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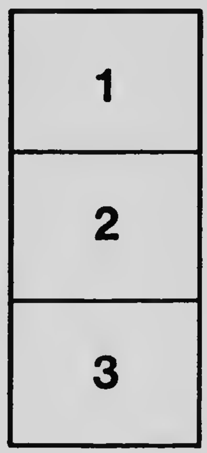
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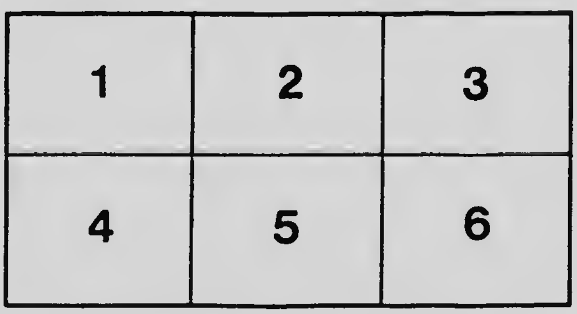
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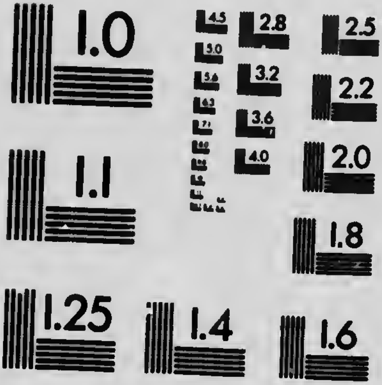

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BULLETIN 207.] **DECEMBER, 1912.**

Ontario Department of Agriculture.

ONTARIO AGRICULTURAL COLLEGE

Ice Cold Storage on the Farm

R. R. GRAHAM.

WHAT COLD STORAGE MEANS.

THE GENERAL MEANING.

The term "cold storage" refers chiefly to the preservation of our perishable products, such as fruit, milk, butter, meat, eggs, vegetables, etc., from premature deterioration and decay, in cold air chambers cooled by ice or some other refrigerating means. It is also associated with the curing of cheese, moth-proof storages for woollens and furs, and many other processes. In fact, the term "cold storage" involves so much nowadays that a large volume would have to be written in order to explain its whole meaning, and its various applications and uses. I wish to emphasize, however, that cold air alone is not "cold storage" in all cases. In most instances of storage it is very essential that the cold air be very pure and sweet, of the proper humidity or degree of moisture, and it should circulate freely throughout the storage chambers. And ventilation, or the renewal of the air in the storages, should be well provided for, especially where large quantities of various classes of goods are stored for any length of time. "Cold storage," then, involves means of controlling not only the temperature, but the humidity, purity, circulation and ventilation of the air within the storage rooms. The degree of these factors varies to a certain extent for the different products and conditions of storage, but "cold storage" proper always involves them all.

WHAT IT MEANS TO THE FARMER.

Cold storage in relation to the farmer means chiefly the use of ice to preserve his perishable products in good condition for such short periods as he may be required to hold them for his own family use, for disposal on the markets or otherwise. An abundant supply of good cold water from a well or spring is very valuable for keeping milk on the farm, or an underground cellar which keeps fairly cool even in the hottest weather serves well in the preservation of perishable products for a few days. These means, then, play no inconsiderable part in cold storage on the farm; but ice is the great factor, for there are many times when its use is indispensable for preventing great losses in farm produce.

THE GENERAL VALUE OF COLD STORAGE.

For the farmer to fully appreciate the need of cold storage in connection with his own business he must understand its place and value in commerce. The following are its chief benefits:

(1) To preserve, or at least lengthen, the life of our perishable products, thus lessening the loss due to their otherwise premature deterioration and decay before consumption.

(2) To increase the length of time during which these products may be used for food, thereby greatly encouraging production.

(3) To make it possible for our people to enjoy a greater variety of food throughout the year.

(4) To make it possible to transport perishable products long distances by railway or steamboat successfully.

(5) To provide the markets with a more uniform supply of perishable goods throughout the year, and thus keep prices more constant from season to season.

(6) To enable the producer to market his products at will; for if the markets are at any time over supplied he can hold his goods until the market conditions improve.

(7) And lastly, it makes it possible for the farmer to supply the market, the customer or the factory with a better article than he could without cold storage.

SOME REASONS WHY OUR FARMERS OUGHT TO STORE ICE AND PROVIDE FOR COLD STORAGE.

From the perishable nature of many products of the farm it is quite apparent that our farmers should store ice and provide for cold storage. We give you herewith a few of the most common advantages:—

(1) To cool the milk and cream;

(2) To preserve butter, eggs, meats and fruits;

(3) To provide for a greater variety of food;

(4) To enable the farmer to market his products at will;

(5) To supply the household refrigerator;

(6) To provide for home-made ice cream and other refreshing deserts;

(7) For use in case of sickness.

The foregoing statements comprise the chief benefits of cold storage to our country and its people; and practical farmers cannot fail to see that they may have a large share in these benefits, if they will make use of it so far as it is possible on their farms, or by co-operative cold storages for the handling and marketing of their perishable products. Each year seems to introduce some new use or application of cold storage in commerce, but in connection with the farms of our country its use is not developing as rapidly as it should. It is believed, however, that it will become more general on the farm in the very near future, as its value is more generally and fully understood.

SOME PROPERTIES OF ICE.

Ice is a crystalline solid formed by the freezing of water. Absolutely pure and distilled water under standard atmospheric pressure freezes or solidifies at a temperature of 32 degrees Fahrenheit or Zero Centigrade. The freezing point of a substance is influenced by the presence of salts, by solids or any foreign matter, and also by pressure to a very slight degree. Common salt brine at its maximum density will not freeze until a temperature of 7 degrees below zero, Fahrenheit, is reached, and a certain strength of calcium chloride brine will not freeze even at 50 degrees below, Fahrenheit, and in the case of fruit juices the freezing point is about 5 degrees below 32, because these juices are not pure water, but a solution of substances in water. Ice always forms on the surface of a body of wa[illegible] remains there because it is lighter than water. Its specific grav[illegible] hat is, its weight is approximately 9-10 of water. Water in free[illegible] nds about 1-10, therefore 1 cubic foot of water produces 1 1-10 [illegible] of ice. A cubic foot of water weighs 62 1-2 lbs.; a cubic foot o[illegible] 92-100 of 62 1-2, or about 58 lbs., and 1 ton of solid ice occupies 35 or 36 cubic feet of space; but as stored in the ice-house it is reckoned that 42 to 50 cubic feet are required for the storage of a ton. The temperature of ice in the very cold weather drops below the freezing point, and twice as rapidly as the water did before freezing, because the capacity of ice for heat is only one-half of what it is for water. As the temperature drops below zero, ice contracts, and this is why large bodies of ice crimple and crack in the very cold weather. As to the strength of ice, it is calculated by Hiles in his book, "The Ice Crop," that "two inches in thickness will usually bear a man, four inches a horse, and ice five inches thick is generally safe for a team of horses and a loaded wagon, weighing two tons. Eight inches in thickness will bear up 150 lbs. per square foot of surface if distributed over an entire field; ten inches in thickness will support 250 lbs. per square foot of surface. It is usual to estimate that ice eighteen inches thick will support a railway train." The melting point of ice is the same as the freezing point of water, namely, 32 degrees Fahrenheit, or zero Centigrade. When 1 lb. of ice melts 142 units of heat are rendered latent or lost so far as temperature is concerned. This brings me to the next topic, the refrigerating or cooling power of ice.

THE REFRIGERATING OR COOLING POWER OF ICE.

The cooling by ice is due chiefly to its melting, and the faster this process takes place the sooner the desired temperature is reached, provided the quantity of ice is large enough. Melting is the physical change of the solid to the liquid form of matter, and this change occurs at a definite temperature for each substance. Water freezes at 32 degrees Fahrenheit, or zero Centigrade, and ice melts at these points. This process of melting abstracts or renders latent a definite quantity of heat, and it is the loss of this heat in the melting of ice that gives it its refrigerating value, for cold is the absence of heat. This heat which is used up in the melting of ice is called the *latent heat of fusion of ice*, and it amounts to 142 heat units per lb. of ice. The practical unit of heat is the British Thermal Unit (B.T.U.), or that quantity of heat which will raise the temperature of 1 lb. of water through 1 degree Fahrenheit. When 1 lb. of ice changes to water the heat that is abstracted is equivalent to what would be required to raise 1 lb. of water 142 degrees Fahrenheit, or required to raise 142 lbs. of water 1 degree Fahrenheit. This quantity of heat is considerable, and accounts for ice being a better cooling agent than ordinary cold water, or even water at 32 degrees Fahrenheit. One pound of ice in melting has therefore 142 times the cooling value of 1 lb. of water in passing from 32 degrees to 33 degrees Fahrenheit, or the refrigerating value of ice as compared with an equal weight of cold water at 32 degrees Fahrenheit, is as 142 is to 1. In respect to the cooling of milk it is the practice to reckon that 10 lbs. of ice have about the same refrigerating value as 100 lbs. of cold well water, that is to say, 10 lbs. of ice and 100 lbs. of cold water have the same effect in cooling warm milk as 200 lbs. of cold water.

RELATION OF THE COOLING POWER OF ICE TO THE COMMON PRODUCTS OF STORAGE.

If we know the specific heat of a substance, that is, the amount of heat required to raise the temperature of a unit mass of the substance one degree, relatively to water, we can determine the quantity of ice necessary to cool a definite weight of that substance to any desired temperature. In the table below is given the quantities of some common products that are cooled 35 degrees by 100 lbs. of melting ice. The temperatures, 75 degrees before storage, and 40 degrees in storage are not used as being correct for all cases, but as being convenient and well within the cooling power of ice. Water is included merely for the sake of comparison as the specific heat of all substances is relative to it.

Name of Product	Specific Heat	Probable temp. before storage	Temp. in storage, say	Fall in temperature	The number of lbs. of each product cooled 35 degrees Fahrenheit by 100 lbs. of ice
Water......	1.00	75	40	35	428.5
Skim milk..	.95	75	40	35	451.05
Fruit (fresh)	.92	75	40	36	465.8
Vegetables..	.91	75	40	35	471.2
Milk	.90	75	40	35	476.1
Cream......	.84	75	40	35	510.12
Fish (fresh).	.82	75	40	35	522.3
Poultry.....	.78	75	40	35	549.4
Eggs.......	.76	75	40	35	563.9
Beef (fresh).	.68	75	40	35	630.2
Mutton	.67	75	40	35	639.6
Butter......	.64	75	40	35	669.6
Cheese......	.64	75	40	35	669.6
Pork (fresh).	.51	75	40	35	640.3

Note:—In these results observe that water is the hardest to cool, then the fruits and vegetables, which contain a large percentage of water, and easiest of all is the pork. Since the fruits and vegetables cool so slowly they are, therefore, more apt to spoil under normal conditions, and require to be well cared for early after harvesting. The water in them holds the heat and renders cooling very slow. These results indicate approximately the quantity of ice necessary for the cooling of the above amount of these products, provided [illegible] the heat is abstracted from the products alone, and therefore this table serves as a rough guide in calculating the amount of ice required for any particular case. In most of our small ice storages there is a loss of 25 per cent. to 50 per cent. cooling power due to poor insulation.

THE STORAGE OF ICE ON THE FARM.

The Ice-House a Necessity.

The most satisfactory way to keep ice is [illegible] a good ice-house, designed and built specially for this purpose. The building may consist of only one room filled with ice, or it may be a combination of ice-house and refrigerator, or ice-house and milk-room, or all combined, but in any case there must be a suitable place for the ice. If the farmer has any such building he will get good results, and will be far more likely to store ice every year, than if he has not a proper storage for it. Those who now and again put away a little ice in the winter in some makeshift place as in a bin under the shed, or in the rear of the woodshed, under a lean-to, or in some dilapidated little old building, are not very likely to have very much ice when they come to use it, especially towards the middle of the summer, or later. When they need it most, it is gone.

The Essentials of a Good Ice-House.

(*a*) A Favorable Site. This should be out of the sun as much as possible, and convenient to the house and the dairy.

(*b*) Adequate Drainage. If the ice-house is built on a loose or gravelly soil, natural drainage will be sufficient, but if on a heavy, compact soil, artificial drainage must be provided for as follows: Make an excavation the size of the inside dimensions of the house to a depth of 8 or 10 inches; below the bottom of this, and lengthwise, lay a row of 3-inch tile at a depth of at least 1½ feet, and fill the trench with stones and gravel. The floor of the excavation should slope somewhat on both sides towards this drain so that all the water may get to it readily. Nearly fill the excavation with cobble stones, and finish with a layer of coarse gravel or cinders. The tile drain should lead to a good outlet, and the outlet should be well protected by some kind of screen. (See Fig. 4 and 5.)

(*c*) Free Circulation of Air Over the Ice. Provision should be made for the free circulation of air through the top of the ice-house, otherwise the enclosed stagnant air, becoming warm in contact with the hot roof in summer days, would conduct a great amount of heat to the ice below, and cause a big waste. This is a common neglect in the storage of ice. The remedy is to put a latticed opening or louvre in each gable and a ventilator on the roof. It is also advisable to leave the eaves open beneath, and the wall open for about 6 inches below the plate. By means of all these openings the air can freely pass through the top of the building, and yet no rain or storm can get in to wet the covering of the ice.

(*d*) Good Insulation. It is very necessary, in order to keep ice well, to surround it with plenty of some non-conducting material which can be readily obtained at a reasonable cost. The insulation of an ice-house consists of the wall itself and the packing about the ice; the chief function of the former being to ward off the direct rays of the sun and the weather and to check the flow of heat towards the ice; that of the latter to preserve the ice from direct contact with the warm air. Sawdust of a good quality, that is, dry and clean, is very satisfactory for packing around the ice; planer shavings are still better, but they are not always easily obtained, and they cost far more than the sawdust. Wild hay, straw and chaff may be used if nothing better is available. If sawdust is used, there should be at least 1 foot of it well packed in between the mass of ice and the side walls, 2 feet under the ice and plenty of it over the top. As the sawdust next to the walls settles, some of that on the top should be packed in from time to time. Wild hay is fairly satisfactory for covering the ice on top, being much used where sawdust is not very plentiful, but a greater depth of it is neecssary. If plenty of packing material is used it is not very necessary to insulate the wall particularly; two thicknesses of boarding with insulating paper between constitute a very good wall. This question is dealt with more fully under construction of ice-houses.

(*e*) Banking. The bottom of the house should be well banked with earth, or cinders, to prevent the warm air getting in beneath to melt the ice.

FORMS OF ICE-HOUSES.

The Ice Pit.

The oldest method of storing ice is to pack it away under the ground in a cave or pit. This was a popular method in the long-ago days with the Romans, and is still used in some places. As the drainage is usually poor, and considerable labor is involved in getting the ice out, the method is not very practicable. The waste is large. The sides and bottom of these pits are lined with boards, stone or brick. (See Figs. 1 and 2.)

Stacking.

The simplest and cheapest way to store ice above ground is by "stacking" it. Select a cool, well drained spot on a slope facing the north, put down a few old rails and boards, cover with straw, wild hay or sawdust to a depth of one to two feet. On this foundation place the blocks of ice, packing them together as closely as possible, and if it is freezing weather the cakes may be made almost one solid mass by throwing water over the ice from time to time as the stacking is carried on. It will keep much better in this solid form, as the air cannot get through it so well, but it will be somewhat more difficult to remove for use. Cover the stack of ice with plenty of straw or wild hay and place some cheap

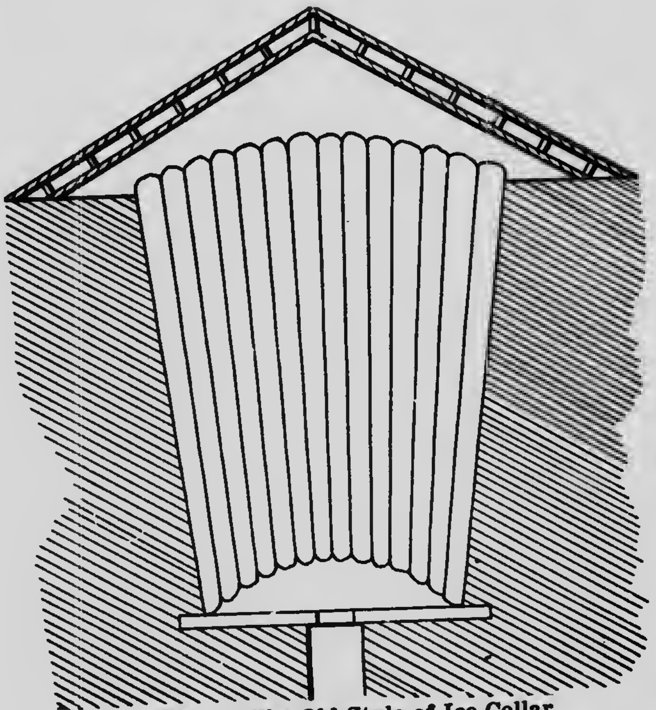


Fig. 1.—The Old Style of Ice Cellar.

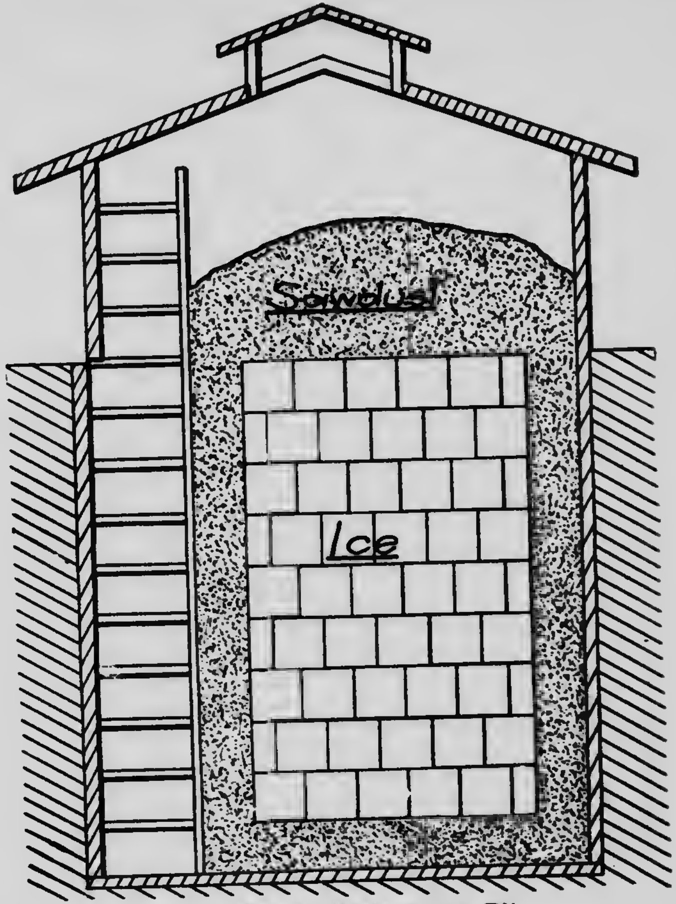


Fig. 2.—Modern Ice Pit.

(From "The Ice Crop," by Hiles.)

temporary wooden protection over it. The waste may not be more than 30 per cent. If a farmer can get plenty of ice easily, and isn't concerned particularly about how much of it wastes, so long as he has enough left for his use through the warm season, and provided he has a suitable place for stacking it, this method may be useful. It is used

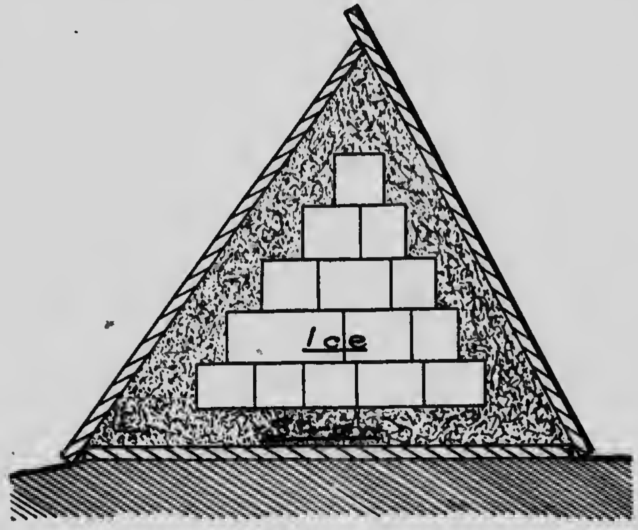


Fig. 3.—A Cheap Method of Storing Ice.

considerably by ice dealers when their storage houses are not large enough. They sell the "stacked" ice first and so do not lose very much of it through exposure. (Fig. 3 and illustrations on page 37.)

Make-Shifts.

These are ice storages, such as a large bin in the woodshed, the drive shed, the open shed at the barn, in a corner of a mow, or under a straw stack. Those who store only a small quantity of ice, say, five tons, or those who store any only occasionally, may find such places quite satisfactory if they store the ice carefully, cover it well and provide for drainage and circulation. The waste of ice is usually very large from small quantities stored in such places, and because of this fact and others already mentioned these storages are not strongly recommended for general use.

Permanent Ice-Houses.

Form No. 1.—Constructed of Cedar Posts and Rough Lumber.

A very simple and cheap, though rather rough appearing, ice-house may be constructed of a few cedar posts and coarse lumber, material which can be picked up about any farm usually. This construction could often be built to good advantage as a lean-to on the shady side of another building. The posts ought to be put 3 feet deep into the ground, and they should extend about 10 feet above ground, be placed 6 feet apart, and capped by 2 by 4's double. The rough boarding may be nailed on the inside hori-

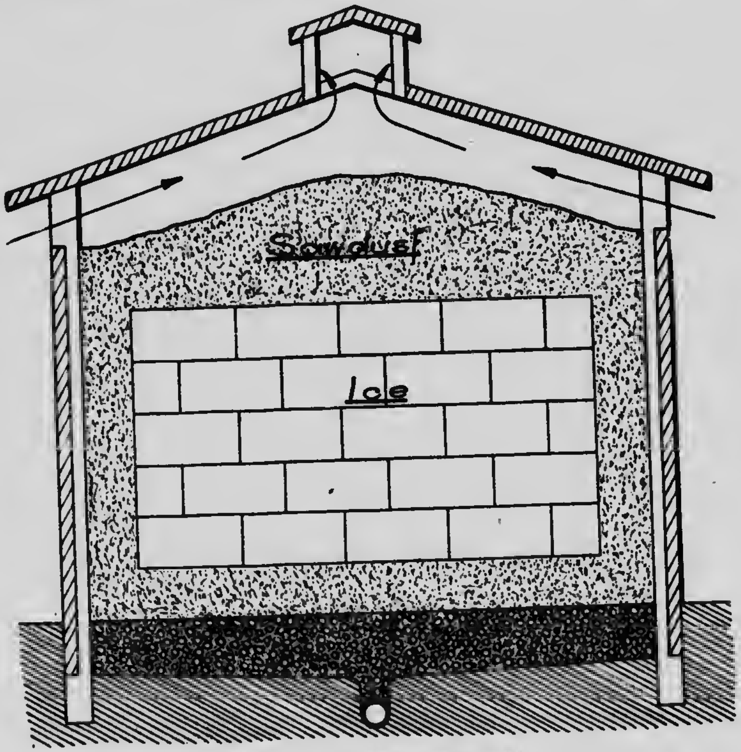


Fig. 4.—Cheap Ice-House.

zontally or on the outside up and down; if the latter, it would be necessary to connect the posts at the bottom and centre by 2 by 4 scantling, and the joints ought to be covered by battens. The gables should be boarded rather loosely in order to let the air pass through freely, but the roof should be well built so that no rain could get in on the sawdust over or around the ice. This form of ice-house may be as satisfactory as any for keeping ice, but it usually lacks style and finish.

Form No. 2.—The Log Ice-House.

A very cheap, easily constructed and satisfactory ice-house can be made of logs where timber is plentiful, as in our northern districts. Pieces of rough boards should be nailed over the joints or spaces between the logs on the inside and plenty of dry sawdust used around all sides of the ice. Drainage and circulation should be provided for as in all other forms.

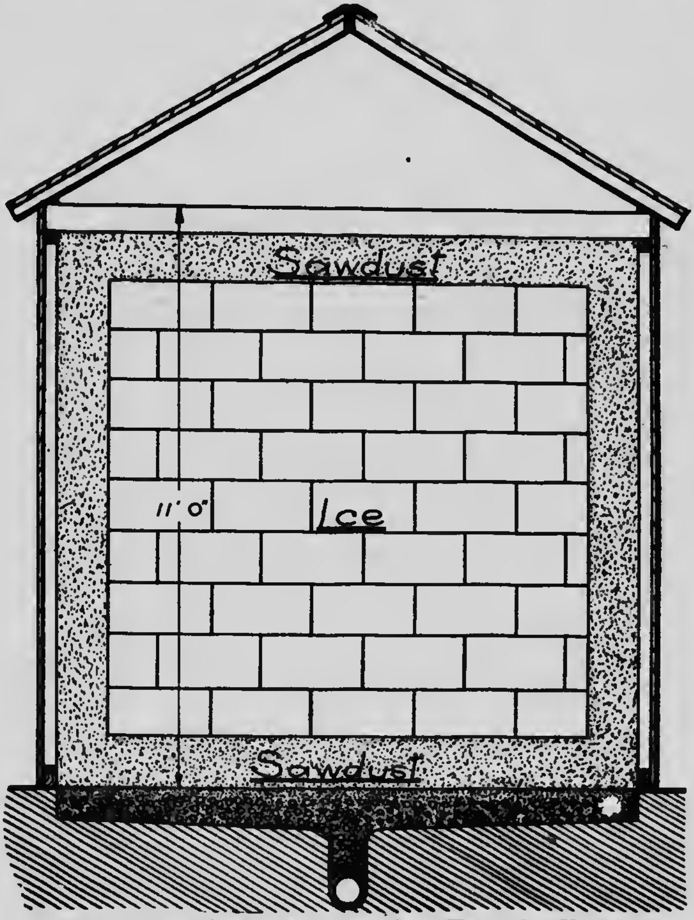


Fig. 5.—Section of an Up-to-date Farm Ice-House.

Form No. 3.—The Standard Type.

Those desiring a better type of ice-house would find that represented by Figs. 5 and 6 very satisfactory. It was designed by Madison Cooper. It is twelve feet square outside and eleven feet high to the plate. It will hold about 20 tons of ice, allowing one foot for sawdust all around the ice. The size is about right for most farmers. The following is Mr. Cooper's description of this ice-house, as given in his text-book, "Practical Cold Storage":

"The sills consist of double 2 x 4's on which are erected 2 x 4 studding, 24-inch centres. These are capped with a double plate of two 2 x 4's, on which rest 2 x 6 joists, 24-inch centres. The studs are boarded up outside with novelty or drop-siding. There is no inside boarding, the sawdust being allowed to fill the space between the studs. The roof is constructed of 2 x 4 rafters, 16-inch centres, boarded and covered with shingles. In each gable is a louvre or slat ventilator for the purpose of allowing free circulation of air. The ice door should be built in two or more sections, hinged to open outwardly. On the inside pieces of 2-inch plank are placed to keep the sawdust or other filling away from the doors."

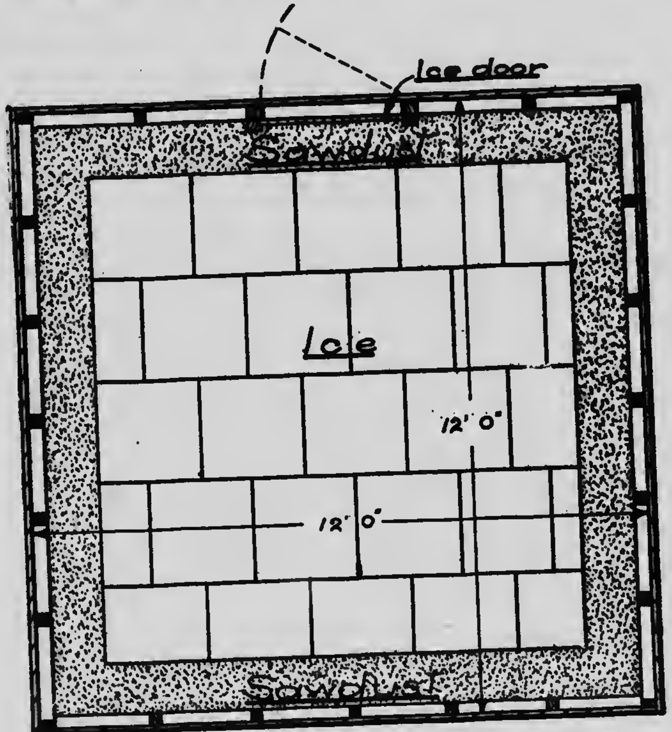


Fig. 6.—Plan of an Up-to-date Farm Ice House.

The Cost.—Mr. Cooper figures the actual cost of material at $30 to $40, and the entire cost of the house at $50, including labor. According to the present cost of material and labor in Canada his estimate is about $25 too low. If the farmer had to buy all the material it would cost about $50 at current prices of lumber, and the labor would probably approximate $20. The material would comprise about 250 feet of rough lumber, 650 feet of drop-siding, 700 feet of 2 by 4's, 85 feet of 2 by 6's, 2 1-4 squares of shingles and about 50 lbs. of nails. Two good carpenters ought to build the house in three days. If the farmer had some timber on his place, and was handy with the hammer and saw, he could put up this house himself for a small outlay. Even if the cost should be as much as $70 or $75 it would pay any farmer well to make the investment. The house would last a lifetime if kept well painted and cleansed out thoroughly each year. The farm equipment is not complete without it.

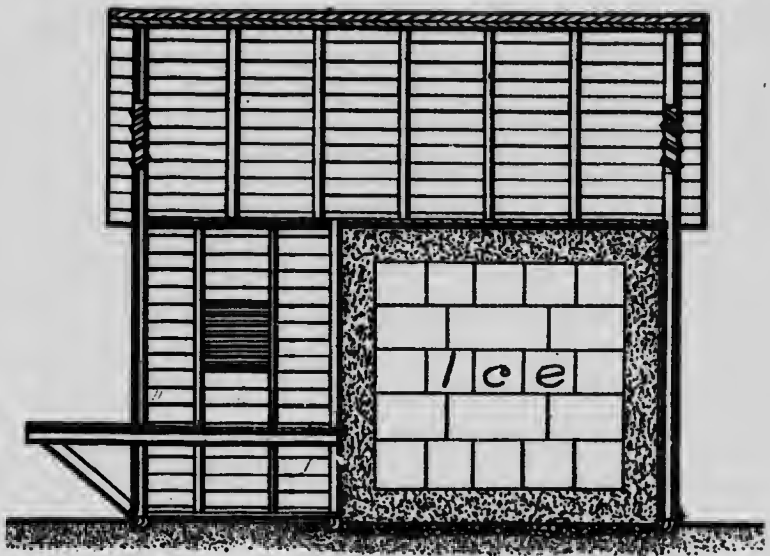


Fig. 7.—Combined Ice House and Milk Stand. Sectional Elevation.

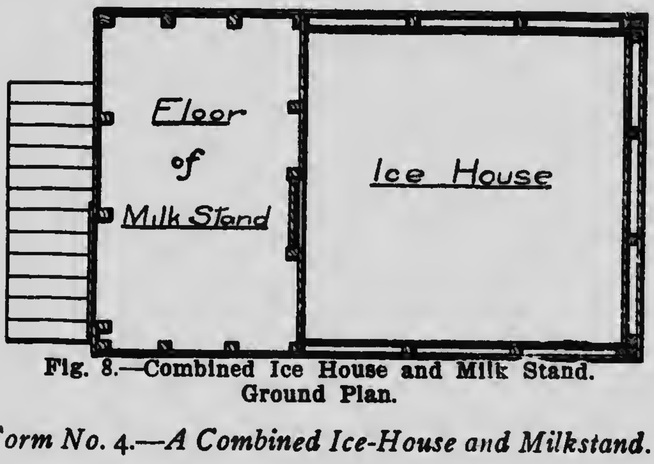


Fig. 8.—Combined Ice House and Milk Stand. Ground Plan.

Form No. 4.—A Combined Ice-House and Milkstand.

The form illustrated in Figs. 7, 8, 9, is taken from Mr. J. A. Ruddick's Bulletin No. 20, "The Use of Ice on the Farm," and the following is his own description of this system.

"This plan was first brought to the writer's attention by Mr. C. G. Publow, Chief Dairy Instructor for Eastern Ontario, when travelling with him through Hastings and Prince Edward Counties, where many of the progressive farmers have adopted this plan. A model combined milkstand and ice-house was erected on the grounds of the Central Canada Exhibition Association at Ottawa last autumn (1906), and attracted considerable attention. This arrangement, which affords both protection from the weather and dust, and also from animals or insects, if all openings are provided with screens, and convenience for the cooling of the milk, cannot be too highly recommended. Very great improvement would be made in our hot weather cheese if the night's milk was always properly cooled, and the saving of loss in cases where the milk turns sour before reaching the factory would amount to a very considerable sum.

"To utilize the ice for household purposes in connection with an arrangement of this kind, it would be necessary to provide an insulated ice-box in which to put articles of food along with a quantity of ice from time to time. A simple arrangement, which will give good satisfaction, is to make a box in the shape of a trunk of chest, lined with galvanized iron, and divided in the centre by a partition open at

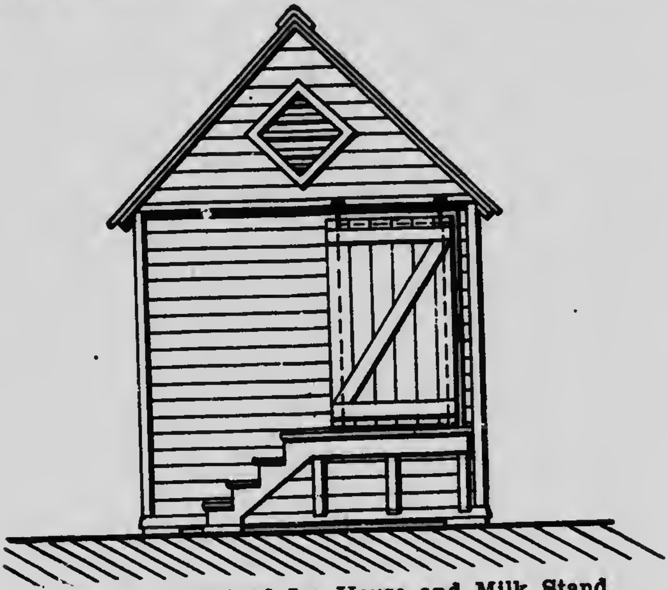


Fig. 9.—Combined Ice House and Milk Stand. Front Elevation.

the top and bottom to allow for a circulation of air between the two compartments. The ice can be placed in one side of the partition and articles of food on the other side. A box constructed as follows will give good satisfaction: A layer of matched boards covered with one inch of hair felt and finished with another layer of inch boards. That is to say, the sides, top and bottom will consist of two-ply of matched boards with one layer of hair felt between. The cover should fit tightly and be provided with a cushion of some kind to make it air-tight. The galvanized iron lining is necessary to prevent the dampness from affecting the wood and destroying the insulation. It is necessary to provide a drainage pipe for the melting ice, and the outlet should be tapped to prevent passage of air. If hair felt cannot be procured easily, leave a space of 3 or 4 inches between the outside and inside finish of the box and fill this space with planing mill shavings or thoroughly dry sawdust.

"Those who desire to have a more complete cold storage on a small scale will find a plan and specification in the Dairy Commissioner's Report for 1906."

The Milk Room.—This building is an ice-house similar in size and construction to that already described under Form 3, Figs. 5 and 6, with an adjoining milk-room provided with the proper conveniences for handling and cooling milk or cream. The size of this milk room is 10' x 6'. It does not need particular insulation, as the object is shelter from sun's rays, protection from dust, animals, etc., rather than an air-tight, well insulated room. Clapboards or drop-siding on the studs would be sufficient wall, but it would be highly advisable to line the inside with match lumber and coat it with whitewash every spring.

The floor should be concrete, finished with a thin layer of cement, and good drainage should be provided for through a trapped outlet, so that all water spilt or used on the floor would get away readily. This room should be kept scrupulously clean, cool, well aired, screened against flies and other insects, disinfected and in every way ideal for the preservation of milk and cream. In it there should be a tank with capacity enough for all the milk cans ever used at one time, a few blocks of ice and some water. A milk room like this is not complete without some contrivance as described below for easily conveying the cans of milk from the wagon to the tank or vice versa. It would also be a great advantage to have the well in the milk room or even just outside for getting the water for the tank and other purposes. The loading platform indicated in the plan extends into the milk room and thus forms an ideal shelter for the cans of milk when it is not necessary to let them down into the ice cold water tank below. The ice may be used for cooling the milk either by being put around the cans in the tank or into long pails or creamers let down into the cans of milk. This milk room should be the regular shelter for the night's milk in the warm weather.

If this building was reasonably close to the house and there was no refrigerator in the kitchen it would be a great aid to the keeping of goods in the hot weather to have an ice-box such as Mr. Ruddick refers to, or some kind of a small refrigerator, in the milk room. These articles are simple in construction, cheap and any handy man could build one in a day or two. The size would depend upon the family and the extent of fresh meat, for example, used in the very warm weather. A box 4 ft. by 2 ft. by 2 ft. and partitioned at about the centre would be a serviceable size for the storage of small quantities of meat, butter, milk, cream, fruit, etc., used daily on the table. The ice box in this chest would hold four medium sized cakes of ice or from 100 to 125 lbs. It should not have to be refilled oftener than once or twice a week. It must be kept well in mind, however, that the circulation of air in an ice-box like this is very poor and the moisture content of the air very high. Therefore conditions are not favourable for keeping perishable goods in any quantity for very long periods, not longer than a few days. Then, since so many articles of food are placed in the same chamber, the difficulty of keeping any one thing well is increased. Do not expect too much of the little ice-box. The cross section diagram illustrates clearly the design and construction of a simple ice-box. However, the household refrigerator is the proper system of cold storage in the home.

The Ice Room.—The ice-house proper is 10 ft. square by 10 ft. high, inside dimensions. The walls are boarded on both sides of the studding and the spaces between the studding are left empty. If these were packed with dry shavings a good deal of the sawdust next to the ice could be dispensed with and the room would hold more ice. With 1 foot of sawdust on all the sides, the bottom and top of the ice, this room will hold 12 tons of ice, and 20 tons if no sawdust were used, but this practice would not be wise unless the walls were very well insulated. It might be a better plan to use the inside sheathing as an extra sheathing outside and allow the sawdust around the ice to fill in between the studding. It would then hold 15 tons allowing for 10 inches of sawdust on

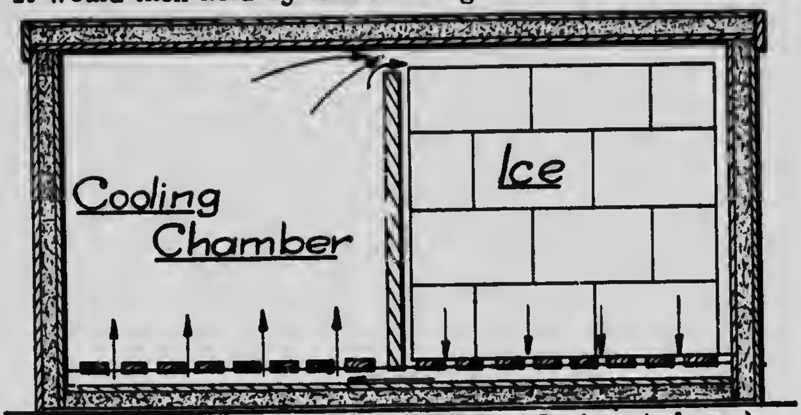


Fig. 10.—Cross Section of an Ice-Box. (Drain not shown.)

the sides and 1 foot below and above the ice. A doorway is shown in the plans through which the ice is brought out into the milk-room as it is required for cooling purposes. The ice house can be filled through this door also.

The Cost.—The material at current prices would cost about $60 and the labor $25 to $30. The total cost then would be somewhat under $100 to the farmer who would have to buy all the material and hire all the work done. The material would consist of about 600 sq. ft. of drop siding, 650 of rough lumber, 3 square of shingles, 800 feet of 2 by 4's, 90 ft. of 2 by 6's, and about 60 lbs. of nails. Two good men ought to put it up in four or five days.

THE CARE OF MILK AND CREAM ON THE FARM.

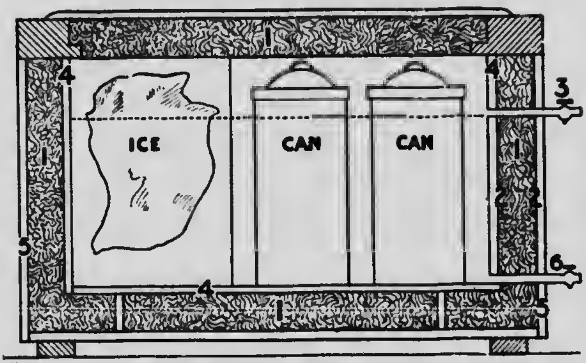
The two diagrams shown below offer valuable suggestions for equipping a milk-room such as has just been described, with cooling tank for either cold water or ice, and a hoist for handling the cans. These appear in two circulars issued by the Dairy Branch of the Department of Agriculture, Toronto, on May, 1912, together with the following extracts:

"The accompanying illustration shows a tank for cooling milk and a crane or hoist for raising the cans from the tank. With such an outfit milk cans may be lowered and raised from the cooling tank with ease, and sweet, cool milk for delivery at the factory is assured during the warmest weather.

Tank for Cooling Milk and Hoisting Apparatus.

"One of the most important factors in the production of cream is that as soon as it comes from the separator it be quickly and thoroughly cooled to a temperature of 50 degrees, and kept cool until it reaches the creamery. Do not mix cold and warm cream.

Tank for Cooling and Keeping Cream.



1—Mill Shavings. 2—Two-ply damp-proof paper. 3—Overflow water-line. 4—Inner tank made of 1 inch lumber. 5—Outer shell of 1 inch lumber. 6—Bottom outlet.

"The accompanying diagram illustrates an insulated tank for cooling and keeping cream. Provide an outer shell made of one-inch matched lumber, and tack on the inside thereof two-ply of damp-proof-paper. Then make an inner tank (cooling tank proper) of a size to provide for a four-inch space, at sides, ends and bottom, between outside of smaller tank and inside of larger shell. The cooling tank should be lined with galvanized iron so that it will be perfectly water-tight. Two ply of damp-proof paper should be tacked on the outside of this tank. The cooling tank should be about 22 inches deep, to hold shotgun cream cans 20 inches high. A couple of supports 4 inches high should be placed in the bottom of the larger tank, and mill shavings or dry sawdust packed in the bottom to a depth of 4 inches. Then place the cooling tank inside the larger one, and pack between the sides and ends with shavings or dry sawdust.

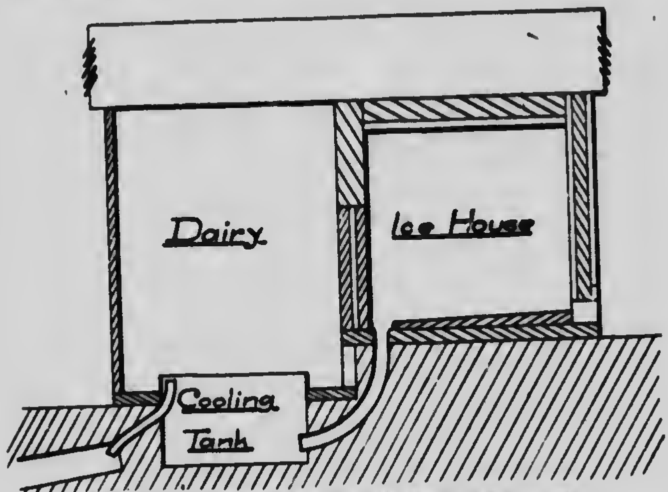


Fig. 11.—Combined Dairy and Ice-House. Sectional Elevation (after Hiles).

"Have an outlet at the bottom and an overflow about 18 inches from the bottom. Make the tank large enough to hold the required number of cans 8 inches in diameter, allowing sufficient space for ice and water to keep them cold. A wire partition may be put in between the cans and the ice if desired. The lid should be of 1 inch tongued and grooved lumber, preferably insulated in the same way as the body of the tank. This saves ice. Such a tank is not affected to any extent by outside temperatures and will keep the cream cold and sweet.

"A tank 22 inches by 40 inches, inside measurement, will hold 6 cans of cream. Tin cans (20 inches high and 8 inches in diameter) are better for keeping cream than crocks of any kind."

Form No. 5.—Combined Dairy and Ice-house.

The particular feature of this arrangement is the utilization of the cold water from the melting ice for cooling purposes. The value of this, however, is more apparent than real. To insure the use of the water from the melting ice and it being in a reasonably pure condition for use in a tank for cooling milk or cream, the cost of the building would have to be greatly increased. The floor would have to be cemented and a suitable drain as indicated provided for and the wall well insulated in order that it would not be necessary to put any dirty packing like sawdust next to the ice. If ice was taken out very often for incidental cooling purposes a great deal of air would get into the ice chamber and melt a great lot of ice. The dairyman needs the ice stored so that he can get at it often and yet not expose the supply too much. The amount of water per day might not be large enough to do the cooling required, nor would it keep cool very long. If the ice-house held 20 tons the average drainage from it would be scarcely 1 barrel per day for the period May to September, inclusive. The diagram shows, at least, how the idea might be carried out, but the writer has his doubts as to its practicability and value on our farms or anywhere.

SMALL ICE COLD STORAGES.

Some Types of Combined Ice-houses and Cooling Rooms or Small Ice Cold Storages.

Under this heading attention is called to some types of ice cold storages, or buildings comprising an ice-room and a cooling-room for the storage of perishable products. Any of them must be carefully constructed and well insulated, and therefore are much more expensive than any forms of ice houses that have been described. In spite of the greater cost some farmers find it necessary and profitable to have a small cold storage in order to care for their products properly, and to realize the highest value from them. These storages will be far more popular and numerous when the farmers know their value. One of these storages will last probably twenty years if it is well constructed and properly cared for each year. Then as ice is so plentiful and so cheaply harvested in this country, the season's ice supply is a very simple and inexpensive matter.

A Small Cold Storage.

For a refrigeration room, say 4 or 5 feet square, in connection with the farm ice-house, a very satisfactory arrangement is that illustrated in Figures 12 and 13. This is the system referred to above at the close of my quotation from Mr. Ruddick's Bulletin No. 20. A full description and plans of it are given in his annual report for 1906 on pages 56-58, and with his permission they are given complete below. He recommends it as a cheap, easily managed and fairly effective arrangement for securing

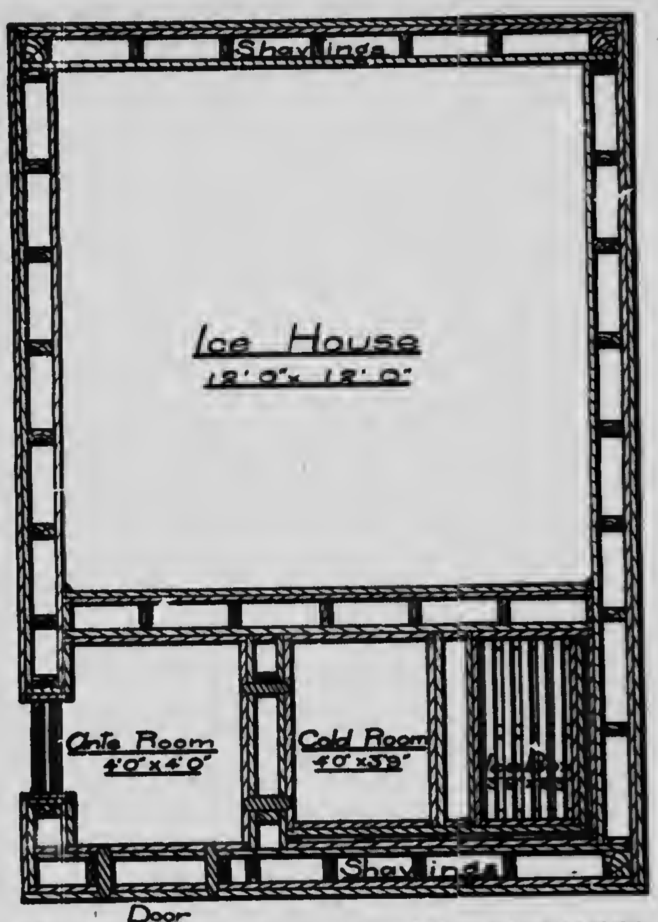


Fig. 12.—Plan of Small Cold Storage (after Ruddick).

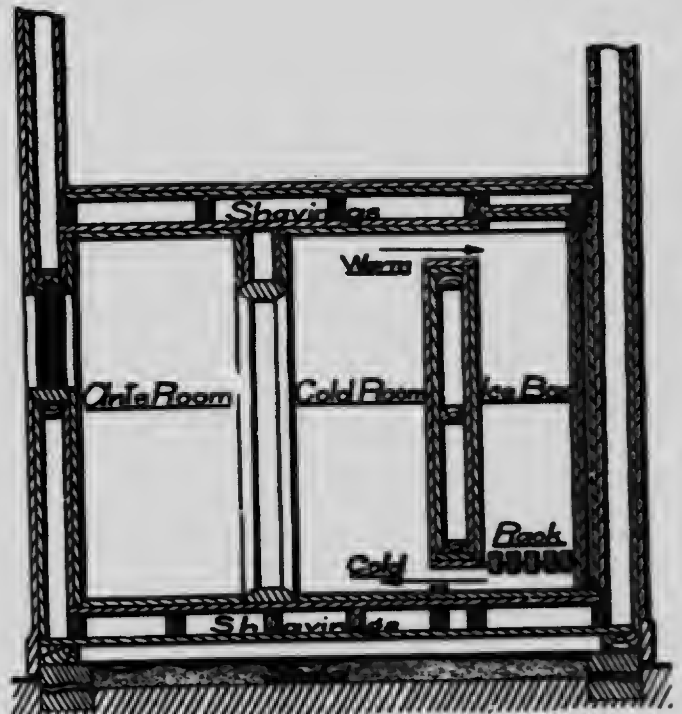


Fig. 13.—Section of Small Cold Storage (after Ruddick).

cold storage on farm or in connection with country stores or butcher shops. The following is his own description of it in the report referred to above.

"All lumber, except clapboards, should be tongued and grooved, and spruce only should be used for the ice-box, cold-room and ante-room. No tar paper should be used, on account of its strong odor.

"The building will be better, and more permanent if placed on a stone or concrete wall. Otherwise it must be well "banked" to prevent circulation of air underneath.

"The extra course of lumber under the siding may be dispensed with on the walls of the ice chamber, but not on the other parts of the building.

"The partitions between the ice chamber and the other compartments, and also between the ice-box and the cooling room, need to be well insulated, as shown, to prevent dampness. A poorly insulated partition against an ice chamber will become cold on the surface and consequently collect moisture. Many refrigerators and cold storages are failures from this cause. Emphasis is laid on this point, because we often find thin partitions placed between the ice chambers and the cool rooms, on the theory that refrigeration secured in this direct way is all that is needed. Dryness in a refrigerator is just as important as a low temperature.

"No proof is shown in the plan. That is left to the fancy of the builder.

"Sufficient room must be left above the small compartments to allow of the blocks if ice being transferred to the ice-box through the ice trap door.

"The window in the ante-room has double sash, each sash being double glazed, giving four thicknesses of glass.

"The floor under the ice-box should be covered with galvanized iron, sloping in one direction, with a gutter at the lowest edge to carry off the water from the melting ice. The drain pipe from the gutter must be trapped to prevent the passage of air. A simple plan is to have the end of the pipe turned down and extending nearly to the bottom of a small dish or vessel of any kind, so that the water will rise above the end of the pipe before the dish overflows.

"Planing mill shavings are highly recommended for filling the spaces between studding and joists as shown on plans. They are always dry and do not become musty. If they cannot be procured, sawdust is probably the next best thing, but it should be *thoroughly* dried before being used.

The spaces between the studding around the ice chamber should not be filled. Any filling will eventually become damp from the ice, and damp material of any kind has very little insulating value.

"MANAGEMENT.—As there is no floor in the ice chamber, the earth beneath it should be well drained. Cover the surface with 6 to 8 inches of broken brick, coal cinders, tan bark or other similar material of a non-conducting character. If nothing better can be procured use broken or cobble stone, covered with a layer of gravel or sand. This material will make the permanent bed.

"Before filling with ice, put 8 inches of sawdust over the permanent bed. This should be renewed every year. The ice should be packed as closely as possible, filling all spaces with crushed ice or snow, well rammed. Leave a space of 12 inches between the walls and the ice, to be filled with dry sawdust. The top of the ice should also be covered with 12 inches of dry sawdust. If sawdust cannot be procured, cut hay or straw may be used, but the space filled should be 18 inches instead of 12, and the filling well packed.

"To utilize the cold room, fill the ice-box with cleaned ice in lumps as large as convenient to handle. The box shown on the plans will hold about a ton of ice, so that it will not need to be filled often. Care should be observed in keeping the trap door tightly closed. The openings at the top and bottom of the partition between the ice-box and the cold room may be fitted with a slide to regulate the circulation of air.

"Particular attention must be paid to the keeping of the doors perfectly air-tight. A cushion of thick felt for the door to close against is about the best thing to ensure a good joint."

The foregoing method is in all essentials the one in use in refrigerator cars cooled by ice. The ice chambers or so-called "ice bunkers" are located in each end of the car. The bunkers are usually double and each half is 6 ft. x 3 1-3 ft. by 3 ft., or thereabouts. Each half has a capacity of a little better than 1 ton of ice, the four bunkers of a car, then, holding about 5 tons of ice. The storage capacity of a car is between 1800 and 2,000 cubic feet.

This system is fairly well adapted for the use of a mixture of ice and salt as the cooling agent. A much lower temperature can be secured with this mixture than with ice alone. An illustration of this method of cooling small chambers was seen at Mr. E. D. Smith's place, Winona, Ontario. He has a small cold storage plant consisting of three cooling chambers, all together, having a capacity of 6 or 8 car loads of fruit. He told me that he got good satisfaction and profit in keeping fruit, especially pears, by using a little salt with the ice. In some of the ice bunkers there are galvanized iron cylinders for holding the ice and salt mixture, the other bunkers being lined with galvanized iron. The year's supply of ice is stored in a separate building, an ice-house, and the ice is conveyed as required, on sort of a tramway to the second storey of the cold storage building where it is broken and then put down into the bunkers through tightly-fitting trap doors. The lower temperature, however, is obtained at the expense of the material in the bunkers for the salt is very corrosive on the galvanized iron. There is always considerable dirt and muss about these bunkers, especially where the salt is used. It is always much colder next to the bunkers than on the other side of the room, the circulation not being very good. The special use of a mixture of ice and salt in small storages is in the "cylinder" system used in many creameries of this province. Instead of bunkers a row of large galvanized iron cylinders are placed along one side of a room 7 ft. or 8 ft. square; the bottoms set in a trough for catching and carrying away the drip; the tops extend through the ceiling and are filled similarly to the bunkers referred to above. For further information of this "Cylinder" system see J. A. Ruddick's Report for 1906, pages 45 and 48 to 50, also his bulletin No. 10, page 6.

The Hanrahan System.

This system of ice cold storage was strongly recommended about twelve years ago by the Provincial Government of Ontario. The Public Works Department at that time prepared, published and circulated a pamphlet describing the system and employed Mr. Hanrahan for a while to advertise the system and supervise the construction of the storage wherever the system was adopted and installed. A number were built in Ontario, one being the present storage at the Dairy and Poultry Departments, O. A. C. Guelph. This plant has given good satisfaction and is still, at the end of twelve years, in a very good condition. Believing that the system has a place among small ice cold storages, and that it might appeal to many desiring to build a storage, I submit an exact copy of the specifications and plans of the plant built at the College to serve as a guide in the construction of such a storage.

The Hanrahan Cold Storage at the Ontario Agricultural College, Guelph, Ont.

The general plan of the building is shown well in the diagrams and photographs accompanying the account of the system. The ice-chamber is 12 ft. square and 20 ft. high and holds about 65 tons of ice. There is no packing used around the ice, as the walls are well insulated. The cooling room is 10½ ft. by 12 ft. by 7½ft. high or it has a capacity of about one-half [illegible]r. The ratio between the size of these two chambers is 3 to 1. The air circulates between them as indicated in the plans. The ante-room is 5 ft. by 4 ft. by 6 ft. high. A temperature of 40 degrees or even lower can be maintained throughout the average summer weather in the storage chamber. The air is usually quite dry and sweet in the storage-room.

The spaces in the walls were packed with sawdust as noted in the specifications. Planer shavings would have been very much better as they keep their place in the wall far better, remain drier, are less subject to attacks by vermin and less liable to decay and rot. Sawdust is not used

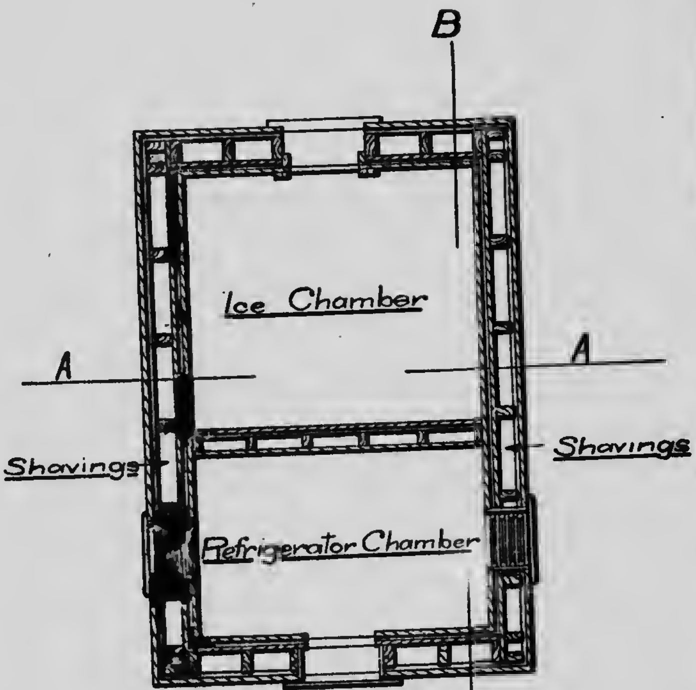


Fig. 14.—Ground Plan.

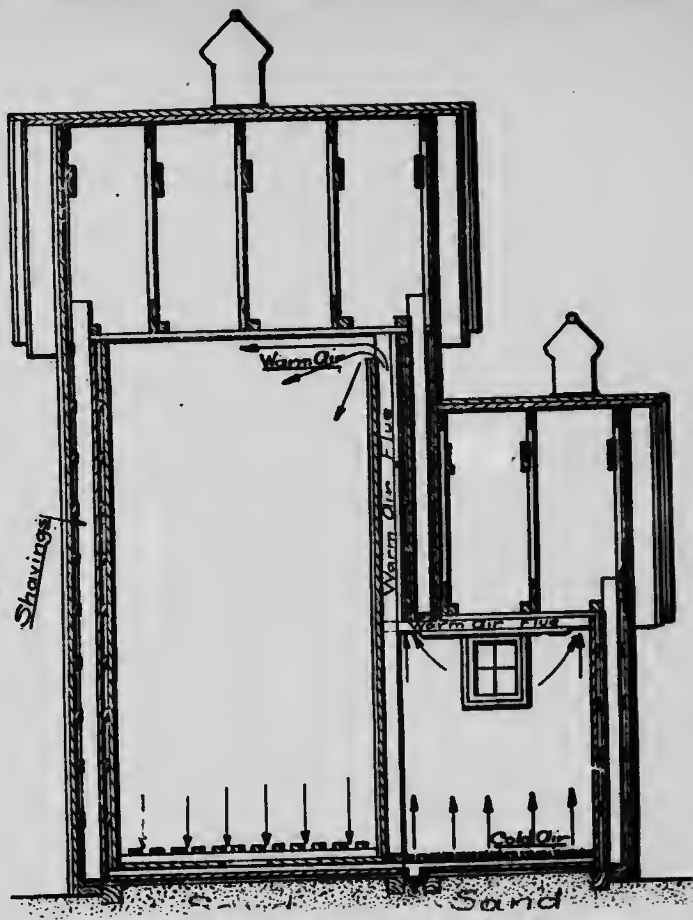


Fig. 15.—Section on line B.B.

Hanrahan System of Cold Storage.

in good storages now-a-days at all. The interior of both the cooling and ice chambers should be treated well with some preservative; shellac for the walls of the cooling chamber and raw linseed oil for the ice-chamber.

The cost is given in the specifications as $210, but it is not likely that this storage could be built for this even twelve years ago, probably $400 would not be too high an estimate for that time. To-day it would cost from $700 to $800.

Plans and Specifications for Erecting Combined Ice-House and Cold Storage Buildings.

"The preservation of the perishable products of the farm, such as fruit, butter, cheese, meat, eggs, etc., is fraught with great blessing alike to the producer and consumer. In any year when an unusually large quantity is produced, if some portion cannot be carried over until the demand recovers, much of it must be wasted, and all of it will be reduced in value. By means of a cold storage system wherein the best existing methods for delaying decay in perishable products are employed, the goods can be held by the producer until the market demands them. The consumer thus secures for his use these delicate luxuries for a much longer period.

"That system of cold storage which will most commend itself will be, first, reliable; second, durable; third, simple in construction; fourth, easy to maintain; fifth, within the reach of persons of limited means.

"The plans and specifications herein presented for cold storage buildings will, it is believed, comply with these conditions, and, if followed closely, will give the maximum results in efficient cold storage.

"The system is known as the Hanrahan System. It is used largely in the United States for long distance transportation and otherwise, and has given excellent satisfaction. It is within the reach of those possessing limited means, and its use will add largely to the profit as well as the pleasure of farm life.

"The principles involved are thorough and continuous circulation of air, the evaporation of all moisture and its condensation on the ice in the ice-chamber. The odors and gases are also absorbed by the melting surface of the ice, with which the air containing them is brought into direct contact. The products are, thus maintained in a dry, even temperature, best calculated to resist decay and leave them in the best possible condition when exposed for sale in a normal atmosphere.

"Following this will be found the plans and specifications for a building to cost $210.00 (known as Series "A"). The Provincial Public Works Department, Toronto, will, if desired, furnish plans for larger buildings."

INSTRUCTIONS FOR ERECTING COMBINED ICE-HOUSE AND COLD STORAGE OF THE HANRAHAN AUTOMATIC SYSTEM.

Series "A." Cost of Labor and Materials, $210.00.

Sills.—The sills to be formed of two pieces of 8 x 2 inches, laid flat and half checked at the ends and bedded in dry sand, and of such length as will make an oblong 11 feet 6 inches by 17 feet 6 inches. On this sill erect 8 by 2 inch studs at the points as indicated on the ground plan, and cut off at a height of 18 feet 4 inches for the walls enclosing the ice and 9 feet 2 inches for the walls of the refrigerator chamber, measuring up from the top of the sill.

Ceiling Joists.—Spike on ceiling joists of 4 x 2 inch to each stud, so that the bottom of the joists will be 12 inches below the top of the stud and letting the joist extend so as to give support to the rafters.

Rafting.—The rafters to be 4 x 2 inch and to be cut to fit over the top of each stud, as shown in section on line A.A., and to be well spiked to side of ceiling joists.

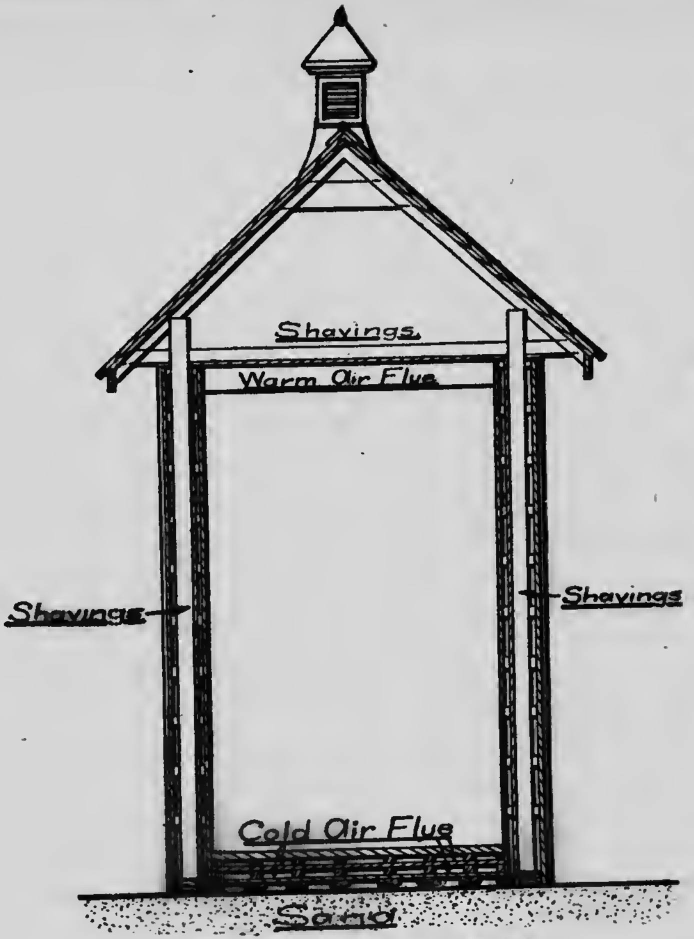


Fig. 16.—Section on line A.A.

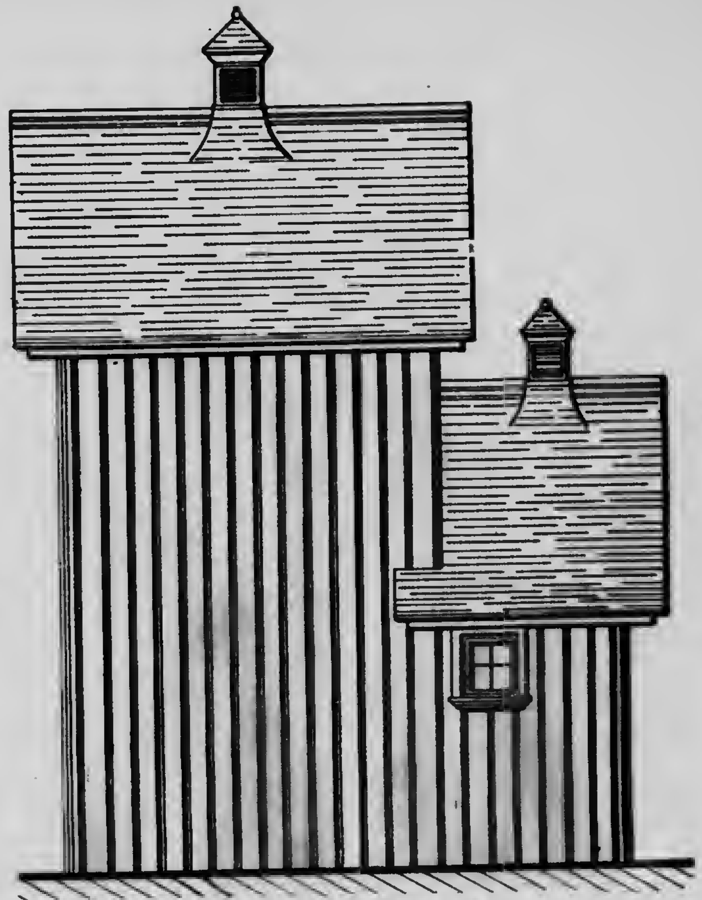


Fig. 17.—Side Elevation.

Hanrahan System of Cold Storage.

Roofing.—The rafters to be covered with 1 inch sound, rough boards and then shingled with good shingles laid showing 4 inches to the weather. The roof ridge to have 5 inch boards and 2-inch roll.

Ventilators.—The ventilators to be put in as shown, the large one to be 18 inches square and the other one 15 inches square. The sides to have ordinary openings and the top capped as shown.

Insulation.—The outside of the studding to be first strapped with 2x2 inch, put on horizontally and spaced as shown, then 10 x 1 inch matched boards well and tightly nailed and each joint covered with a 2 inch bevelled batten. The inside of studding to be first sheeted with 1 inch matched boards, then with paper on walls around corners. In fastening paper on wall with tacks about ⅝ inch long, do *not* drive the tacks home, *let them* project about half their length, then take a ball of twine, No. 8 cotton, if procurable, or something similar to a ball of thick yarn, not too hard, run this twine over the heads of the tacks, which must be placed so as to have a line of twine directly under the 2 x 1 inch battens to be put on. When the twine is on, then drive tacks home, on the paper, and over the twine place vertically 2 x 1 inch dressed battens, about 18 inch centres, between these battens fix similar ones horizontally over the twine, and about 36 inches apart. These horizontal battens must be cut true and fitted in tight between vertical pieces, using a mitre box for the purpose. Over these battens lay another layer of paper and twine, put on the same as before, over vertical and horizontal battens, then sheet with matched lumber fixed vertically. Over this inside sheeting, place 2 x 1 inch battens vertically about 18 inch centres from floor to ceiling.

Ceiling.—The ceiling joists to have matched boards nailed to the underside thereof, having three nails to each joist, and the joists to have a batten on the top to prevent the sawdust from working through.

Division.—The partition between the two chambers to be made with 6 x 2 inch studs, as shown, and resting on a sill of one piece of 6 x 2 inch. These studs to be well dressed as the side next to the refrigerator chamber will be exposed. The side next the ice to be sheeted horizontally with 1 inch matched boards, then with paper, and then with another sheeting fixed vertically similar to that used elsewhere. This double sheeting to stop within 10 inches of the ceiling so as to form the warm air flue as shown. From the ceiling of the refrigerator chamber up to the top of these 6 x 2 inch studs put 4 x 2 inch studs, placing them edge to edge with the 6 x 2 inch ones, and thus forming the warm air flue 10 inches wide.

Next form that part of the end wall of the ice chamber over the refrigerator chamber as previously described; this latter to be supported by 4 x 2 inch joists running from the end wall of the refrigerator chamber to the 6 x 2 inch studs of the division partition, as shown in section on line B.B. The underside of these joists to be sheeted with 1 inch sound matched boards, leaving a space 12 inches wide along the end wall of the refrigerator chamber and 10 inches wide along the opposite side.

Collars.—The rafters to have collar ties of 10 x 1 inch as shown, and strips of 4 x 1 inch running therefrom down to the ceiling rafters.

Doors.—The doorway to the refrigerator chamber to be constructed as shown, and fitted with two doors hung to open out. The frame to have a sill of some good hardwood, and the doors to be made of two layers of 1 inch matched material with heavy paper between.

Windows.—The windows in this chamber to be made as shown with 1 inch jambs and head, and 2 inch sill in the frames and the sash in four pieces, each 1½ inches thick, and glazed with four lights of glass, each 10 x 8 inches, the sash to be put in with stops.

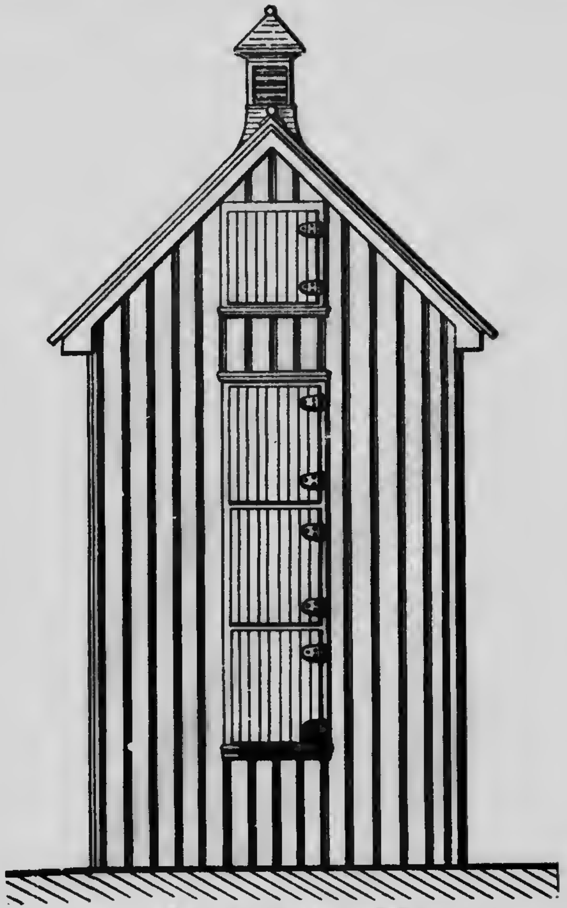


Fig. 18.—Rear Elevation.

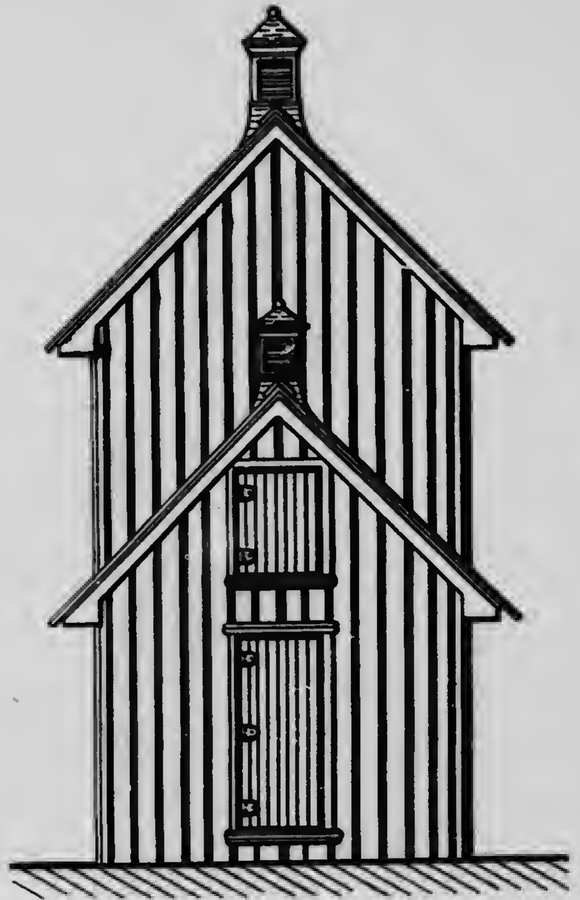


Fig. 19.—Front Elevation.

Hanrahan System of Cold Storage.

DOORS.—The doors in the ice chamber to be made to match the outside sheeting, be hung to open out and be in a series of three doors, each 4 feet high, and starting 4 feet above the ground level. Movable 1 inch boards to be put on inside to keep the sawdust in place, as it is packed in as the ice is placed in position.

DOORS.—Small batten doors to be put in in the front gable of the ice part, and in the end gable of the other part to give access to the spaces above the chambers.

FLOORS.—The floor of the ice chamber to consist of 4 x 2 inch pieces laid flat on 6 x 6 inch sills and bedded in sand, and carrying a floor of 1 inch matched boards, having a fall of 1 inch towards the drain; on this floor place eight pieces of 4 x 2 inches, as shown on edge and directly over the first pieces; on these joists lay another floor of 1 inch matched lumber, leaving a space of 1 inch next the dividing partition and another one of 12 inches in the centre running the full length of the ice chamber as shown. Upon this floor lay 3 x 2 inch joists directly over the others and thirteen pieces of 4 x 2 inches laid flat and at right angles to the 3 inch strips, the first piece next the dividing partition to be against the wall and the remainder evenly spaced. Upon this lay the ice supply.

FLOORS.—The floor of the refrigerator chamber to have 4 x 2 inch strips on 6 x 6 inch sills and bedded in sand, and carrying 1 inch flooring, laid with a fall of 1 inch towards the drain, then 4 x 2 inch strips on edge carrying fifteen pieces of 2 x 1½ inches, evenly spaced and at right angles. This lattice floor to be made in sections convenient for lifting up.

DRAIN.—A box drain to be formed of 1 inch material and laid with a fall of 3 inches from one side of the building to the other and discharging into a pipe having a trapped inlet below grade and protected by a box cover.

SAWDUST.—All the spaces around the studding to be firmly packed with dry sawdust, and all ceilings to have at least 14 inches of sawdust as a cover, as shown by the drawings. Particular care must be taken to have the sawdust well packed and from time to time go over it and press down tightly.

SAND.—The timbers touching the ground must be well bedded in dry sand, and the sand filled in so as to leave all tight and free from any air spaces between the ground and the first floor laid. The outside of the building to be well packed with earth at least 15 inches high.

SHELLAC.—The inside walls of the refrigerator chamber to be given two coats of good grain shellac.

NOTE.—Three nails to be used to each joist or stud.

PAPER.—All paper used to be heavy "Sulphite" as made by The E. B. Eddy Co., of Hull, or of similar quality.

NOTE.—The sheeting in the refrigerator chamber to be about 6 inches wide.

LOCATION.—The building to be located on a well drained site, and where possible with the gable of the ice-house facing the south.

NOTE.—The plans and specifications must be strictly adhered to in order to obtain the best possible results both in saving products and ice.

NOTE.—See the bill of materials required for the building as described, and be sure to use the right pieces in the correct places.

BILL OF MATERIALS FOR THE ERECTION OF A COMBINED ICE HOUSE AND COLD STORAGE BUILDING AS PER PLANS. SERIES "A." HANRAHAN AUTOMATIC SYSTEM.

Sills....................	4	pieces	6 in.	x 6 in.	x 10 ft.	
Bottom wall plates.......	2	"	8	x 2	x 10	10 in.
Bottom wall plates.......	2	"			16	10
Wall studs...............	16	"			18	4
Wall studs...............	6	"			10	1
Wall studs...............	14	"			9	2
Ceiling joists...........	8	"	4	x 2	x 14	
Ceiling joists...........	6	"			7	9
Rafters..................	16	"			10	3
Collar ties..............	8	"	10	x 1	x 4	
Collar ties..............	8	"	4	x 1	x 6	
Ridge cap................	3	"	5	x 1½	x 14	
For division partition.....	6	"	2	x 6	x 16	8
For division partition.....	1	"			10	
For division partition.....	6	"	2	x 4	x 9	6
Ice chamber floor........	8	"	4	x 2	x 9	6
Ice chamber floor........	8	"			9	4
Ice chamber floor........	8	"	3	x 2	x 8	8
Ice chamber floor........	13	"	4	x 4	x 9	8
Refrigerator chamber floor	8	"			6	
Refrigerator chamber floor	8	"		6	x 6	4
Refrigerator chamber floor	15	"	2	x 1½	x 9	6
Cornice..................			6	x 1	x110	
Cornice..................			4	x 1	x110	
Ridge roll...............					21	
Rough boards, 1 in.......					600	sq. ft.
Shingles.................					5000	"

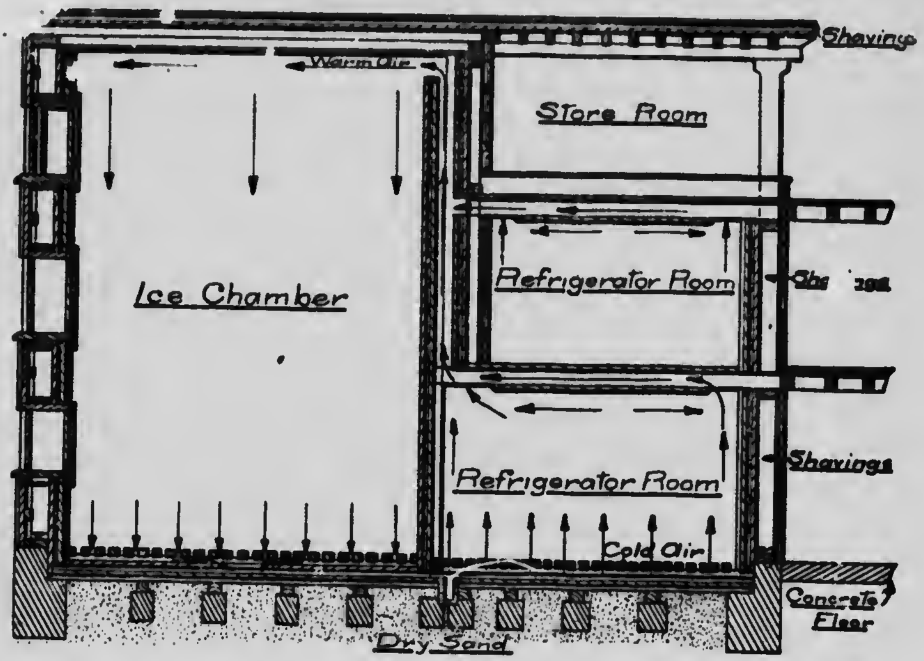
Ventilators as shown, 2

Outside strapping........	700 lin. ft.	2 in.	x 2 in.	
Inside strapping, dressed..	700	2	x 1	
Bevelled battens.........	1500	2	x 1	
Ice house battens........	35 pieces	2	x 1	x 16 ft.

1 door 2 ft. 8 in. x 6 ft. 6 in. high, to refrigerator chamber
1 " 2 11 x 6 6 " with frames to suit
3 " 2 10 x 4 " to ice chamber
1 " 2 10 x 3 3 " to lofts
1 " 2 11 x 4 " to lofts
2 window frames and 8 pieces glazed sash to refrigerator chamber
3500 sq. ft. of 1 in. sheeting for walls, floor, ceilings, etc.
2000 sq. ft. of paper
Sawdust for filling
Shellac for walls of refrigerator chamber
Hardware such as nails, screws, hinges, bolts, etc., etc.

A MODIFICATION OF THE HANRAHAN.

Attention is called to the diagram (Fig. 20) which illustrates the use of two cooling chambers, one above the other, in connection with this system. A certain butcher of Guelph has this modification of the Hanrahan in his abattoir and he says that it works well. The cold air enters the upper chamber chiefly through wooden flues, not shown in the diagram, which convey the cold air from the ice room through the wall at points just beneath the flooring. The cold air may be admitted also from the lower chamber through openings in the floor. The temperature of the upper chamber is usually about 4 degrees higher than that of the lower. The lower chamber is used for the storage of curing and pickling vats and rougher material, while the upper is for the dressed pork which is not kept there longer than a day or so before marketing. In order to get the best results with this arrangement the ice chamber should be kept



Longitudinal Section

Fig. 20.—Hanrahan System with two Refrigerator Rooms.

well filled, else the temperature of the upper chamber will go too high in the very warm weather. The ice chamber ought to extend well above the top of the cooling chambers. The success of any form of the Hanrahan system depends very largely on the height of the ice in the ice-room.

Ice-Overhead Systems.

These are probably the oldest systems of ice cold storage in use at the present day. Their history is very interesting, but cannot be treated fully here. It was, however, in the United States some twenty or more years ago that various forms were tried with the result that only one or two have proven very successful. These were the Steven and Jackson forms.

and those in use in Canada to-day are very similar to them in principle and construction. The very large plants have not been a success, and have gone almost out of use, but the small and medium sized ones are very rapidly increasing in number, and, I understand, are giving very good satisfaction. They are patented in Canada and handled by companies which make a specialty of refrigerators and small ice cold storages. The main parts, such as the side walls, ceiling, etc., are made and finished in the factories according to specifications received from an applicant. The parts are easily and quickly put together by a few large wood screws on the site. The largest use for these storages is in connection with butcher shops, abattoirs, restaurants, creameries, hotels, institutions of various kinds, florist stores, etc. These are built inside the buildings, in which they are used and hold from one to five tons of ice at one time, according to size. A few larger ones holding say, 90 or 100 tons of ice are in use as separate buildings. There is one at the Jordan Harbour Fruit Experiment Station, Ontario, which holds 90 tons of ice and has two storage rooms with a total capacity of 1½ cars. It is said that a uniform temperature of 40 degrees can be maintained in the storage chambers, and that the ice will last the season under ordinary use. Further information pertaining to costs, names of refrigeration companies, reliable references, etc., may be had by applying to the writer.

HOUSEHOLD REFRIGERATORS.

Reference has been made to the necessity and value of a refrigerator in the home. It seems to me that it is one of the essentials of the house equipment. In building a house provision for the refrigerator should be made in the plans, and it should be made a part of the house just as much as the kitchen or pantry. It could then be located to the best advantage, designed and constructed as desired, and made a permanent part of the house. At the present day there are a great many kinds and grades of refrigerators on the market, many of them being very neat articles, indeed, and capable of giving very good results if they are properly cared for. Refrigerators are usually procured through our hardware men, although they may be bought direct from the firms. The names of reliable firms may be had by applying to the writer.

The Essentials of a Good Refrigerator.

Good Insulation. The walls should be so constructed that they would keep out the heat, at least, reasonably well, otherwise a low temperature cannot be maintained in the food chamber, the foods will not keep well, and there will be a great waste of ice. A great many of our manufactured refrigerators, especially the cheaper grades, are not sufficiently well insulated. The character of the insulation, rather than the design and finish, should be the feature that a purchaser ought to keep well in mind.

Free Circulation. The circulation of air in the refrigerator largely controls the degree of moisture and the purity, and to some extent the temperature of the air in the food chamber. The circulation depends on the relation and connection between the ice and food chambers, and the difference of temperature between the two chambers.

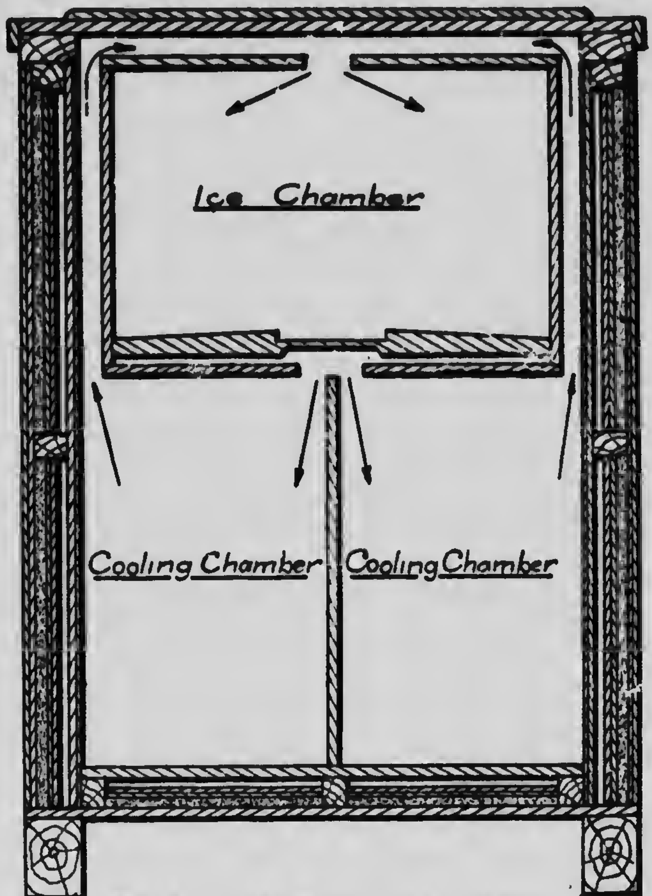


Fig. 21.—Cross Section of an Ice-Box.

Opinions among refrigerator and cold storage men differ as to the proper design of a refrigerator for good circulation; some claiming that the ice box should be above the food chamber, others, that it should be at the side. So far as the average sized household refrigerator is concerned, there is not much difference in the degree of circulation between the two cases, provided that flues are properly arranged to convey the cold air to the bottom of the food chamber, and the warm air to the top of the ice chamber. Arrangements are now being made by the writer for carrying on conclusive tests on this particular point in the very near future.

Easily Kept Clean and Sanitary. The lining of the chambers should be an odorless material; smooth, hard, free from checks or openings, not subject to decay, and something easily kept clean and sweet. The most desirable woods for lining are spruce, hemlock, basswood, and whitewood. A wood lining should be extremely well seasoned, very free from knots and checks, carefully put together, and then well coated with shellac. A good quality of galvanized iron makes a very satisfactory lining for the food chamber. The shelves are made of the same material. The expensive linings used to-day in the high-grade refrigerators are white enamel, porcelain, opalite, etc. These materials make a very sanitary, durable, and highly finished interior.

Durability. A great many of the cheaper grades are poorly constructed from very improperly seasoned material, the result is that the doors and walls soon get out of place. A good quality of oak or ash well-seasoned makes a very satisfactory material for the outside finish. Of course, good care is an important factor in the life of a refrigerator, as it is in anything else.

Reasonable Price. Since a refrigerator is so essential in every home the price ought to be reasonable and well within the reach of all, although any farmer could well afford to expend $25, or even more, on a good refrigerator. A serviceable one ought to be bought for much less.

Size. The sizes suitable for homes vary somewhat. A general idea of the range of sizes may be had from the following list:—

SMALL SIZE

	Height	Width	Depth
Outside measurements	45 in.	27½ in.	17¾ in.
Ice chamber	9¾ in.	18 in.	11⅝ in.
Provisionchamber	18¼ in.	20½ in.	12⅝ in.
Shipping weight	150 lbs.		
Ice capacity, about	70 lbs.		

MEDIUM SIZE

	Height	Width	Depth
Outside measurements	49 in.	29½ in.	21¾ in.
Ice chamber	10 in.	22 in.	16 in.
Provision chamber	22 in.	24½ in.	16 in.
Shipping weight	200 lbs.		
Ice capacity	115 lbs.		

LARGE SIZE

	Height	Width	Depth
Outside measurements	57 in.	44 in	27 in.
Ice chamber	27 in.	14 in.	18 in.
Provision chamber No. 1	12 in.	17 in.	22 in.
Provision chamber No. 2	19 in.	17 in.	22 in.
Shipping weight	560 lbs.		
Ice capacity	220 lbs.		

These three sizes, or thereabouts, will meet the requirements of almost any home in city or country. The small size is large enough for very small families in the city, the medium for small country homes and the large one for very large families in the city or country. Many of the large refrigerators have two or three separate cooling chambers and this is a very desirable feature when considerable quantities of different foods are stored for several days, because certain products as eggs and butter will absorb odor from fruit and vegetables if stored in the same chamber for even a few days.

QUANTITY OF ICE REQUIRED PER WEEK.—The amount of ice that any refrigerator will use per week or month will vary with the temperature of the room where the refrigerator is kept, the amount of goods stored, the insulation of the walls of the refrigerator and the quantity of ice in the ice-box. It is noted that the ice capacity of the small size is 70 lbs., the medium 115 lbs., and the large 220 lbs. These quantities are, in the writer's opinion, rather too high unless the ice is packed in pretty well. In practice the amounts put in at one time are about 50, 90, and 175 lbs., respectively.

It is advisable to keep the ice-chamber as well filled as possible, because the ice will last longer and a lower and more uniform temperature will be maintained in the food chamber below. A large household refrigerator about the size mentioned above and well insulated requires about 30 lbs. of ice per day or from 200 to 225 lbs. per week for average conditions of summer weather. The small or medium size not so well insulated will use about the same amount. Assuming that the refrigerator would be used for five months of the year it would be necessary to provide for three or four tons or loads of ice for household use; this amount would supply plenty for the household purposes and allow for considerable waste.

PRICES.—The cost varies from about $10 to $75 according to insulation, size, and finish. The small size, lined with galvanized iron and insulated only fairly well, costs from $10 to $15. This grade gives very good satisfaction for a small family. No family can afford to be without one at this cost. A large size better insulated and lined with enamel or porcelain and durable for a lifetime costs about $35. The expensive ones, even, are cheap in view of their durability and efficient service. To be without a refrigerator is poor economy indeed.

SUGGESTIONS ON THE USE OF REFRIGERATORS.

Every refrigerator is furnished with a set of directions and these should be followed closely if one wishes to get the best results from its use. The following are a few of the most important points to watch:—

(1) Keep the refrigerator on a level floor in a cool dry place, and where it can be filled easily and without mussing the kitchen floor.

(2) Fill the ice box regularly and use plenty of ice. Wash ice well before putting into the ice box.

(3) Clean the ice-box and the food chamber thoroughly once a week. The shelves, racks, and flues are all easily taken out, hence the cleaning can be well done in a few minutes. A damp cloth moistened with soda water or with water in which two table-spoonfuls of sweet nitre to the pint has been added is strongly recommended for cleaning the walls of the interior. It is advisable to place a saucer of charcoal in the food chamber to absorb odors and moisture. It will need to be renewed occasionally.

(4) Keep the doors or lids closed as much as possible, and when an article is put into the refrigerator or removed, the door or lid should be closed as quickly as possible afterwards.

(5) Do not cover the shelves with paper or cloth and thereby obstruct circulation which is so necessary in the keeping of perishable products in cool chambers.

(6) Avoid putting hot, steaming or over-ripe, tainted or partially spoiled food or fruits in the refrigerator. If such a practice is followed the food chamber will be damp, foul and altogether unfit for keeping food of any kind in good condition.

(7) Keep the drain always clear.

HARVESTING THE ICE CROP.

Where more than one farmer in a vicinity puts in ice the harvesting should be carried on co-operatively. This would be a very practicable proposition. Greater interest would be taken in this line of work and consequently far more ice would be stored. Time, labour and money would be saved by such a plan and the operations could be performed much more satisfactorily. All the ice for the neighborhood could be harvested in a few days. The ice storages in connection with creameries and cheese factories, etc., could be filled at the same time. The number that would probably form an Ice Harvesting Society or Club in any vicinity would vary greatly, and also the number of tons of ice stored. In any case it would be highly advisable for the co-operation to procure an up-to-date equipment for harvesting the ice. Below is given a list of tools, etc., also photo-engravings of the most important ice tools and of harvesting scenes. The equipment lists, Set No. 1 and 2 below, were prepared, and sent to me by a certain Ice Tool Company. I obtained the prices from their 1911-12 catalogue and the discounts from a separate list, and then calculated the total outlay as given for each case. The duty on this kind of goods is about 25 per cent., and discount about 25 per cent. on the average. These two sets will serve as a guide in computing the probable outlay for any case. I think they are probably more complete then might be really necessary, so the cost might be reduced somewhat.

The Iceman's Harvest—Note the Stack of Ice.

SET NO. I.

"Suitable for harvesting 100 to 500 tons of ice, using three to six men and one horse, alternating plowing and raising ice with the horse, and hoisting into one room with one grapple:

"If plowing and raising are to be done at once, two horses and more men will be required."

Number of tools required	Name of tool	Cost, less discount
1	8 in. 5 tooth special Plow.......	$22.50
1	Plow Rope....................	1.40
1	5 ft. Ice Saw..................	3.85
1	Plow Grapple and Handles......	2.97
1	Fork Bars....................	3.20
1	Caulking Bar..................	2.00
1	Bar Chisel....................	2.45
1	Floor Shaver..................	1.06
1	Ring Splitting Chisel...........	1.75
1	Line Marker..................	.60
1	Sieve Shovel..................	1.22
3	4½ ft. Ice Hooks...............	1.66
1	6 ft. Ice Hooks................	.61
1	12 ft. Ice Hooks...............	.82
1	12 in. Upper Gin...............	4.92
1	12 in. Lower Gin...............	6.75
		Total, $57.76

SET No. 2.

"Suitable for harvesting 1,000 to 3,000 tons of ice, using say, ten men and two horses, hoisting into two rooms with one grapple."

Number of tools required	Name of Tool	Cost less discount.
1	8 in. Swing Guide Plow for ice 12 in. thick	$21.00
1	for 14 in. ice	42.70
1	Plow Rope	1.40
2	5 ft. Saws	7.70
2	Grapples and Handles	5.95
1	Splitting Fork	2.50
2	Caulking Bars	4.00
2	Bar Chisels	4.90
2	Floor Chisels	2.00
1	Ring Splitting Chisel	2.06
1	Needle Bar	1.5.
1	3-tined Needle Bar	2.63
1	Line Marker	.63
1	Sieve Shovel	1.22
8	4½ ft. Ice Hooks	4.44
2	6 ft. Ice Hooks	1.23
2	10 and 16 ft. Ice Hooks	2.10
1	24 in. Boston Tongs	1.07
2	12 in. Upper Gins	9.90
2	12 in. Lower Gins	13.50
		$91.08

Thus a very complete and up-to-date equipment for harvesting upwards of 500 tons of ice can be secured for about $60; for a harvest of 1,000 to 3,000 tons of ice the cost would be about $100. Five hundred tons of ice will supply 20 or 25 farmers, so that the cost of equipment to each should not exceed two or three dollars. The tools, if well cared for, will last for many years. By co-operative harvesting the farmers ought to be able to store their year's ice for about 20 or 25 cents per ton. This method should appeal very forcibly to any neighborhood of farmers as their ice can be harvested so easily, quickly and cheaply. The accompanying illustrations show several of the ice tools in operation, for example, the ice plow, saws, a simple convenience for loading ice on sleighs, apparatus for hoisting the ice into the top of the ice house, etc. The device for loading the cakes on to the sleighs is worthy of special attention, as it is a very essential part of the outfit, because it saves much time and a great deal of hard, disagreeable work in loading the heavy, cold, wet cakes. A handy man can make it very cheaply. The harvesting of ice is therefore comparatively easy work, when the proper tools and conveniences are provided for.

The Iceplow and Its Work.

If the ice is 1 foot thick it will require an area of about 6 feet square for one ton, and an area 50 feet square for 40 tons. The ordinary sized cake about 20 inches square and 1 foot thick will weigh about 150 lbs. and 20 or 25 cakes, say 1½ or 2 tons is about as much as can be carried conveniently on a sleigh.

Loading Ice—How Easily It's Done.

STORING THE ICE.

Suggestions on the Storage of Ice.

1. Take the ice from a clean, pure and deep lake, pond or stream. Do not by any means store snow or poor ice.

2. The ice should be at least 1 foot thick.

3. Store the ice preferably on very cold days. It will handle more satisfactorily and keep better.

4. Put plenty of dry sawdust on the bottom of the ice-house, at least 1 foot, before beginning to store the ice.

5. Pile the ice cakes as closely as possible in rows and layers, breaking the joints, and fill the chinks with small pieces of ice or snow. The air space should be reduced as much as possible.

Storing Next Summer's Supply of Ice at the Ontario Agricultural College.

6. Do not fill the spaces among the cakes with sawdust. This practice is not advisable and is therefore going out of date.

7. Leave at least 1 foot space between the ice and the wall of the ice house and pack it well with a good quality of dry sawdust as the ice is put in.

8. After all the ice is stored put a foot or two at least of sawdust over the top. An extra amount will not be amiss to refill the settling of the sawdust at the sides. Two or three feet of wild hay is a very good covering for the top of the ice if plenty of sawdust cannot be obtained, and wild hay or straw chopped would do for the sides if about twice as much is used.

9. See to it that the ice is kept well covered throughout the summer, especially after any ice is removed.

Size of the Ice Cakes.

The standard sizes for commercial use are 22 inches by 22 inches and 22 inches by 32 inches. These are rather too large for storage on the farm, although the large cakes keep better. A cake 18 inches by 18 inches would be about right. A cake 18 inches by 18 inches and 1 foot thick would weigh about 130 lbs. and if smaller pieces are required for use these cakes can be divided after they are taken out of the sawdust.

The Tonnage-Space of Ice.

The following data is given by Madison Cooper on this point in his excellent little monthly publication entitled "Cold":—

"It is customary to figure from 40 to 50 cubic feet for a ton of ice, house measurement. By house measurement is meant the inside dimensions of the ice storage room. Where the house is small and the ice is packed in sawdust or other packing material in the old fashioned way, it is customary to allow about 50 to 55 cubic feet for a ton of ice; in larger houses less in proportion.

"In the modern houses such as are used in connection with the Cooper Cold Storage Systems no packing material is used, whether at the sides or on the top, as the walls, floor and ceiling are thoroughly insulated. In such a house 40 cubic feet is ample to allow for a ton of ice.

"Forty-two cubic feet is the figure which has probably been used more than any other in connection with the storage of natural ice for retail purposes. This allows for packing every third tier at least on edge. It takes a little more space where part of the ice is packed on edge.

"The actual space occupied by a ton of solid ice is only about 35 cubic feet, so you will see that all of these figures are simply estimates to allow for loss of space from various causes when packing the ice in the house."

The Cost of Handling and Storing Ice.

The cost per ton varies from 20 to 75 cents, according to conditions, such as season, cost of labor, distance of supply from storage, quantity stored and so on. In Ontario it costs from 30 to 50 cents to store one ton of ice in a commercial ice-house on water front and having a capacity of about 5,000 tons. In the United States the cost of handling ice for small houses is 20 cents a ton on the average, and the cost to our farmers should not exceed this if they would harvest their ice co-operatively as has been suggested.

ESSENTIAL CONDITIONS FOR SUCCESSFUL STORAGE OF PERISHABLE PRODUCTS.

Preparation for Storage.

(1) All the storage rooms and corridors should be thoroughly cleaned, white-washed, and aired each year after all the stored goods are removed or shipped out. While the rooms remain empty they should be kept

very clean, dry, and well aired. Keep the ventilation system working well. The white-wash will act as a disinfectant and fungicide. Two coats of white-wash should be used; the first very thin, the second thicker, or of a pasty consistency. The slaking of the lime should be done carefully and slowly. A good quality of dry sawdust or quicklime is useful on the floors to take up moisture. Chloride of Calcium is a good absorbent of moisture and odors.

(2) Too little attention is usually given to the condition and care of the products just before storage. No class of goods will come out of storage in a satisfactory condition unless it was in a first-class condition when stored. Careless storage is ruinous to the cold storage man, the customer and to commerce. Do not store hot, tainted, bruised, over-ripe or diseased products. Eggs, for example, should be carefully candled, graded, and packed, and fruit cautiously picked, well sorted, allowed to cool off some, and then packed carefully in proper crates.

(3) Crates, barrels, etc., should be somewhat open on all sides to allow good circulation of air throughout all the goods, and to permit the gases emanating from the goods to escape. Closely constructed barrels and packing boxes should not be used. All wrappers should be porous.

(4) Too much attention cannot be given to the careful handling of the goods on the way to the storage, and while being stored away in the rooms. One bruise is often responsible for a heavy loss.

(5) Do not forget that cold storage is not a cure-all for all the defects, natural or otherwise, of perishable products, and that if they are put into storage in an imperfect condition they will be sure to come out in as bad, if not a worse, condition.

Arrangement and Packing of Goods in Storage Rooms.

(1) Goods should be kept a few inches away from the walls, floors and ceiling to allow the air to circulate well around all the sides.

(2) Nor should they be packed tightly but with spaces. At least one-half inch space should be allowed around all sides of egg cases, fruit crates, etc. In our best storages, egg cases for example, are piled in tiers with a small space between the cases in the tiers, and each tier is separated from the one above it by an inch strip. This arrangement permits of thorough circulation around the eggs.

(3) Large quantities of different classes of goods should not be stored in the same rooms for any length of time, as some goods taint others, and all do not require the same temperature. Eggs and butter are easily tainted, and these should not be stored with fruit or vegetables or with any other goods in fact. No specific rule can be laid down to suit all conditions, but for regular storage it is highly advisable to have a separate room for each class of goods. In small storages this is not

possible, so many goods are stored together and often without serious results, if the period of storage is not very long.

Cold Storage and Freezing Temperatures for Our Most Common Products of Storage.

Mr. Madison Cooper furnishes the information contained in the following table of storage temperatures. It is reliable and up-to-date.

Apples	42	Maple Sugar	45
Asparagus	33	Maple Syrup	45
Berries, Fresh (few days only)	40	Meat (fresh) (ten to thirty days)	30
Bulbs	34	Meats, fresh (few days only)	35
Butter	14	Meats, salt (after curing)	43
Cabbage	31	Milk (short carry)	35
Canned Fruits	40	Nursery Stock	30
Canned Meats	40	Nuts in shell	40
Carrots	33	Oatmeal	42
Celery	32	Oils	45
Cheese (long carry)	35	Onions	32
Cheese (cool cooling)	50	Oxtails	30
Cider	32	Oysters, iced (in tube)	35
Cranberries	33	Oysters (in shell)	43
Cream (short carry)	33	Parsnips	32
Cucumbers	38	Peaches (short carry)	50
Currants (few days only)	32	Pears	33
Cut roses	36	Plums (one or two months)	32
Dried fruits	40	Potatoes	34
Eggs	30	Poultry (after frozen)	10
Ferns	28	Poultry (dressed, iced)	30
Fish, fresh water (after frozen)	18	Poultry (to freeze)	0
Fish, salt water (after frozen)	15	Raisins	55
Fish (to freeze)	5	Ribs (not brined)	20
Fruit Trees	30	Salt Meat, curing room	33
Fur and fabric room	28	Sauerkraut	38
Furs (undressed)	35	Sausage Casings	20
Game (after frozen)	10	Shoulders (not brined)	20
Game (short carry)	28	Strained Honey	45
Grapes	36	Sugar	45
Hams (not brined)	20	Syrup	45
Hogs	30	Tenderloin, etc.	33
Hops	32	Tobacco	42
Huckleberries (frozen long carry)	20	Tomatoes (ripe)	42
Ice Cream (for few days)	15	Veal	30
Ice Storage room (refrigerated)	28	Watermelons (short carry)	40
Lard	40	Wheat Flour	42

Humidity in Storage Rooms.

The term "humidity" is another name for dampness, and the term "Relative Humidity" refers to the percentage of moisture in the air. If the air is saturated the relative humidity is 100 per cent., if half saturated 50 per cent., etc. The humidity is an important factor in the storage of some classes of goods; for example in the storage and curing of cheese; if the air is too dry the cheese lose excessively in weight, if too damp, they mold; likewise with eggs, fruit and vegetables. It is important, therefore, that these goods be stored under the proper conditions of humidity. With such products as butter, meats, fish, and all goods held at very low or freezing temperatures, the matter of humidity is not so important. Eggs, vegetables, and fruit should be held at a relative much moisture. Eggs, vegetables, and fruit should be held at a relative humidity of about 80 per cent. Cheese about the same, or maybe a little less, though it is usually higher in many of our small curing rooms. If the storage rooms are provided with adequate circulation of pure air and with trays holding Calcium Chloride there will not be any particular trouble with the question of moisture. Humidity determinations are made by an instrument called a hygrometer and a set of tables. Space will not permit a description of this instrument or the method of use here, but information about it may be procured from the writer.

Length of Storage Periods.

The length of time that perishable products may be held in cold storage depends on many conditions, such as the class of goods, condition at time of storage, temperatures maintained in rooms, humidity, packing, handling, etc. From reports of Canadian Cold Storage Warehousemen it is learned that eggs are usually held for 8 or 10, or even 15 months with good results, apples 8, butter 8 to 10, poultry 10 to 12, meats 6, fish 8 or more, and lemons, etc., 3. There is no doubt that most of these goods could be held much longer than these periods if it were necessary, but that they come out of storage in good condition at the end of these periods is a very significant fact.

The following paragraph by S. H. Fulton, Pomologist, of the U. S. Department of Agriculture, in Bulletin 108, Bureau of Plant Industry, should be noted with interest in this connection:

The Length of Time Small Fruits Keep in Cold Storage.

The length of time small fruits keep in cold storage depends upon the variety, the conditions under which the fruits are grown, and the methods of handling them in picking, packing, shipping, etc. In the Department tests, with fruit handled under good commercial conditions, strawberries kept from one to two weeks in good condition so far as appearances were concerned, but the flavor usually began to deteriorate after three or four days. Some of the firm-fleshed varieties, like Gandy, kept even longer than two weeks, when picked dry, and carefully handled, while tender varieties, like Tennessee, went down much more quickly. Red raspberries usually began to mould after two or three days in storage. Black raspberries kept in sound condition for a somewhat longer period. Most varieties of blackberries kept a week, while some of the firmer fleshed sorts kept several days longer. Dewberries behaved similar to blackberries. Currants kept well for two weeks with slight loss to flavor. Gooseberries retained their normal appearance and flavor, after which the fruit turned red and became unsalable. Cranberries kept throughout the winter and were withdrawn the last of April in good commercial condition.

These statements are based upon tests with small fruits packed in the customary way as for market and stored in a temperature of 32°F. Wrapped fruit and fruit stored in moderately tight packages kept for somewhat longer periods."

The following facts regarding the storage of fruits have been pretty well borne out in experiments in United States and Canada:

(1) Bartlett pears keep in good condition for six weeks in cold storage at a temperature of 32°F. if stored within 48 hours after packing. When storage was delayed four days after picking there was a loss of from 20 to 30 per cent. from softening and decay. The Kieffer if packed and stored right after picking will keep until spring. Pears should be picked before they are mature, and if kept for long periods a wrapper is a great advantage.

(2) Powell and Fulton give the following summary in their Bulletin 48, Bureau of Plant Industry, on the apple in cold storage:

"An apple usually should be fully grown and highly colored when picked, to give it the best keeping and commercial qualities. When harvested in that condition, it is less liable to scald, of better quality, more attractive in appearance, and is worth more money than when it is picked in greener condition.

"An exception to the statement appears to exist in the case of certain varieties when borne on rapidly growing young trees. Such fruit is likely to be overgrown, and under these conditions the apples may need picking before they reach their highest color and full development.

"Uniform color may be secured by pruning to let the sunlight into the tree, by cultural conditions that check the growth of the tree early in the fall, and by picking over the trees several times, taking the apples in each picking that have attained the desired degree of color and size.

"Apples should be stored as quickly as possible after picking. The fruit ripens rapidly after it is picked, especially if the weather is hot. The ripening, which takes place between the time of picking and storage, shortens the life of the fruit in the storage house. The fruit rots multiply rapidly if storage is delayed, and the fruit becomes heated. If the weather is cool enough to prevent after-ripening, a delay in the storage of the fruit may not be injurious to its keeping quality.

A temperature of 31° to 32°F. retards the ripening processes more than a higher temperature. This temperature favors the fruit in other respects.

"A fruit wrapper retards the ripening of the fruit; it preserves its bright color, checks transpiration and lessens wilting, protects the apple from bruising, and prevents the spread of fungous spores from decayed to perfect fruit. In commercial practice the use of the wrapper may be advisable on the finest grades of fruit that are placed on the market in small packages.

"Apples that are to be stored for any length of time should be placed in closed packages. Fruit in ventilated packages is likely to be injured by wilting. Delicate fruit, and fruit on which the ripening processes need to be quickly checked, should be stored in the smallest practicable commercial package. The fruit cools more rapidly in small packages.

"Apples should be in a firm condition when taken from storage, and kept in a low temperature after removal. A high temperature hastens decomposition and develops scald.

"The best fruit keeps best in storage. When the crop is light it may pay to store fruit of inferior grade, but in this case the grades should be established when the fruit is picked. The bruising of the fruit leads to premature decay.

"The scald is probably caused by a ferment or enzyme which works most rapidly in a high temperature. Fruit picked before it is mature is more susceptible than highly-colored, well-developed fruit.

"After the fruit is picked its susceptibility to scald increases as the ripening progresses.

"The ripening that takes place between the picking of the fruit and its storage makes it more susceptible to scald, and delay in storing the fruit in hot weather is particularly injurious.

"The fruit scalds least in a low temperature. On removal from storage late in the season the scald develops quickly, especially when the temperature is high.

"It does not appear practicable to treat the fruit with gases or other substances to prevent the scald.

"From the practical standpoint the scald may be prevented to the greatest extent by producing highly-colored, well-developed fruit, by storing it as soon as it is picked, in a temperature of 31° to 32°F., by removing it from storage while it is still free from scald, and by holding it after removal in the coolest possible temperature.

"A variety may differ in its keeping quality when grown in different parts of the country. It may vary when grown in the same locality under different cultural conditions. The character of the soil, the age of the trees, the care of the orchard—all of these factors modify the growth of the tree and fruit, and may affect the keeping quality of the apples. The character of the season also modifies the keeping power of the fruit."

(3) Reynolds and Hutt of the Ontario Agricultural College give the following summary in their Bulletin 123 on the Cold Storage of Fruit:

"1. Apples and pears [illegible] best when wrapped singly in paper, and packed in a shallow box, not larger than a bushel. They ship best when, in addition, they are packed in layers with excelsior between.

"2. Apples keep better at a temperature of 31° than at a higher temperature. Our experiments do not show what is the best temperature for pears.

"3. Cold storage cannot make bad fruit good; neither can it keep bad fruit from becoming worse. Only good specimens will keep for any length of time in cold storage, or will pay for storage.

"4. For long storage, it pays to select the best fruit and to pack it in the best manner known. The extra labor and the cost of material are more than repaid in the greater quantity and better quality of fruit left at the end of the storage period.

"5. With apples and pears at least, and, it seems likely, for most kinds of fruit, the fruit should be picked and stored in advance of dead ripeness. The maturing process goes on more slowly in cold storage than on the tree or bush.

"6. With the two kinds of fruit tried, apples and pears, the medium sizes of fruit keep longer than the largest, all being perfect specimens and picked at the same time. It would, therefore, be an advantage, especially with pears and peaches, to pick the larger specimens first, and leaves the smaller to mature later.

"7. Fruit, on being removed from cold storage, should be allowed to warm gradually, and moisture should not be allowed to deposit upon it. But if the wetting cannot be prevented, then the fruit should be spread out and dried as quickly as possible.

"8. With all kinds of fruit, there is a time limit beyond which it is unprofitable to hold the fruit in cold storage, or anywhere else. That limit, for sound fruit, is dead ripeness. Duchess pears can be kept profitably until late in December; Fameuse, or Snow, apples, until March or April. The time limit has to be determined for each kind of fruit.

"9. In addition to proper conditions in the storage room, the most important points in the storage of fruit are the selection of sound fruit, grading into uniform sizes, one variety only in a case; and careful packing. Therefore, the results of these experiments can be made use of by the family, in preserving fresh fruit for their own use; by the fruit-grower, in securing better prices for good fruit later in the season, in the local markets; and by the shipper, in enabling him to take advantage of the higher prices offered in foreign markets."

(4) Peaches may be kept two to four weeks in good condition if they are picked at just about full ripeness, wrapped in paper, and packed in small cases at a temperature of 36°F.

(5) Grapes may be kept well for 6 or 8 weeks, depending somewhat on the variety. The early grapes usually keep the best. Dryness is very essential to the keeping of grapes in storage, hence the practice in places of packing them in sawdust and ground cork.

(6) Plums will not keep much longer than a month under the best conditions.

(7) Tomatoes have been kept about two months when picked as they are beginning to redden, wrapped in tissue paper, and packed in cases with excelsior. Green tomatoes may be held for months.

CANADIAN BULLETINS AND REPORTS ON COLD STORAGE.

DOMINION.

Published by J. A. Ruddick, Dairy and Cold Storage Commissioner, Ottawa, Canada.

1. "Creamery Cold Storage." Bulletin No. 10.
2. "Ice on the Farm." Bulletin No. 20.
3. "Subsidies for Cold Storage Warehouses." Bulletin No. 16.
4. "Plans and Specifications of a Cool Cheese Curing Room." Bulletin No. 7.
5. The Commissioner's Annual Reports contain very valuable information on Cold Storage work in our Dominion. They also may be had by writing to Mr. Ruddick, at Ottawa. See Reports from 1906 up to the present time.
6. Mr. Ruddick's evidence before the Select Standing Committee on Agriculture and Colonization, of the House of Commons. See copies of this report for years 1906-07, 1907-08, 1909-10.

PROVINCIAL.

Published by the Department of Agriculture, Toronto, Ontario

1. "Plans and Specifications for Cold Storage Buildings" (The Hanrahan System), also Acts in regard to Provincial aid (1900).
   NOTE: This pamphlet is out of print I understand.
2. "Ripening of Cheese in Cold Storage," compared with ripening in the ordinary curing-room.
   Bulletin No. 121, by Professors Dean, Harrison, and Harcourt, of the O. A. C. Revised in 1903 as Bulletin 131.
3. "Cold Storage of Fruit." No. 123, by Professors Reynolds and Hutt.

MISCELLANEOUS REPORTS.

1. "Cold Storage of Cheese and Butter." 1904 Report of the Ontario Agricultural College, Guelph.
2. "Cold Storage Experiments," J. B. Reynolds, 1900 Report of the Ontario Agricultural College.
3. "Cold Storage for Fruit and Other Products." See Ontario Fruit Growers' Association Report for 1900.
4. "Cool Curing of Cheese." By J. A. Ruddick and Ballantyne, Ontario Dairymen's Association Report for 1902; also see 1901 Report.
5. "Fruit Shipments to Britain." See Fruit Growers' Association Report for 1901; also 1910 and 1911 Reports of the Fruit Branch, Department of Agriculture, Toronto, Ontario.

NOTE.

A second bulletin dealing with the mechanical systems of refrigeration, cold storage warehouses, pre-cooling, insulation, cold storage legislature, etc., is being prepared for publication by the writer.

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