

9. How should ice be packed in small houses in order to keep most efficiently? In what way does this method differ from packing in large storage houses?

10. What kind of a storage house do you have on your farm?

11. How do you handle the ice as it comes from the storage house during the season?

12. What percentage of ice stored do you obtain for use during the entire season?

Name.....

Address.....

Date.....

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THE CORNELL READING COURSE FOR THE FARM

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A. R. MANN, DIRECTOR OF EXTENSION SERVICE

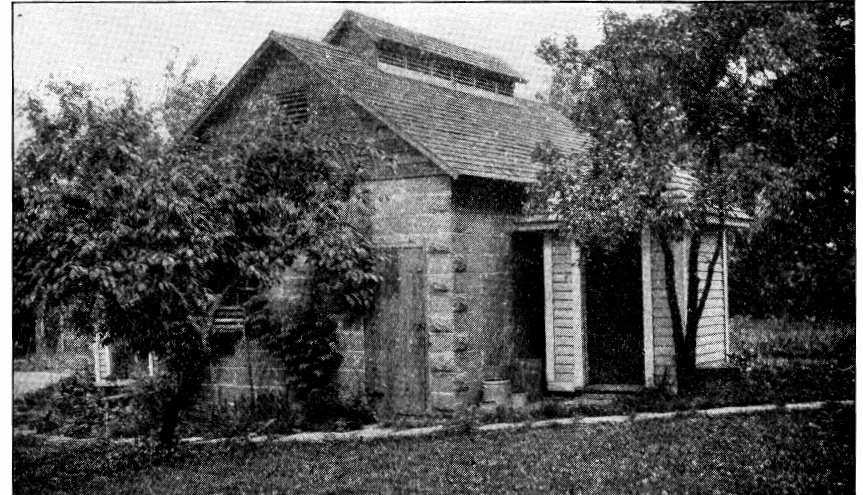
LESSON 135

RURAL ENGINEERING SERIES

JULY, 1918

THE FARM ICE SUPPLY

B. B. ROBB AND J. L. STRAHAN



THE MILK HOUSE CONVENIENTLY LOCATED NEAR THE ICE HOUSE

Published and distributed in furtherance of the purposes provided for in the
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THE CORNELL READING COURSE FOR THE FARM

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BRISTOW ADAMS
RUTH VAN DEMAN

“Upon the farmers of this country in large measure rests the fate of the war and of the nations.”—PRESIDENT WILSON, April 15, 1917

Under war conditions the skillful work of the man on the land has become more important than ever before. There is indeed every reason for zeal in increasing food production. Knowledge will help to make labor productive. Abraham Lincoln once said, “No other human occupation opens so wide a field for the profitable and agreeable combination of labor with cultivated thought as agriculture.” The College of Agriculture, thru the Reading Course for the Farm, offers twelve series of lessons for home study free to residents of New York State. The attached discussion paper gives details about these series. The reading course lessons are elementary and brief. Three advanced reading courses, in farm crops, fruit growing, and vegetable gardening, provide more complete instruction in accordance with modern correspondence methods.

In a number of communities groups have organized for the discussion and study of common problems, and have adopted the name Cornell Study Club. The primary purpose of a Cornell study club is to furnish an occasion and an incentive for discussing reading course lessons for the farm and for the farm home, but the objects include the accomplishment of local improvements, the encouraging of cooperative buying and selling, and the bringing of outside speakers into the community. Cornell study clubs are educational and social centers, and should develop local leadership and the human resources of the community. Assistance is given in organizing and conducting clubs, and speakers are sent to clubs occasionally in connection with the regular extension work of the College.

Correspondence is a medium for the exchange of helpful information. Letters will receive careful attention.

THE FARM ICE SUPPLY

B. B. ROBB AND J. L. STRAHAN

Many farmers in New York State desire to maintain a summer ice supply that will be adequate for the rapid cooling of their milk and cream and for stocking a refrigerator of such size that they can have a reasonably continuous supply of fresh meat and other perishable foods for the table.

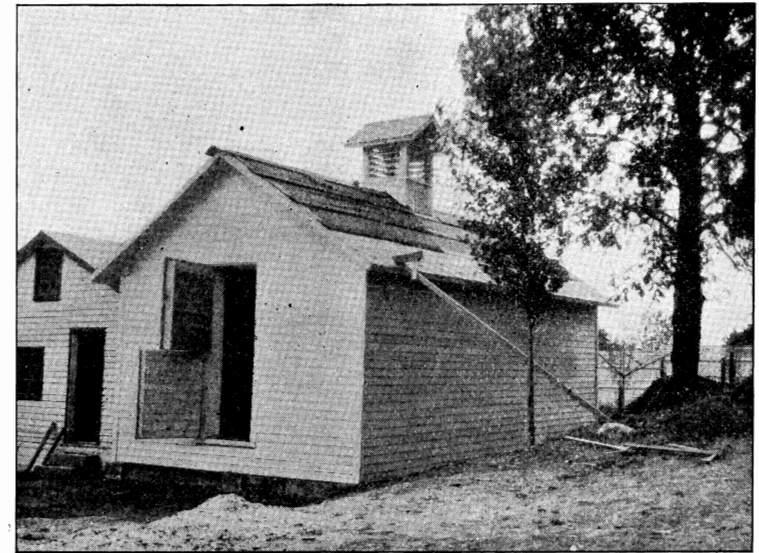


FIG. 1. ICE HOUSE WITH INSULATED WALLS

For such farmers who desire to know good methods of storing and handling natural ice, this publication has been prepared.

In order that ice may keep well in storage, it must be properly packed in a well-designed house and carefully handled during the season when it is being used.

SITE FOR THE ICE HOUSE

The site selected for the ice house should be easily accessible from the points where the ice is to be used and so located that the ice will be protected from excessive loss by melting.

The milk room and the house kitchen are the two places where the ice will be needed during the summer. Small amounts of ice will be delivered

at frequent intervals from the storage house to these two points; such trips should be made as short as possible in order to conserve labor. It is undoubtedly easier to haul ice in large quantities over snow-covered ground on bobs in the winter than it is to move it in small lots in a wheelbarrow in the summer. Also, time is a more important economic element in the summer than in the winter and cannot well be spared for filling the cooling tank or the ice box from a great distance. The house should be located, therefore, with reference to labor economy in the summer rather than ease of access at the time the ice is harvested.

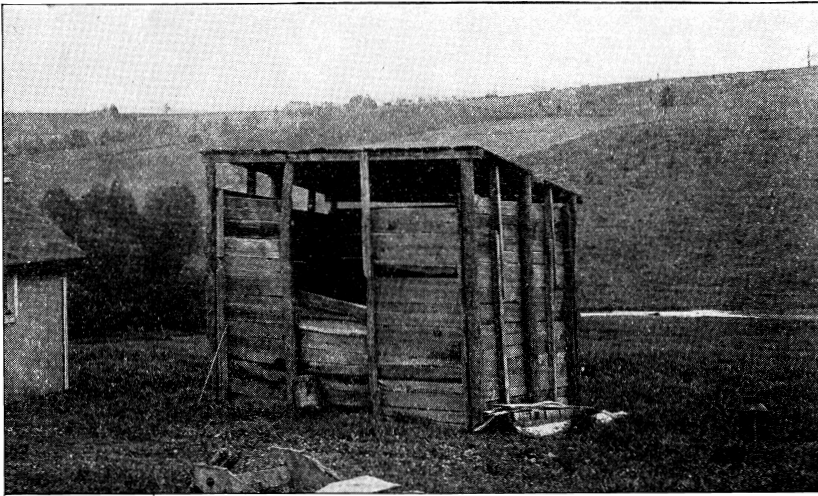


FIG. 2. TEMPORARY ICE HOUSE

This crude structure combines all the necessary features of an adequate ice storage building

From the standpoint of protection against heat, a site with a northern exposure, shaded by trees with dense foliage, is to be desired, but is not essential. Good drainage however is essential. A slight rise in elevation from the surrounding ground is desirable, and the site will be still further improved if underlaid with a porous, gravelly soil.

TYPES OF ICE HOUSES

Two types of ice storage houses are in use on New York State farms. These differ from each other in one principal respect, that is, the construction of the walls.

In one of these types protection against heat is provided by a specially constructed wall containing within itself some nonconducting material

that acts as an insulator. Because the first cost of construction of such insulated houses is high and because cheaper houses with noninsulated walls have been found by experience to be adequate to meet the needs of farmers in this State, a detailed discussion of the expensive house as illustrated in figure 1, is omitted in this publication.

In the other type of storage house, which experience has shown to be best adapted to average New York State conditions, protection against heat is provided by a layer of sawdust placed between the ice stack and the walls of the building, the principal function of the latter being merely to hold the insulating material against the ice.

Two methods of constructing houses of this type are shown in figures 2 and 3. The building in figure 2 is the merest shack, consisting of poles

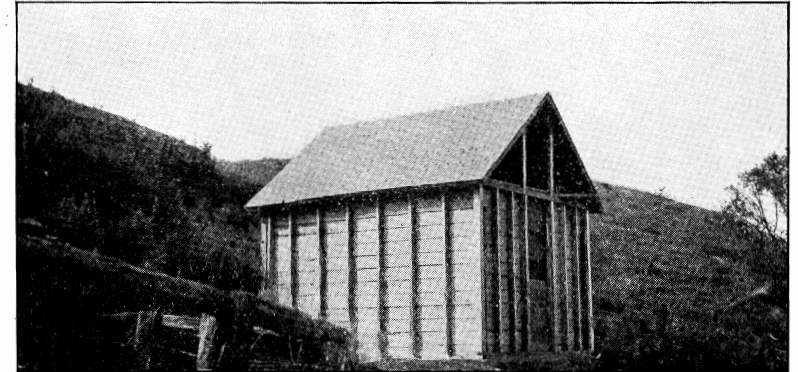


FIG. 3. AN INEXPENSIVE BUT EFFICIENT ICE HOUSE

This is a more shipshape structure than that shown in figure 2, but it is essentially of the same type as those shown in figures 2 and 4

set in the ground and roughly boarded on the inside. When ice is properly packed and carefully handled during the season when it is being used, it can be kept with a very fair degree of efficiency in such a building. Probably one-half to two-thirds of the ice stored will be available for use during the summer.

More shipshape structures are shown in figures 3 and 4. The building in figure 3 has all the essentials of a storage house for use on a New York State farm; the building in figure 4 has essentially the same construction except that it is double-boarded and provided with a weatherproof roof. These are not elaborate houses and are to be always preferred to the rough structure illustrated in figure 2, save only when the very strictest economy in materials is necessary.

CONSTRUCTION OF THE ICE STORAGE HOUSE

The details of construction of a house of the general type shown in figure 5, are as follows:

FOUNDATION AND FLOOR

The foundation wall is of concrete 8 inches thick and extending beneath the surface of the ground far enough to avoid frost action. The concrete should be mixed in the proportions of 1 part cement, 2½ parts sand, and 5 parts gravel, or the equivalent of clean bank run material. While the concrete is still soft, bars of strap iron, bent as indicated in the wall

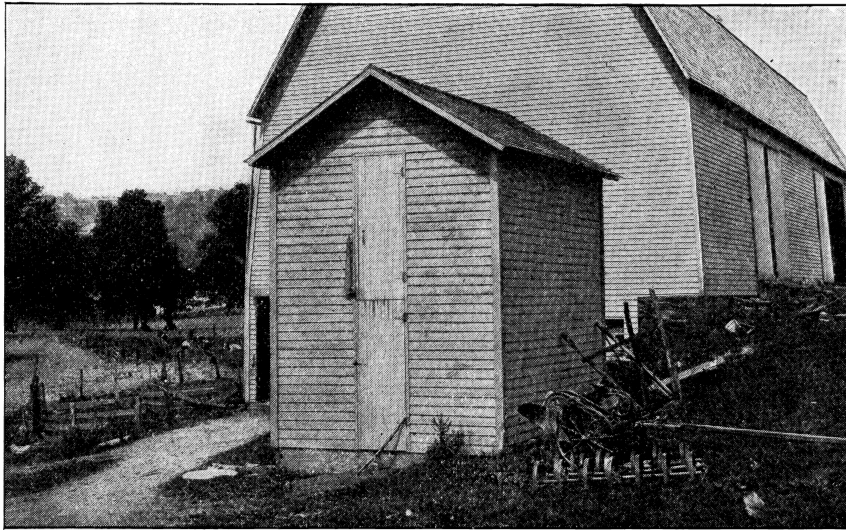


FIG. 4. A GOOD TYPE OF ICE STORAGE HOUSE FOR THE NEW YORK FARM
This ice house differs from those shown in figures 2 and 3 only in finish

detail (fig. 6), should be set in at intervals of 24 inches to take the ends of the studs in place of a sill, for reasons explained later.

The floor is excavated to a depth of approximately 2 feet thru the center, gradually rising on two sides to within 12 inches or less of the average ground level outside the wall. Thru the center of the depression thus formed is laid a line of 3-inch common land drain tile, around and over which is placed a layer of flat field stones to within 6 or 8 inches of the finished floor grade. On this is placed a layer of 6 or 8 inches of coarse gravel or cinders so that the floor gradually slopes toward the center, where it is several inches lower than at the wall. When ice is stored on a floor so graded, the cakes have a tendency to slide against

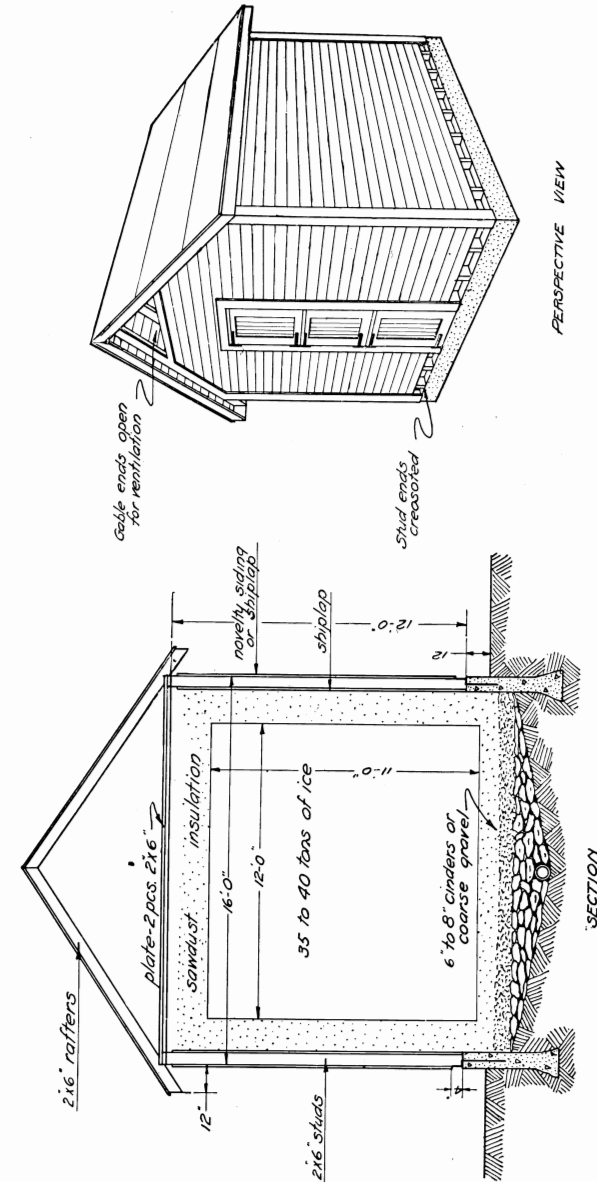


FIG. 5. DETAILS OF CONSTRUCTION OF AN ECONOMICAL AND EFFICIENT ICE HOUSE

instead of away from each other, thus causing little or no side pressure against the frame walls. The drain tile should extend far enough away from the building to insure adequate and complete removal of all water as fast as it accumulates.

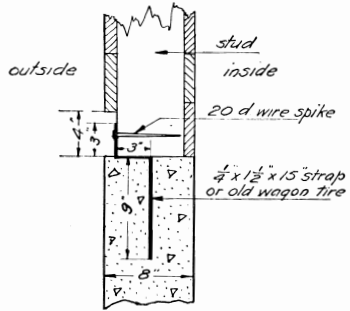


FIG. 6. DETAIL OF WALL AT SILL

FRAME WALLS

Studs of 2x6-inch material placed 24 inches on centers form the frame of the wall. These are covered on the inside with common ship-lap siding, extending from the top of the concrete foundation to within 6 inches of the plate, which is 4 x 6 inches in a small building and 4 x 8 inches in large ones, tied across where necessary.

If outside siding is to be used, it should be placed on the studs from a point 4 inches above the top of the foundation wall to a point 8 inches below the plate. An opening is thus provided entirely around the base of the building on the outside and around the plate, both inside and outside, in order to allow a free circulation of air between the studs to prevent them from rotting due to continual dampness.

The ends of the studs should be treated with hot creosote in order to make them more rot resistant.¹ This may be done by dipping them in hot creosote and allowing them to soak up as much of it as they will for a distance of from 12 to 18 inches from the ends. The sill is replaced in this construction by the strap iron ties, because of the comparative difficulty on the average farm of adequately treating the whole length of a timber with creosote.

A continuous sectional hinged door thru which the ice may be stored or removed should be provided on one end of the building. If the house is built against a bank, as is quite often advisable, doors should be provided on two ends so that the ice may be put in from an upper level and removed from a lower level. The upper

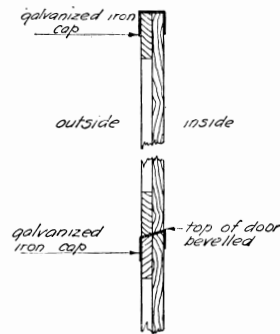


FIG. 7. DETAIL OF DOOR TO SHOW PROTECTION AGAINST WEATHERING

edge of each section of the door should be protected with a metal cap (fig. 7) to prevent rotting caused by continual weathering at this point.

The siding on the gable ends is left off for several feet under the ridges in order to provide ample ventilation for the top of the stack during the summer.

ROOF

The roof is constructed of 2x4-inch or 2x6-inch rafters cut to a one-third pitch and spaced 24 inches on centers. These are covered with common roofers or ship-lap, over which should be laid weatherproof roofing. Many persons think it advisable to construct a ventilator

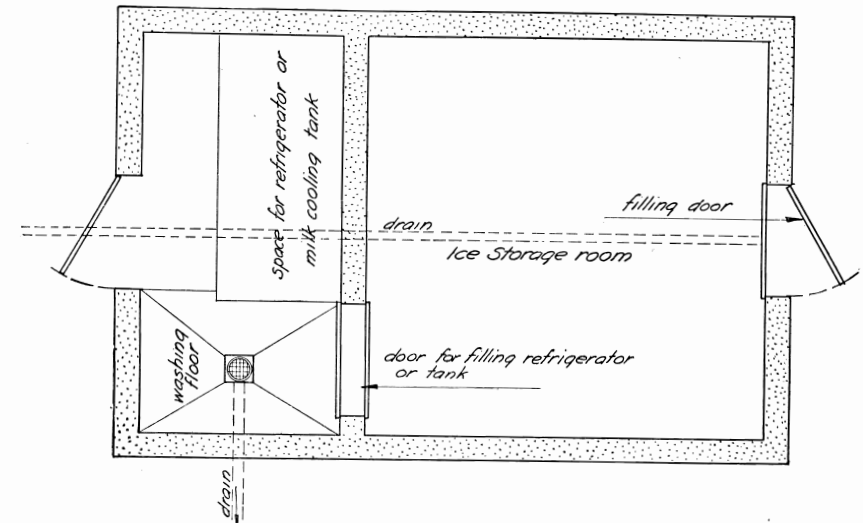


FIG. 8. PLAN OF COMBINATION ICE STORAGE ROOM AND MILK OR REFRIGERATOR ROOM

in the roof to supplement the gable-end ventilation, but it is questionable whether the expense of such construction is warranted by any added efficiency of storage obtained.

COMBINED ICE HOUSE AND COOLING ROOM

In order to conserve building material and make the handling of the ice as easy as possible, in some cases the actual ice storage house has been combined with a refrigerator room or milk cooling room. This has been done fairly successfully when the cooling room is made a separate compartment distinct from the storage room and connected only by a door thru which ice is passed (fig. 10). It has been found very wasteful of ice to attempt to cool a refrigerating room by building it inside the

¹ Descriptions of this treatment are given in the following publications:
The preservative treatment of farm timbers. Forest Products Laboratory, Wisconsin Agricultural Experiment Station (Madison, Wisconsin). Mimeographed circular.
The preservative treatment of farm timbers. George M. Hunt. United States Department of Agriculture. Farmers' bulletin 744.
Preservative treatment of fence posts. G. B. MacDonald. Iowa State College of Agriculture and Mechanic Arts (Ames, Iowa). Bulletin 158 (abridged).

storage room and in contact with the ice stack, depending on the ice in storage for direct refrigeration. A plan of a building containing a cooling room that will accommodate a refrigerator of sufficient capacity to meet

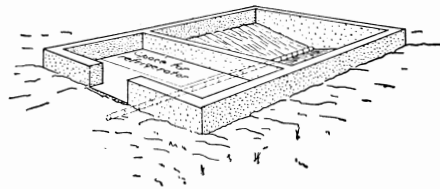


FIG. 9. FIRST STAGE IN CONSTRUCTING THE ICE HOUSE

This much of the construction must be completed before frost

the average farm needs is shown in figure 8. Both storage room and cooling room are under the same roof, but are not connected for direct cooling in any way. On the busy farm new construction is often delayed by other work. The following suggestions are made to the farmer who needs an ice house, either with or without the additional cooling room, but has very limited time at his disposal for completing such a structure before freezing weather and the ice harvest arrive. First, all concrete work should be completed before cold weather to avoid the danger of freezing the concrete before it sets. This stage of the construction is shown in figure 9.

Before ice harvest the construction shown in figure 10 should be completed. Sometime before warm weather the roof should be constructed, as well as the walls of the milk room or the refrigerator room. The outside siding may finally all be put on at one time, thus avoiding the appearance of having been pieced together. The completed structure is shown in figure 11.

SIZE OF THE ICE HOUSE

The common practice among dairy farmers, who are the largest consumers of ice in the rural districts, is to store a sufficient amount to insure them from one to one and a half tons of ice for each milch cow, with from three to six tons for household consumption, after making a liberal allowance for loss by melting.

This allowance for the average house should be about 43 per cent of the net amount required for the summer.

Ice as stored in large commercial houses occupies approximately 45 cubic feet a ton. A solid ton of ice occupies about 35 cubic feet. These

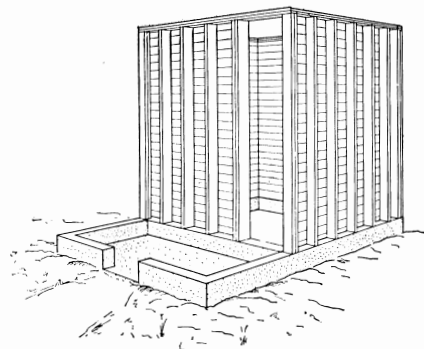


FIG. 10. SECOND STAGE IN CONSTRUCTING THE ICE HOUSE

The construction must reach this stage before ice harvest

figures indicate an allowance of 28 per cent space in the house for cracks and holes due to irregularity of the cakes and uneven filling. In the small house this percentage should not be so large, as it is quite necessary to have the cakes packed closely.

Fifteen per cent is a reasonable allowance for this excess space. On this basis each ton of ice in the house will occupy about 40 cubic feet.

The capacities of houses of various sizes filled to different depths when packed tightly (40 cubic feet for a ton) are shown in table 1. The dimensions given are outside dimensions for the type of house illustrated in figure 5, and it is assumed that 2x6-inch studs are used with inch boards inside for walls and that 12 inches of insulating material is placed between the wall and the ice. A 12x12-foot house would therefore have an actual packing capacity of approximately 9 x 9 feet.

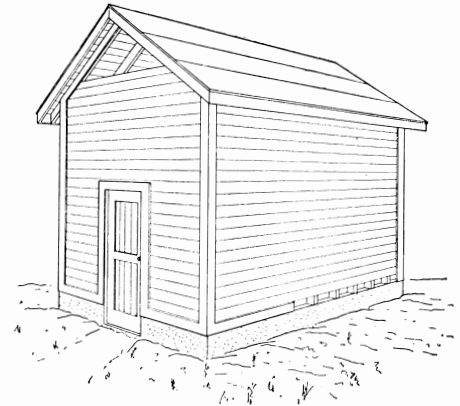


FIG. 11. THE COMPLETED BUILDING

The ice house should be completed before warm weather

TABLE I. CAPACITY, IN TONS, OF ICE HOUSES OF VARIOUS SIZES*

Size of house (feet)	Packing capacity (feet)	Depth of filling								
		6 feet	7 feet	8 feet	9 feet	10 feet	12 feet	14 feet	16 feet	18 feet
10 x 10	7 x 7	7.4	8.6	9.8	11.0	12.3	.....	.....	.....	.....
12 x 12	9 x 9	12.2	14.2	16.2	18.2	20.3	24.3	.....	.....	.....
14 x 14	11 x 11	.....	21.2	24.2	27.2	30.3	36.3	42.4	.....	.....
16 x 16	13 x 13	.....	29.6	33.8	38.0	42.2	50.6	59.0	67.4	.....
18 x 18	15 x 15	.....	39.3	45.0	50.7	56.3	67.4	78.7	90.0	.....
20 x 20	17 x 17	.....	.....	57.7	65.0	72.2	86.7	101.1	115.6	130.0
22 x 22	19 x 19	.....	.....	72.3	81.1	90.3	108.2	126.2	144.2	162.5
24 x 24	21 x 21	.....	.....	88.4	99.4	111.0	132.2	154.5	176.3	198.5

* Allowance is made for one foot of insulating material between the stack and the walls.

The table may be used to determine the size of house necessary for given conditions as follows:

Assuming that a farmer has a herd of fifteen cows and needs five tons of ice a season for household use, his requirement will be as follows:

$$15 \times 1.3 = 19.5 \text{ tons for cooling milk}$$

$$5.0 \text{ tons for household use}$$

Total.....24.5 tons for actual use

$$10.5 \text{ tons, allowance for melting (43 per cent of 24.5 tons, or 30 per cent of 35 tons)}$$

Total.....35.0 tons, amount to be stored

According to the table, the size of house required for this amount is 14 x 14 feet with 14-foot posts, the ice being stored to a depth of 12 feet. A house 16 x 16 feet with 14-foot posts with the ice stored to a depth of 9 feet will also meet the requirements, and may be somewhat more conveniently filled than the smaller house.

SHAPE OF THE HOUSE

A stack of ice that is as high as it is long and broad will have less exposed surface in proportion to its total volume than one of any other shape. For this reason a cubical stack will show the least possible percentage of loss, as most of the melting occurs around the outside of the stack. In larger houses, over 20 feet square, it is not economical to attempt to retain the cubical shape by building the walls as high as would be required, but for smaller houses the cubical shape is best.

PACKING

Two methods are employed in packing ice cakes in the house. In houses where ice is stored in large quantities commercially, it is essential that the cakes come out without being mutilated. They are therefore spaced three or four inches apart each way. The mass of ice is so large that the temperature within the stack itself remains below freezing even in spite of the fact that a certain amount of air can circulate thru the spaces between the cakes.

This condition does not hold in houses where only a small amount of ice (fifty tons or less) is stored. Here the ice is removed in portions of one hundred pounds or less, and at each removal the insulating sawdust on top of the mass is disturbed, allowing heat to enter the stack and cause comparatively rapid melting, particularly if there are any cracks



FIG. 12. MUTILATED CAKES OF ICE

These are unfit for use in the stack in their present condition

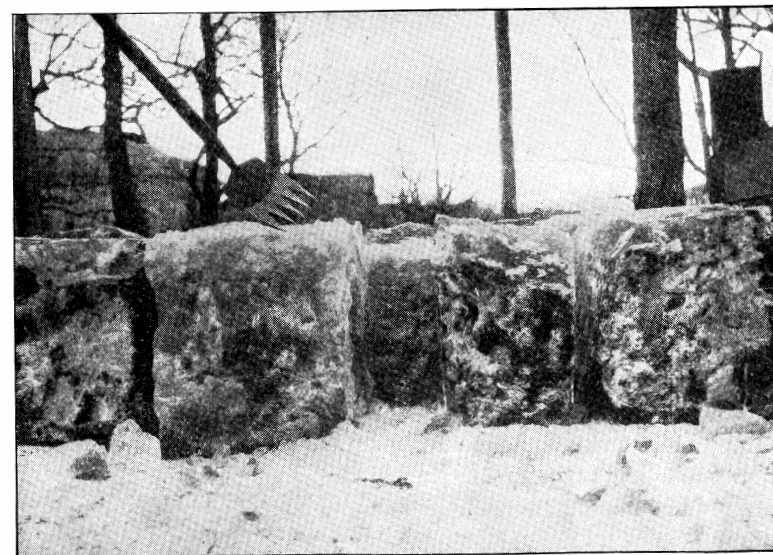


FIG. 13. TRUING UP ILL-SHAPED CAKES

These are the same cakes shown in figure 12 after they have been smoothed off with the hand shaver

between the cakes. Most of the loss by melting in small houses is from this cause and not from poor insulation in the walls themselves. Therefore it is good practice in filling small houses to pack the cakes closely, in order to exclude the air as far as possible from the mass of ice. Remaining cracks should be filled with crushed ice or snow, of which an abundant supply is usually available, owing to the necessity of scraping smooth the surface of each tier before the next one is added. The more uniformly the cakes are cut, the more exactly will they fit together in the house and hence the less work necessary to scrape the surface and true them up.

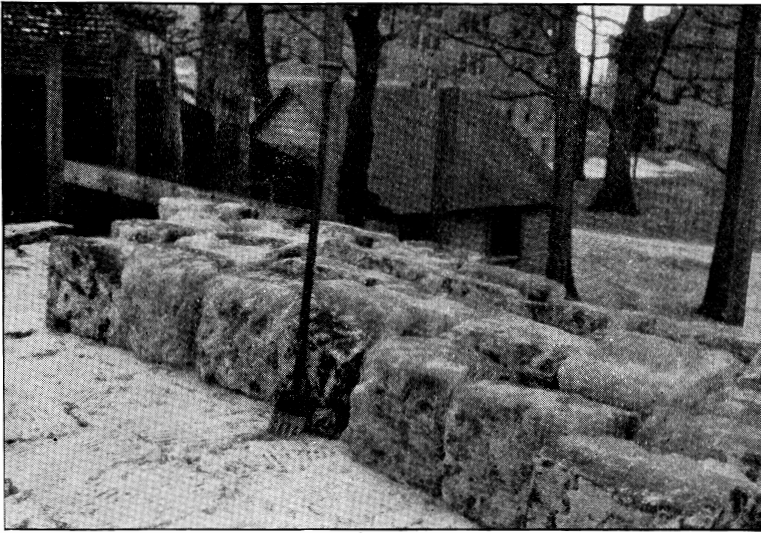


FIG. 14. COMPARISON OF A FINISHED AND AN UNFINISHED TIER SURFACE
For best results each tier should be smoothed off and the cracks filled up

The placing of unshapely pieces in the regular tier allows air holes to form (fig. 12). A method of truing up irregular cakes is shown in figure 13. The tool shown is particularly handy for the purpose, and very little physical effort is required to do efficient work with it.

Comparison of a finished and an unfinished tier surface is shown in figure 14. The work required to finish off this surface was very slight and provided sufficient cracked ice to fill almost completely the cracks left by the irregularities in the shape of the cakes.

Cakes packed on edge are shown in figures 12 and 13. They may be packed with an equal degree of efficiency on the flat surface, and many prefer this latter method, as there is less tendency for the cakes to slip out of place.

When preparing the floor of sawdust, it is advisable to leave a slight depression in the center so that the cakes of ice in the stack will have a tendency to press inward rather than to slide away from each other.

HANDLING THE ICE

Ice on the farm is used in small amounts at frequent intervals during the warm months. This means that the stack is constantly being opened for the purpose of removing cakes and the top layer of insulating material is being constantly worked over, thus allowing the warmer material to come in contact with the ice and causing more or less rapid melting. In order to reduce such loss to a minimum the cakes should be removed in regular order, and an entire tier should be used before beginning on the one below. The insulating material should be disturbed as little as possible and always put back in place after ice has been removed. One man may well be assigned to the work of getting out the ice, so that a regular and careful system of removal will be followed.

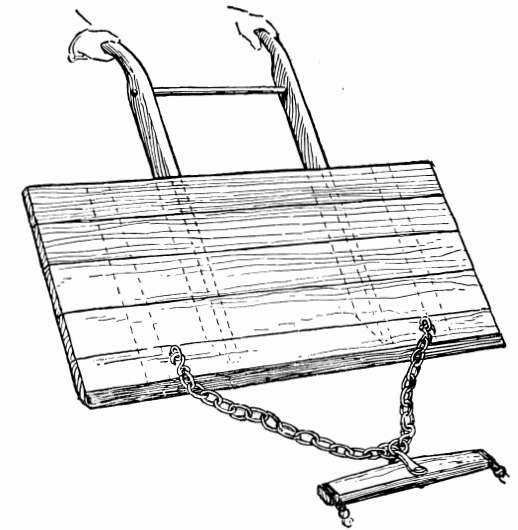


FIG. 15. A HORSE-DRAWN SCRAPER FOR CLEANING SNOW OFF THE ICE FIELD

As the storage season advances, and melting occurs on the outside of the stack, the insulating sawdust or other material should be tramped down along the walls to prevent the formation of air passages. A good practice is to press down the sawdust thoroly around the edges at least once a week.

SOURCE OF THE ICE SUPPLY

The greater part of the farm ice supply is obtained from ponds, small lakes, and pools in rivers and streams. Some farms, however, are not located within a reasonable hauling distance of such sources of supply. In such cases a very small stream may be made to furnish a considerable area of ice surface by widening the banks and forming a dam with the excavated material. If the stream is larger and other topographical

features are favorable, often merely a dam will form a natural lake of sufficient capacity.²

It is important that the water which feeds the ice pond be free from contamination. If weeds grow in the pond during the summer, they should be cut out in the fall before it fills for the winter. Weeds and other matter frozen in the ice are very objectionable, as they collect in the refrigerator.

If green spawn or algae persist in growing in the pond, it should be drained in summer and allowed to dry up. If this is impossible, the

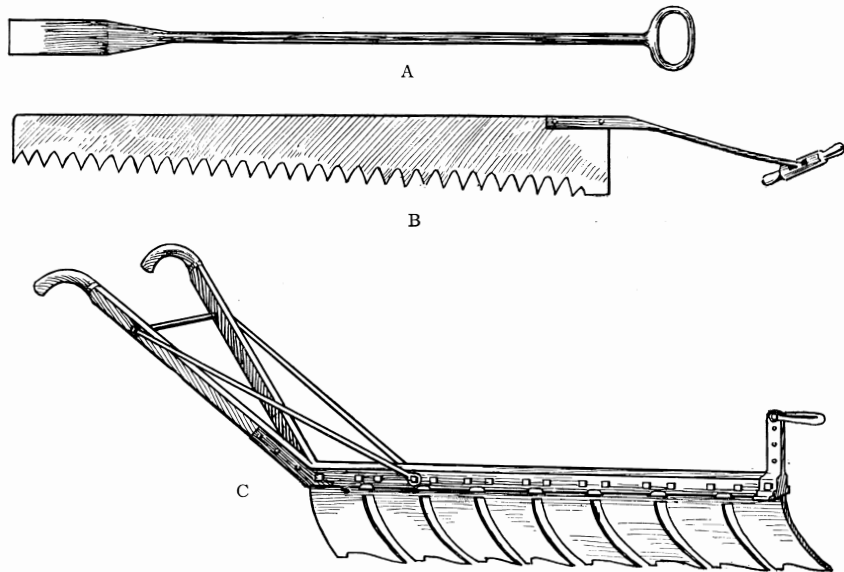


FIG. 16. MODERN ICE-HARVESTING TOOLS
A, spud; B, hand saw; C, ice plow

growth of the algae may be controlled by the following method described in a publication of the United States Department of Agriculture.³

Ponds in which green spawn or algae grow profusely can be rid of these pests by the use of copper sulphate. The crystals can be placed in a cloth sack, which is hung to a pole and trailed through the water until the salts are dissolved. One or two treatments of the sulphate during the season at the rate of 1 pound to 100,000 gallons [13,000 cubic feet] of water will be sufficient to keep down such growth and make the water clear and pure. It is impossible to have pure ice unless the pond or stream is clean and the water is free from contamination.

THE ICE HARVEST

Three or four feet of water under ice used to be thought necessary in order to cut and harvest it. This was in a measure necessary when the

²A description of an artificial pond is given in Cornell Reading Course Lesson 94, entitled *The Farm Fishpond*.

³Ice houses. L. C. Corbett. United States Department of Agriculture. Farmers' bulletin 475.

only tool available was a crosscut saw with one handle removed. With the more modern tools, however, anywhere from eight to eighteen inches of water under the ice is sufficient.

Snow often hinders the ice harvest. It tends to prevent further thickening of the ice and also to settle the ice below the normal water level. To insure the maximum thickness of good ice, to prevent the formation of snow ice on top of the clear ice, and to facilitate harvesting, snow should be removed from the ice field as soon as possible after it has fallen. On very small fields, snow may be removed with shovels, but it is easier and more economical to use horse-drawn scrapers. A simple plank scraper that gives good results is illustrated in figure 15.

In general, ice is not harvested in this State until it is at least eight inches thick. The average thickness is about twelve inches. This permits the use of practically all the modern ice-harvesting tools.

In the early days of harvesting ice the only tools used for cutting and handling the ice were a crosscut saw with one handle taken off, a crowbar, an axe, and a pair of tongs. Later the ice saw was perfected (fig. 16B). This saw is a series of narrow chisels and is much more efficient and much easier to operate than the crosscut saw.

The ice plow, illustrated in figure 16C, is also a series of narrow chisels one behind the other, held securely in an adequate frame and arranged to be drawn by a horse.

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- 50 Nature, effects, and maintenance of humus in the soil
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- 78 Land drainage and soil efficiency
- 127 Farm manure: its production, conservation, and use

FARM CROPS

- 66 Meadows in New York
- 90 Alfalfa for New York
- 108 Culture of sweet clover and vetch
- 110 Buckwheat
- 112 Potato growing in New York
- 124 Field bean production

LIVESTOCK

- 114 Silos, and the production and feeding of silage
- 115 Keeping sheep for profit
- 116 The dairy herd
- 117 Computing rations for farm animals
- 119 The curing of meat and meat products on the farm
- 126 Swine production in New York
- 131 Contagious abortion of cattle
- 134 Starting a flock of sheep

DAIRYING

- 86 The production of clean milk
- 102 Cooling milk
- 82 Cream separation
- 32 Composition of milk and some of its products
- 60 Farm butter-making
- 98 Practical examples in dairy arithmetic
- 118 The Babcock test, and testing problems

FARM FORESTRY

- 12 The improvement of the woodlot
- 62 Methods of determining the value of timber in the farm woodlot
- 28 Recent New York State Laws giving relief from taxation on lands used for forestry purposes
- 40 County, town, and village forests

FRUIT GROWING

- 125 Orchard soil management
- 104 Pruning
- 84 Insects injurious to the fruit of the apple
- 123 Top-working and bridge-grafting fruit trees
- 36 Culture of red and black raspberries and of purple-cane varieties
- 48 Culture of the cherry
- 52 Culture of the blackberry
- 72 Culture of the grape

PLANT BREEDING

- 38 Principles and methods of plant breeding
- 44 Methods of breeding oats
- 68 Improving the potato crop by selection
- 129 Improving the corn crop by selection and breeding

THE HORSE

- 46 Feeding and care of the horse
- 56 Practical horse breeding
- 113 Judging draft horses

POULTRY

- 80 Incubation
- 88 Feeding young chickens
- 130 Rearing chickens: Brooder house construction
- 133 Preparation of market eggs on the farm

VEGETABLE GARDENING

- 120 Hotbeds and cold frames
- 122 Planting the home vegetable garden
- 92 Summer care of the home vegetable garden

FLOWER GROWING

- 106 Spring in the flower garden
- 128 Autumn in the flower garden
- 121 The culture of garden roses

COUNTRY LIFE

- 64 The rural school and the community
- 76 Birds in their relation to agriculture in New York State
- 94 The farm fishpond
- 96 The surroundings of the farm home

FOOD PRESERVATION

- 132 Drying fruits and vegetables in New York State

RURAL ENGINEERING

- 59 Sewage disposal for country homes
- 135 The farm ice supply

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A. R. MANN, DIRECTOR OF EXTENSION SERVICE

LESSON 135

RURAL ENGINEERING SERIES

JULY, 1918

THE FARM ICE SUPPLY

DISCUSSION PAPER

The discussion paper takes the place of the teacher in encouraging thought and self-expression on important points in the lesson, and aims to assist the reader in reviewing and applying them. Each discussion paper filled out and returned is read carefully, and a personal reply is made to questions on any agricultural subject. In order to continue a course, the reader should sign and return the discussion paper so that another lesson may be sent. Questions are included on the discussion paper for the purpose of assisting those readers who desire to give the lesson special study. The preparation of answers is optional.

The available reading course lessons for the farm are arranged in series on the following subjects: THE SOIL, FARM CROPS, LIVESTOCK, DAIRYING, FARM FORESTRY, FRUIT GROWING, PLANT BREEDING, THE HORSE, POULTRY, VEGETABLE GARDENING, FLOWER GROWING, COUNTRY LIFE, FOOD PRESERVATION, RURAL ENGINEERING. New readers may enroll in one or more of these subjects. The first lesson in the series is sent on enrollment, and subsequent lessons are sent, one at a time, on the return of discussion papers. The reader may register for the Rural Engineering Series by signing and returning this discussion paper. The space below on this page is reserved for registration in other series, and also for names and addresses of residents of New York State likely to become interested in the reading course.

(Detach, sign, and return for the next lesson in this series.)

(In answering questions, attach additional paper if needed and number the answers.)

1. What do you consider the chief object in maintaining a supply of ice during the summer? State other advantages.

2. What is the main factor to be considered in selecting the site for the ice house?

3. Is it desirable to construct a cooling room or a refrigerator within the storage room in an effort to obtain direct refrigeration?

4. Describe a good method of combining the cooling room or the milk room with the storage room.

5. Do you consider insulated wall construction essential to economic ice storage on your farm?

6. Under what conditions would you consider the construction of an ice house with insulated walls?

7. Why is it necessary to ventilate the walls of a frame ice house? How is it accomplished?

8. Do you consider drainage under the ice house of sufficient importance to warrant the installation of a tile where natural drainage is poor?