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SMALL COLD STORAGES

BY

J. A. RUDDICK and J. G. BOUCHARD

Bulletin No. 35---Dairy and Cold Storage Series

OTTAWA
GOVERNMENT PRINTING BUREAU

1913

LETTER OF TRANSMITTAL.

OTTAWA, June 28, 1913

To the Honourable,

The Minister of Agriculture.

SIR,—I have the honour to submit the manuscript for a new bulletin on 'Small Cold Storages,' with plans and specifications, suitable for use on farms or in connection with country stores, hotels, butcher shops, &c., in localities where a supply of ice is available. There is a growing demand for information along this line. It is not practicable to employ an architect for such small jobs and the average carpenter has not had the necessary experience to enable him to make satisfactory designs for cold storage buildings. These reasons are, in my judgment, ample justification for the publication of detailed instructions which can be followed by any intelligent workmen.

The work of drawing the plans herewith presented was performed by Mr. J. G. Bouchard of the Dairy Division.

I have the honour to recommend that this bulletin be printed for general distribution as Bulletin No. 35 of the Dairy and Cold Storage series.

I have the honour to be, sir,

Your obedient servant,

J. A. RUDDICK,

Dairy and Cold Storage Commissioner.

SMALL COLD STORAGE

BY

J. A. Ruddick and J. G. Bouchard.

INTRODUCTION.

If the losses which occur every year in Canada on farms, at country hotels and stores, butcher shops, &c., owing to the lack of proper cooling facilities for perishable foods in hot weather, were compiled, the total would make an enormous sum. A tremendous saving in dollars and cents could be effected with comparatively small outlay, to say nothing of the added comfort and the greater healthfulness of these food products, if all such places were provided with some adequate means of utilizing the cooling power of ice. There are few localities in Canada where a supply of ice cannot be obtained in the winter months. The cost, even by contract, need not exceed \$1 per ton except in rare cases, and it can often be done for less. Farmers or others who can do the work themselves are able to store the ice without any cash outlay. In view of the ease with which a summer's supply of ice may be obtained the wonder is that any one is content to do without it.

The Storage of Ice.

The mere preservation of a few blocks of ice is a simple matter. Any unoccupied corner of an outbuilding or shed can be utilized. A rough frame work of boards enclosing the necessary space is all that is required. About 40 cubic feet should be allowed for every ton of ice to be stored. There should be no floor in this kind of an ice house. If the soil is light and porous no special provision need be made for drainage. If it is impervious clay it will be better to under drain the area to be used for ice storage. The earth should be covered to a depth of six inches with broken stone, coarse gravel or cinders. Before laying in the ice, spread about one foot of sawdust or planing mill shavings over the floor. A space of at least one foot should be left between the ice and the walls to be filled with sawdust or planing mill shavings, the latter preferred. Cover the ice with one foot of the same material.

Improved Ice Houses and Refrigerators.

The plans shown and described in this bulletin are intended for those who may have to erect special ice houses or who may desire to provide more convenient and permanent facilities than the ordinary ice supply affords.

Plan No. 1* is intended primarily for the use of patrons of cheese factories and creameries, and is really a combined covered milk stand and ordinary ice house.

Plan No. 2 is an ordinary ice house with milk room and refrigerator.

Plan No. 3 is the same as No. 2, without the milk room. The refrigerators in Plans 2 and 3 are arranged on the same principle as an ordinary house refrigerator with an extra large space for ice. The ice box is filled from time to time as required.

* Reproduced from Bulletin No. 20

Plan No. 4 shows an ice chamber with refrigerator and ante-room constructed according to what we describe as the automatic or circulation system. This plan provides for a permanent insulation in the walls, floor and ceiling of the ice chamber to take the place of the usual covering or packing material. In plans 1, 2 and 3, the insulation or covering of sawdust, shavings or other material must be renewed every time the ice house is filled.

In cases where convenience of operation and general efficiency are given first consideration as against initial cost, we strongly recommend Plan No. 4. The first cost is greater than for plans 2 and 3, because in addition to the extra row of studs and one more course of lumber in the walls, an insulated ceiling must be provided for the ice chamber to take the place of the covering material which is used in the other plans.

The advantages and disadvantages of the two systems are obvious. Plans 1, 2 and 3 provides for the cheapest construction, but the annual renewal of the insulation or covering material and the labour of filling the ice boxes from time to time are very important considerations. Plan No. 4 has the very decided advantage of being automatic in its operation, requiring no attention throughout the season. The ice not being covered permits of a circulation of air between the ice chamber and the refrigerator, for cooling purposes, as shown by the arrows in the section at 'A. A.' An opening at the bottom of the partition between the ice chamber and the refrigerator allows the cold air to flow into the refrigerator while the warm air returns to the ice chamber through a similar opening at the top of the partition.

These openings should not be over 6 x 18 inches and both should be fitted with sliding covers to regulate the circulation of air, or to shut it off entirely when not required. The circulation system also has the advantage of giving dry storage, because the moisture in the air which circulates is condensed on the cold surface of the ice. It is advisable also to have smaller openings in the partition between the ante-room and the ice chamber, especially if it is to be used at all for cool storage. The section at 'A. A.' shows the refrigerator with a lower ceiling than the ice chamber. The object of this is simply to reduce the air space which has to be cooled. The ceiling of the refrigerator need not be more than seven feet high. Any space in excess of that height would be useless for storage purposes.

SPECIFICATION.

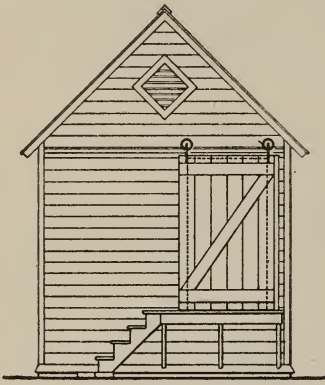
Plan No. 1.

The foundation may be of concrete, stone or wooden sills. Erect on top of foundation 2-inch x 4-inch studs ten feet long at three-foot centres. Cover the outside with clapboards or shiplap siding. Inside the studs around the ice chamber, erect one course of rough lumber or $\frac{3}{4}$ -inch T. & G. sheathing. For convenience in handling the milk cans, a floor should be laid over that part of the building reserved for the milk stand at the usual height from the ground. The construction of the building is so plainly shown in the illustration that no further description is necessary.

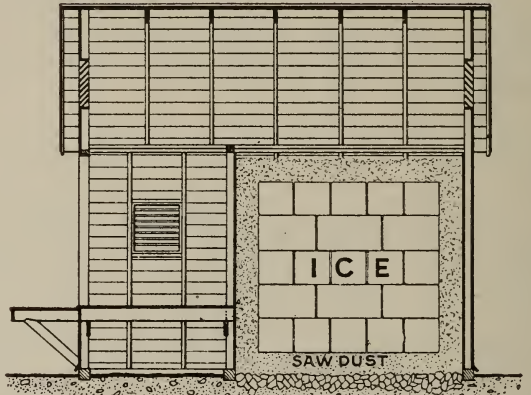
When putting in the ice, it should be surrounded with at least one foot of sawdust or planing fill shavings. The space over the ice should be well ventilated. This helps to carry off the heat which will accumulate under the roof and to keep the sawdust on top of the ice in a dry condition.

Plan No. 2.

The foundation may be made of concrete, stone or wooden sills resting on the ground. Erect 2-inch x 4-inch studs, 12 feet high, at 24-inch centres, with 4-inch x 4-inch corner posts. Erect 2-inch x 6-inch studs at 24-inch centres for partition between ice chamber and refrigerator and ice chamber and milk room and also between milk room and refrigerator. Erect a further row of studding on the inside of the wall around the ice box and refrigerator so as to leave a space of one foot between the inside and outside sheathing. Cover the outside of building with $\frac{3}{4}$ -inch T. & G. sheathing and finish with clapboards or shiplap siding. The sheathing may be dispensed with around the ice house, but it is important next to the refrigerator and milk room. On the inside of the studs around the ice house erect one course of $\frac{3}{4}$ -inch T. & G. sheathing. Over that part which adjoins the ice box lay 2 ply of damp proof paper and finish with another course of $\frac{3}{4}$ -inch T. & G. sheathing as shown in plan. Finish the inside of milk room with one course of $\frac{3}{4}$ -inch T. & G. matched lumber. On the side next the ice box and refrigerator, lay two-ply of damp proof paper and a second course of $\frac{3}{4}$ -inch T. & G. matched lumber. Finish the inside of the refrigerator and ice box space with two courses of $\frac{3}{4}$ -inch T. & G. sheathing with 2 ply of damp proof paper between. Erect a partition between the ice box and refrigerator as shown in plan of 2-inch x 4-inch studs covered on both sides with two courses of $\frac{3}{4}$ -inch T. & G. sheathing with damp proof paper between. Fit all corners in refrigerator with quarter round mouldings. Between refrigerator and milk room erect a bevelled edge frame door cover with two courses of $\frac{3}{4}$ -inch T. & G. matched lumber with two-ply of damp roof paper between, leaving a space in the centre of 6 inches to be filled with shavings. Cover the bevelled edge of the door with felt to make an air-tight joint. Over the area of the refrigerator and ice box, lay 6 inches of dry sand or cinders. On top of this leaving a space of 2 inches, lay a false floor of 1-inch lumber, on top of which lay 2-inch x 8-inch joists at 2-foot centres. Cover the joists with one course of $\frac{3}{4}$ -inch T. & G. lumber, and one course of 1-inch flooring with 2-ply of damp proof paper between. Cover the bottom of the ice box with galvanized iron and connect to the drain with a trap to carry off the drip from the melting ice. Fix a rack of 2-inch x 4-inch scantling at 4-inch centres in the bottom of the ice box, with a clear space of 6 inches underneath. Leave 6-inch openings at the top and bottom of the partition between the ice box and refrigerator for circulation of air. At seven feet clear from the floor lay 2-inch x 8-inch joists to form ceiling. Cover the under side of the joists with two courses of matched lumber with damp proof

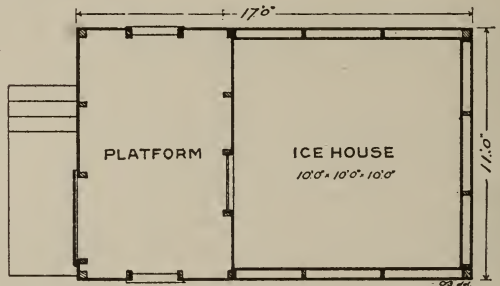


ELEVATION.



SECTION.

MILK PLATFORM
WITH ICE HOUSE



PLAN.

paper between. Make a hatch over the ice box similar to the door between the refrigerator and the milk room. Fill the spaces in the floors and ceilings between the joists and also in the walls between the studs with planing mill shavings. The floor in the milk room may be constructed of wood or concrete as desired. If constructed of concrete, the floors should be made in connection with the foundation and the work should extend at least 6 inches above the floor. This will form a base to protect the wooden walls from dampness. Place an ordinary door in the milk room and a window opposite the door into the refrigerator. On the outside of the ice house, erect a door in sections extending from top to bottom. On the inside of the door frame, fit loose boards to be put in place as the ice chamber is filled with ice. In both gable ends of the building make a louvre opening for ventilation, as shown in plan.

Plan No. 3.

The specification for plan No. 3 are practically the same as for plan No. 2. The ice chamber is smaller and no provision is made for a milk room. The ante-room to the refrigerator is only large enough to swing the door in. The door between the ante-room and the refrigerator and the hatch over the ice box are intended to be constructed in the same manner as the door and hatch in plan No. 2. It is important that the window in the ante-room should be opposite the door of the refrigerator to give light in the refrigerator when it is required. It is safer to have the window fitted with a double sash, and it need not be more than 18 inches square.

Plan No. 4.

Foundations.—The foundations should be of stone or concrete, fourteen inches thick and two or three feet deep, according to the nature of the site.

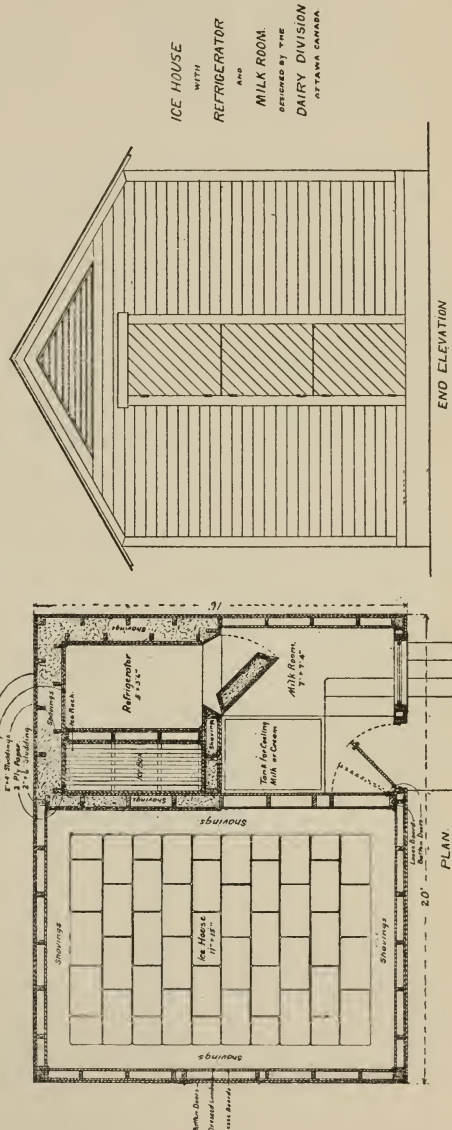
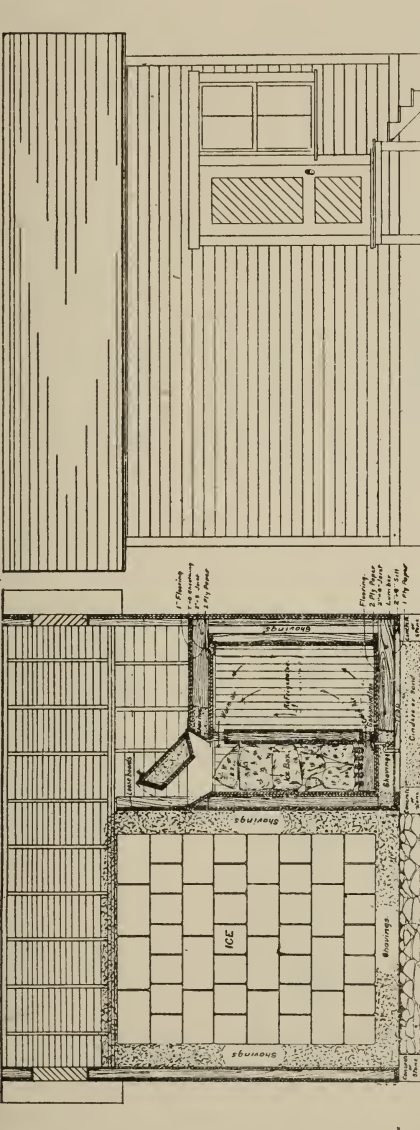
Floor in Ice Chamber.—The area of the floor in the ice chamber should be graded with a slope of three inches to one corner. Lay rows of field tile three feet apart leading to the low corner and connect same to the drain outside the building. The connecting should be trapped to prevent passage of air. Cover the tile with eight inches of coal cinders. If cinders are not procurable, clean gravel may be used. On top of cinders or gravel, lay loose boards. This forms the permanent floor of the ice chamber and provides drainage for the melting ice.

Floors in Refrigerator and Ante-room.—These floors may be made in one of the following ways:—

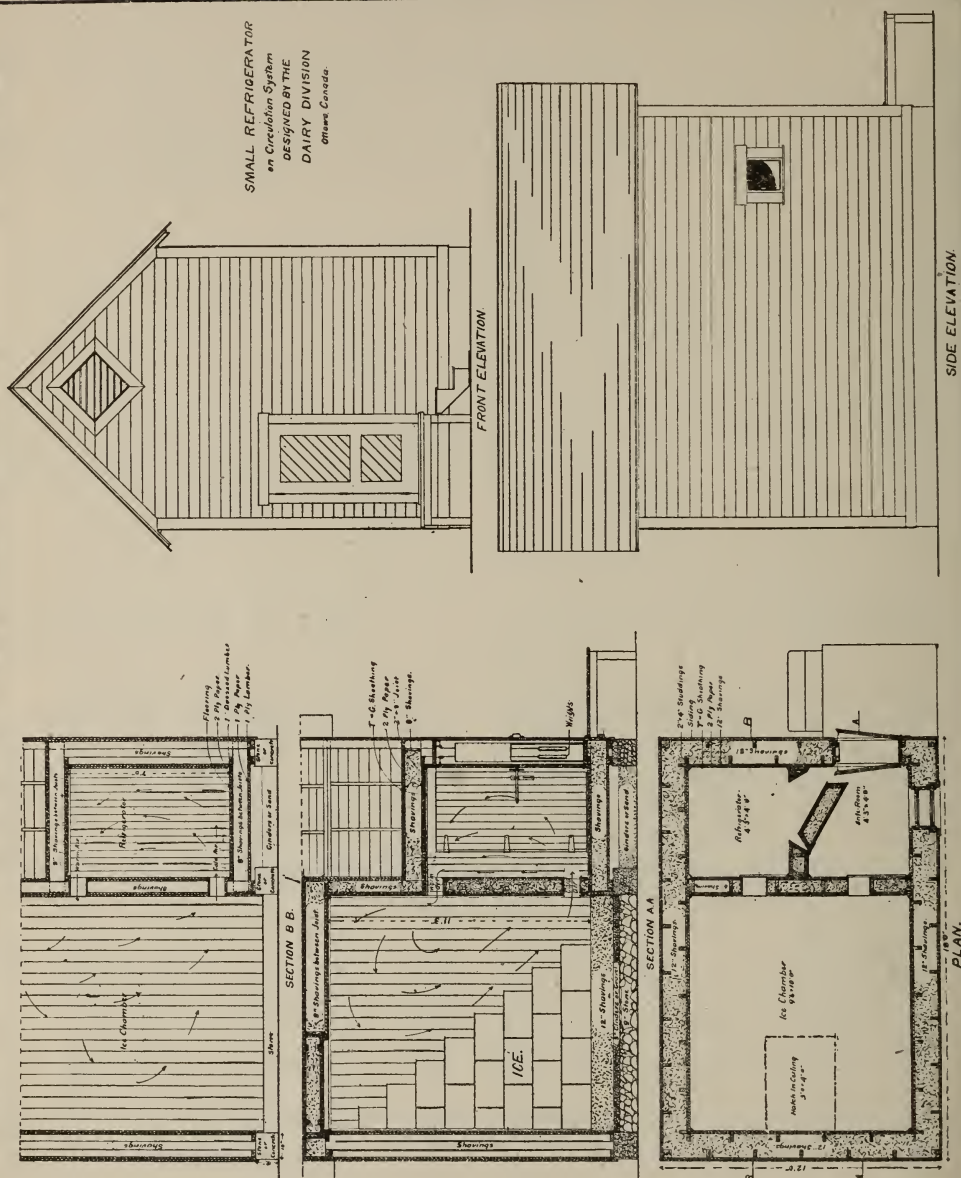
1. Lay four inches of concrete over area of floors. On top of this, lay three inches of cork board and finish with one-inch of cement. (See detail drawing.)
2. Cover area of floor with six to eight inches of coal cinders or dry sand or gravel. Lay a $\frac{3}{4}$ -inch tongued and grooved floor on 2-inch x 4-inch joists. Cover with damp proof building paper and then place 2-inch x 6-inch joists at 24-inch centres. Fill space between joists with planing mill shavings and cover with $1\frac{1}{4}$ -inch flooring tongued and grooved. (See detail drawing.)

NOTE.—The concrete-cork board floor is much the best and being of permanent construction will be the cheapest in the end.

Walls of Ice Chamber, Refrigerator and Ante-room.—Erect two rows of 2-inch x 4-inch studs, 'staggered,' so as to leave a space of 12 inches between the inside and outside sheathing to be filled with shavings. Cover the outside with one course of $\frac{3}{4}$ -inch tongued and grooved lumber (spruce preferred), two ply of felt building paper, and finish with siding or clapboards uniform with the creamery building. Cover the



SMALL REFRIGERATOR
on Circulation System
DESIGNED BY THE
DAIRY DIVISION
Ottawa, Canada.



SIDE ELEVATION.

PLAN.

inside of the studs with two courses of $\frac{3}{4}$ -inch tongued and grooved spruce sheathing, with two-ply of damp-proof paper between.

Ceilings.—Erect 2-inch x 8-inch joists at 24-inch centres. Cover under side of joists with two courses of $\frac{3}{4}$ -inch tongued and grooved spruce sheathing, with two-ply of damp-proof paper between. Finish ceiling of ice chamber with an additional course of $\frac{3}{4}$ -inch tongued and grooved spruce over one-inch furring strips, same as specified for walls of ice chamber.

Partitions.—Partition between ice chamber and ante-room, and between ice chamber and refrigerator, to be constructed in the same manner as the outside walls. Partition between refrigerator and ante-room to be constructed with 2-inch x 6-inch studding covered on both sides with two courses of $\frac{3}{4}$ -inch tongued and grooved spruce sheathing with two-ply of felt paper between.

Doors.—The door into ante-room and the door between ante-room and refrigerator to be fitted with bevelled frames, as shown in plan. Make the doors bevelled to fit frames, with two courses of $\frac{3}{4}$ -inch spruce sheathing both inside and outside with a 4-inch space filled with shavings, these doors to have an opening 6 feet x 2 feet 6 inches clear.

The door from the ante-room into the ice chamber to be of same construction as other doors, with an opening 4 feet x 2 feet 6 inches clear. The bevelled faces of all doors to be covered with felt to make as nearly as possible an air-tight joint.

Window.—Make a window 2 feet x 2 feet in ante-room opposite the door in the refrigerator so as to allow some light to enter the refrigerator when the door is open. The window to be fitted with double sash well battened.

Openings for air circulation.—Make two openings, each 18 inches x 6 inches in the partition between ice chamber and refrigerator. Place one opening at the ceiling of refrigerator and the other near the floor. Fit each opening with a sliding cover. Make two similar openings 12 inches x 6 inches in partition between ante-room and ice chamber.

Inside finish.—The whole interior of the ice chamber, ante-room and refrigerator should be given a coat of boiled linseed oil. The ante-room and refrigerator should be finished in hard oil varnish or whitewash.

Put no ventilator in the ice chamber, ante-room or refrigerator.

General Notes.

Filling the Ice Chamber in Plans 1, 2 and 3.—Before filling the ice chamber, lay about ten inches of planing mill shavings or sawdust over the permanent floor and cover with loose boards. This layer of insulating material can be renewed every year or when it shows signs of decay or mustiness. Leave a space of at least one foot between the ice and the walls to be filled with sawdust or planing mill shavings.

Filling the Ice Chamber in Plan No. 4.—When proper provision has been made for drainage, cover the floor with a layer of sawdust or planing mill shavings as in Plans 1, 2 and 3. Pack the ice closely against the walls and put no covering material over it.

Insulation.—Refrigerating engineers have during the last few years practically discarded the empty space—the so-called dead air space—once extensively used for

insulating purposes. Theoretically, a dead air space is a poor conductor of heat, but the ordinary air space is not a dead air space. As one side of the space becomes warmer than the other, the air immediately in contact with it becomes lighter on account of the increase in temperature, and at once ascends, while colder air from the other side takes its place. Thus we have a circulation of air within the space and heat is carried from one side to the other by convection.

Moreover, it is extremely difficult to get the work done properly when empty spaces are depended on for insulation. The slightest crack or opening, even a nail hole, tends to destroy the efficiency of this form of construction.

In the insulation of wooden walls, the best practice at the present time provides for an outer and inner shell, as nearly as practicable impervious to air and dampness, with a space between to be filled with some non-conducting material. The width of the space will depend on the filling to be used and the temperature to be maintained in the storage room.

For a cold storage constructed of wood, there is no better material for filling spaces than planing mill shavings. Where available at all, they are cheap; they are elastic and do not settle readily; but most important of all, they can be obtained in a very dry condition, which is essential, and, further, they do not absorb moisture readily after being placed in position. They may be some difficulty in obtaining a sufficient supply of shavings in places remote from manufacturing centres, but many of the large sash and door factories now pack shavings in bales, weighing about 75 pounds each, for convenience in shipping. The weight of shavings required to fill a given space will depend somewhat on the kind of wood from which they are made, and also to some extent on how tightly they are packed, but a fair average is from seven to nine pounds per cubic foot of space. They should be packed sufficiently to prevent subsequent settling.

Sawdust vs. Shavings.—Because it costs little or nothing and is readily available in most country districts, there has been a tendency to use sawdust for filling spaces in the walls of small cold storage buildings. It is, however, far from being a satisfactory material for this purpose. In the first place, as sawdust is cut from green timber, it is always more or less damp and is, therefore, not a good insulating material. The dampness not only conducts heat, but it encourages the growth of mould and rot, first in the sawdust itself, and then in the walls of the building. As a result of the mould, the air in the storage room becomes musty and thus injurious to the quality of the foods stored therein. The settling of the sawdust, caused by the growth of mould and consequent heating, leaves open spaces, which further weakens the insulation. In the experiments already referred to, we found by actual test that shavings are very much superior to sawdust for insulating purposes, apart from the objection to the sawdust on account of the mustiness which nearly always appears in rooms where it is used as a filling in the walls. If it is found impossible to procure shavings, sawdust is probably the next best material if it is well dried before being used.

Insulation must be dry.—One of the problems in cold storage construction is to provide against moisture being absorbed by the materials composing the insulation. Moisture or dampness may come from the outside air or from the goods in storage. It must be understood that dampness, as referred to in this connection, does not imply the presence of water in the ordinary sense, but simply the presence of moisture as we find it, say, in green lumber as compared with dry or well seasoned lumber.

In a wooden wall filled with shavings, it is the shavings which must be protected from dampness. This can be done by using damp-proof building paper between the two courses of sheathing, or boarding, both on the outside and the inside of the walls.

Brick or cement concrete absorb moisture readily, and unless they are given some special water-proofing treatment, the insulating quality of such a wall is rather low. The outside surfaces of brick walls may be painted with some effect, but where

shavings are to be used inside of brick or concrete, the inner surface may be coated with pitch, paraffin wax, or some of the patented coatings on the market. Coating walls with either pitch or paraffin in cold or even cool weather without special apparatus is a rather difficult operation, on account of the tendency of both substances to harden very quickly. In using pitch, care must be taken not to get tar, or any mixture of tar, which would be ruinous on account of its odor. Pitch is odorless when it hardens. If the inside surfaces of brick or concrete walls cannot be properly waterproofed, the next best plan is to put one-inch furring strips on the wall, then one course of matched lumber, which will form the inside surface of the space to be filled. It will be all the better if the sheathing is covered with damp-proof paper

Spruce Lumber to be Used.—Only spruce lumber should be used for the inside finish of refrigerators, ice boxes, or for the ice chamber in No. 4.

Plan for a Larger Cold Storage.—Any person who desires to erect a larger and in some respects a more complete cold storage should apply for a copy of Bulletin No. 36, which gives particulars of a plan designed especially for creamery purposes.

Blue Prints Supplied Free.—Blue prints on a scale of $\frac{1}{2}$ inch to one foot for any of the plans in this bulletin will be supplied free on application to the Dairy and Cold Storage Commissioner.

Size of Ice Chamber.—It is impossible to lay down any general rule for the size of the ice chambers, as so much depends on what the ice or the refrigerator is used for. In Plans 1, 2 and 3, one ton of ice will occupy about 40 cubic feet of space including covering material. In Plan 4, where no covering material is used it requires a somewhat less space for a ton of ice, depending on how closely it is packed.

Quantity of Ice Required for Season's Supply.—A cubic foot of ice weighs $57\frac{1}{2}$ pounds. One ton of solid ice measures, approximately, 35 cubic feet. A consumption of two cubic feet (115 pounds) per day for four months would amount to nearly seven tons. Allowing for the waste when such a comparatively small body of ice is stored, a building 10 feet square and 10 feet high will afford ample space for that quantity of ice if it is carefully packed.

Fifty pounds per day for four months would amount to three tons. Allowing for waste, a solid block of ice six feet square and six feet high should be sufficient if properly stored.

For the purpose of estimating the weight of ice roughly by the number of blocks, the following table will be found convenient:—

12	blocks	18 x 36	inches,	8	inches	thick	= 1 ton.
10	"	18 x 36	"	10	"		= 1 "
8	"	18 x 36	"	12	"		= 1 "
7	"	18 x 36	"	14	"		= 1 "
6	"	18 x 36	"	16	"		= 1 "
5	"	18 x 36	"	20	"		= 1 "

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