided with inflow and outflow pipes, to allow a constant stream of water around the milk cans.

In the case of a tank for cooling milk to 33° Fahrt. with water and ice, an outflow tap at the top and another at the bottom, to be used for cleaning purposes, are all that is necessary.

SIZE OF TANKS.

The size of tanks should be adapted to the number and form of cans to be used.

The tank should be 4 inches (inside measure) higher than the cans used. It should be 4½ inches (inside measure) wider than the cans used ; there should be a space of 5 inches between each can, and between the last two cans and the extremities of the tank.

RULE.

To find the height of a tank, add 4 inches to the height of the cans to be used. To find the width of a tank add 4½ inches to the width of the can. To find the length of the tank multiply the longest diameter of the can, by the number of cans which the tank is to contain, and to the product add 5 as many times, and one more, as the tank is to contain cans.

Supposing that six 40 lb. oval cans, are to be used.

An oval can 17 inches high, 16 inches long and 6 inches wide, will hold 40 lbs. of milk.

$17 + 4 = 21$ inches = Height of the tank.

$16 + 4\frac{1}{2} = 20\frac{1}{2}$ " = Width " "

$6 \times 6 = 36$ " $36 + (7 \times 5) = 71$ inches length of tank.

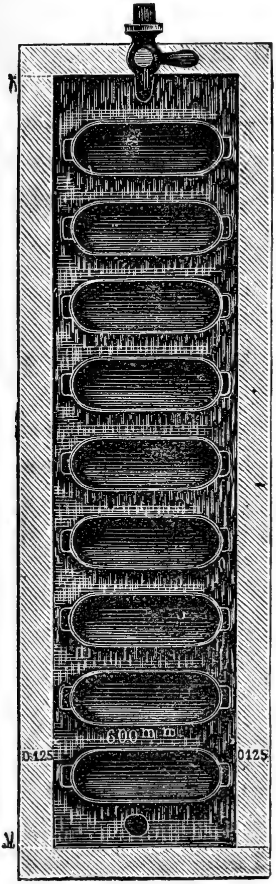


Fig. 7.

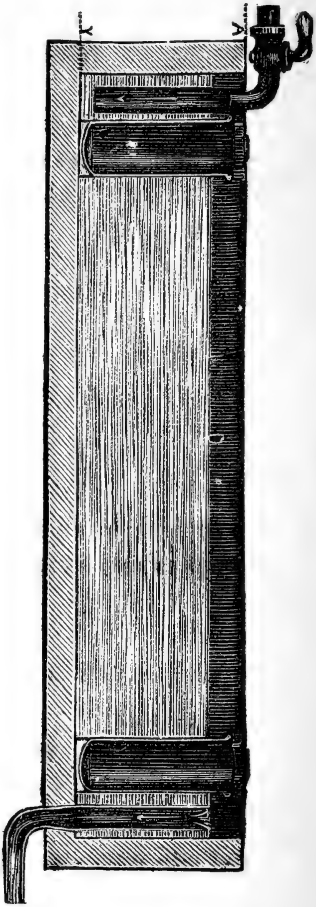


Fig. 8.

Fig. 7 represents a horizontal view of a tank containing milk cans.
Fig. 8 represents a sectional view of same tank.

The tanks may be covered or not. It depends on the room in which they are placed.

In a cool room where the air is pure and temperature uniform a cover is not strictly necessary.

Otherwise it would be advisable to use a cover over the tanks. In any case the use of a cover saves ice

SKIMMERS.

Skimming from the top, necessitates a specially made

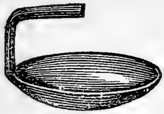


Fig. 9.

skimmer. The skimmers, are round or oval (see fig. 9). They are generally made of enameled iron.

CREAMERS OF DIFFERENT DESCRIPTION.

CABINET "OR BOX" CREAMERS

There is a great variety of cabinet or box creamers, all being modifications of the deep and shallow setting methods. They consist in general of cooling pails set in a box surrounded by water, some submerged, as in the Cooly plan, and others arranged so as to be surrounded with ice and water, or to have ice at the top.

Amongst these we find the following:

THE HARDIN.

Mr. L. S. Hardin is probably the first man who used deep setting in the United States. In his method the cans are set in a box with doors in front like a cupboard. It has a shelf on which the ice is placed over the milk,

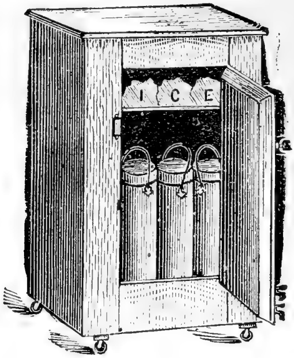


Fig. 10.—The Hardin Creamer.

and a sink on which the cans are set, and which holds the water dripping from the melted ice. The cooling medium is cold air. (See fig. 10.)

THE COOLY CAN.

The Cooly is a round shaped can with a cover projecting

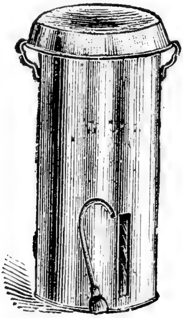


Fig. 11.—The Cooly Milk Can.

outwards, and so arranged that the whole may be placed under water. It has also a specially constructed tap.

This can is extensively used in the United States and Canada.

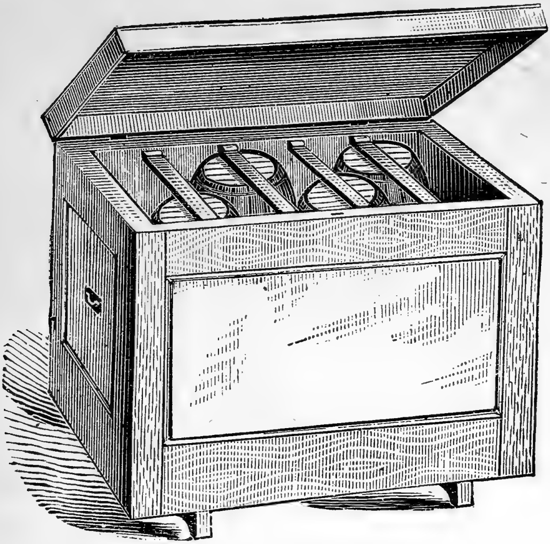


Fig. 12.—The Cooly Creamer.

THE FERGUSON.

Ferguson's Bureau Creamer raises the cream on the shallow pan system. Ice is used on a rack in the upper part for the purpose of maintaining a uniform temperature. The arrangement for drawing out the pans to skim is handy.

THE LITTLE GEM.

In this, the cover of each milk vessel is provided with an opening or ventilator.

Openings corresponding to those in the covers of the milk vessels, are made in the cover of the box, in order to allow the "animal odor" to escape. (See fig. 13.)

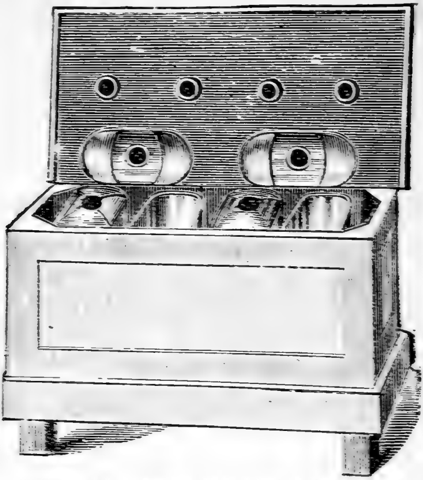


Fig. 13.—The Little Gem Creamer.

THE KELLOG.

It consists of a pan or tank, which is divided into two compartments an upper and a lower one. The lower

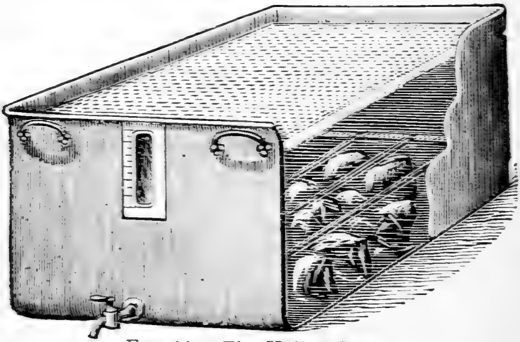


Fig. 14.—The Kellog Pan.

one is filled about one quarter of its depth with pure clean ice. The upper is then filled with milk to the depth of 4 or 5 inches. The skim milk can be drawn by a tap at the bottom.

We also find the "Mosely and Stoddard Cabinet," the "Wooster perfection creamery," the "Excelsior creamer" "Dripp milk cooler and creamer," "Butler's Cabinet creamery," "Clark's Revolving pan" and many others.

The latest plan is to have the cans dropping or hanging into a lower chamber, thereby avoiding lifting and slopping.

THE "HOME CREAMER."

This is a novelty in construction. The milk is cooled by pumping cold air through it and this is effected in warm weather by drawing the air from a well through rubber pipes attached to the pump. The air tight compartment, where the milk is is then closed, and the air exhausted by the pump so that the cream is raised *in vacuo*.

THE "MARQUIS PAN"

This is another more recent apparatus for raising cream on the deep setting principle.

In its general appearance it is an oblong vat with rounded bottom, with a cylindrical tube of tin passing lengthwise from end to end through the middle. The cylinder is placed below the cream line. This cylinder has an inner cylinder and pipe for carrying off water. Cold water is forced by a pump through this cylinder and the refrigeration of the milk is of course rapid. This vat, or one similar to it in construction is used in a great number of creameries.

THE CREAM GATHERING SYSTEM.

The main feature of this system is that each farmer sets the milk, in vessels of uniform size and shape, in his own dairy. It is skimmed by the cream gatherer, who is employed, and sent out daily by the creamery.

VESSELS REQUIRED TO SET THE MILK.

Round, oval or conical shaped deep cans may be used. But farmers sending cream to one creamery should all have vessels of same size and form. In the side of the

Fig. 15.

can two or three inches from the top, is fixed a glass graduated scale. This scale graduated in inches and parts of inches, indicates the dividing line between the cream and the skim milk, and enables the cream gatherer to see at a glance the thickness of cream, and to measure the quantity to be credited to the account of each farmer. (See fig. 15.)

ICE BREAKERS.

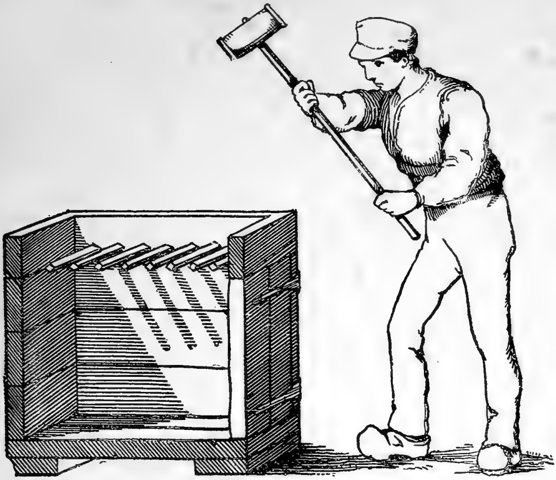


Fig. 16 —Section of box specially constructed to break ice.

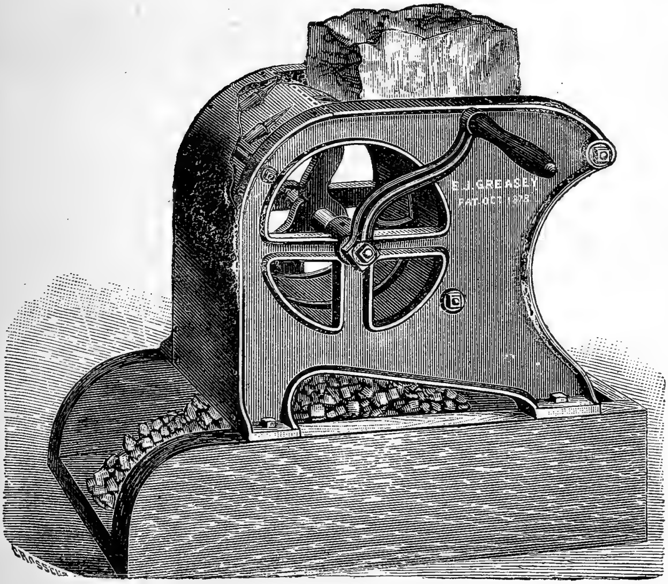


Fig. 17.—The Creasey hand Ice breaker.

The main parts of the Creasey ice breaker consist of an iron box, placed in an inclined position, over a revolving cylinder, to which steel knives are riveted.

Its operation is so simple that the cut is almost all that is necessary to explain its working.

The block of ice is placed in the box, it slips down slowly towards the revolving cylinder, and the steel

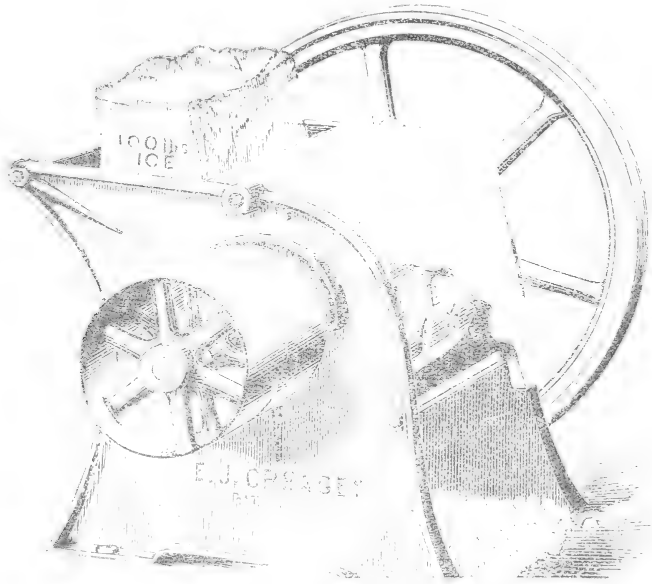


Fig. 16.—The Creasey Improved Ice-breaker.

knives break it off into small pieces, the size of which is further regulated by a "comb casting," through which the ice falls. (See fig. 17 and 18.)

As the knives follow each other closely, a large cake of ice is rapidly broken, yet so gradually, that a small amount of motive power is required to drive the breaker

DIFFERENT WAYS OF USING THE NATURAL METHOD.

While dairymen agree as to the theory, that milk should be set at 98° Fahrt. (or blood heat) and cooled down, they differ as to the vessels to be used, as to the cooling medium to be used, some taking ice, others water ; they also differ as to the length of time during which it is necessary to let the cream rise ; these differences, in the use of the natural method, are designated by different names.

Thus we have, the "Ice 10 hrs." plan. This means, that the milk was set in deep vessels and remained in ice during 10 hours.

Again there is the "Ice 34 hours" plan. This, indicates that the milk vessel was deep, the cooling medium was ice, but that the time instead of being 10 hours, was 34 hours. Another plan is the "Water at 50° Fahrt. 34 hours". In this case the milk is also set in deep vessels, the cooling is done by means of water at 50° Fahrt. and the time was 34 hours. There is also the "Shallow pan 34 hours" plan. In this, the milk is set in shallow-pans, is cooled to 55° Fahrt. and remains at that temperature 34 hours.

Still another plan is the "Churning of milk". This plan, consists as its name expresses in churning the whole milk.

THE MECHANICAL PROCESS.

The mechanical process consists, in depriving the milk of its cream by centrifugal force.

Centrifugal force is a force of nature, by which an object revolving around a given centre is continually trying to break away from that centre.

If the object, which is revolving, is a vessel containing a liquid composed of elements of different weight, such as milk, these elements will separate and arrange themselves according to their weight ; the heavier ones will be further from the centre, the lighter ones nearer.

Milk as already explained, is a liquid containing elements of unequal weight, namely cream and a watery liquid somewhat heavier ; therefore if milk is placed in a vessel which is made to revolve, it is evident that the cream, the watery liquid, and any impurities the milk contains, will separate and form three distinct rings. The impurities being heaviest will form the outside one, the skim milk will form the next. and the cream being the lightest of all will be closest to the centre. This is the principle upon which all centrifugal separators are constructed ; the differences between them, are differences of detail.

We shall now give cuts of several of them, with a complete and detailed description of those which are generally used in America.

DESCRIPTION OF MILK SEPARATORS.

The Burmeinster & Wain Centrifugal Milk Separator, known as Danish Weston in the United States.

This Separator, whose action is continuous, consists of a hollow steel drum revolving on a vertical axis. This Separator differs from others in the manner of removing the cream and skim milk. Two curved metallic tubes (see fig. 19) are used which are screwed on and curved around the safety cap of the drum, without interfering with its working. These tubes draw up the cream and skim milk from their respective receptacles. They are pointed at the ends, and are inserted one, in the inside surface of the cream ring, and the other in that of the skim milk ring (see fig. 22). They are moved to and from the centre of the drum, thereby cream of any required thickness (from the consistency of butter almost, to the consistency of milk) can be obtained while the machine is working. The drum has attached to its inside, three vertical flanges extending 5 inches towards the centre. These flanges extend from the bottom, almost to the top. They serve a double purpose. 1st They prevent the milk from revolving independently of the drum. 2d They serve to support the cream cover. The cream cover is a horizontal flat ring of metal which rests on these vertical flanges ; it does not touch the sides. Its use is to keep the cream and skim milk separate at the out flow.

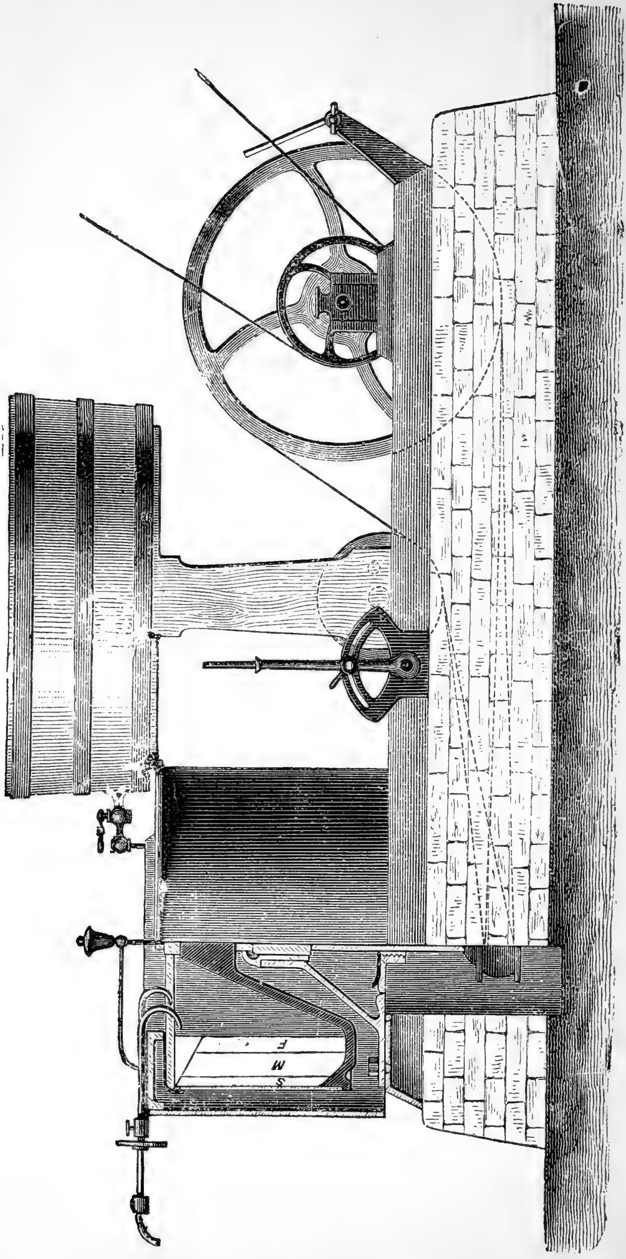


Fig. 19.—The Burmeister & Wain MilkSeparator, in working order. Model A.

These machines are made of different sizes and capacities. According to Prof. Fjord's experiments, the A size can skim 1200 lbs of milk per hour, with a speed of 1800 revolutions per minute. As the speed of this Separator has lately been increased to 2300 revolutions per minute, it is evident that it can now skim a much larger quan-

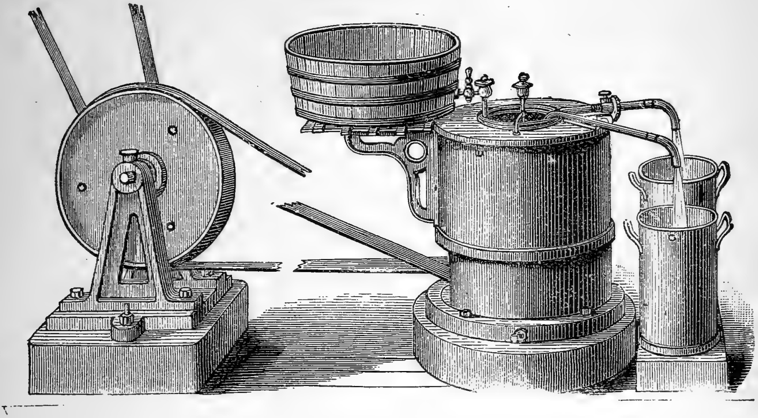


Fig. 20.—The Burmeinster & Wain Milk Separator in working order Model, AA

tity of milk than 1200 lbs per hour. (See Chapter on comparison between different separators).

The B size is calculated to make 3000 revolutions per minute. According to the result of Prof. Fjord's experiments, it will skim, 700 lbs of milk per hour and leave 0.25 o/o (1) of butter fat in the skim milk.

The B size is built after the A.A. Model.

The latest improvements on this machine consist of a speed indicating apparatus, pipes for lifting fluid, d.d, fig. 22, and a controlling funnel showing the quantity of milk flowing into the machine. (see bb, fig. 22.)

(1) 4 ounces in the skim-milk obtained from 100 lbs. of whole milk.

The controlling funnel consists of a tin vessel 5 inches high, to which are attached two conical tubes, through which the milk enters the drum of the Separator. (See a, b, c, d. fig. 21 and b, b, fig. 22). By elevating or lowering two vertical cylindrical rods, placed in the conical tubes

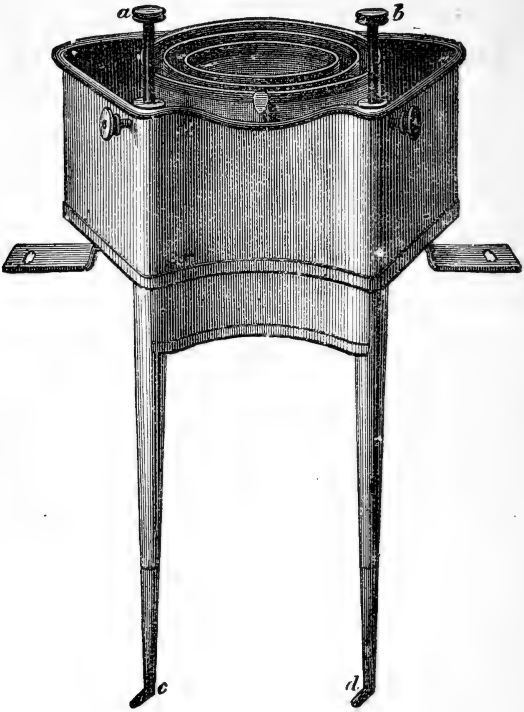


Fig. 21.—Controlling funnel.

the flow of milk is increased or decreased at will. A graduated scale situated at the upper end of the vertical rods, indicates the quantity of milk flowing per hour into the machine. (see fig. 22).

Fig. No. 22 represents a sectional view of the drum of the separator and also the milk regulator. It shows how the skim milk, by means of an elevating tube may be raised by centrifugal force, as high as 8 feet or more, and

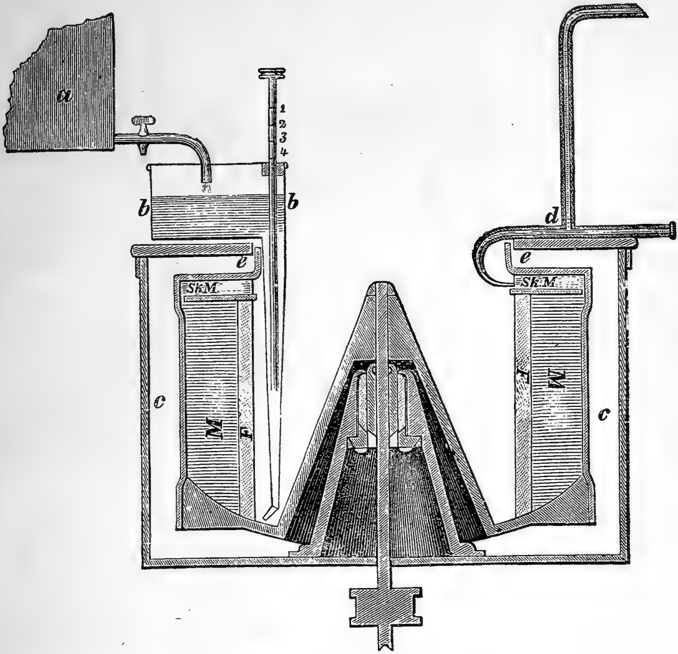


Fig. 22.—Section of the Separator.
a, Milk vat ; b, Controlling funnel ; c, Safety Jacket ; F, Cream ; SKM. Skim milk ; d, Tube for removing the skim milk.

led into a cheese vat, reservoir, or to a great distance away from the factory or dairy, to a barn, piggery &c.

The cream may also be raised in a similar manner, and led into a cooler specially made for this purpose.

HOW THE MACHINE WORKS,

The new milk is placed in a milk vat (a. fig. 22) and flows through the controlling funnel (b. b. fig. 22) into a drum, which revolves rapidly; the centrifugal force thus generated, separates the different substances according to their weight. The impurities being the heaviest, collect upon the sides of the drum. The skim milk next in weight collects next, and by a constant inflow of new milk, it gradually rises to the top, where it is stopped by the cover and forced into the outflow pipe, by a constant inflow as well as by centrifugal force.

The cream collects in a wall upon the inner surface of the skim milk, and flows in a constant stream through another tube similar to tube d. From the above description it will be seen that once started it works continuously until the whole amount of milk is separated.

THE SKIMMING OF THE FIRST AND LAST MILK CONTAINED IN THE SEPARATOR.

These operations require care and attention. With the Burmeinster & Wain Separator they are done in the following manner:

FIRST CONTENTS.

After filling the drum ¾ full, the machine is started slowly, and the milk is allowed to run into the drum at the ordinary flow, until it reaches the skimming tubes.

The tubes must then be regulated in such a manner as to draw off the cream. It must be remembered that *both* the tubes draw off cream at the beginning. But the operator should let the flow from the cream tube, run into the cream receiver, and the flow from the other tube (although it is cream and partially skimmed milk) run to the skim milk receiver.

The flow should now be considerably checked, and should remain so until one fifth (1) of the first contents has been drawn off. At this point the milk is allowed to enter the drum at the regular flow. The tubes are then regulated so that from 18 to 20 o/o of the contents of the drum shall be drawn off in the shape of cream.

The machine is now in full operation.

THE LAST CONTENTS.

When the whole milk vat is empty, there remain but the last contents of the drum to be skimmed.

1st Partially unscrew the skim milk tube so as to check entirely the skim milk flow, and keep up the cream flow until the end of the operation. To displace the last contents, allow an intermittent inflow of skim milk. The quantity of skim milk necessary, is equal to one-fifth of what the drum is capable of containing while in operation (2). This operation takes from 10 to 15 minutes.

A great number of these separators are now in successful operation in different countries of the world. The Danish manufacturers being unable to supply the demand, they are now manufactured in the United States by the Philadelphia creamery supply Co. under the name of Danish Weston, and in Canada by Messrs. Garth & Co., Montreal, under the name of Burmeinster & Wain.

This Separator was introduced into Canada in the

(1) This one-fifth which is composed of cream and partially skimmed milk, should be thrown back into the whole milk vat, to be skimmed anew.

(2) The drum of the large size contains 130 lbs., of small size, 33 lbs.

spring of the year 1882, by a public spirited gentleman of Beauce, Mr H. J. J. Duchesnay

THE DE LAVAL MILK SEPARATOR.

Fig. 24 gives an outside view of the machine when in operation. The standard and bed-plate are in one

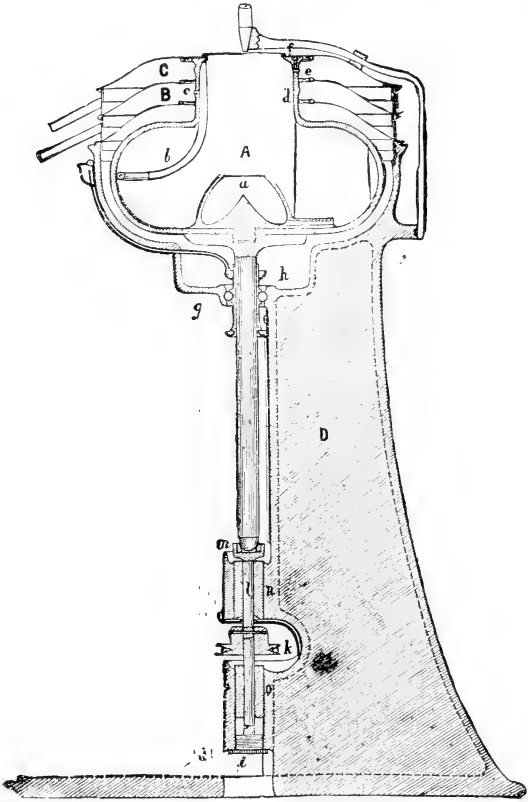


Fig. 23 —Sectional view of the De Laval Separator.

piece, so that the whole can be at once attached to the floor of the dairy, or to the frame of the intermediate machinery. Its action is also continuous.

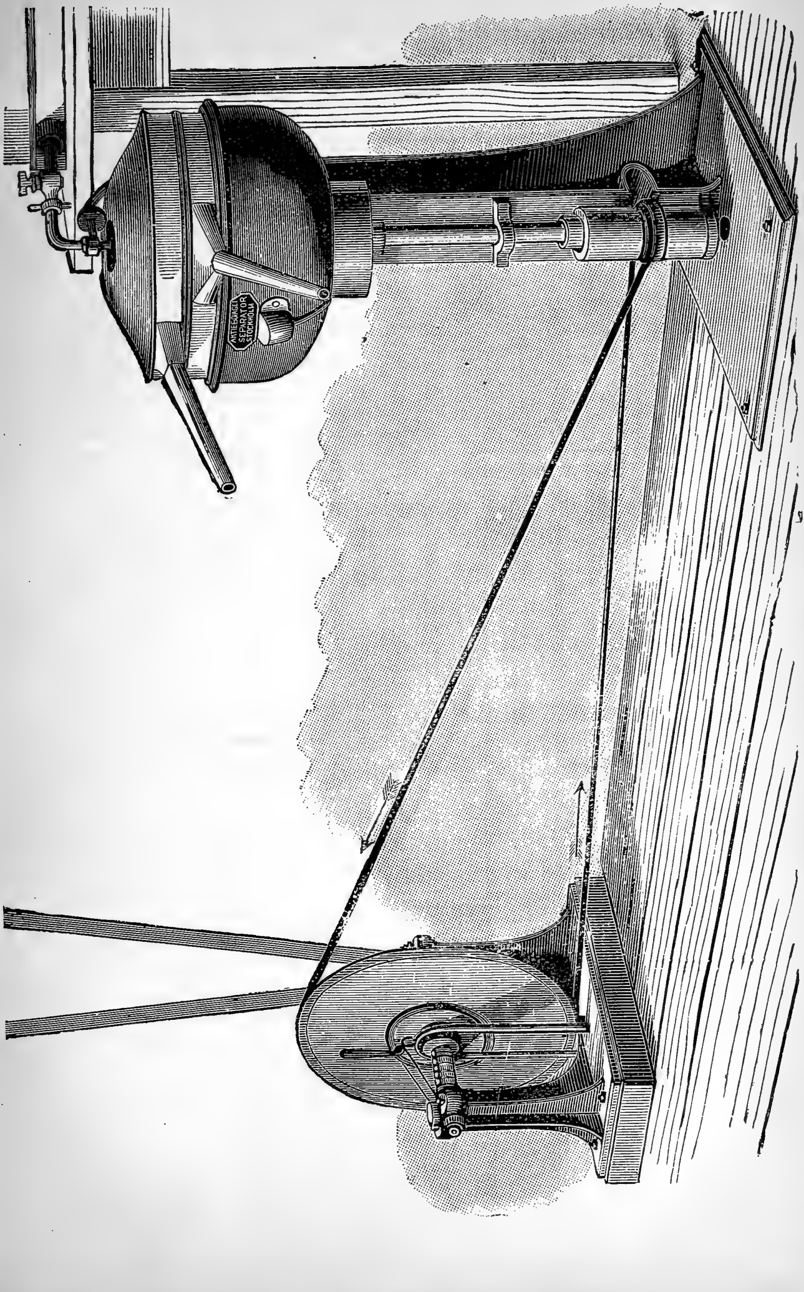


Fig. 24.—Outside view of the De Laval Separator.

The cream and skim milk flows out of this Separator by the power of gravitation alone, and such power is not sufficient to allow of the use of elevating tubes, to lead the cream and skim milk through a cooler to their respective vessels.

Fig. 23 gives a sectional view of this cream separator, consisting of a steel drum capable of resisting a pressure of 42 atmospheres; but as these machines are not sent out from the factory until they are tested at a pressure of 250 atmospheres they are perfectly safe

The machine is worked in the following manner. The new milk runs into the bottom of the centrifugal chamber *a*, from which by means of a small tube, it flows to that spot in the drum where the separation of the cream and skim milk takes place by centrifugal force. A flange fixed to the side of the milk chamber, prevents the milk from revolving independently of the rotating vessel. The skim milk is forced into the pipe *b*, it enters the aperture *c* in the stationary chamber B, and runs out by means of an exit spout.

At the same time, the cream collecting in the centre, rises along the neck *d*, escaping by the opening *e*, into the stationary chamber C. The opening *e* may be enlarged or diminished at will, by means of a small screw *f*, placed above the chamber C, to regulate the amount of cream taken from a certain amount of new milk, but this regulation of the density of cream must take place while the machine is stationary. Thus it is impossible to obtain thick or thin cream while the apparatus is in operation. The spindle supporting the rotary vessel is mounted on bearings *h*, surrounded by an elastic packing *g*, and its lower end fits, in a socket *m*, upon the upper end of the shaft *l*, which is mounted on bearings, and is set into motion by a belt or band *k*.

The stand D supports the machine which requires no heavy foundation.

A small lubricating cup attached to the lower part of the spindle, gives through a pipe a constant supply of the oil required for lubricating the spindle,

The milk drum is driven at the rate of 6000 to 7000 revolutions per minute, and according to Prof. Fjord's experimental test, will skim from 600 to 700 lbs. of milk per hour, and leave from 0.25 to 0.30 o/o (1) of butter fat in the skim milk.

This separator made its first appearance in Canada, during the winter of 1884. It is quoted at $260.00.

THE LEFELDT MILK SEPARATOR.

A full description of this separator was given in my report to the Minister of Agriculture of the province of Quebec, in 1881. In the same year, it was tested by Prof. Fjord, and found to loose 0.85 o/o (2) of butter fat during every hour of its working. This loss was caused by the suction of cream by air into the skim milk, The last contents of the drum could not be skimmed completely. We do not know whether these defects have been remedied or not since.

(1) From 4 to 5½ ounces in the skim milk obtained from 100 lbs. of whole milk.

(2) This is 13½ ounces

In this machine, the consistency of the cream cannot be regulated while it is in operation. It must be stopped to do so.

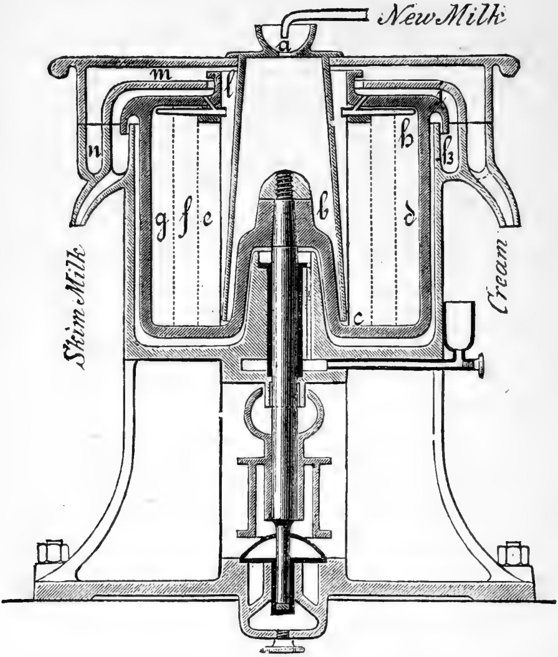


Fig. 25.—The Lefeldt Milk Separator. *e*, cream ; *f*, milk in process of separation ; *g*, skim milk.

Dr Fleischman quotes the price and capacity of the Lefeldt separator as follows :

No 0.	330 lbs. of milk per hour, . . .	$125.00
No 1.	550 " " . .	250.00
No 2.	1100 " " . .	375.00
No 3.	1650 " "	500.00
No 4.	2250 " " . .	625.00
	Intermediate motion . . . ,	$37.00

The new model of the Lefeldt Separator, (fig. 26) has not to our knowledge been thoroughly tested, and we are unable to state exactly, what it can do.

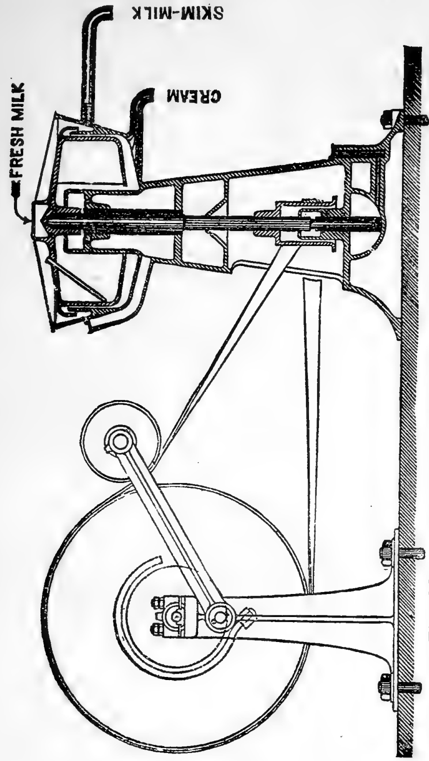


Fig. 26. Lefeldt's latest Milk Separator (small size).

The capacity claimed for it is 600 lbs per hour. Cost : $225.

THE FESCA MILK SEPARATOR

This separator was also described in my report to the Minister of Agriculture, &c., &c.

In this Separator the skim milk only is continuously discharged during the operation, the cream remains in the drum. At the end of every hour the machine must be stopped and the cream emptied. For this reason it is

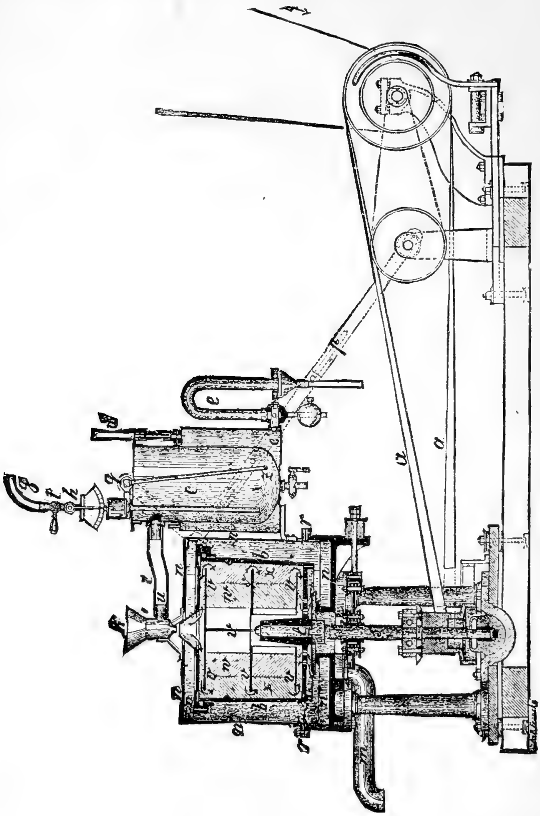


Fig. 27.—The Fesca Milk Separator.

not to be recommended. Mr Fesca has lately built a separator working continuously, but it is not extensively used. This separator is built in Berlin, Germany.

THE NAKSKOV MILK SEPARATOR.

This small separator was exhibited at Aalborg, Denmark, in June 1883, but was considered too imperfect to compete with the Burmeinster & Wain and De Laval, during the Vestervig experimental trial and competition.

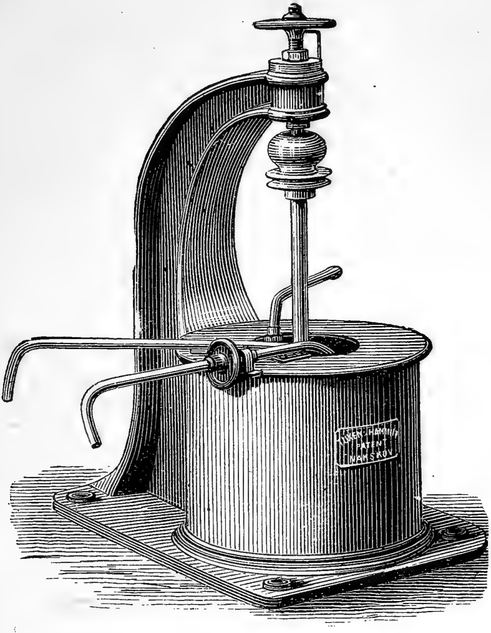


Fig 8.—The Nakskov Milk Separator.

Its defects were classified as follows :

1st, The sprinkling of cream and skim milk.

2nd. The suction of cream by air into the skim milk.

3rd. Difficulties in oiling the lower bearings.

We understand that some of these defects have been remedied since. The capacity claimed for it is 500 lbs of milk per hour.

This machine is made by Messrs. Tuxen & Hammerich, Nakskov, Denmark.

THE HENRICH PETERSEN SHALE MACHINE.

This machine differs in its construction from those we have already described. Instead of a drum revolving on a vertical axis, we find one or two drums moving on a horizontal shaft.

In this separator, the skim milk is removed by moveable knives or shalers.

By the proper use of the shalers, thin or thick cream may be obtained while the machine is in operation.

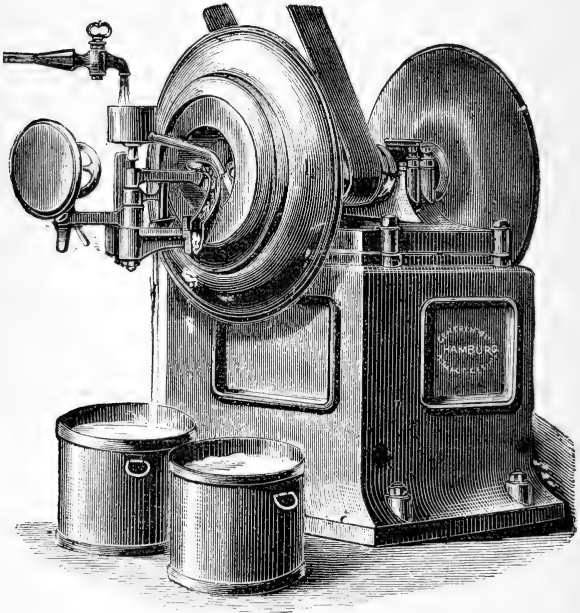


Fig. 29.—The Henrich Petersen Shale Machine.

Great modifications have lately been made in the construction of the Shalers of this machine.

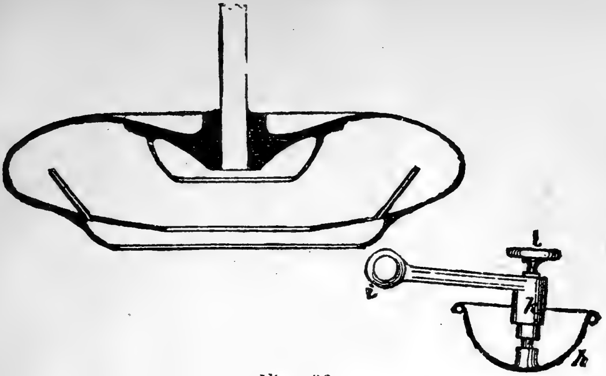


Fig. 30.

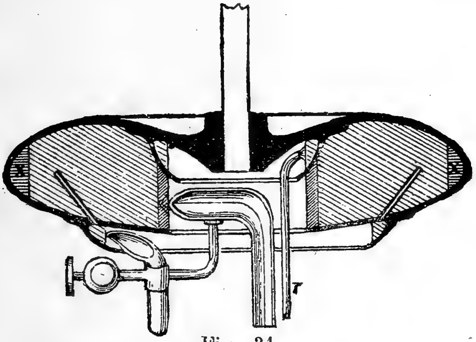


Fig. 31.

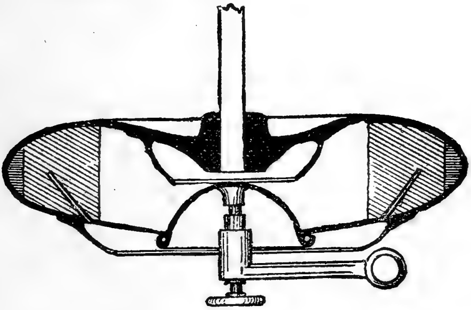


Fig. 32.

Cuts Nos. 30, 31 and 32, represent details of the shale machine.

The new shaling tubes are arranged so as to remove all the skim milk from the drum, at the end of the operation. This machine is said to make from 1,000 to 1,100 revolutions per minute, and to require 1½ horse power. The capacity claimed for it is 1,000 lbs. of milk per

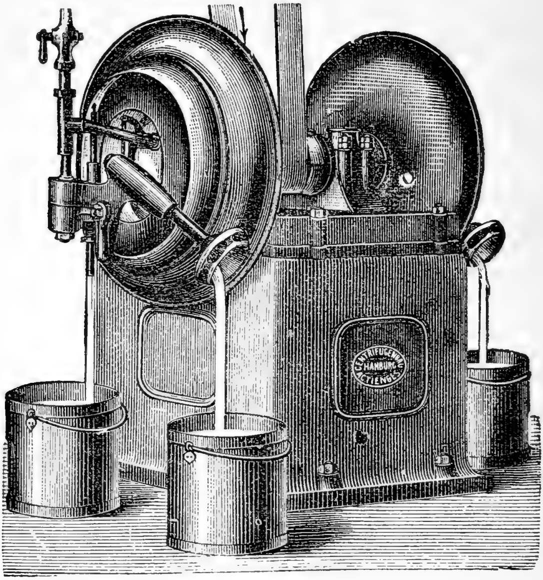


Fig. 33.—Petersen's Shale Centrifugal with new shaling tubes.

hour for a single drum, and 2,000 lbs. for a machine having two drums. This machine is sold by Montreicht & Co., Hamburg, Germany. Price, $825.

THE HERMAN PAPE MACHINE.

This new machine is made with either perpendicular or horizontal drums. The cream and skim milk instead of being removed by gravitation or centrifugal action, is forced out of the drum by hydrostatic pressure. The outflow of cream and skim milk can be regulated during the operation by a suitable faucet.

Contrary to that of other separators, the drum is completely filled and closed air tight. From this machine, the cream and skim milk come out in quiet streams, without the foaming liable to occur, when the liquids are extracted by centrifugal force.

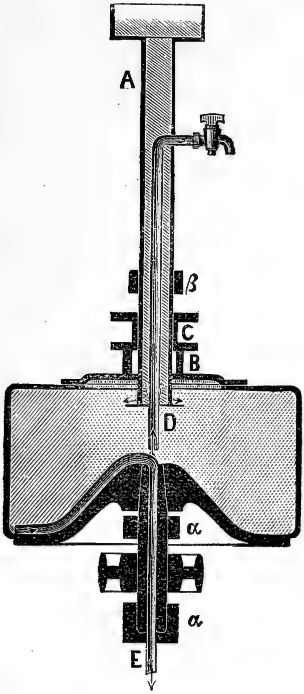


Fig. 34.

A, stationary pipe. *B*, cover rotating with the drum. *C*, rotating box in which the inlet pipe is tightly fitted. *D*, stationary outlet pipe for the cream. *E*, rotating pipe for the skim milk, *a a*, boxes on which the shaft is mounted. *B*, support for the inlet pipe.

The air tight cover has to be fastened on the drum every time the machine is used.

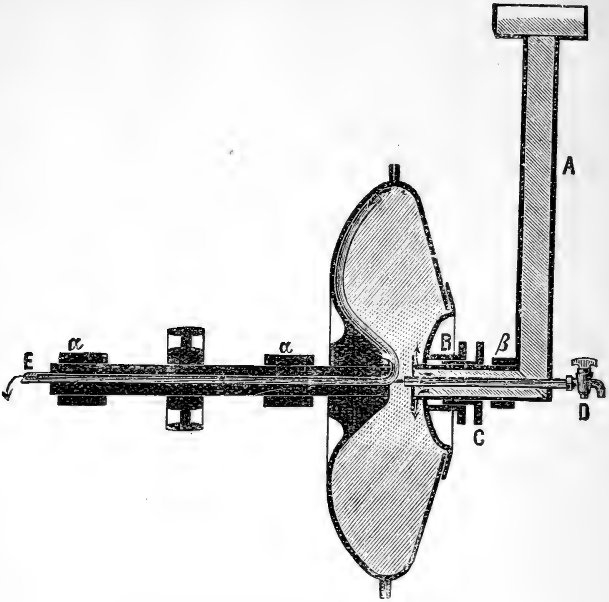


Fig 35 —The Herman Pape Machine.

THE AHLBORN MILK HEATER.

A very useful apparatus for heating milk (when it is deemed advisable to do so) was constructed by Mr. Ahlborn, of Hildesheim, Germany. I have introduced it into Canada. It can be seen in operation at the Saint-Sebastien creamery, province of Quebec.

This very simple and useful apparatus consists of a copper box with an inclined and ribbed surface, something like a wash-board. A perforated spout is placed across this inclined surface at its highest extremity. The box is filled with water and heated by means of a steam coil running through it. The cold milk falls through a tap from the reception vat into the perforated spout, it is spread in a thin sheet over

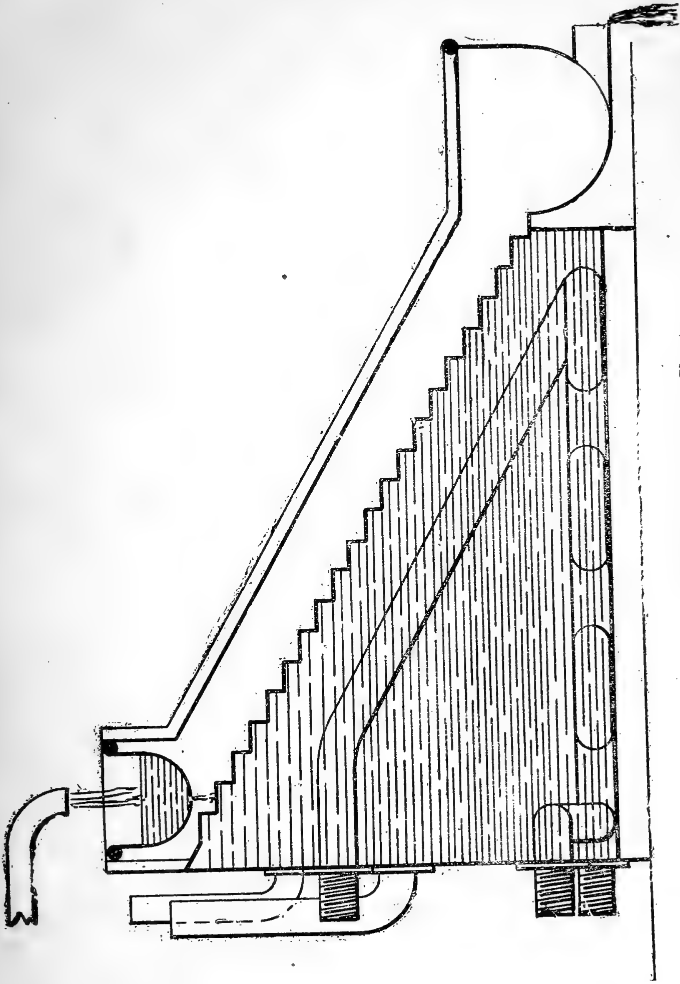


Fig. 36.—Ahlborn Milk Heater.

the inclined surface, and by the time it has reached the other extremity, it has acquired sufficient heat to be led through a pipe directly into the milk separator. Thus the milk is constantly heated, and only in sufficient quantities to feed the separator. With this apparatus there is no danger of heated milk, souring in the vats.

FJORD'S CREAM COOLER.

For cooling cream (see figs. 37 and 38) a special apparatus has been constructed by Prof. Fjord.

DESCRIPTION.

A tin vessel is placed inside another, leaving a space to be filled with ice. From the bottom of the inner can

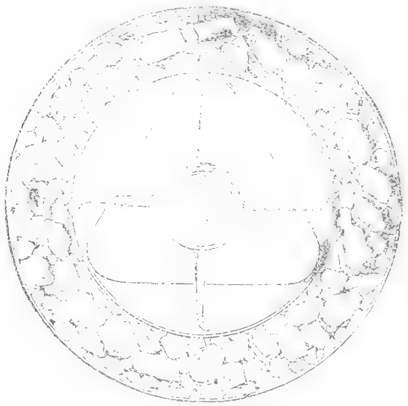


Fig. 37. Fjord's Cream Cooler.

a tube extends through the side of the other. On the partial cover of the inner can a funnel is placed so as to revolve easily around a delicate spindle at its lower extension. (See fig. 38.)

The funnel which is solid at the bottom is provided with four discharge pipes extending close to the circumference of the can, and bent at the ends as shown in section, fig. 37. The cream drops from the skimming pipe of the separator, which, if necessary, may be extended above the machine (see fig. 22) into this

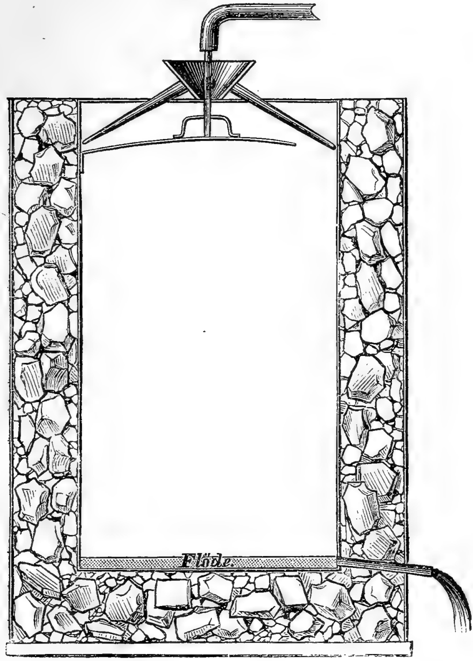


Fig. 38.—Fjord's Cream Cooler

funnel, and flowing through the four tubes, it makes the funnel go round, distributing the cream around the sides of the can. Flowing down in a very thin sheet, along the wall of the can, it is cooled to a temperature below 50° Fahrt. before reaching the bottom. A similar apparatus may be used for cooling the skim milk..

PROF. FJORD'S MILK CONTROLLER FOR TESTING MILK.

This instrument is destined to render great services to our cooperative dairies, for it can in a few minutes show precisely the richness of from 12 to 24 samples of milk.

It consists of a scalloped disk of copper which can be made to revolve upon the spindle of a large size centrifu-

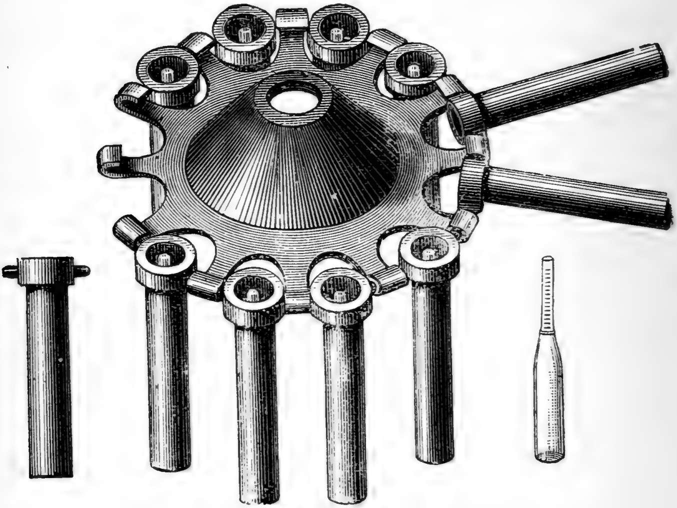


Fig. 39.—Fjord's Controller for testing milk.

gal, or on any other rapidly revolving vertical pivot. To this disk can be hooked from 2 to 24 copper tubes. In these tubes are placed graduated bottles holding samples of milk (see fig, 39) When at rest, these tubes assume a perpendicular position and hang down, but when in motion they fly out and become horizontal, like the two at the right of fig. 39.

Each bottle has on its neck a scale divided into units and halves, from 0 to 12 to indicate at the end of the operation, the quantity of cream in the milk. These bottles are numbered so that they may be identified.

The separation takes place by centrifugal force in the milk bottles, the cream accumulating in the neck.

MODE OF OPERATION.

The bottles are first half filled with the milk to be tested, (a mark on the outside indicates the half). The remaining space is then filled up with hot water to the mark O in the neck, and the whole is heated up to 90° Farht. When the milk has attained the required temperature the bottles are placed in the metal tubes, at the bottom of which rubber is placed to prevent breakage. The disk is then made to revolve.

Mr Fjord estimates that 40,000 revolutions are required to completely separate the cream. This apparatus should not be made to go faster then 1200 revolutions per minute.

RULE.

Allow for the time which the disk takes to reach the maximum speed one half the number of revolutions per minute that is counted when it has attained the highest speed.

EXPLANATION.

For the first four minutes, while the machine is acquiring the required speed, we count 600 revolutions per minute; this gives for these four minutes 2400 revolutions. There now remain 40,000 revolutions, less 2400 to be made, equal to 37,600. The machine having acquired its speed is then running at 1200 revolutions a minute. Therefore the number of times which 37,600 will contain 1200, is exactly the number of minutes which it will take to complete the operation. This is $31\frac{1}{3}$.

And $31\frac{1}{3}$ with 1 added equals $32\frac{1}{3}$ minutes the time required.

Value of different systems of skimming.

In Denmark where the importance of the dairy industry is well understood, the government keeps a staff of experts of great capacity, constantly employed in testing new systems, as they appear, in comparing them with the old and giving to the country at large the benefit of their experiments, and of the knowledge thus acquired. It is true that the country is obliged to expend a considerable sum of money for this purpose, but there is no doubt that it is a profitable investment; Danish farmers and dairymen don't invest in inventions and improvements, until they have ascertained their exact value from the government reports.

When the Cooly can first made its appearance in Denmark, and the claim was made that it could raise all the cream between milkings, or in 10 hours with water at 46° or 50° Fahrt., the Danish government ordered Prof. J. N. Fjord, the greatest living dairy expert, to investigate this claim and report on it.

When the centrifugal at first made its appearance, Prof. J. N. Fjord was commissioned to examine it, and to let the public know its value.

COMPARISON OF THE COOLY WITH OTHER SYSTEMS.

We give below the result of the experiments then made, showing the comparative butter yield of the following systems: the "Centrifugal", the "Ice 12 hours", the "Ice 24 hours", the "Water at 46° Fahrt. 12 hours and 24 hours", the "Water at 40° Fahrt. 12 hours and 24 hours", and the "Cooly".

The size of the Cooly can used in these experiments was equal to that of the ordinary deep can. Both the "Cooly" and the ordinary cans were placed in the same cooling vessel, and left at the same temperature, the same length of time, so that all the conditions of skimming with the use of these different methods were perfectly identical. The results are about similar to those obtained in preceding experiments, and prove once more that THE LOWER THE TEMPERATURE, THE LARGER THE YIELD.

TABLE No. 2

	Centrifugal.	Ice 32° Fahrt.		Water at 46° Fahrt.			
		12 hrs setting	24 hrs setting	12 hours setting.		24 hours setting.	
		Ordinary can.	Ordinary can.	Ordinary can.	Cooly can.	Ordinary can.	Cooly can.
45 lb. milk cans							
Proportionate yield of butter......	115.8	96	100	79 9	80.1	89 9	90.2
Lbs. of milk to a lb. of butter...	27	32.7	31.6	39.6	39.5	35.2	35.1
30 lb. milk cans							
Proportionate yield of butter......	118	96.7	100	80.7	80.8	—	—
Lbs. of milk to a lb. of butter.....	27.2	33.3	32.2	39.9	39.8	—	—
				Water at 40° Fahrt.			
45 lb. milk cans							
Proportionate yield of butter......	115	96.8	100	91.0	91.1	96.2	96.3
Lbs. of milk to a lb. of butter.....	27.2	32.7	31.5	34.6	34.6	32.7	32.7
30 lb. milk cans							
Proportionate yield of butter......	114.5	96 0	100	25 0	92.7	—	—
Lbs. of milk to a lb. of butter...	27.4	32.6	31.3	33 9	33.8	—	—

The milk from Danish cows is somewhat poorer than that from Canadian cows.

It is easy from this table to determine the value of these methods.

When from a certain quantity of whole milk the "Centrifugal" extracted 115.8 lbs. of butter, the "Ice 24 hours" extracted from the same quantity of whole milk of the same richness, 100 lbs.; and the "Ice 12 hours" extracted 96 lbs., and "Water" (according to the can used and the number of hours of setting) produced 79.9, 80.1 lbs.; 89.9, 90.2 lbs.

It is thus seen that using the "Centrifugal" it takes 27 lbs. of whole milk to make 1 lb. of butter. Using "Ice 24 hours" it takes 31.6; "Ice 12 hours" requires 32.7 lbs. to make a lb. of butter, &c.

Another series of experiments was made by Prof. Fjord at the experimental farm of Ourupp. The object of these experiments, which continued during 12 months, from April, 1881, to March, 1882, was to ascertain the relative butter yield of the following six systems:

"ICE, 10 HOURS;" "ICE, 34 HOURS;" "WATER AT 50° FAHRT, 34 HOURS;" "SHALLOW PANS 34 HOURS;" "CENTRIFUGAL;" "CHURNING OF MILK."

Each experimental day, 609 lbs. of milk were used, divided in the following manner: 50 lbs. for each trial by the "Ice," the "Cold water" and the "Pan" systems; 400 lbs. for the "Centrifugal," and 9 lbs. for the "Churning of milk," methods.

The milk was cooled to 33° Fahrt by the "Ice system." By the "Cold water" system, setting in deep cans, the milk was maintained at a uniform temperature of 50° Fahrt. The thickness of the milk in the "Low pans" ran up to two inches, and the milk was maintained at a temperature sufficiently low, to keep it perfectly sweet during 34 hours, even in the hottest days of Summer.

Each 50 lbs. experiment with the "Ice," "Cold water, and "Low pan" systems gave about 9 lbs. of cream, and each portion of cream was churned separately. One-eight of the cream (or nearly 9 lbs.) obtained through the centrifugal process, was cooled, heated again, acidulated and finally churned. Acidulation had preceded the churning of the 9 lbs, of whole milk.

During the period above mentioned, 600 experiments, divided into two series, were executed; that is, one series was made with milk from the farmer's own cows and the other with milk bought from several farms.

For the "low pan" experiments, the milk was kept at a lower temperature (5° nearly) than that which is generally found in ordinary dairies or butter factories, consequently, the butter yield was superior to that generally obtained in the "low pan" butter factories.

We give the results in tabular form below. For the information of such of our readers as have neither time nor inclination to go over the tables, we give the averages in larger type.

NOTE.—The third and fourth decimals do not always appear in the columns of the tables, but they are reckoned in the general averages.

TABLE 3—MILK FROM THE FARMER'S OWN COWS.

	Lbs. of Butter per 100 lbs. of Milk.						Lbs. of Milk to a lb. of Butter.						Number of Experiments	Temperature of Milk at the time of setting.
	Ice 10 hours.	Ice 34 hours.	Water at 50° Fahrt 34 hours.	Low Pans 34 hours.	Centrifugal.	Churning of Milk.	Ice 10 hours	Ice 34 hours.	Water at 50° Fahrt 34 hours.	Low Pans 34 hours.	Centrifugal.	Churning of Milk.		
April	3.18	3.43	2.86	3.59	3.90	3.66	31.4	29.2	35.0	27 8	25.6	27.3	4	84° Fahrt.
May	3.22	3.42	2.91	3.49	3.86	3.54	31.0	29.2	34.3	28.6	25.5	28.2	8	83° "
June	3.33	3.53	3.16	3.55	3.92	3.62	29.9	28.3	31.5	28.3	23.4	27.6	4	83° "
July	3.61	3.88	3.47	3 84	4.27	3.89	27.7	25.8	28 8	26.0	24.0	25.7	4	84° "
August	3.62	3.82	3.33	3.76	4.16	3.93	27.6	26.2	30.0	26.5	25.0	25.4	4	83° "
September	3.32	3.56	3.05	3.51	3.99	3.67	30.1	28.1	32.8	28.4	25.0	27.2	4	84° "
October	3.36	3.69	3.09	3.72	4.30	3.80	29.8	27.1	32.3	26.9	23.2	26.3	4	78° "
AVERAGE	**3.37**	**3.62**	**3.12**	**3.63**	**4.06**	**3.73**	**29.6**	**27.7**	**32.1**	**27.5**	**24.6**	**26.8**		**83°** "
Milk of old calved cows only.														
November	1.79	2.28	2.31	3.54	4.53	4 10	55.8	43.8	43.0	28.2	22.0	24.4	4	81° "
December	1.25	1.57	1.89	3 42	4.27	3.83	79.6	63.7	52.9	29.2	23.4	26.1	4	83° "
AVERAGE	**1.52**	**1.92**	**2.10**	**3.48**	**4.41**	**3.96**	**67.7**	**58.7**	**48.1**	**28.5**	**22.7**	**25.2**		**82°** "
Milk of newly calved cows.														
January	3 44	3.72	3.06	3.85	4.24	3.90	29	26	32	26	23	25.6	4	84° "
February	3.39	3.61	2.98	3.80	4.18	3.88	29	27	33.5	26	23	25.7	4	85° "
March	3.36	3.66	2.95	3.70	4.12	3.81	29	27	35.8	26	24	26.2	4	86° "
AVERAGE	**3 40**	**3.67**	**3.00**	**3.79**	**4.18**	**3.87**	**29.0**	**27.2**	**33.0**	**26.0**	**23.9**	**28.8**		**85°** "

TABLE 4—MILK FROM SEVERAL FARMS.

	Lbs. of Butter per 100 lbs. of Milk.						Lbs. of Milk to a lb. of Butter.						Number of Experiments.	Temperature of Milk at the Time of Setting.
	Ice—10 hours.	Ice—34 hours.	Water at 50° Fahrt. 34 hours.	Low Pans 34 hours.	Centrifugal.	Churning of Milk.	Ice—10 hours.	Ice—34 hours.	Water at 50° Fahrt. 34 hours.	Low Pans 34 hours.	Centrifugal.	Churning of Milk.		
April	3.05	3.28	2.66	3.34	3.73	3.53	32.7	30 5	37.6	29.9	26 8	28.3	4	72° Fahrt.
May	3.01	3.24	2.65	3.16	3.61	3.20	33.2	30.8	37.7	31.6	27.7	31.2	3	66° "
June	3.33	3.52	3.06	3.46	3.86	3.38	30.0	38.4	32.7	28.8	25.9	29.6	4	76° "
July (1)	......	......	......	......	......	......	......	......	......	......	......	......	......	......
August	3.68	3 88	3.35	3.77	4.23	3.93	27.2	25.8	29 8	26.5	23.6	25.4	4	75° "
September	3.74	3.95	3 32	3.85	4.41	4.07	26.7	25.8	30.1	25.9	22.7	26.4	4	76° "
October	3.33	3.60	2.95	3 68	4.24	4 10	30.0	27 7	33 9	27.2	23.6	24.4	4	65° "
November	3.04	3.33	2.58	3.29	4.00	3.83	32.8	30.0	38.7	30.3	25.0	26.1	4	65° "
December	2.98	3.24	2.56	3.27	3.88	3.73	33.5	30.8	38.9	30.5	25.8	26.8	4	60° "
January	2.98	3.23	2 57	3.26	3.81	3.58	33.5	30.9	38 8	30.7	26.2	27.9	4	66° "
February	2 99	3.23	2.70	3.27	3.76	3.57	33.4	30 9	37.0	30.5	26.6	28.0	4	64° "
March	2.92	3.14	2 47	3.16	3.59	3.40	34.1	31.8	30.4	31.6	27.8	29.4	4	69° "
AVERAGE	**3.18**	**3.46**	**2.80**	**3.41**	**3.92**	**3.66**	**31.5**	**30.2**	**3[illegible].9**	**29.4**	**25.6**	**27.4**		**69°** "

(1) No experiments made during this month.

TABLE 5.—MILK FROM THE FARMER'S OWN COWS.—AVERAGE YIELD OF DIFFERENT SYSTEMS.

	Average Butter yield of the different Systems.						The Centrifugal gives more Butter per cent. than—				
	Ice 10 hours.	Ice 34 hours.	Water at 50° Fahrt 34 hours.	Low Pans 34 hours.	Centri-fugal.	Churning of Milk.	Ice 10 hours.	Ice 34 hours	Water at 50° Fahrt 34 hours	Low Pans 34 hours.	Churning of Milk.
April	92.7	100	83.4	104.8	113.8	106 8	22.7	13.8	36 5	8.6	6.6
May	94.0	100	85.1	102 0	112.9	103.4	20.0	12.9	32.6	10.7	9.2
June	94.4	100	89.4	99.8	110.9	102.5	17.5	10.9	24.1	11.0	8.2
July	93.0	100	89 5	99.0	110.3	100.4	18.5	10.3	23.2	11.3	9.8
August	94.8	100	87.2	98.7	108.9	102.9	14.9	8 9	25.0	10 4	5.9
September	93.4	100	85.7	98.8	112.2	103.2	20.2	12.2	30.9	13.5	8.7
October	91.0	100	83.8	100.8	116.6	103.0	28.2	16.6	39.2	15.8	13.2
AVERAGE	**93.3**	**100**	**86.3**	**100.5**	**112.8**	**103.1**	**20.0**	**12.0**	**30.2**	**11.6**	**8.8**
Milk of Old Calved Cows only.											
November	78.6	100	101.3	155.4	198.9	179.7	152.0	98.9	96 4	27.8	10.6
December	80 .0	100	120.4	217.8	271.8	244.0	239.0	171.8	125.8	24.8	11.3
AVERAGE	**78.3**	**100**	**110.5**	**186.6**	**235.0**	**212.0**	**196.0**	**135.0**	**111.0**	**26.3**	**10.9**
Milk of New Calved Cows only.											
January	92.5	100	83.3	103.4	114.0	104.9	23.2	14.0	38.4	10.2	8.6
February	92.6	100	81.3	103.7	114.1	106.0	23 3	14.1	40.3	10.0	7.6
March	93.1	100	81.7	103.0	114.0	105.4	22.5	14.0	39.5	10-7	8.2
AVERAGE	**92.7**	**100**	**81.8**	**103.3**	**114.0**	**105.4**	**23.3**	**14.0**	**39.4**	**10.3**	**8.0**

TABLE 6—MILK FROM DIFFERENT FARMS.

	Average Butter yield of the different Systems.						The Centrifugal gave more Butter per cent, than—				
	Ice—10 hours.	Ice—34 hours.	Water at 50° Fahrt. 34 hours.	Low Pans 34 hours.	Centrifugal.	Churning of Milk.	Ice—10 hours	Ice—34 hours.	Water at 50° Fahrt. 34 hours.	Low Pans 34 hours.	Churning of Milk.
April	93 4	100	81.1	102.0	113.9	107.7	22.3	13.9	40.5	11.7	5.8
May	92.9	100	81.7	97.5	111.3	98.8	19.8	11.3	36.3	14.2	12.7
June	94 4	100	86 8	98.4	109 6	95.5	16.0	9.6	26.2	11.4	14.2
July	......	......	......	......	......	......	......	......	......	......	....(1)
August	94.8	100	86.5	97.2	109.2	101.3	15.1	9.2	26.2	12.3	7.8
September	94.7	100	84.1	97.5	111.6	103.1	17.9	11.6	32.7	14.4	8 3
October	92 4	100	81 8	102.0	117.6	103.0	27.3	17.6	43.7	15.3	3.5
November	91.5	100	77.5	99.0	120.2	113.6	31.4	20.2	55.1	21.4	4.5
December	92.0	100	79.1	101.1	119.6	115.1	29.9	19.6	51.1	18.4	4.0
January	92.3	100	79.7	100.9	118.0	115.0	27.9	18.0	48.0	10.9	6.4
February	92.4	100	83.4	101.3	116.2	110.3	25.8	16.2	39.4	14.8	5.4
March	93.1	100	78.7	100.5	114.2	108.1	22.7	14.2	45.1	13 6	5.6
AVERAGE	**92.9**	**100**	**81.8**	**99.7**	**114.6**	**106.5**	**23.2**	**14.5**	**40.4**	**14.4**	**7.1**

(1) No experiments made during this month

In table No. 5, the basis of comparison is "Ice 34 hours." Thus the table is read in the following manner: taking April when "Ice" 34 hours gives 100 lbs. of butter, "Ice" 10 hours gives only 92.7 lbs., "Water at 50° Fahrt. 34 hours" gives still less, 83.4 lbs.; "Low pans 34 hours" give 104.8 lbs.; the "Centrifugal" gives 113.8 lbs.; the "Churning of milk" gives 106.8 lbs.

From these tables the following facts may be gathered:

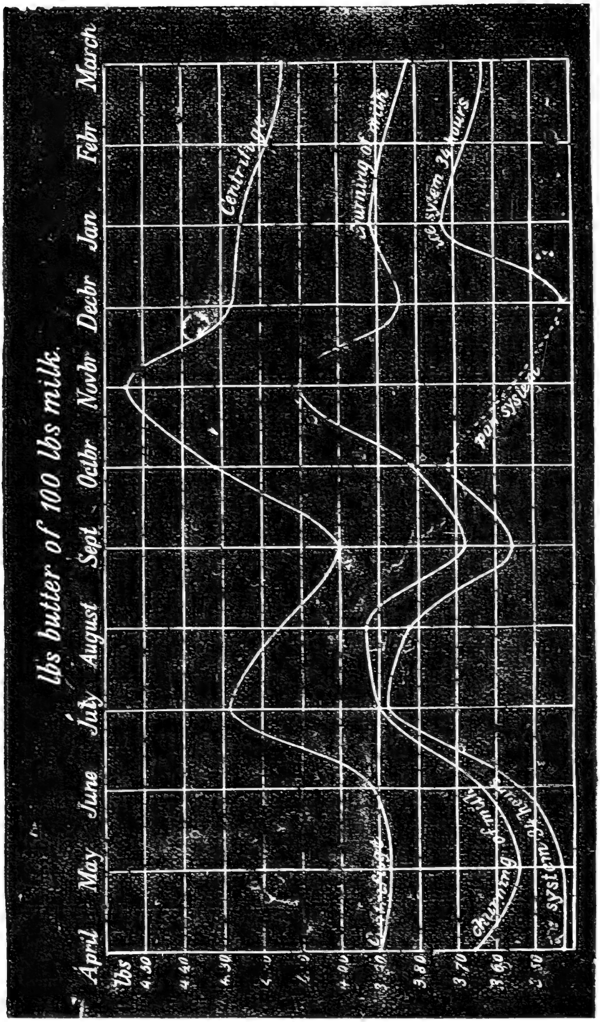
1o. A method, which works well at one season, may not work well at another. Thus during the month of December (see table 3) by the "Ice 10 hours," it took 79.6 lbs. of milk to make 1 lb. of butter, while by the same method, during the month of August, it took but 27.6 lbs. All the conditions of skimming in both cases were perfectly identical. The difference was caused by "*heavy milk.*"

2o. The loss from heavy milk was less apparent in the milk obtained from several farms, than in that taken from the farmer's own cows, because in the first case the milk of old calved cows was mixed with that of newly calved cows; and old calved cows give comparatively little milk.

3o. Milk transported from other farms, shows an average loss of temperature of 14° Fahrt, over that obtained on the farm. This loss of heat caused the butter yield to be 2½ per cent. less than that obtained from the milk of the farmer's own cows.

We give below an indicator diagram, showing the decrease or increase of the cream yielding power of milk during different months, with different methods of skimming:

TABLE No. 7.



Indicator Diagram.

The value of the systems can here be seen at a glance First comes the "Centrifugal": then the "Churning of milk," and afterwards the "Ice system" for a part of the year.

During the months of October, November and December the "Ice" system being unable to raise a sufficient proportion of the cream, on account of the milk being "heavy," it was superseded by the "Low pan" system. This substitution is shown for these months by means of a dotted line; the months during which the "Ice" system was used being indicated by a full line.

From the above tables we take the following general results.

TABLE 8.

GENERAL RESULTS.

	Experiments made with milk from the farmer's own cows. Duration of experiments, 10 months. Pounds of milk required to make 1 lb. of butter.			Experiments with bought milk. Duration of experiments, 11 months. Pounds of milk required to make 1 lb. of butter.		
	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.
Centrifugal	24.4	23.	25.8	25.5	22.7	27.8
Churning of milk	26.7	25.4	28.2	27.3	24.4	31.2
Ice 34 hours	27.5	25.8	29.2	29.2	25.3	31.8
Ice 10 hours	29.5	27.6	31.4	31.3	26.7	34.1
Water at 50° Fahrt. 34 hrs	32.	28.8	35.9	35.9	29.6	40.0

RESULT OF CHEMICAL ANALYSES OF "BUTTER-MILK," "BUTTER" AND "SKIM MILK."

The "butter milk," "butter" and "skim milk" obtained by the above methods of treating milk, were next analysed by Prof. Storck, of the Stein experimental Station, Denmark, in order to determine the quantity of butter fat contained in each of them, and thus to ascertain if the difference in the butter yield was due to the differences of efficiency of the several methods of treating milk, or if it could be partly attributed to the *incomplete churning* of the cream, or to the *ineffectual working* of the butter in some cases.

ANALYSIS OF THE "BUTTER MILK."

The "butter milk" was then analyzed, and the result shows a remarkable uniformity in the quantities of butter fat contained in the different butter milks, obtained from milk of same quality, but which had been skimmed by different methods.

The butter milk derived from 100 lbs. of whole milk gave in no case a larger quantity of butter fat than 1½ ounces. It was therefore evident that the difference in the butter yield could not be attributed to a waste in the butter milk.

The difference in the butter yield must then be attributed either to the presence of an unusual quantity of water or cheesy matter in some of the butter, or to the superior efficiency of some systems of skimming over others.

ANALYSIS OF THE BUTTER.

The results showed that the butter obtained from milk treated by different methods of skimming contained the same quantity of water, in every case the quantity was 2½ ounces to a pound of butter.

ANALYSIS OF THE SKIM MILK.

It was now plain, that the differences in the butter yield, must be caused, by some methods of skimming leaving in the skim milk a larger proportion of butter fat than others.

TABLE No. 9.

Chemical Analysis of the "Skim Milk."

PERCENTAGE OF BUTTER FAT IN THE SKIM MILK.

	Different Methods of Skimming.				
	Ice—10 hrs.	Ice—34 hrs.	Water at 50° Fahrt.	Low Pans.	Centrifugal.
1881.	ozs.	ozs.	ozs.	ozs.	ozs.
June 7th—Milk from the cows of a private dairy	....	8	12	....	2
June 8th—Milk from the cows of different farms	....	6 4/10	15 ¼	....	1 ⅛
September 28th—Milk from a private dairy	13	9	18 4/10	8 ½	2 2/25
October 4th—Milk from a private dairy	17 3/25	12	20 ⅓	9 ¾	2 ½
November 8th—Milk from the cows of different farms	20 4/25	15	25	14 ½	4 ½
November 27th—Milk from the cows of a private dairy	....	46 ½	....	16 ½	2 ⅞
December 16th—Milk from the cows of a private dairy	....	41 1/7	......	17	2 4/10
Milk from newly-calved cows only:					
November 27th—Milk from the cows of a private dairy	....	9 3/25	....	7	1 ¾
December 16th—Milk from the cows of a private dairy	....	7	....	6 ⅞	1 3/5
1882.					
January 23rd	13	8 4/5	21 ¼	5 ¾	1 3/5
February 13th	18	12	22 ¼	9 ¼	1 3/5
March 6th	11	7 ½	15 ⅓	5 ¾	1 ¾

From this table, we see that the differences in the butter yield, are entirely due to some methods of skimming milk, being more efficient than others.

The quantity of butter fat contained in milk from Danish cows varies from 3 to 4°/o of its weight. We may adopt 3.50°/o as an average

WHAT THE DIFFERENT METHODS CAN DO AND SHOULD DO.

TABLE No. 10

Methods.	What the methods should do.		What they really do in Denmark.	
	The smallest quantity of butter fat left, in best circumstances, in the skim milk.	Fraction, of all the butter fat, left in the skim milk.	Average quantity of butter fat which is generally left in the skim milk, when the whole milk is in normal condition.	Fraction, of all the butter fat, left in the skim milk.
Ice 34 hrs	5 6/10 ozs. of butter ...	1/10	ozs. of butter 9 92/100	nearly 1/6
Shallow-pans 34 hrs.	6 4/10 " "	1/9	10 88/100	1/5
Centrifugal	16/25 " "	1/87	2 4/10	1/23

Thus we can see at a glance, what the different methods can do and should do, when used to their utmost capacity.

We find that in Danemark with the "Ice method 34 hours," $\frac{1}{6}$ of all the butter fat is left in the skim milk, with the Shallow pans 34 hours, $\frac{1}{5}$ of the butter fat remains in the skim milk and, that the "Centrifugal" leaves about $\frac{1}{23}$.

This shows that the Danes find it advantageous to skim the milk very closely.

CONCLUDING REMARKS ON THE DIFFERENT SYSTEMS (1).

1o. Advantages and disadvantages.

2o. Appreciation of the quality of butter produced by each system.

3o. When and how to use them.

THE SHALLOW PAN SYSTEM.

ADVANTAGES.

1o. When large pans are used, it requires less labor than the deep setting in cans, and the first cost of the plant is less than that of the centrifugal.

2o. It may be used with advantage in the treatment of heavy milk.

DISADVANTAGES.

In some countries where butter making is well understood and well practiced, the shallow pans are rapidly disappearing out of small private dairies, where ice can be had. They are also superseded by the centrifugal separator in large and cooperative dairies.

Good butter can be made from milk set in shallow pans, but this system offers the following disadvantages:

1o. It requires very much time.

2o. " an abundance of running water.

3o. " much space.

4o. " a cool specially constructed and well aired room, and a uniform temperature.

(1) Shallow pans, deep setting in cold water, deep setting in ice, and the centrifugal systems, are now in use in Canada Deep setting in cold water (45 to 55 ° Fahr.) is most in use in our private dairies.

5o. It exposes the milk to atmospheric changes, and to the absorption of impurities from the surrounding air.

6o. In hot weather, cream from the shallow pans is apt to be cheesy, and the quality of the butter generally lacks uniformity.

7o. The cream is apt to over ripen.

8o. During the heat of summer even when milk can be kept sweet during 34 hrs., this mode of skimming gives less butter than deep setting in "Ice" 34 hrs.

9o. In hot weather it leaves the skim milk in a bad condition.

10o. It is not very well adapted to cooperative dairies, because it requires the transportation of milk twice a day.

The shallow pan system may be used with advantage. in places, where no other cooling medium than cold air or cold running water is to be had, and also in the treatment of heavy milk.

HOW TO USE THE SHALLOW PANS.

Milk should be set to the depth of from 2½ to 4 inches,(1) immediately after each milking, at a temperature of about 55° Fahrt. (2) and kept sweet 36 hours before skimming. The best time to skim is, when the milk is yet sweet. If the operator desires to see if the cream has completely risen, he should make a streak with a spoon across the surface. If this streak remains visible for a little while, after it is made, the cream has finished rising.

(1) According to the temperature of the place where it is set, and the time of the milking period.

(2) If the temperature of the room is kept below 57° the milk will remain sweet 36 hours. If the temperature ranges from 57° to 63° the milk will remain sweet from 30 to 24 hours. In any case it should be skimmed before acidulation takes place.

DEEP SETTING.

ADVANTAGES OF DEEP SETTING.

1o. It saves space.

2o. It saves water.

3o. If proper means are taken it will keep milk free from atmospheric impurities.

DEEP SETTING IN WATER AT 50° FAHRT.

According to the result of Prof. Fjord's experiments. deep setting at 50° Fahrt. gave the poorest yield of any system of skimming. It gave something like 40 o/o less butter than the centrifugal.

It may be used in small dairies, where the only cooling medium to be had is cold or spring water.

Milk should remain in the vessels at least 36 hours.

IMPORTANCE OF USING ICE WITH THE DEEP SETTING SYSTEM.

In order to give the farmer a practical illustration of the advantage of using ice, in a country like this, where any quantity is furnished every winter by nature, let us give some figures in this connection.

According to Prof. Fjord's experiments and those of other dairy scientists, the ice system, 34 hours gives from 11 to 17 per cent. more butter than cold water at 50° Fahrt. 34 hours—average 14 per cent

Thus if we obtain 100 lbs. of butter out of 2500 lbs. of milk cooled to 33° Fahrt., we will get only 86 lbs. out of the same quantity cooled to 50° Fahrt. Loss 14 lbs. at 25 cts. : $3.50.

Supposing that a farmer keeps 10 cows, and obtains from them a yearly average of 3750 lbs. of milk, or about 150 lbs. of butter. The loss on 150 lbs. is equal to $5.25 multiplied by 10 equal $52.50.

Prof. Fjord calculates that to every 100 lbs. of milk $1\frac{1}{4}$ lbs. of ice are required for every degree of heat to be expelled. The quantity varies with the time the milk stands, the form of the milk can, the kind of refrigerator or cooling tank used, and also the temperature of the milk room.

To bring 100 lbs.of milk just short of freezing point with single sided tanks, with 24 hours setting, it would requires says Mr. Fjord from 65 to 70 lbs. of ice a day average $67\frac{1}{2}$ lbs. between May and September, and 42 lbs. during the remainder of the year. A cubic foot of of ice weighs about 45 lbs.

Thus to cool 3750 lbs. of milk (or about the milk of one cow) to 32o Fahrt., it would require in summer 2531 lbs. or about $1\frac{1}{4}$ tons of ice per cow, giving about 150 lbs. of butter (56 cubic feet of ice). (1)

From the figures given above, any one can see the advantage of using ice.

ADVANTAGES OF "DEEP SETTING" IN ICE.

1o. It gives a perfectly sweet cream.

2o. It gives a product of uniform quality.

3o. The best butter makers of the world regard deep setting in ice, as one of the best means of obtaining the finest and longest keeping butter.

4o. It keeps the skim milk sweeter than any other system.

(1) 56 cubic feet of ice is a block of about 3 ft. 10 inches long, 3 ft. 10 inches wide, and 3 ft. 10 inches thick.

DISADVANTAGES.

1o. Towards the end of the milking period, when milk is *heavy*, it will not make a sufficient quantity of the cream rise and therefore it must be discarded. (1)

The proper method of treating *heavy* milk, is by shallow pans (small or large), or by the churning of whole milk, or still better by using a centrifugal separator.

2o. Some people seem to think that the necessity of using ice is a disadvantage, but it is nothing of the kind, the superior yield, more than makes up for any extra trouble.

We consider this the best system of milk setting for the average private dairy of Canada.

HOW TO USE THIS SYSTEM.

When milking use a covered milk pail provided with a strainer. (2)

Immediately after milking, while the milk is still warm, strain it directly into the cans, and place the cans in the tank which has been previously half filled with cold water. Place a small temporary wooden cover over each separate can, in order to prevent any ice from falling into the milk, while the operator is shoveling it into the tank.

The ice should be broken to the size of large nuts, and enough of it should be used to fill the tank up, to

(1) It is not strictly necessary to discard the vessels provided, milk is set in them to a depth of 2 or 3 inches only, during 34 hours at 55° Fahrt.

(2) There are several pails of this kind in the market. A covered milk pail has a cover with a hole in it, through which a funnel provided with a strainer is run or otherwise fixed.

about the level of the milk in the cans. After a little while, when the milk in cooling has melted, a small portion of the ice, the overflow tap of the tank is opened, a little water runs out, and the tank is filled up again with ice to the same height as before. (1)

The covers are then taken off the cans, and the milk remains exposed to the action of pure cold air, which carries off the animal odor and other impurities of the milk. When covers are used (and they should be used in all dairies when the air cannot be kept perfectly pure, and when the conditions as regards cleanliness are not excellent), they should not be placed on the cans, until the temperature of the milk has reached the temperature of the dairy. If the cans are covered before this, the cowey odor will remain in the milk. If, on the contrary, they are left uncovered after this, the milk will absorb any bad smell, that there may be in the dairy.

The most economical plan is to leave the cans uncovered, but to cover the tanks. By this means, one cover does for all. This gives less trouble, costs less, and takes less ice than if the tanks are left uncovered.

With the deep setting, the cream is " thin," but let it not be supposed that this makes it more difficult to completely skim the milk, for the coating of cream is easily removed from the skim milk. Still care must be taken. The cream is taken off with the skimmer until the blue milk appears.

After some practice, a person can skim a can in one or two minutes. By skimming from the top of the can, one is sure of getting pure cream, which has not been mixed

(1) The water should be changed often enough to keep it perfectly pure and odorless.

with impurities, such as are often found round the sides and the bottom of the cans.

CABINET CREAMERS, VATS, PANS, ETC.

As regards the great variety of cabinet or box creamers, vats and pans, constructed on the deep and shallow setting plan, we may state that some of them are very handy devices, but as we do not know that they have been scientifically tested by disinterested parties, we are in no position to express an opinion as to their respective value.

THE CREAM GATHERING SYSTEM.

ADVANTAGES.

1° It is very economical, as it saves the drawing of milk to and from the creamery.

2° The creamery building need not be expensive.

3° The cream can be collected over a much larger territory, than it would be possible to carry the milk, if delivered at one factory.

The dairyman or farmer generally realizes considerably more than he would, were he to manufacture butter on the farm, and sell it on his own account.

DISADVANTAGES.

1o. The cleanliness and temperature of 300 (and even more) dairies are not generally uniform. Again some dairies will use ice, while others will use water at varying degrees of temperature, as cooling mediums. Therefore the milk set in all these dairies is set in different conditions. This want of uniformity injures the quality and diminishes the quantity of the butter.

2o. In the best circumstances that is when all the farmers use ice water at 33° Farht., and the milk is set 34 hours, this system gives about 14 per cent. less butter than the centrifugal — (see table No. 6 of Prof. J. N Fjord's experiments, page 56).

3o. Owing to the milk being set in different conditions as to temperature, &c., the cream so obtained varies very much in density, therefore it is very difficult to measure it accurately, and do justice to the patrons.

4o. In the fall of the year, when milk is *heavy*, this system offers difficulties not generally understood.

As already explained in the article on "Heavy milk" (1) there is sometimes no distinctly marked line between the cream and skim milk, consequently its measurement would be a difficulty of the most serious kind.

Again, according to the result of Prof. Fjord's experiments (see page 53 table No. 3) from 50 to 75 per cent. of the cream would remain in the "*heavy*" milk if the deep setting were persevered in; if the deep setting were superseded by shallow-pans, it would require two sets of vessels. It is true that his difficulty can be overcome to a certain extent by using the deep cans even for "heavy" milk, setting milk in them only to the depth of four inches. In this case it would be necessary to provide them with an extra gauge near the bottom.

The cream gattering system may be used in thinly settled section, and sections where the herds are small.

MANNER OF WORKING.

Milk should be set in ice 33° Fahrt. at least 24 hours For details see page 67, on deep setting in ice.

(1) This peculiarity of milk is found on one farm to day, and on the next to-morrow, &c.

THE CHURNING OF WHOLE MILK.

ADVANTAGES.

1o. The butter yield by this system is second only to that of the centrifugal.

2o. It may also be used with advantage in the treatment of heavy milk.

DISADVANTAGES.

1o. The churning of whole milk requires too much work to be of any practical value, where large quantities of milk are handled.

2o. The butter, from churned milk, contains a little more cheesy substance than that obtained by other systems.

HOW TO CHURN THE WHOLE MILK.

The milk should stand at a high temperature, until slightly sour (artificial means may be taken to produce this effect), and churned at about 68 Fahrt.

THE CENTRIFUGAL SYSTEM.

ADVANTAGES.

The centrifugal system offers the following advantages :

1o. IT ALLOWS OF THE TRANSPORTATION OF MILK TO THE FACTORY, BUT ONCE A DAY. THUS HALF THE COST AND TROUBLE OF MILK TRANSPORTATION IS SAVED.

2o. IT SAVES SPACE.

The space covered by a centrifugal is very small, not on an average more than 20 inches x 6 feet for the small sizes and 3½ ft. x 8 for large sizes.

3o. IT SAVES TIME.

By this system 10,000 lbs. of milk will yield its cream in 4 or 5 hours. While by any other system, to yield considerably less cream it would require from 24 to 36 hours.

4o. IT SAVES WATER AND ICE.

With this system, water is used only for washing butter, cleaning purposes and for the engine. It must be remembered that with this system only the cream is cooled, while with other systems, the whole mass of milk and cream has to be cooled. Instead of cooling 100 lbs. of milk the dairyman cools 20 lbs. of cream only.

5o. BY IT THE MILK IS SAVED FROM EXPOSURE TO IMPURE AIR, AND TO ATMOSPHERIC CHANGES.

6o. IT SAVES LABOR.

7o. It gives a perfectly sweet cream in large quantities, (two milkings can be skimmed at a time). This cream, uniformly fresh, can be soured to suit the taste of the butter maker.

8o. IT GIVES A GREATER YIELD OF BUTTER.

The latest experiments of Mr Fjord, show that the centrifugal system gave during 12 months, an average of 23 per cent. more butter than the "Ice 10 hours" 14 per cent. more than the "Ice 34 hours, 41 per cent more than the "Water at 50 Fahrt.", 14 per cent. more than the "Pans 34 hours" and 7 per cent. more than the 'Churning of milk".

9o. IT GIVES A BETTER QUALITY OF BUTTER.

However carefully the milking and straining have been done, the centrifugal extracts from the milk and cream, and consequently from the butter, a large amount of impurities, (1) which older methods could not remove.

(1) Often as much as 0.15 per cent. of the weight of new milk.

Therefore, centrifugal butter is sweeter and purer. It has also a higher melting point, (1) consequently it ought to keep longer than the ordinary product.

10o. IT LEAVES THE SKIM MILK SWEET FOR THE CALVES AND SWINE.

DISADVANTAGES.

It requires more outlay for plant. When large centrifugal separators are used (or two small ones) and steam power is required, the running expenses are somewhat greater than with older methods.

The larger the dairy, the less expense comparatively speaking. For very large cooperative creameries, the running expenses are not greater than by other methods, (if we except the cream gathering system.)

Therefore, this system is the best adapted to large private, and to cooperative or public dairies.

For comparative value of all the systems see tables of averages, Nos. 5 and 6, pages 55 and 56.

(1) Melting point of centrifugal butter.......... 98° Fahrt.
" " ordinary butter...... 94° Fahrt.
Difference................ 4°

Centrifugal Milk Separators.

SPEED AND INFLOW.

The capacity of a centrifugal machine, is the largest quantity of milk which it can skim per hour, leaving but an extremely small quantity of butter fat in the skim milk (about .25 %, or four ounces in 100 of whole milk).

Thus a machine, of 700 lbs. capacity, is one which can skim 700 lbs. per hour, leaving but a minimum of fat in the skim milk.

The completeness of the skimming depends :

1o. On the speed.

2o. On the inflow of milk.

An example will illustrate our meaning. A machine is running at 3.000 revolutions a minute, and at this rate of speed, is capable of completely skimming 450 lbs. of milk per hour. If through any cause the speed diminishes, the milk will not be completely skimmed. A part of the butter fat will be lost in the skim milk. The greater the diminution of speed, the greater will be the *waste* of butter fat in the skim milk.

The same loss would take place if, instead of the speed diminishing, the inflow of milk should increase : if instead of 450 lbs., the inflow should rise to 600 or 700 lbs., there would remain a much larger proportion of butter fat in the skim milk.

A series of experiments was made to find the relation between speed and inflow. The following law was discovered:

The inflow should vary as the square of the speed.

When the number of revolutions which a given centrifugal must make, to completely skim a certain quantity of milk, is known, the number of revolutions, which it should make to skim any other quantity, is found by the following rule:

Multiply the given number of pounds by the square (1) of the required speed, and divide the product by the square of the given speed.

EXAMPLE.

A dairyman having a centrifugal capable of skimming 450 lbs. of milk per hour, when running at a speed of 2,400 revolutions per minute, desires to know how many lbs. he can skim when running at 3,000 revolutions per minute.

SOLUTION.

As $2{,}400^2 : 3{,}000^2 :: 450 : x$

$2{,}400^2 = 5{,}760{,}000$

$3{,}000^2 = 9{,}000{,}000$

$5{,}760{,}000 : 9{,}000{,}000 :: 450 : x$

$$\frac{9{,}000{,}000 \times 450}{5{,}760{,}000} = 703 \text{ lbs.}$$

In the above problem the given number of pounds was 450. The required speed was 3,000. of which the

(1) The square of a number is obtained by multiplying it by itself; thus the square of 3 is 9, of 4 is 16, of 5 is 25, of 6 is 36, etc.

THE QUESTION OF SPEED IS OF GREAT IMPORTANCE.

For example, with a milk flow of 435 lbs. per hour, the small size Burmeinster & Wain's separator left a minimum of 2 ounces of fat in the skim milk, but the quantity increased to 5¼ ounces, when the speed of the machine fell from 2,410 to 2,287 revolutions per minute, and to a maximum of 6¼ ounces, when the speed was still further reduced to 2,257 revolutions per minute.

WHEN IS IT ADVISABLE TO BUY A CENTRIFUGAL MILK SEPARATOR, AND WHAT SIZE IS IT ADVISABLE TO BUY?

It is not, at present, advisable to buy a Centrifugal Separator for a dairy of less than twenty cows.

SIZE.

The question of size depends on the quantity of milk to be skimmed and on the time which the dairyman can afford for this operation.

In large public dairies the time allowed for skimming should not exceed from four to six hours. In private dairies the work should be finished in from one to three hours.

It is desirable to have at least one large size Separator in every creamery of any importance. Prof. Fjord's control centrifugal for *telling* the *amount of cream*, in milk brought to the creamery, is adjustable to large Separators only. No well managed public creamery can do without this instrument.

Table showing the number and size of Separators necessary to skim a given quantity of milk.

TABLE 12.

Creameries receiving daily from	Number and size of Separators necessary.
4 to 5,000 lbs. of milk	2 small Separators.
6 to 8,000 " "	1 small and 1 large Separator.
9 to 12,000 " "	2 large Separators.
13 to 15,000 " "	3 " "
16 to 20,000 " "	4 " "

The largest Separator will skim from 12 to 1600 lbs per hour. The small Separator from 4 to 700 lbs.

If a small Separator will do the work in a reasonable time get a *small* one.

If a large one will do, it is preferable not to try a large one, but rather to buy *two* small ones. For if one gets out of order, the second can be made to do all the work while the first is being repaired. This rule does not apply to large establishments ; it is better to have *two* or *three* large Separators, than *four* or *six* small ones. We give below our reasons.

1o. It takes less power to drive two large Separators than four small ones.

2o. *Four* small Separators will require far more care in regulating the milk flow, than *two* large Separators.

3o. Four small Separators will require far more care in regulating the speed, in looking after, in oiling, in cleaning, than two large Separators.

4o. Four small Separators will cost more to buy, to set up, to keep in order, and to run than *two* large Separators.

5o. Four small Separators require more space than two large ones.

ADVICE TO INTENDING PURCHASERS OF THE CENTRIFUGAL.

Some one asks which Centrifugal to buy? We say buy a *good* one.

Points of a good Centrifugal Separator.

1o. A good Separator should be safe and strong, and its workmanship perfect.

2o. Its motion should be easy and steady.

3o. The foundation should be solid, and the revolving parts well protected.

4o. It should require but a moderate degree of power in proportion to the work done.

5o. It should be easy to take apart and to clean. There should be but few pieces to take apart.

6o. Its construction should be simple and plain, and the manner of working readily understood.

7o. It should be built so as to regulate the density of cream (getting thin or thick cream), while in operation.

8o. It should thoroughly skim the first and last milk contained in the drum.

9o. The separated liquids should be discharged in good condition.

10o. The machine should be cheap in the first cost, and cheap to put up. But the main point is that the machine be good, for a poor troublesome Separator, even cheap, will be more expensive in the long run, than a good one at a higher price.

DEFECTS TO BE GUARDED AGAINST IN CENTRIFUGAL SEPARATORS.

1o. Liability to lose speed through any cause, shaking for instance. (This is a very serious defect.)

2o. Sprinkling of milk and cream.

3o. Suction of cream by air into the skim milk.

4o. Loss of oil and heating, through imperfect means of oiling the bearings.

POWER REQUIRED TO RUN CENTRIFUGAL SEPARATORS.

It is often supposed that centrifugal separators require much power to run them. This is a mistake. It takes less than three horse power to start the largest separators. Having reached full speed it requires much less power to keep it agoing. For this reason, several machines can be run by a power little greater than that which is necessary to start one or two large ones.

Of course, in this case, the machines are not all started together. The first is set going, and is got well underway before the second is started; when these two have reached the highest speed a third is set going, etc.

In dairies where two small separators are used the dairyman should provide 3 or 4 horse power. This is more than the power absolutely necessary, but it is always wise to have some spare power. In large creameries from 6 to 10 horse power is required.

REMARKS ON THE USE OF ANIMAL POWER IN RUNNING CENTRIFUGAL SEPARATORS.

In using a horse to run a separator, it is well to remember that the strain on the animal depends :

1. On the speed of the separator. For example a horse could easily run a churn containing from 60 to 80 lbs. of cream and a small Burmeinster & Wain separator, at a speed of about 2200 revolutions per minute, while the same horse would have all he could do to drive the same separator at a speed of 3000 revolutions per minute.

2o. On the time required to perform the day's work. Some farmers have milk for an hour daily. Others have milk enough for two or three hours, work. The less milk, the shorter is the time of the operation, and the more strain the horse could stand.

3o. On the kind of horse-gear used.

4o. On the speed at which the horse is made to go (1). In order to diminish the strain, use a larger pulley and decrease the speed of the horse. With a sweep power, the horse's pace should be regulated so as to cover less than three feet of ground per second.

Prof. Fjord's experiments with the small separator of Burmeinster & Wain gave the following results :

With 2000 revolutions a minute and to skim from 2 to 300 lbs. per hour it requires ½ horse power ;

(1) It must not be forgotten that the speed of the separator, and the speed of the horse are two different things. The horse may be and should be (if the work is to last a long time) traveling very slowly, while the machine is working very rapidly.

With 2400 revolutions a minute and to skim from 3 to 400 lbs. per hour it requires ¾ horse power.

With 2800 revolutions a minute and to skim from 3 to 400 lbs. per hour it requires 1 horse power.

THINGS TO BE REMEMBERED IN USING A MILK SEPARATOR.

1o. Start the machine slowly, skim the first and last contents according to directions given on page 28.

2o. LET THE SPEED BE CONSTANT. For this purpose, every centrifugal milk separator should be provided with: 1o A speed indicator attached to the spindle (1) so that the operator may ascertain the actual number of revolutions of the drum; 2o A belt strainer, to be used when the machine is losing speed.

3o. LET THE INFLOW BE CONSTANT. For this purpose some means of controlling the inflow should be adopted. Prof. Fjord's controlling funnel is the best means we know of (see description, page 26).

4o. WHEN THE SPEED DECREASES, DIMINISH THE INFLOW; WHEN THE SPEED INCREASES INCREASE THE INFLOW. A decrease of 10 %, 20 %, 30 % in the given speed of the Burmeinster & Wain separator, must be attended by a decrease of 20 %, 35 %, 50 % in the milk inflow per hour. An increase of 10 %, 20 %, 30 % in the speed must also be followed by an increase of 20 %, 40 %, 70 % in the quantity of milk worked per hour, if the same amount of butter is expected from a given quantity of milk.

(1) We say *spindle* and not the main shaft, advisedly, because the revolutions of the latter do not represent accurately the revolutions of the drum.

5o. SKIM THE MILK WHILE WARM. If this be inconvenient, the milk can be warmed to 88° Fahrt. before skimming.

6o. FOR COLD MILK let the inflow be ⅓ less than the inflow for warm milk. If a machine skims 300 lbs of hot milk in an hour, it will skim 200 lbs of cold milk in an equal time.

7o. KEEP WORKING PARTS VERY WELL OILED. Use for this purpose the best lard oil or neat's foot.

8o. CLEAN IMMEDIATELY after using.

RELATIVE VALUE OF DIFFERENT CENTRIFUGAL SEPARATORS.

In determining the comparative value of rival Separators, it is necessary 1o. to determine what good skimming is; 2o. to ascertain how large a quantity of milk each Separator can skim when leaving a given quantity of butter fat in the skim milk; 3o. to see how long these can be run at their highest speed.

In Denmark the standard for average skimming by the Centrifugal is, to leave 0.15 of a pound of butter fat in the skim milk. (This is equal to a trifle less than 2½ ounces.) In Germany it is 0.35. (This is equal to a trifle more than 5½ ounces.)

We believe that between 0.20 and 0.25 is the proper standard—that is to say between 3 and 4 ounces.

As some of our readers may think that there is not a great difference in the value of two machines, which. when skimming, the same quantity per hour leave, the one 2½ ounces [.15] and the other 5½ ounces [.35] of butter fat in the skim milk, it is well to remark that in some cases, if the inflow into the machine which is leaving $2\frac{1}{2}$ ounces were increased so as to leave $5\frac{1}{2}$ ounces; the inflow would be increased between 300 and 400 lbs. an hour.

This is a very important consideration and should not be lost sight of in buying.

We give below the result of a series of experiments made by Prof. J. N. Fjord to ascertain the exact capacity of the four undermentioned Separators in the following circumstances. [The Burmeinster & Wain small and large sizes, the Neilsen & Petersen and the De Laval Separators.)

1o. When each of the four Separators is extracting from the milk an equal quantity of cream of the same richness, [that is containing the same percentage of butter fat] and leaving the same quantity of fat in the skim milk.

2o. When it is desired to leave a still larger proportion than 3 or 4 ounces of butter fat in a 100 lbs. of skim milk.

On page 85 we give the result of these experiments in table No. 13.

We see that during the period from April to July, and for the smallest quantity of milk worked per hour, the differences between the "minimum" and the "maximum"(1) quantities of butter fat, left in the skim milk, amount to 1, $\frac{8}{10}$ ozs. and to $\frac{9}{10}$ and $\frac{12}{25}$ ozs. during the month of September.

This comparatively small difference shows the uniform reliability of the Centrifugal Milk Separator when properly used.

(1) The figures in the column of averages are not obtained from the figures of the minimum and maximum only, but from a whole series of experiments.

TABLE No. 13.

Note.—In order to avoid large fractions, we have prefixed to the number of ounces the sign *minus*, when the proper figure is a trifle less than the given one. We have used the sign *plus* when the proper figure is a trifle more.	Speed—Revolutions per minute.	Percentage of butter fat left in the skim milk.			Differences between min and max. quantities (in ounces.)	Number of trials
		Average. (in ounces)	Minimum (in ounces)	Maximum. (in ounces)		
April and July 1882.						
A Burm. & Wain's centrifugal (small size)		(1)				
1. 290 lbs. of milk skimmed per hour	2410	— 2	—1½	—2½	+ 1	9
2. 435 lbs. do do do	—	3½	—2½	6¼	3¾	28
B De Laval's centrifugal...........						
1. 300 lbs. of milk skimmed per hour	6000	+ 2⅞	2 2/25	3½	1 13/25	5
2. 450 lbs. do do do	—	5	3 9/25	6¼	2 89/100	7
C Nielsen & Petersen's centrifugal						
1. 490 lbs. of milk skimmed per hour	1490	1¾	+ 1¼	2 2/25	8/10	10
2. 810 lbs. do do do	—	2⅞	2 14/25	3 1/5	16/25	14
D Burmeinster & Wain's centrifugal (large size)						
1. 870 lbs. of milk skimmed per hour	1950	—2½	1¾	—2¾	1	4
2. 1280 lbs do do do	—	—4⅓	3 9/25	6¼	2 89/100	8
September 1882.						
a Burmeinster & Wain's separator (small size).						
1. 290 lbs. of milk skimmed per hour	2410	—2	1¾	—2	¼	8
2. 435 lbs. do do do	"	4	+ 3½	—4½	1	4
3. 580 lbs. do do do	"	6 14/25	6 2/25	+ 7½	1 21/50	4
4. 720 lbs. do do do	"	11 9/25	—10¼	12 16/25	2 39/100	4
b Burmeinster & Wain's milk separator (large size)						
1. 780 lbs. of milk skimmed per hour	1800	—2¾	2 14/25	3 1/25	12/25	5
2. 1580 lbs. do do do	"	11 1/5	9 7/25	12 16/25	3 9/25	5

With a milk flow of 435 lbs. per hour, the small size Burmeinster & Wain Separator left a "minimum" of $2\frac{1}{2}$ ozs. and a "maximum" of $6\frac{1}{4}$ ozs. of butter fat in the skim milk.

With a milk flow of 1,280 lbs. per hour, the large size Burmeinster & Wain Separator, left a "minimum" of $3\frac{9}{25}$ ozs., and a "maximum" of $6\frac{1}{4}$ ozs. of butter fat in the skim milk.

With a milk flow of 1.580 lbs. per hour, the same size Separator left a minimum of $9\frac{7}{25}$ ozs. and a maximum of 12[illegible]/25 ozs of butter fat in the skim milk.

In *average* of the whole series of experiments in the 1st case was $2\frac{1}{2}$ ounces; in the 2nd $4\frac{1}{3}$ ounces, and in the 3rd $11\frac{1}{5}$ ounces.

From the experiments made from April to July, the Separators if classified according to efficiency, should be found in the following order:

TABLE NO. [illegible]

FOR THE SMALLEST QUANTITY OF MILK WORKED PER HOUR.

—			Fract of a lb. of butter fat left in 100 lbs. of skim milk.	In ounces.
Nielsen & Petersen	490	lbs. per hour.	0.11	$1\frac{3}{4}$ ozs.
The small Burm. & Wain.	290	" " "	0.12	Almost 2 ozs
" large " "	870	" " "	0.15	2 4/10 ozs.
The De Laval	300	" " "	0.18	$2\frac{7}{8}$ ozs.
		Average.........	0.14	2 2/15 ozs.

TABLE NO. 14. *Continued :—*

FOR THE LARGEST QUANTITY OF MILK WORKED PER HOUR.

Nielsen & Petersen.........	810	lbs. per hour.	0.18	$2\frac{7}{8}$ ounces.
The small Burm. & Wain	435	" " "	0.22	$3\frac{1}{2}$ "
" large " "	1,280	" " "	0.27	$4\frac{1}{3}$ "
The De Laval	450	" " "	0.31	5 "
		Average.........	0.24	3 11/15

The average quantity of butter fat left in the skim milk amounts to $2\frac{2}{15}$ ozs. in the case of the first four Separators on the list, and to $3\frac{11}{15}$ ozs. in the case of the last four.

This last figure is nearly 75°/o larger than the first.

It is then safe to say, that an increase of 50°/o in the quantity of milk worked per hour, produces an increase of 75°/o in the amount of butter fat left in the skim milk.

This increase amounts to about $1\frac{3}{5}$ ozs. of butter fat, and is equivalent to a decrease of 1_3 ozs. in the yield of butter per 100 lbs. of milk, that is if the "*smallest*" quantity of milk worked per hour gives 4 lbs. of butter per 100 lbs. of milk, the "largest" quantity of milk worked per hour gives only 3.90 lbs. or 3 lbs. 14 ounces, and instead of 25 lbs. of milk to a lb. of butter, it would take $25\frac{2}{3}$, or $\frac{2}{3}$ of a lb. more.

In a series of experiments made to test the relative value of the Nielsen & Petersen and Lefeldt Centrifugal, it was found, that a loss of butter fat amounting to $13\frac{1}{2}$ ounces took place for every hour the Lefeldt Centrifugal was worked. This loss was due to a certain amount of cream being drawn into the skim milk by air. This defect is known under the name of "Suction of cream".

We do not know whether this defect in the Lefeldt Separator has since been remedied.

POWER REQUIRED TO DRIVE THE BURMEINSTER AND WAIN AND DE LAVAL MILK SEPARATORS.

We now give, in tabular form the result of a series of experiments made by Prof. Fjord to determine the power necessary to drive the Burmeinster & Wain and De Laval milk separators.

DYNAMOMETER EXPERIMENTS.

TABLE No. 15.

These figures show the Separator's own consumption of power only.

With the use of Steam Power.	Lbs. of milk per hour.	Speed, revolutions per minute.	Horse Power required.
Burmeinster & Wain's Centrifugal (small size)...............	700	3,000	0.75
De Laval's Centrifugal.........	700	7,000	1.03
Burmeinster & Wain's Centrifugal (small size)...............	450	2,400	0.53
De Laval's Centrifugal	450	5,600	0.70

TABLE No. 16.

This table shows the full consumption of motive power, horse power and gearing included.

With the use of Horse Power.	Lbs. of milk per hour.	Speed, revolutions per minute.	Horse Power required.
Burmeinster & Wain's Centrifugal (small size)...............	700	3,000	0.88
De Laval's Centrifugal	700	7,000	......
Burmeinster & Wain's Centrifugal	450	2,400	0 63
De Laval's Centrifugal	450	5,600	0.81

The experiment, with the De Laval machine, running at a speed of 7,000 revolutions per minute could not be carried out with a common horse, as it was unable to keep up the speed, the power required being calculated to be 1.20 horse power,—0.80 horse power is reckoned to represent the outside amount of work that we can expect from a horse, if the strain is to be kept up for some time.

Therefore, an inflow of 450 lbs. of milk per hour, and a speed of 5,600 revolutions per minute, must be taken as the maximum capacity of De Laval's separator, driven by horse power.

Experiments showing the relative merits of the Burmeinster & Wain and De Laval Milk Separators, as regards Speed, Consumption of power, Percentage of butter fat in skim milk, and inflow.

TABLE NO. 17.

Same quantity of milk worked per hour.	Unequal consumption of motive power.		
	Percentage of Fat in the Skim Milk.		
	In special trial.	In 200 lbs. of milk.	In all the milk skim'ed in one hour.
1st Series, 450 lbs. per hour.			
A—Burmeinster & Wain......Speed, 2,400; power, 0.63 h. p.....	0.25	0 21	0.23
B—Laval..Speed, 5,600; power, 0.81.	0.23	0.23	0.33
2nd Series, 700 lbs. per hour.			
A—Burmeinster & Wain......Speed, 3,000; power, 0.88.....................	0 30	0.22	0.28
B—Laval..Speed, 7,000; power, 1.20	0 29	0 29	0.29

In the "special trial" the De Laval had the advantage. In the trial "In 200 lbs.", the Burmeinster & Wain had the advantage. In the trial "In all the milk in an hour", the results were the same.

The general result shows that De Laval's milk separator requires 29 per cent. more power than Burmeinster & Wain's in the first series, and 36 per cent. in the second series.

TABLE No. 18.

The same quantity of milk worked per hour.	Same consumption of motive power.		
	Percentage of Fat in the Skim Milk.		
	Special trial.	In about 200 lbs. of milk.	In all the milk skim'ed in one hour.
3rd Series, 450 lbs. per hour.			
A—Burmeinster & Wain......Speed, 3,000 revolutions; 0.81 horse power	0.14	0.12	0.13
B—Laval.. Speed, 5,600 revolutions; 0.81 horse power..........................	0.23	0.27	0.25
4th Series, 600 lbs. per hour.			
A—Burmeinster & Wain .....Speed, 2,950 revolutions; 0.83 horse power	0.23	0 17	0.21
B—Laval.. Speed, 5,600 revolutions; 0.83 horse power...........................	0.38	0.36	0 37

In this case Burmeinster & Wain's milk Separator had the advantage all through. In the special trial, Laval's milk Separator leaves:

In the first series, $\frac{9}{14}$ or 64 per cent.; in the second series, $\frac{15}{23}$ or 65 per cent. more fat in the skim milk than Burmeinster & Wain's.

These differences correspond to $1\frac{1}{2}$ and $2\frac{1}{2}$ ozs. of fatty matter in 100 lbs. of skim milk, and show, in reckoning

25 lbs. of milk to a lb. of butter, that Burmeinster & Wain's milk Separator gives from $2\frac{1}{2}$ to $3\frac{3}{4}$ per cent. more butter than De Laval's.

TABLE No. 19.

Unequal work per hour.	Equal consumption of motive power.		
	Percentage of Fat in the Skim Milk.		
	Special trial.	In 200 lbs. of milk.	In all the milk skim'ed in one hour.
5th Series. Power for each Separator, 0.81 *horse power.*			
A—Burm. & Wain...Speed, 2,875 revolutions; work, 565 lbs. per hr	0.21	0.17	0.20
B—Laval..Speed, 5,600 revolutions; work, 450 lbs. per hour............	0.24	0.25	0.24

These last experiments clearly show that, with the same amount of motive power, the small milk separator of Burmeinster & Wain can skim 115 lbs., or about 25 per cent. more milk than De Laval's, and leave much less fat in the skim milk. *And with the same completeness of skimming* and *the same consumption of power*, Prof. Fjord says, that Burmeinster & Wain's separator can skim 150 *lbs. or* 33 per cent. *more* milk than De Laval's.

Summing up, the result of the comparison may be shortly described as follows :—

1st. With the same completeness of skimming and the same quantity of milk worked per hour, De Laval's separator requires one-third *more* power.

2nd. With the same completeness of skimming and the same consumption of power, Burmeinster & Wain's small (B) separator skims one-third *more* milk than De Laval's.

3rd. With the same quantity of milk worked per hour and the same consumption of power, De Laval's leaves 64 to 65 per cent. *more* fat in the skim milk.

The same report shows that Burmeinster & Wain's large size separator requires 1½ horse power.

HOW TO SKIM HOT MILK.

Milk fresh and warm from the cow, is in the best condition to yield its cream by centrifugal force. If it is allowed to cool, it loses a part of its cream yielding power. If run cold into the Separator, other conditions being equal, a larger quantity of fat will be left in the skim milk.

Nevertheless, when milk has to be transported to a creamery it is impossible to avoid cooling it, because it is transported only once a day.

The loss caused by cooling the milk can be avoided by following carefully the following rule :

1o. Aerate the evening's milk ; 2o. Cool it to 60° Fahrt., and keep it all night in cold water , 3o. Bring it on the following morning, with the morning's milk to the creamery. It is better to bring the two milkings in separate cans. At the creamery, weigh the milk, empty it into a vat, mix it well in order to have it of uniform richness, heat it up to about88° Fahrt.,and pass it through the separator in this condition. The operator should *cool* the cream immediately on its discharge from the separator to 45° Fahrt. (1).

(1) It must be borne in mind that the *cream* is cooled to counteract the injurious effect of *heating* the *milk*. Therefore the higher the milk has been heated the lower the cream must be cooled. For every degree higher than 88° Fahrt. cool another degree below 45° Fahrt.

Any neglect to cool the cream will be attended with various disadvantages. 1o. The cream will contain an extra amount of cheesy matter, the effect of which is to injure the quality of the butter ; 2o. It will prevent the complete churning of the cream, thereby diminishing, the quantity of the butter.

HOW TO SKIM COLD MILK TO THE BEST ADVANTAGE.

When the operator is not pressed for time, he can skim cold milk nearly as well as warm milk, by diminihsing the flow about $\frac{1}{3}$, or by increasing the speed proportionately.

We give below a table with experiments on this subject.

A quantity of evening milk amounting to 1350 lbs. having been well mixed, was divided into three equal parts of 450 lbs, one of which was skimmed immediately after milking, and the other two portions, being cooled to 52° Farht., were kept over night. The next morning, one portion was skimmed while cold, and the other after being previously heated to 104° Farht.

We give the result of these experiments in table No. 20.

The milk skimmed immediately after milking gave 3.72 lbs. of butter, there remained in the skim milk, three and one fifth ounces of butter fat.

The milk skimmed, after having been cooled and heated, gave but 3,51 lbs. of butter and, singular to say, the same amount three and a fifth ounces of butter fat remained in the skim milk. It should have left 6½ ounces. But it was discovered that the portion of fat which

TABLE No. 20.

	Pounds of butter from 100 lbs. of milk.			Quantity of butter fat left in the skim milk, obtained from 100 lbs. of whole milk.		
		Evening's milk skimmed next morning.			Evening's milk skimmed next morning.	
	Immediately after milking. Temperature of milk, 87° Fahrt.	Cooled to 52° Fahrt.	Cooled to 52° Fahrt in the evening, and warmed to 104° Fahrt. next morning.	Immediately after milking. Temperature of milk, 87° Fahrt.	Cooled to 52° Fahrt.	Cooled to 52° Fahrt. in the evening, and warmed to 104° Fahrt. next morning.
450 lbs. per hour	3.72	3.41	3.51	$3\frac{1}{5}$ ounces.	Almost 8 ozs.	$3\frac{1}{5}$ ounces.

could not be accounted for, $3\frac{1}{3}$ ounces, had been lost in churning. It was found in the butter milk. This loss was due to the cream not having been cooled as it left the machine

In another series of experiments, where the cream was immediately cooled, there was no loss in the churning, and the *heated* milk gave as good a yield as the milk skimmed immediately after milking.

What to do with the skim milk.

In places where large creameries are established, the question naturally arises what to do with the skim milk. The answer to this question must vary to a certain extent with the locality.

In this country I do not think it is advisable to convert the skim milk into skim cheese, at least at present, because :

1o. The demand for skim cheese is yet very limited.

2o. The methods for making skim cheese are not generally understood in this country.

3o. The making of skim cheese, as generally made in the United States and Canada, is liable to destroy the splendid reputation of Canadian cheese on foreign markets. (1)

We think, the best thing to do with the skim milk, is to use it as food for calves and swine. We give below our reasons.

1o. We import large quantities of po.k.

2o. There is a large demand for pork and beef in Europe.

3o. The using of the skim milk in this manner has for result to restore to the soil, in the shape of manure, a part of the fertilizing substances, which had been drawn therefrom.

(1) We do not find anything objectionable in skim-cheese, if it is made and sold as such. In Holland and other European countries it bears a special form, by which it is easily distinguished.

THE

CONSTRUCTION

OF

ICE HOUSES

OF ALL KINDS AND DESCRIPTIONS,

WITH A CHAPTER ON FREEZERS, ROOMS AND CELLARS

FOR COLD STORAGE.

The Construction of Ice Houses.

The information contained in this chapter has been compiled from the best foreign and American authorities, and from our own experience; and we have no doubt, it will prove of some interest to dairymen and farmers.

GENERAL PRINCIPLES.

Water freezes at a temperature slightly below 32° Fahrt. Ice melts at a temperature ever so little above 32° Fahrt.

The three enemies of ice are water, heat and moisture. Water and moisture are more destructive of ice than ordinary atmospheric heat; at least when the ice is protected from the direct rays of the sun.

In building an ice house, therefore. the ice must be protected from these three things.

Moisture generally comes from the bottom of an ice house, and heat from the sides and the top.

Moisture in an ice house may be produced by two causes: by the atmosphere and by some defect in th- bottom of the building.

That which is caused by the atmosphere must be car ried off by properly constructed ventilators; that which comes from the foundation, must be carried off by good drainage.

SIZE OF AN ICE HOUSE.

For dairy use it will of course depend on the quantity of milk, cream and butter handled daily.

We can give no special rule, but the following figures may guide farmers and dairymen, as to the size of the buildings required for their special wants.

In an ice house, where the ice is packed closely, ice men generally allow about 45 lbs of ice for every cubic foot of space, or 45 cubic feet to the ton. Where the ice is loosely packed, they allow about 40 lbs of ice for every cubic foot of space, or about 50 cubic feet to the ton.

Table showing, in cubic feet, the quantity of ice required for setting milk 24 hours, in single sided tanks, according as the ice is closely or loosely packed.

	From May to November or 180 days.			
	Ice closely packed or at 45 cubic feet to the ton, about 45 lbs to the cubic foot.		Ice loosely packed or at 50 cubic feet to the ton, about 40 lbs to the cubic foot.	
	Cubic feet	Tons	Cubic feet	Tons
100 lbs of milk or cream per day	270	6	300	6
200 " " " "	540	12	600	12
300 " " " "	810	18	900	18
400 " " " "	1080	24	1200	24
500 " " " "	1350	30	1500	30
600 " " " "	1620	36	1800	36
700 " " " "	1890	42	2100	42
800 " " " "	2160	48	2400	48
900 " " " "	2430	54	2700	54
1000" " " "	2700	60	3000	60
2000" " " "	5400	120	6000	120

In order to find out the storing capacity of an ice house multiply the length, width and height together, the result is the capacity in cubic feet. By dividing the number of cubic feet by 45 or 50, the capacity in tons is obtained. Thus a house 10 feet long, 10 feet wide and 12 feet high = 1200 cubic feet. This divided by 45 or

50 according as the ice is closely or loosely packed gives 26⅔ or 24 tons.

Other things being equal, the higher an ice house is built, the better the ice keeps.

We give below a few figures on the dimensions of ice houses.

We do not advise to build an ice house smaller than 8 x 8, 10 feet high, inside measurement.

Storing capacity of ice houses of different sizes.

Length, width, height, in feet.	Capacity in cubic feet and tons.	
	Cubic feet.	Tons.
10 x 10 x 10	1000	22
12 x 12 x 13	1872	41½
12 x 15 x 15	2700	60
12 x 18 x 16	3456	77
20 x 20 x 16	6400	142

SHRINKAGE.

In deciding the question of size one important thing must be considered, that is the waste known as shrinkage.

The larger the ice house, the less waste in proportion. In a well constructed ice house of 165 tons capacity or 7500 cubic feet, the waste should not be greater than 15 per cent, or 25 tons.

In one whose capacity is only 28 tons or 1250 cubic feet, the waste should not exceed 25 per cent, or 7 tons.

In building an ice house, build it rather too large than too small.

SITE AND DRAINAGE

The house should stand, as much as possible, by itself, in a high, airy, and sunny position (1) because such a site requires but little drainage. When such a position is not to be had, and when the soil is not of a sandy, gravelly or otherwise porous nature, the drainage should receive the builder's most careful attention. On porous soil, an outside ditch is all that is necessary.

Loamy and heavy land should be thoroughly underdrained. In the case of small houses, these drains should be round the outside of the buildings. In large ice houses, and when the land is very wet, it is sometimes necessary to carry the drains under the buildings.

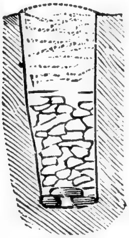


Fig. 40.

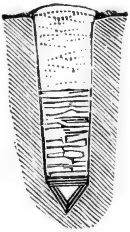


Fig. 41.

Fig. 42.

What are known as "French drains" (see fig. 40, 41 and 42) trenches filled with stones, answer admirably, and are cheap besides.

These trenches should be dug across the place where the ice house is to be built, with a grade of descent of at least one quarter of an inch to the foot. They should

(1) This exposure to the sun and air, will not be detrimental, as many suppose, for if the house is properly constructed and the ice sufficiently protected, the heat cannot penetrate it to any great extent, whilst the exposure will serve to absorb vapor and dampness, which are more detrimental than the heat outside of the house.

be two feet wide (or more), filled with small stones up to within three inches of the level of the ground, which three inches should be filled with shavings or some other material that will keep the dirt out. The end of the drain should be carried a fair distance from the building.

Tiles or wood may be used for the same purpose, but in this case the drain should terminate by a pipe shaped like a V, to form a trap. This to a certain extent prevents the air from entering.

BEST MATERIAL FOR AN ICE HOUSE.

Wood is the cheapest and best material for building an ice house. Its porous character is favorable to free evaporation, and evaporation is the key to the secret of keeping any building dry. The most porous wood is the best. The kinds most in favor are hemlock and the three branches of the pine family, namely spruce and white and yellow pine. The main points aimed at in the selection is their relative durability.

Stone or brick retains the vapors and causes sweating, which melts the ice.

THE BOTTOM OF AN ICE HOUSE.

The bottom of an ice house should be as dry as possible, and at the same time impervious to heat, air, dampness and water, for if through defective drainage, the ice is constantly immersed in water, the waste will be much greater at the bottom of the ice house, from this cause, than at the top from the heat of the sun. It would therefore, hardly be possible to give the subject of drainage and construction of the bottom too much attention, when houses are first built.

FOUNDATIONS

Large houses should stand on a stone foundation, although it is the custom with many builders to do away with the wall, and rest the sills directly on the ground. In low places the sills rest on piles. When they rest on the ground, the sills should be of cedar or white pine.

If a stone foundation be laid, it should be of masonry of the best description; it should be carried below the line of frost, and one foot above the surface of the ground. When a stone foundation is laid, the sills may be of the same material as the rest of the building.

THE FLOORING OF AN ICE HOUSE.

The drain and foundation having been constructed. level the ground inside. If there be any slope, let it be towards the drain. Cover the ground to a depth of at least 10 inches, with a bed of fine gravel, cinders, shavings, tan or sawdust. (We prefer cinders.)

Lay stringers 4 × 4 about 3 feet apart, and fill and pack well between stringers with cinders or sawdust. Over these stringers nail 2 inch boards. They should neither be tongued and grooved nor tightly fitted together. This is to allow the water to trickle down between them, and thus escape.

A TIGHT FLOOR.

When ice houses are built in connection with dairies etc. and it is desirable to utilize the drippings, a tight floor is put in. This can be made of tongued and grooved boards closely fitted together, after the bottom has been prepared in the manner previously described. Asphalt, cement or concrete floors may also be constructed.

A tight floor should slope from two sides to the middle. A small groove, along the middle of the floor, receives the water, and conducts it to an end of the building from which a pipe carries it to the cold room or dairy. The end of the pipe should be bent in the form of a V, so as to prevent the air from entering.

WALLS.

The best ice houses have three shells, an inside, a middle, and an outside shell. The space between the inside and the middle shells varies, with the size of the ice house. The smaller the house, the greater should be the inner space. The smaller and lower the ice house, the less should be the outer space, or draught chamber.

HOW TO PUT UP THE WALLS.

FOR LARGE HOUSES.

The uprights should consist of stout 8 × 10 posts around the outside, at intervals of 12 feet placed on sills 6 × 10. On these posts, the frame work and rafters of the roof will rest. Immediately on the inside line of these posts 3 × 6 studdings, should be firmly placed at a distance of 3 feet apart. Commencing about 3 inches from the bottom, (so as to leave an open space) nail weather boards on the outside of the posts, (not to the studs) up to the eaves. Commencing close at the bottom, nail to the posts and studding on the inside, tongued and grooved boards. They should be fitted as closely as possible.

Upon the inside of this wall stretch a sheating of felt. (1)

(1) Common roofing felt, or better Sackett's sheating consisting of a layer of cement between two layers of manilla paper. It costs ½ ct. a square foot.

Then place against this papered wall studs of 3 × 8 at the same distance apart as the first. From stud to stud, stretch another course of manilla sheating, and over this commencing at the bottom, nail tongued and grooved boards. They should be joined as closely as possible.

The space between the two interior walls, known as the packing chamber, should be filled (when convenient) (1) with *dry* saw-dust *very tightly packed.* If sawdust cannot be had use dry tan, shavings or chaff.

The outside space, called the draft chamber (fig. 48) which is in this case about 10 inches, has an opening at the bottom to allow the air to enter and at the top, to allow it to escape. Its purpose is: to prevent the rays of the sun from striking directly on the walls; to protect the walls from rain and to afford better ventilation.

Some of the largest Canadian builders construct their walls in the following simple manner: They place on the sills, uprights 3 or 4 inches by 10 or 12 inches from 3 to 4 feet apart. Over these they nail rough boards and fill in with saw-dust.

In many cases the draught chamber is dispensed with. When this is done, the space between the walls of the packing chamber should be at least 18 inches.

WALLS FOR SMALL HOUSES.

The walls for these, should be built upon the same plan as for large houses, (smaller timber should be used than for large houses.) The difference is that the space for the packing chamber, should be considerably greater, and that for the draught chamber considerably less. For an ice house 15 feet high, the draught chamber should be from 2 to 5 inches.

(1) When it is not convenient to fill the space, be careful in boarding up to make it as air tight as possible, this is known as a dead air chamber.

Thus in a small building, the packing chamber should be about 14 inches and the draught chamber five.

ROOF AND VENTILATORS

A good water-tight roof of reasonable pitch should be placed over the walls. Wood and shingles are the best materials to use. For those desiring a model roof see fig. 48 with description.

When no air chamber is constructed, two small doors in the gables placed as near to the top of the roof as possible will help to ventilate. These doors should be

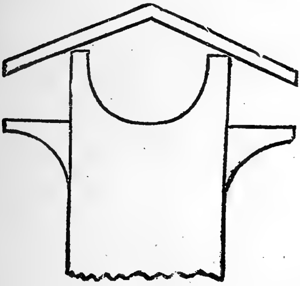


Fig 43.

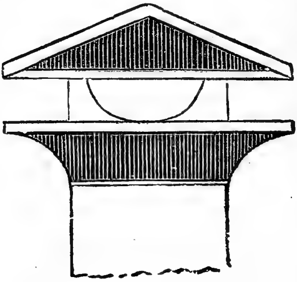


Fig. 44.

opened during cool nights to let out the warm air, which may have accumulated during the day.

One style of ventilator consists of an opening at the ridge pole, running the whole length of the roof. It is covered with a box-shaped cap, open at the extremities. (See fig. 48.)

Another style of ventilator is very simple and effective (see fig. 43 and 44). It consists of 4 boards out of which a U shaped piece is cut. These boards are nailed together, and, a roof shaped cover, projecting at least 3 inches, is fixed at the top. Four pieces of wood 2 × 3 inches, having the underneath beveled, are nailed to the sides of this ventilator. This gives it a better shape, and increase the current.

The roof of the ventilator, should extend well over the under piece to prevent the rain from entering.

The size of box ventilators should be made in proportion to the length and breadth of the building. The smaller the ice-house the larger the ventilator should proportionately be.

For an ice house 10 × 10 ft., the ventilator should be 4 square inches to the square foot. Thus, it should have a surface of 20 × 20 inches.

For an ice house of 20 × 20 feet, the ventilator should be 3¼ square inches to the square foot. This would give a ventilator of 36 × 36 inches.

For an ice house 50 × 60 the ventilator should be 1⅗ square inches to the square foot of surface. This would give a ventilator of about 36 × 120 inches.

If a square box ventilator is used the sides should be of lattice, like window blinds.

A LOFT FLOOR.

In good ice houses, a loft floor is generally made. It is more necessary in small ice houses then in large ones.

This floor should be covered with saw dust,hay or straw to the depth of from 10 to 12 inches.

If the house is to be frequently opened, lengthwise, along the middle of the floor, an opening should be left for ventilation. Its extremities should be about 2½ feet from the gables. The width will depend on the width of the ice house. It is a safe rule to allow 3 inches for every foot in the width of the building.

For instance an ice house 12 × 10 feet inside measure, would have an opening 3 feet wide. Lengthwise on each side of the opening is fixed, with good stout well varnished hinges, a trap. When one of these traps is closed, one half of the opening is covered. When the two are closed, the whole is covered.

To the upper side of these traps, is fastened a stout rope, which is passed through a short piece of tube (1) running through the floor, for that purpose. By this

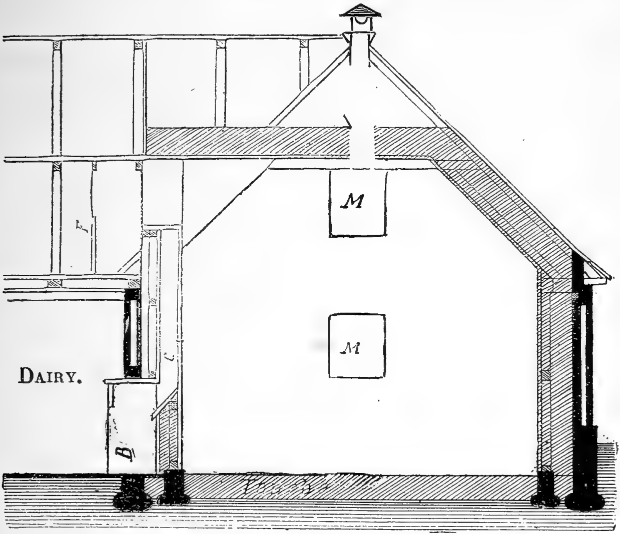


Fig. 45.—Ice house and dairy.—*MM*, Openings for filling the house *B*, Ice box. *C*, Shaft. *F*, Entrance.

means the trap can be raised or lowered at will from below. Thus any desired degree of ventilation is obtained.

At the back of these traps, there should be fixed to the floor a piece of wood, sufficiently high to keep the trap in such a position, that it will close by its own weight, when the rope is loosened.

(1) A tube is used to prevent the dunnage from falling through the floor.

If the house is not to be opened frequently, or in small ice houses, a small box ventilator larger at the top then at the bottom is sufficient. It should be made to project 5 or 6 inches above the loft floor and be provided with a cover.

SECTIONAL VIEW OF AN ICE HOUSE AND DAIRY,

Having two compartments.

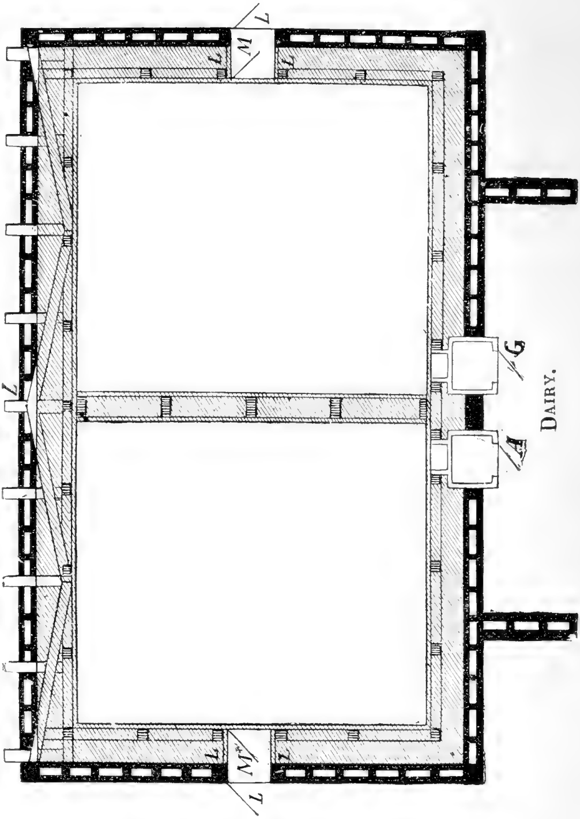


Fig. 46.—*A G*, Entrances.—*M L*, Openings for storing the ice

Where there is a double roof as in fig. 48 the air current from the air chamber, instead of going out under the eaves, should find its way between the double roof into the ventilator at the to .

In the case of a single roof, the air from the draught chamber should go out under the eaves.

In fig. 45 we have a loft floor differently constructed. In this case it is above the eaves, and offers more store room. It is laid on the collar beams. That part of the roof which extends from the eaves to the collar beam is provided with an outside shell filled with dunnage. The space filled with saw-dust, is of the same thickness as the walls. In the centre of the loft floor is an opening for ventilation. (See fig. 45.)

THE DIVISION OF ICE HOUSES.

Large ice houses should be divided into two or four compartments according to the size (see fig. 46.) These divisions offer the double advantage of preventing draughts of warm air from spreading all over the house, and also of removing the insolating material from a section when necessary.

A house 50 feet long should be divided into two sections, and 100 feet long into four sections. The division wall should be double and filled with saw-dust.

OPENINGS.

Openings in the building for the deposit and removal of ice should be as few as possible. Too many of them weaken the structure whilst they afford additional facilities for the entrance of warm air and moisture.

Large houses.

In large ice houses one opening 4 feet wide, extending from the top to the bottom of the building should be made. This should be arranged so as to open in sections, commencing at the top. The smaller these sections, the less the waste of ice. According as the house is filled, these sections which are like the wall, double, are filled in with saw dust.

Small houses.

For small houses an opening, the top of which should be on a level with the loft floor, and the bottom as far as

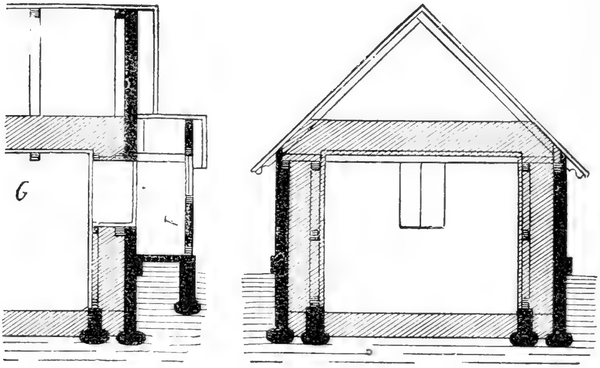


Fig. 47.—Ice house with outside porch.—*G*, Ice house. *F*, Porch.

possible from the ground should be made. (See fig. 47.) It should be provided with double doors. When the ice house is not very high, a good porch should be constructed. (See *F*, fig. 47. and *D*, fig. 51.)

Thus with the construction of a porch as shown in fig. 47 and 51, it is necessary to open three doors before entering the ice house. The first one is fixed on the inner edge of the opening made in the wall of the ice house. The second is hinged on the outer edge of the same opening. Both of these doors open outwards. The third one closes the porch.

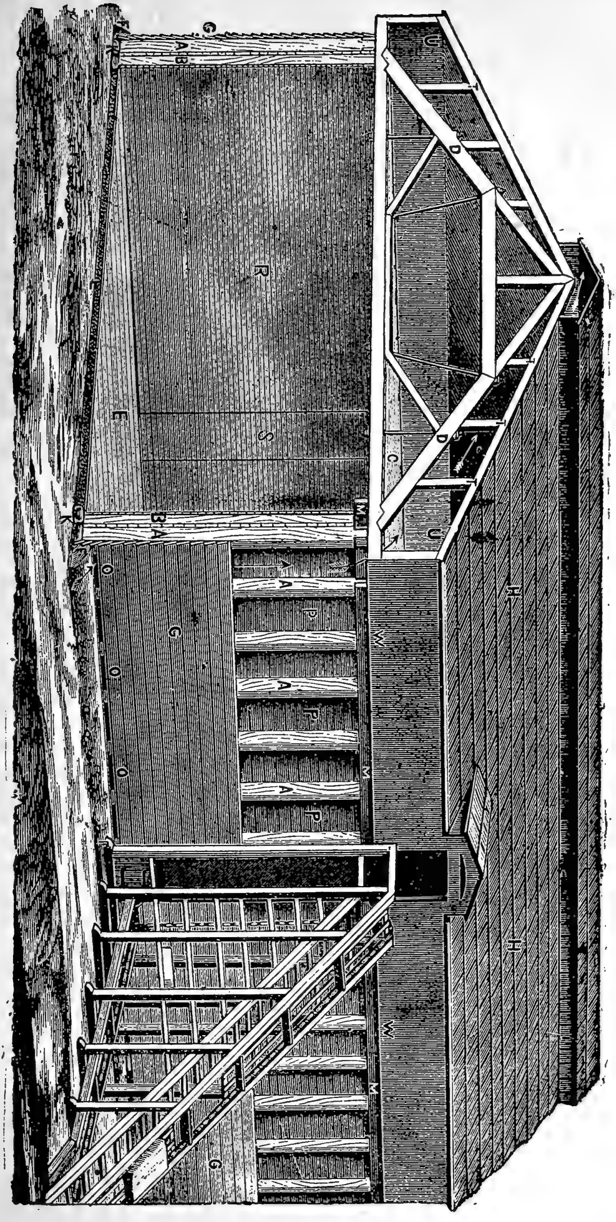


Fig. 48.—Ice house with inclined plane elevator.

ICE HOUSES WITH INCLINED PLANED ELEVATORS.

On page 113 we give a cut of an ice house, with inclined plane elevator.

A represents the unfilled space of the outside wall; B the filled space of the inside wall; C the covering on the loft floor; D the main rafter on which the double roof boarding is placed; E the floor of the ice house; F the embankment of dirt around the sill of the house, one foot above the level, to exclude air; G outside sheating of lap boards (part way up, showing the middle boarding P); H shingle roof; I Ventilator running the length of the peak of the roof, with opening; K stone foundation; L a filling of three inches of charcoal or sawdust under the floor; M plates placed edgewise on the outside upright to allow the air to pass freely from the bottom of the outside wall of house to the ventilator at peak of the roof, and give additional strength: O openings between each upright to admit cool air at bottom and drive out the warm; P middle sheating of grooved or worked boards; R open end, showing inside sheathing; S doorway boarded up; U raised roof at eaves by purlines placed on rafters; T purlines placed on rafters; W projection of roof, to prevent rain beating against sides of house. Arrows show the current of air passing from openings at the bottom through unfilled space A to ventilator at peak of roof. (1)

We give below a description with cut of the ice house, of Mr. W. G. Walton of Hamilton, which is one of the best in the Dominion.

It stands at the water edge of Burlington bay, near G. T. R. Depot in the city of Hamilton, with siding from main line of G. T. R., for shipping purposes.

It is 120 × 100 × 41 ft. high and has a storing capacity of about 12,000 tons. It is divided into four compartments, and provided with a steam elevator and galleries, extending the whole length and height outside of the building.

The elevator is driven by a 12 horse power engine.

For filling this house a field of from $\frac{1}{4}$ to $\frac{3}{4}$ of a mile square extending from the shore in deep, clear water is at hand. The ice is plowed into blocks 22 × 30 inches

(1) From the *Ice Journal*, Philadelphia

and towed down to the elevator by horses in large rafts of 500 to 1000 blocks each, through a channel cut in the ice. It is then broken off, in single blocks, caught and carried up by the elevator.

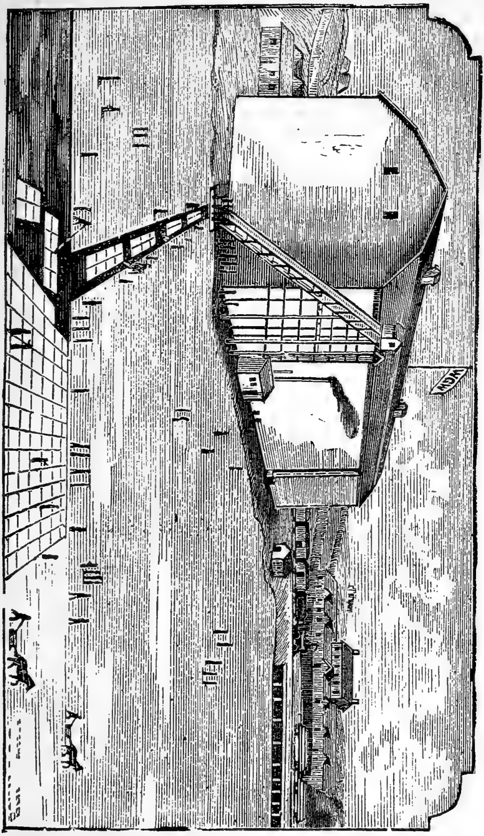


Fig. 49.—The Walton ice house.

The elevator, galleries, and skids are so arranged that the ice is elevated to any gallery desired, and distributed to any room, and to any part of each room, without being handled until it is placed in position by the men

Cars can be loaded directly from the ice field, by the elevator and galleries. Thus from one to two hundred tons of ice per hour, can be stored, or loaded ready to ship when desired. The house is also provided with two sets of automatic gigs for lowering the ice into cars or wagons. (1)

INCLINED PLANES, ELEVATORS, SKIDS, AND HOISTING TONGS.

ELEVATORS.

The rule is to use inclined planes with elevators (see fig. 48 and 49) for filling, whenever the storage capacity exceeds 2000 tons. The planes can be made to suit the capacity to be filled, and to be run by horse or steam power. The former is often resorted to in smaller houses especially in cold climates, where there is ample time for harvesting.

The rule as to fall is to have the base 50% more than the height. If the height is 20 feet, the foot of the plane would be 30 feet from the house, and by running it 5 feet into the water, the required fall would be given and ample water to float the ice to the chain. By this means, several hundred tons of ice can be lifted 30 feet in an hour.

SKIDS.

Ice men of large experience use for handling ice in large ice houses, specially constructed skids or runs, for moving ice during the summer and for loading it on wagons, cars or ships.

(1) The description of this ice house, which we visited and examined carefully, was kindly furnished by Mr. W. G. Walton.

The skids may run in any direction in the ice house; so that the furthest blocks from the outside opening may be run along the skids as well as those close to it. The ice can be lowered in self acting baskets or gigs, and emptied on the skids, which are so arranged as to reach the bottom of a car or the hold of a ship. By this means the ice is moved and loaded by its own weight, without any handling.

This method effects a great saving of time and labor, and reduces the breakage of the ice.

HOISTING TONGS.

In smaller ice houses, hoisting tongs fixed to a rope and pulley, are used for hoisting and lowering the ice. The pulley is strongly fixed over the opening of the ice house.

They can be worked by a horse.

DAIRY ICE HOUSES.

For convenience, of late years ice houses have been built close against dairies or creameries in order to utilize them for cold storage. In this case, the building should be put up towards the East or South East of the dairy, as the morning sun will absorb the dampness of the air.

Ice houses for dairy purposes are constructed on the same plan as those already described. The only things calling for remark are.

1st. The manner of entering.
2d. The using of the meltage from the ice.
3d. The manner of utilizing the ice for cold storage.

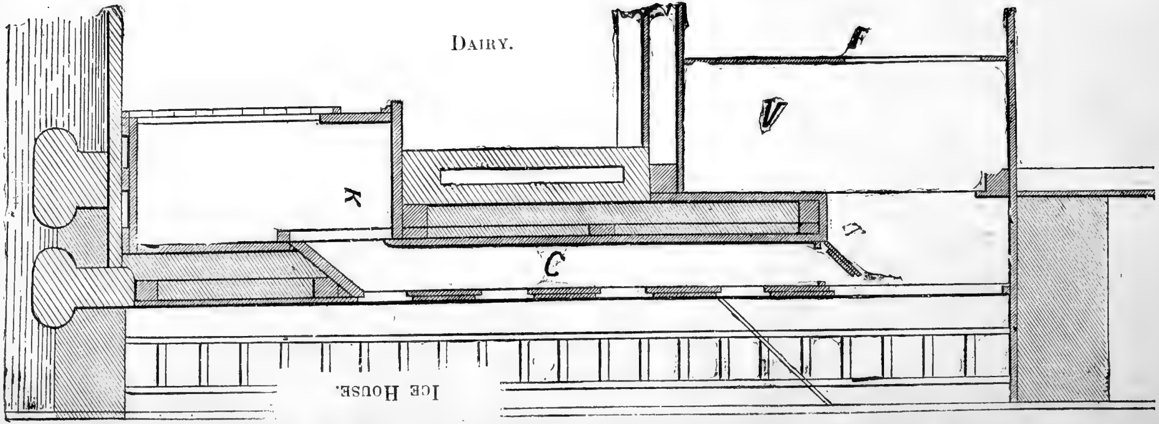


Fig. 50.—Dairy Ice House.—*F*, Window. *V*, Porch. *T*, Trap. *C*, Shaft. *K*, Ice box.

ENTRANCE OF DAIRY ICE HOUSES.

When ice houses are built close against the dairy or creamery, the entrance may be made in the upper part, by building in the upper story of the dairy a porch joined to a passage opening directly into the ice house. (See fig. 50.)

It will thus be necessary to open two doors before entering the ice house proper. A window in the porch,

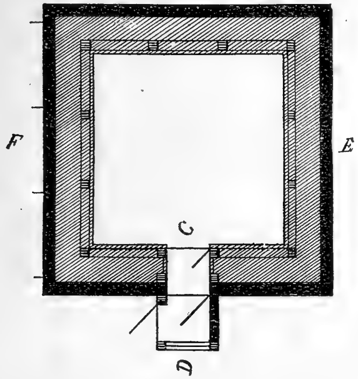


Fig. 51.—Ice house with porch.

will, when the doors are opened, allow the light to penetrate into the interior.

When the ice house is high, it is convenient to build directly under the opening, between the wall of the ice house, and that of the dairy, a shaft by means of which the ice may be thrown into a box, placed to catch it inside the dairy. (See fig. 50.)

The bottom of the shaft is covered with an iron plate, to protect it against the blows of the blocks of ice. The shaft is closed by means of a trap door. (See fig. 50.)

Opposite the shaft, and placed one above the other, in the walls of the house, are openings through which the ice may be taken out at any height, as the quantity diminishes in the ice-house. (See fig. 50.)

In smaller ice houses, or ice houses completely isolated, an outside porch may be built. (See D. C. fig. 51.)

MELTAGE.

In the chapter on floors, we have already described the method of utilizing the meltage from the ice in the dairy.

THE CONSTRUCTION OF COLD STORE ROOMS AND FREEZERS.

COLD STORE ROOMS.

There are many methods of constructing cold store rooms. We shall describe a few of the best. The information here given has been derived from some of the largest users of cold storage in Montreal and elsewhere, as well as from the best builders and inventors.

All cold store rooms are built on the same principle. The differences are differences of detail. This principle consists in placing the ice overhead, or along side of the building; in some cases in placing it both along side and overhead.

Openings are then made either in the ceiling or sides, or both, to create an air current. They are arranged in such a manner that any warm air, which enters the apartment, immediately ascends to the cooling room above, where it is cooled and from which it returns in the shape of cold air.

We give below the description of an unpatented cold store room.

The cold store room, for an ordinary size creamery, should be from about 12 to 15 feet square, and two stories high. The lower chamber should not exceed 7 feet in height. The top or ice chamber may be of the same length and breadth, but a little higher. In the case of a room 12 × 12 it should be about 8 feet high. Where economy is not a prime consideration, the ice chamber may with advantage be made higher.

The walls of such a building are like those of an ordinary ice house, but somewhat stronger to stand the pressure.

MEANS OF PRODUCING THE AIR CURRENTS.

In the ceiling of the cold store room, there should be, at right angles with the beams, two openings. When possible these openings should be, one on the side nearest to the door, and the other on the opposite side. One of these openings is called *the hot air flue*, the other the *cold air flue.* In our description, the one nearest the door is the *hot air flue.* They should be from 5 to 12 inches wide, according to the size of the room, and run the length of the building. They should be provided with traps.

Both these traps should be hinged to the sides of their openings farthest from the walls. The one nearest to the door opens upward in the flue, the other one downward into the room, and when open is suspended from the ceiling. Along the split between the hinges of this latter on the lower side, nail a narrow strip of soft leather listing or cloth. This is to prevent the warm air from ascending between the trap and the ceiling into the cold air flue. These traps are used to regulate the temperature in the cold store room. They should be provided with cords running through hooks, by means of which, they can be closed or opened, as much or as little as is necessary. (1)

It will be easy to understand, how the traps are arranged, when it is remembered that to close the one in the hot air flue, it is necessary to let go the rope, and to close the other it is necessary to pull on the rope.

The opening nearest to the door is made to allow the warm air to ascend.

On the upper floor, on the inner edge of the *warm air flue*, construct a double wall, with hollow space of about 6 inches, which should be filled with saw dust. This wall should be carried to within 7 or 9 inches of the top of the ice chamber. If the ice is 12 feet high, the space may be increased to about a foot.

Running parallel with the packed wall, lay on the floor, at 15 inches apart, a series of stringers 3 inches thick and of decreasing height. The highest, which should be 8 inches, is placed along side of the packed wall. The lowest, which never should be less than 3 inches, is placed along the inner side of the cold air flue, and within a foot of the edge. These stringers should be firmly fastened to the floor, their upper edge should be bevelled so that if a board was laid upon them it would form an inclined plane. Fill in the space between the stringers with saw-dust.

Over the stringers lay a flooring of boards. We now have an inclined floor, the highest part of which is against the warm air flue, and the lowest point of which is near the edge of the cold air flue.

(1) If the cords from the traps are arranged, so that they can be carried to the middle of store room, the circulation can be increased and the room thoroughly ventilated, by seizing these ropes one in each hand, and rapidly opening and closing the traps in succession.

Cover this with sheets of zinc, thus producing a water tight floor. The edges of the zinc close to the walls should be turned up about 5 inches. The end nearest to the cold air flue should form a spout. From this spout a pipe is run to carry off the water.

Underneath where the sheets of zinc meet, a slat 1 × 2 inches is placed. The zinc is fastened to this and soldered. Upon this zinc floor, lay another series of stringers at right angles to the wall, cut in the shape of inclined planes; they should be 3 inches thick and placed 15 inches apart. The larger end (which should be 8 inches high) should be placed farthest from the packed wall, the smaller (which should be 3 or 4 inches high) touching it.

Across these, lay 3 × 4 inch stringers about 3 inches apart. On this bed of stringers, pile the ice.

There is now a vacant space over the cold air flue. This space must be arranged so as to allow the ice to be piled above, without closing it up completely, and without allowing the meltage to drop into the store room below. This is done in the following manner.

Upon the beams, which have been uncovered by the opening made in the floor, place on end, against the wall, pieces of wood 3 × 4 inches and about 14 inches high. Resting on the top of these pieces, and also on the inclined planes, which come directly over the zinc, place on edge pieces of plank 3 inches thick 15 inches high at one end and 14¾ inches at the other, and 30 inches long, or of less length according to the size of the opening in the floor.

Cover the top of this frame work with 3 inch planks, over which sheathe with zinc; the edges of this zinc should project about 3 inches, so as to allow the meltage to drop into the spout formed by the larger zinc.

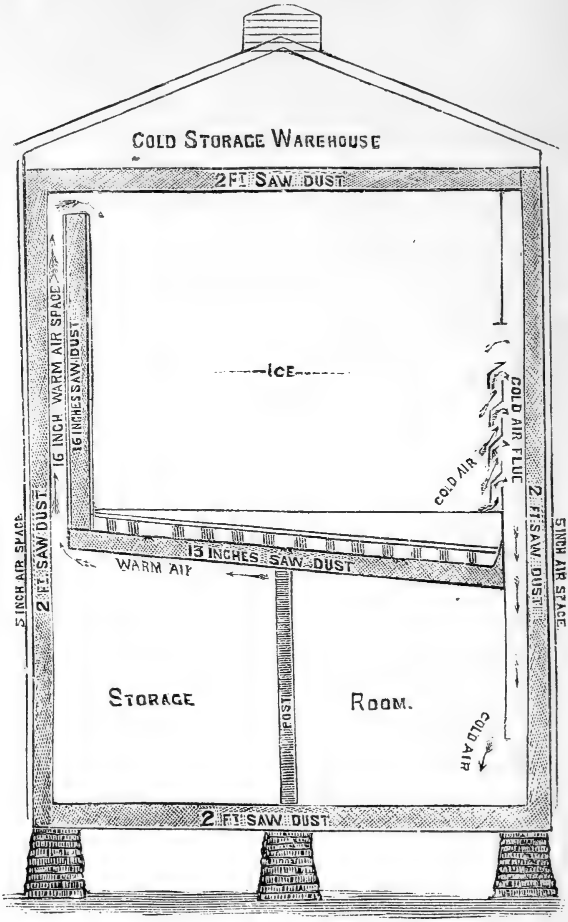


Fig. 52.

Cut No 52 represents a cold store room on another plan. In this the floor of the ice chamber and the ceiling of the store room are both inclined. This is an advantage. The warm air always seeks the highest part of the room. It is therefore evident, that it will gradually find its way to the warm air flue.

On the other hand, the cold air flue is continued to within a few feet of the floor of the store room. This continuation prevents the formation of a double current in the cold air flue, and helps to cause a complete circulation. By looking at the figure it will be seen that the cold air flue is carried up to the ceiling. Openings in the side of it allow the cold air to descend. A glance at the figure will make clear the position of the inclined plane stringers, which are placed at right angles to the packed wall, 3 inches apart and serve to form a level surface upon which the ice is piled. Without this precaution much of the weight of the ice would come upon the partition of the cold air flue.

In building a floor, such as is seen in figure 52, the beams should be put in as in an ordinary building. We have already described on pages 122 and 123 how the slant is obtained.

When the room intended for cold storage is built against the ice house, two openings are made through the walls of the latter, one close to the floor, and the other close to the ceiling of the store room. By this means, cold air is constantly pouring into the store room. The openings are provided with sliding covers by which the current can be increased or diminished at will, thus regulating the temperature.

When it is desired to build a cold store room without having the ice house over head, and without making openings in the sides of the ice house, proceed in the following manner:

Build the room for cold storage as close as possible to the ice house. The ice chamber should be considerably smaller than the room to be cooled. Of course, the size depends on the temperature required in the room. For a temperature of about 55° Fahrt, the size of the ice chamber should be about $\frac{1}{10}$ of the size of the room to be cooled, but this ice chamber will have to be filled every 10 or 15 days.

To cool a room 12 × 12, 7 feet high, the ice chamber would be a box whose length breadth and height, would be 5 feet. It would contain 125 cubic feet of ice. This would take about $2\frac{1}{2}$ tons of ice every 10 or 15 days. The ice chamber should be settled in the same manner as in the store rooms already described.

The meltage from the ice may be utilized as a cooling agent for different purposes.

Mr Jos Baril of Montreal, is the patentee of an excellent system of cold storage and freezers. He has already constructed a large number of these for butchers, produce dealers, dairy-men and others.

In his system the ceiling is sloped as in fig. 52. There are two cold air flues situated, one at each end of the building, and one hot air flue at one side. The partitions of the cold air flues are carried down a certain distance below the ceiling into the store room.

The ice chamber is provided with a zinc covered floor slightly inclined. At the inner edges of the cold air flues, an open frame work runs up to the ceiling. This prevents the ice from dropping into these openings, and allows the air to circulate freely. This system is very effective.

FREEZERS.

Freezers are constructed in the following manner: The room should be low, and the smaller the better.

The walls should be well built and thick. It should be provided with double doors and an ante-room. The doors should be provided with weather strips.

Along the ceiling, on at least three sides, make an opening. Above this opening, in the ice chamber, fit a water tight trough, from the bottom of which, at intervals, pipes should be run into the chamber below. The diameter of these pipes should be equal to that of an ordinary stove pipe. The lower ends of these pipes should be conical in form and come close to the floor. They should be connected at their lower extremity with an outlet pipe, to carry off the meltage from the ice.

The greater the degree of refrigeration required, the greater should be the number of these pipes, and in some cases it is necessary to run a certain number from the midle of the ceiling, as well as those we have already described around the walls. The central ones may be, when necessary, much larger and if oval shaped are more effective.

The upper chamber should be as low as possible (the lower the better). Into the troughs, which should be provided with packed covers, as well as packed sides, the ice is thrown, after having been broken quite fine and mixed with salt. The quantity of salt is from 8 to 10 per cent. of the quantity of ice.

CHEAP ICE HOUSES.

A family ice house need not be an expensive structure. It may be built cheaply, and serve its object excellently. A building of 12 feet square and 9 feet high is sufficient for the wants of the most exacting family.

It may be a frame building entirely above the surface of the ground (better still if supported on posts elevated a few inches, to be certain of good drainage,) built of joists 2 or 3 inches, with an outer boarding, having inside another series of uprights, also boarded, from 6 to 10 inches removed from the outer shell, and a solid floor of plank. Fill the space between the two walls with tan bark, saw dust, swamp moss, etc.; put on a roof of good pitch, and the ice house is complete.

A drain for water should be made from the floor, and the pitch of the roof filled with straw, hay or similar dry porous material. On the roof should be a ventilator, the top defended from the rain. The ice should be packed in one solid mass, the sides not reaching the inner walls of the building, but allowing a space of from 12 to 6 inches all round.

The top of the ice should be covered with straw, and the doors should be like the sides of the building, or double doors should be made, one in the outer and the other in the inner wall.

Two workmen, if not practical carpenters, can put up such a building in one or at most two days. It will prove a useful adjunct to the farm and dairy. It is very useful as a refrigerator on a large scale for preserving food.

It costs but a little to build an ice house, that will keep ice the year round, where practical utility only is aimed at, and not elegance of structure.

A writer on this subject, thus tells how he constructed an ice house. I set posts in the ground so as to make a house 12 feet square (three posts on each side), then I boarded it up 8 feet high on the outside. I then dug out the surface earth 6 inches deep, and filled in with saw dust, one foot deep, making it 6 inches above the level of the earth.

I packed the ice carefully, 9 feet square and 6 feet high, leaving a space of 18 inches between the ice and boards, which I closely packed with sawdust. I placed the same thickness of sawdust over the ice. I have a board roof over this ice house, the space above the saw dust is left open so that the air can circulate through. The result is that we have used ice daily and have plenty yet. As to the cost, four men with one team cut, hauled and packed the ice, and filled in the sawdust in less than two days. We had to haul the ice ½ a mile.(1)

KEEPING ICE IN BARNS, SHEDS OR IN STACKS.

IN BARNS OR SHEDS.

Ice will keep in a barn or a shed, when properly packed. In the first place skids, small stones and sawdust are laid down for foundation and drainage.

The ice is piled in a bed of snow to prevent the air from reaching it. It is then surrounded and covered with 18 inches of well packed sawdust, or three feet of hay or straw.

IN STACKS.

Construct a pen near a pond, or a stream, where the ice is to be gathered. If such a site is not to be had choose a convenient spot outside of droppings from roofs, always making provision for drainage.

The pen may be made of rails 12 feet long or of any desired length. The larger the pen, the better the ice will keep. Lay up two rails upon each of the four sides, make the bottom level, and cover it a foot or more with sawdust, tan or straw etc.

(1) Youman's Dictionary of every-day wants.

Cut the cakes of ice in the usual manner and pack them closely, filling the interstices with pounded ice. Pack the outside with a foot of straw, saw-dust or other material, and put up the fence as the pile rises. The pile can be conveniently made from 8 to 12 feet high.

Cover the ice with at least 18 inches of saw-dust, or two feet of straw or hay trodden down closely, make a roof of boards, or slabs, slanting to the North, sufficiently steep to shed water, and fasten with a few nails.

AN ICE BOX.

In connection with such a start, a cheap ice box made with double sides, and packed with sawdust will be wanted. The ice chamber should be about 2 feet long, 2 feet deep and 18 inches wide. This will hold a single cake of ice weighing one hundred pounds, or more and leave room on the top for cold storage.

If the stack is not disturbed more than once or twice a week, it will probably supply the family through the summer with an abundance of ice.

As the stack diminishes, care must be taken to see that it is kept closely packed.

THE OPENING OF AN ICE FIELD.

FOR LARGE ICE HOUSES.

On running water, cutting a hole in the ice and dumping the snow into it, is a very good plan.

On still, shallow water it is impracticable as the hole will soon fill up with the sinking of the snow to the bottom If banked up on the field it may, in some places, sink the ice, and let the water on

When the snow is loose, it can often be got rid of, by running a V scraper or snow plough, thus throwing the snow into the water. But this method is only available, where there is only one elevator to feed. In very large ice houses it is too slow.

A good way, to dispose of this greatest of nuisances, is to run it ashore in scoops made for this purpose.

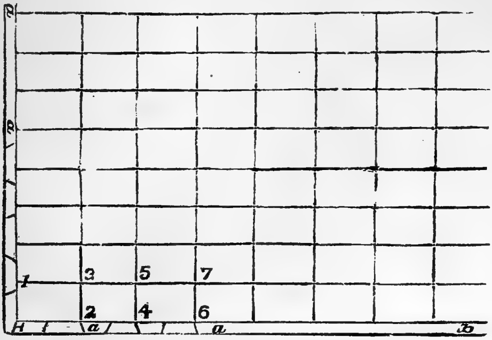


Fig. 53.—Ice field marked in blocks.

The field is marked with very ingenious ice markers driven by horses. It is then furrowed to a certain depth, with specially constructed ice cutters called ploughs, also driven by horses.

FOR SMALL ICÉ HOUSES.

Having chosen a place where the ice is clear and sound clear off the snow. Then with a plank, 12 feet long and 10 inches wide, to serve as a ruler and a chisel, mark off the field something like a checker board. Making the blocks 20 inches long, by 40 wide. (See fig. 53.) Enough should be marked at a time for a day's work.

Having made a hole in a corner with an axe, sufficiently large to pass a saw, saw one block, push it

STORING OF SNOW.

In places where ice cannot be conveniently had, snow may be stored, and used as a cooling agent, with nearly as much advantage as ice.

A cubic foot of snow well packed weighs about 48 lbs.

The softest and heaviest snow contains 40% more cooling power than light dry snow. It must, therefore, be gathered when soft and wet, in layers of 4 or 5 inches in thickness, and tramped with the feet, or otherwise well pressed. Tramping with the feet is about as good a means of pressing as any. One man can in a day's work press about 700 cubic feet. Snow keeps just as well as ice.

Cover well with straw, hay, or rushes as in the case of ice. Do not use saw-dust for snow.

GENERAL REMARKS ON ICE HOUSES.

1st. The ground should be banked up round the sides of the houses (about 18 inches high,) that the water from the roof may run off, and that the air may not pass under the walls of the house. (See fig. 18.)

2d. A good coat of lime (whitewash) should be given to the walls and roof. (1)

(1) The following recipe for whitewash is considered one of the best. It is almost as good as oil paint, and will answer on wood, brick or stone: Slack ½ a bushel of lime, with boiling water, keeping it covered during the process. Strain it and add a peck of salt, dissolved in warm water, 3 pounds of ground rice put in boiling water, and boil to a thin paste; half a ½ lb. of powdered Spanish whiting, and a lb. of clear glue, dissolved in warm water. Mix this well together, and let it stand for several days. Keep the wash thus prepared in a kettle, or portable furnace, and when used, put it on as hot as possible with painters or whitewash brushes.

3d. See that the ice is kept air tight as much as possible and to effect this, close up any chinks or crannies in the walls or floor, and keep the covering on the ice and floor of the loft.

4th. If the house is not to be opened until the end of the season, dispense with ventilation in the ice chamber by closing up the aperture in the loft floor, and keep the room close.

5th. If the house is opened frequently, supply the ice chamber with ventilation, to carry off the moisture produced by the warm air admitted, when it is opened.

6th. Go over the house carefully from time to time, and see that every thing is right inside, and check anything that may be amiss.

THE END.

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TABLE OF CONTENTS.

—A—

—B—

—C—

—C—

—D—

—E—

—F—

—F—

—G—

—H—

—I—

—I—

—K—

—L—

—M—

—M—

—N—

—O—

—P—

—R—

—S—

— S —

— T —

— V —

— W —

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