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POPULAR BULLETIN No. 95

The Dairy Barn and Milk House, How to Construct Them

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THE DAIRY BARN AND MILK HOUSE, HOW TO CONSTRUCT THEM

INTRODUCTION

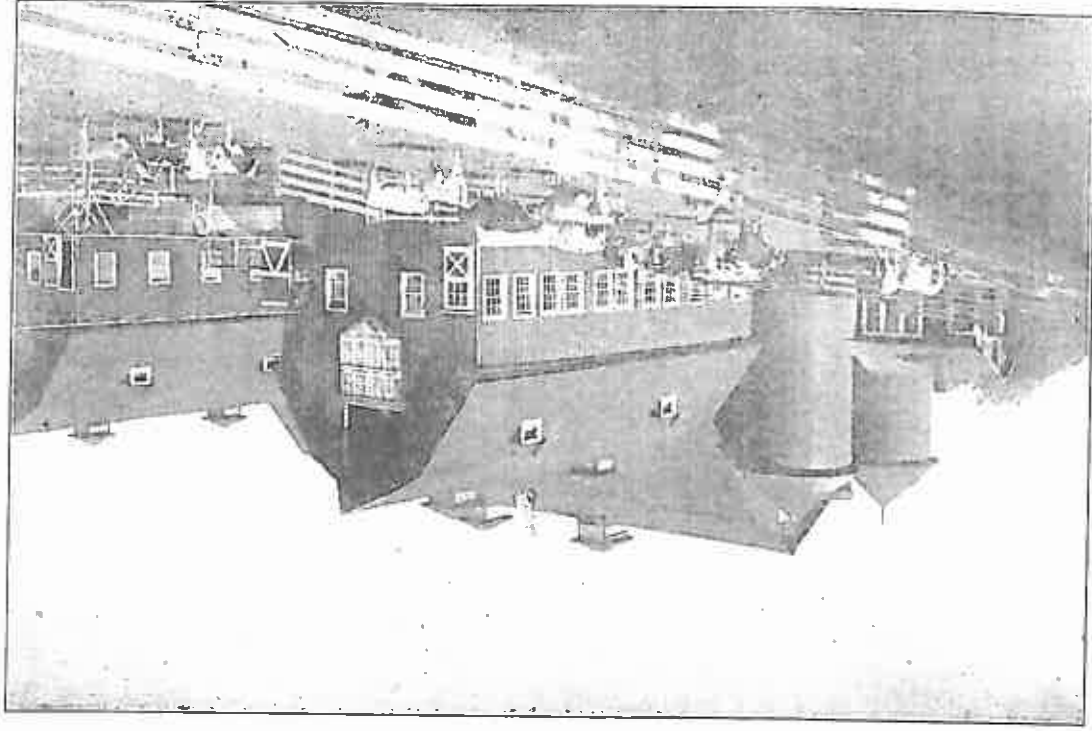
Washington a Dairy State

The State of Washington is fast becoming known as one of the leading dairy states, and it is generally recognized that its possibilities along this line have been developed but little. Natural conditions of soil and climate favor this type of farming, and the proper kind of building will aid in achieving the best results. A prominent dairyman of the state considers the proper housing of his stock of such importance that should he start in the business again, the barn would be of primary and the stock of secondary consideration. With climatic, soil and market conditions of the best, good housing conditions for the stock will assist greatly in making Washington a banner dairy state.

Many Farmers Are Entering the Dairy Business

On account of the conditions favoring dairying, many farmers are changing, more or less, their type of farming to suit dairying. Besides this, many farmers from without the state are coming in and are engaging in the business. These factors have necessitated much thought and attention being given to the question of the proper housing of the dairy stock.

In those sections formerly entirely devoted to orcharding, farmers are turning to the dairy business. The logged-off lands of the state are suitable for dairying, and are being used for that purpose. The high price of orchard lands and the cost of clearing logged-off lands, necessitates a type of farming like dairying, which will bring in the greatest returns per acre.



The Dairy Barn at the State College of Washington—Note the two silos and the milk house

Clean Milk Possible in Well Constructed Barns

A well built, properly equipped barn and milk house will increase the chances of the production of a clean and desirable supply of milk and cream. The question of the quality of dairy products is as essential as quantity, and the well built barn and milk house will help solve this question. The time is at hand when dairy products are being purchased on the quality basis, and it is certain that this method will be widely used in the future.

The Barn a Permanent Improvement

A properly constructed barn will add considerable value to the property and, although sometimes considered as an unnecessary expense, it is more often regarded as one of the permanent improvements which can be easily realized upon. In order to add the most to the farm, the barn should be planned so that the size, location, material, and other factors will harmonize with the other buildings on the place. The barn may be made a pleasing object, not out of harmony with the other buildings on the place, and so constructed as to impart the impression of comfort and stability to the whole farmstead.

Barns Must Meet Board of Health Requirements

Many states have general regulations, and in the case of the larger cities, specific directions regarding the production, handling and sale of milk. Since much of the city milk supply is traced to its source, cleanliness, good health, and the proper care of cattle in well constructed barns has become a necessity. Comfortable, well ventilated, well drained and properly lighted barns mean as much to the dairyman as to the ultimate consumer of milk. To the former, it means healthier, more productive stock, and better working conditions. From the standpoint of the consumer, a properly constructed dairy barn means better and cleaner milk with less chance for the accumulation of an undesirable bacterial content.

Economy of Operation

That phase of barn building often considered last, and in some cases apparently entirely overlooked, is the matter of

convenience, and economy of operation. The dairy barn should be so planned and located that the labor necessary with the stock can be carried on with the minimum amount of work and time. The time factor, although not of much importance in any one day, becomes of considerable importance in the year, and is a matter that is receiving more and more attention.

Purpose of the Dairy Barn.

The purpose of the dairy barn is to house the stock so that it will be as comfortable as possible. It should be built with as much economy of space as is compatible with the number of cows kept and in a manner which will admit of as much economy of labor as possible. The barn should provide sufficient space for the storage of hay, fodder and the grain necessary to carry the stock through the feeding season. The entire structure should be constructed of durable material and at a minimum cost. Barns have been called the farmers' factories, where grain and roughage are converted into the more expensive product, milk and butter fat. Whether the profits are large or small may depend largely on the comfort and housing conditions rather than on the feed that the stock receives. Dairy stock of a fair grade will give good results in a well built barn, while high grade stock may give poor returns in a poorly constructed barn.

TYPES OF DAIRY BARNs

The type of dairy barn that one should build depends on a number of different factors. The location and topography of the land may favor one type over the other. Severe climatic conditions would favor a warmly constructed barn, while the sections with a milder climate could do without that type of building. The grade of milk produced would influence the construction of the barn to some extent. The amount of money available for building would influence the type of construction more than any other factor.

The Shed Type of Barn

The simplest type of barn and one that gives some measure

of satisfaction, is the one-story shed barn. This type of barn can be very cheaply constructed; all the features of a permanent construction are done away with and only enough protection provided for sun, wind and rain. The facilities for storage of feeds and hay must be provided in some other structure. This type of barn is used in some sections of the state where the climate is mild the entire year.

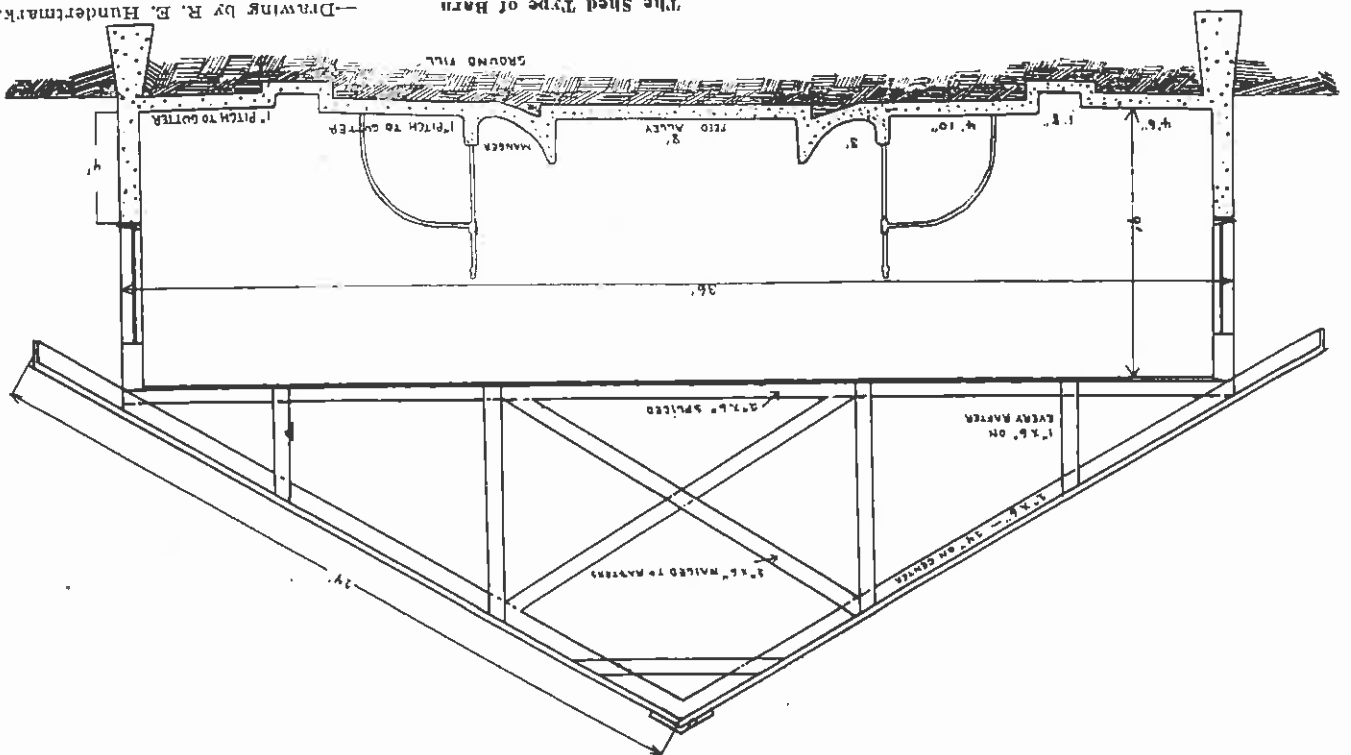
The Open Shed System

In those sections of the state where the range of temperature is not severe, the open shed system of housing stock has been practiced successfully. In this system, the stock is fed all the roughage in open racks in yards constructed for the purpose. The yard is partly covered and is protected from wind and rain. For purposes of milking, a small barn is provided, equipped with all of the essentials for sanitary milk production. The stock is driven into the milking barn in groups, depending on the number of stalls provided, and after milking, another group is driven in until all have been milked. The grain feed is given to the cows while they are being milked. This type of barn is desirable in some cases because the expense of construction is not great and the stock does better in the open than would be the case if it were housed a great part of the time. This type of barn is advised by milk commissions in that all requirements of construction can be met with on a small scale, which on a large scale might prove to be too expensive.

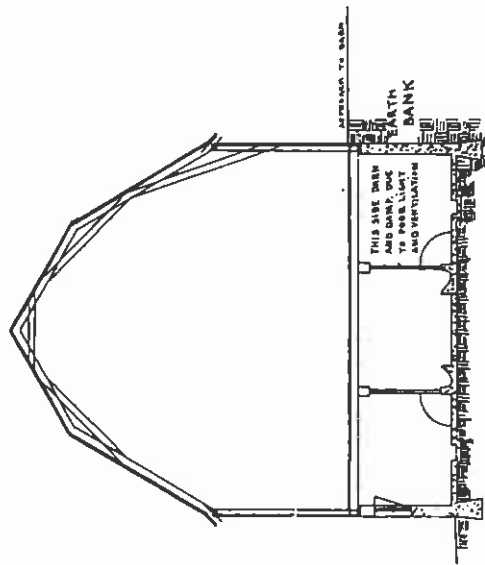
The Bank Barn

In some sections, the topography is such that bank barns can be easily constructed. The bank barn is a two-story barn, the stock being housed in the lower part, while the upper part is given over to the storage of feed. It has generally been the case that the side of the barn adjacent to the bank has been dark and damp, while all of the light and air came in from the other side. Although the bank allows one easy access to the second story with loads of grain and fodder, the disadvantage of having the lower story damp and dark overbalances the desirable features. When it is possible to exca-

—Drawing by R. E. Hundertmark.

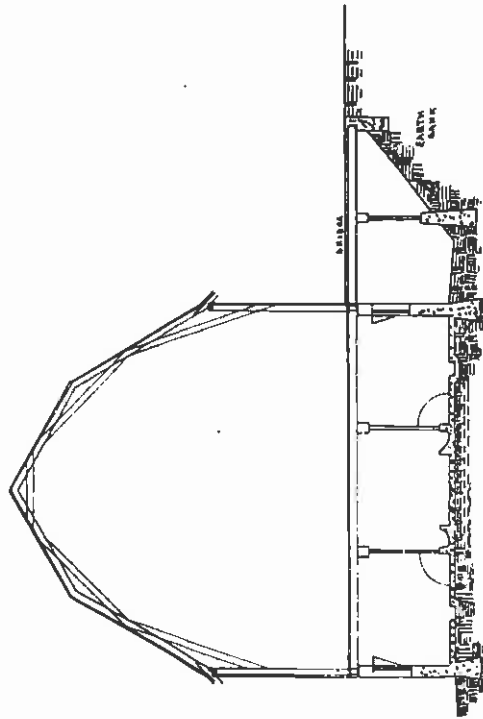


vate in order to install windows on the side of the barn toward the bank, it is very desirable that this should be done. The construction of this type of barn is similar to that of the two-story barn.



The Bank Barn—Sunlight cannot reach one side of the barn.

—Drawing by R. E. Hundertmark.



The Proper Construction of Bank Barn

—Drawing by R. E. Hundertmark.

The Two-Story Barn

The two-story barn is the kind often built. The desirable features of this type of barn are the storage facilities for grain and hay, thus having all feeds near at hand for the entire feeding season. Besides this, the construction can be such that the stock will be well housed, the stable well lighted, in all parts and adequate ventilation provided. It has been found desirable to house as much stock as possible under one roof, and when the hay and grain is added to this the cost for the building will be less than when buildings for stock and fodder are constructed separately.

Objections have been made by city Milk Commissions that this type of barn will not allow of the production of a high grade of milk on account of the fodder stored in the upper story. This objection can be overcome entirely by constructing a tight loft floor and ceiling over the cows.

THE SITE FOR THE DAIRY BARN

Having selected the type of barn that would be most desirable, the proper location for the barn would be the next consideration. The essential features when locating the dairy barn are rapid drainage of water, good circulation of air, protection from the prevailing winds of winter, plenty of sunlight and a good water supply.

Drainage

When handling stock in any manner it is essential that some method be provided for the rapid escape of water about the barn. This is necessary from a sanitary standpoint. Drainage can be secured by locating the barn on a quick drying soil, elevated to some extent if possible, so as to allow of drainage without an elaborate system of tiling. Besides natural drainage it is often essential to install a few lines of tile in order to facilitate the removal of water from the roofs and yards.

Winds

There should be a free circulation of air, but some protection should be secured from the prevailing winds of winter.

Hills, trees, or other natural objects can serve this purpose to some extent. The arrangement should be such that the prevailing winds do not carry from the barn to the house, rather the reverse, if at all. This is also an advantage in that the various odors, often prevalent about a barn, will be carried away from rather than to the dwelling.

Sunlight

In the dairy barn, the disinfecting action of sunlight may be used to considerable advantage, and by locating the dairy barn with the long way north and south this is taken advantage of as much as possible. The barn may be so constructed that the direct sunlight will reach some part of the stable at least once a day while the sun is shining. This will be found of considerable advantage in maintaining the barn in a sanitary condition.

Water Supply

Since an adequate and plentiful supply of water is a necessity for dairy stock, the location of the barn with reference to this is of some importance. Without a free flowing well, some arrangement for pumping will be necessary, and when the water supply can be pumped to a higher level and then allowed to flow to the barn by gravity, this arrangement will be found very desirable.

Other Buildings

The dairy barn should be located with reference to the other buildings on the place. This is necessary in order to obviate useless work in caring for the stock, or in handling feed, grain and manure. It is often desirable to re-arrange buildings so as to economize in labor, rather than to continue in the old way. Many steps will thus be saved during the course of a year.

THE SIZE OF THE DAIRY BARN

The factors that determine the size of the dairy barn are: first, the style of farming; second, the storage room necessary; third, the number of stock to be housed.

Style of Farming

The style of farming carried on, and the individual circumstances determine largely whether the barn should be one, one and a half or two stories high. In some of the drier sections of the state the one-story barn has found favor with many. This allows for some other structure to answer the purpose of storage—a cheaper building, or one already on the place. In the two-story type of barn, the stable floor and roof would cost the same as for the one-story barn, the extra storage room offered costing only for extra material and labor for the construction of a few extra feet of wall.

Storage Room Necessary

Ample storage room is necessary in a dairy barn, for a farmer can not afford to re-fill the loft during the winter time. Furthermore, drawing hay and fodder from stacks damages it in quality, and adds much to the expense of getting the feed to the cows.

Assuming that a ton of well packed hay will occupy a space of 512 cubic feet, a barn to accommodate enough hay for 21 cows for 300 days in the year, feeding them 12 pounds per day, or 3600 pounds per cow during the year, should have a capacity of about 22,000 cubic feet.

Number of Stock to House

A certain width of building has been found to be the most desirable for dairy stock, and for this reason the width of the stable for the average sized dairy stock has reached a definite standard, and with but few variations is seldom deviated from. A width of 36 feet for the barn is the usual size. Of this width 5 feet is used for an alley-way back of the cows, 1½ feet for the gutter, 4 feet 8 inches for the platform for the cows to stand on, 4 inches for the support of the stanchions and partitions, 2½ feet for the manger, and 3½ feet for one-half of the feeding alley between the cows. The width of the stall depends upon the size of the cow and varies from 3½ to 4 feet. In order to provide the necessary

amount of air space for the stock, which has been found should be not less than 500 cubic feet per head, the height from the floor to the joists should be from 8 to 9 feet, preferably $8\frac{1}{2}$ feet. This, together with the space between the joists, gives an air space of approximately $9\frac{1}{2}$ feet, providing the stable is not ceiled. In some cases it is desirable to change the dimensions of the stable to suit local conditions, and this can be done without altering the general plan.

LIGHTING THE DAIRY BARN

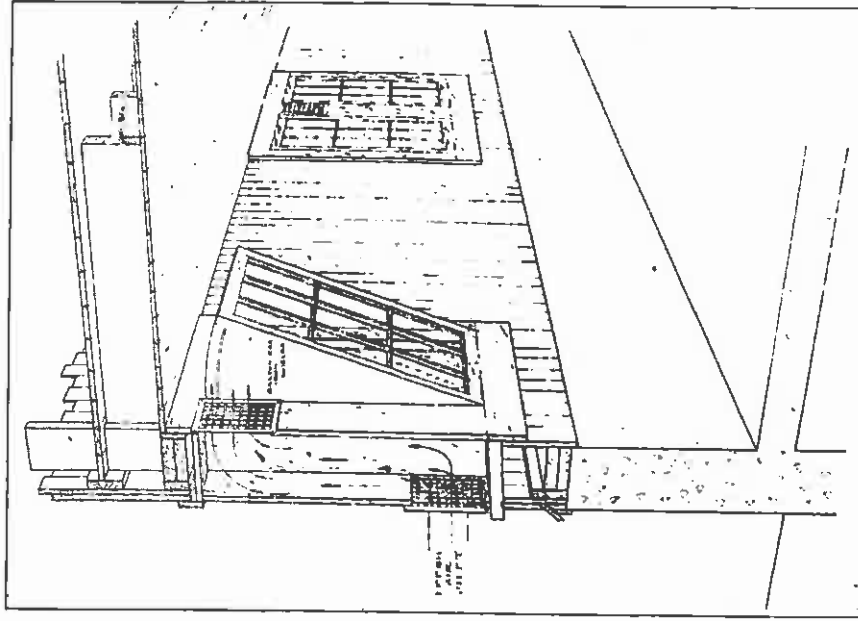
The dairy barn should be well lighted. A dark barn is difficult to keep clean and it is unhealthful. Sunshine is a great purifier and the maximum amount is always best in a dairy barn. It will be found that the stock in a well lighted barn is healthier, more productive, and easier taken care of, than stock in a badly lighted barn.

Windows

The position of the windows is of considerable importance. In a rectangular barn with the long way north and south, it will be found that windows on both sides will give the best results. This arrangement will admit direct sunlight to the stalls at least once a day. The windows on the north side of the barn admit light, but no sunlight, and unless the south windows are quite numerous, sunlight will not be admitted to all parts of the barn. The amount of window glass found to be desirable for dairy barns is not less than four square feet per cow, well distributed on all four sides of the barn.

Types and Arrangement of Windows

Single sash windows, hinged at the bottom, are more desirable than double sash, as the single sash can be dropped at the top, thus lessening the chance for draft directly on the cows, and furthermore the upper sash is another place for dust and dirt to collect. The windows should be flush with the inside of the barn walls. This will prevent dust from lodging on the window sill. It has been found that the win-



A Good Method of Ventilation—no direct draft on the stock

dows placed vertically rather than horizontally will afford better distribution of light, especially into the center of the barn.

VENTILATING THE DAIRY BARN

On account of the abundance and seemingly inexhaustible supply of air, it is not always recognized how indispensable it

is to have plenty of fresh air for the proper development and growth of dairy stock. In the old style of barn, the question of proper ventilation was given but little thought, resulting in an inadequate supply at times and an over supply at other times.

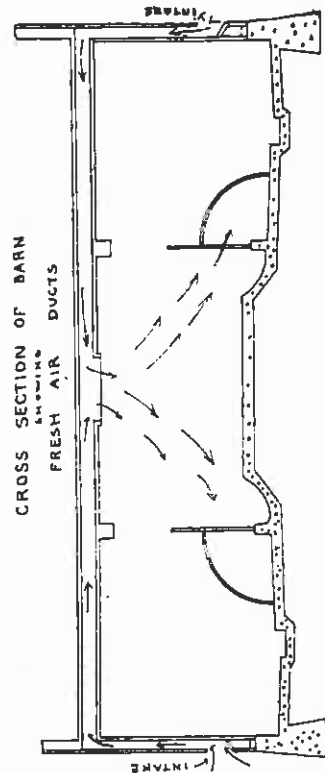
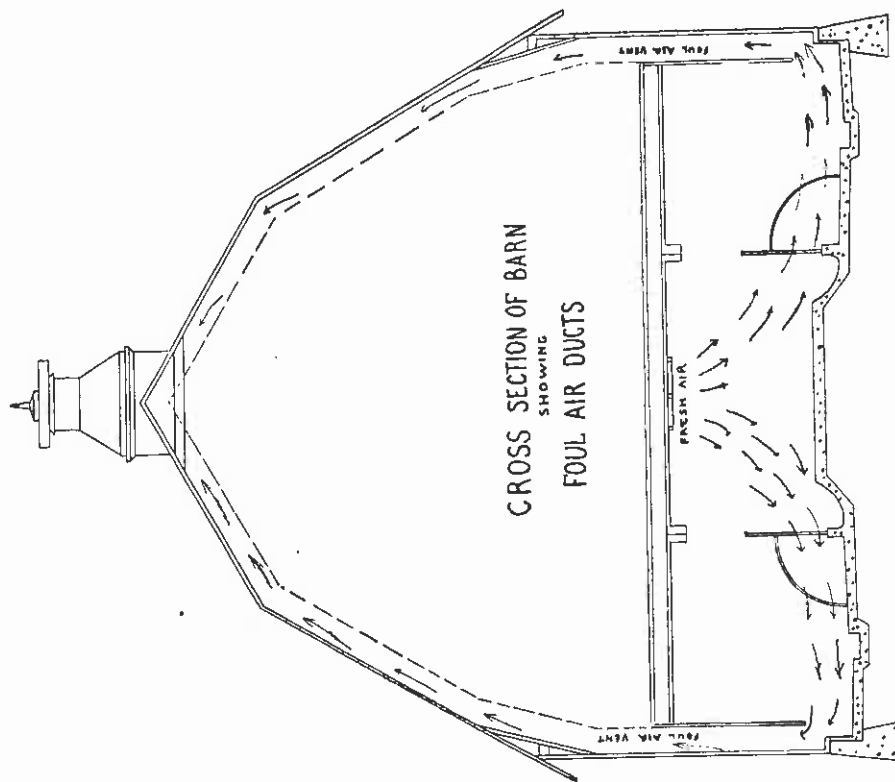
The Principle of a System of Ventilation

The principle on which a system of ventilation is based is the fact that when live stock is placed in a barn the air becomes warmer, expands, becomes lighter, and therefore rises. The cold air sinks to the floor and displaces the warmer air. The impure cold air will remain near the floor, increasing in foulness, until some fresh air is brought into the barn. As soon as the air in the stable becomes warmer than that outside, it will rise, providing a flue is furnished for its escape. When out-take flues open near the floor inside of the stable with the vents of the flues near the gable of the roof, a draft will be established strong enough to remove the foul air which has collected near the floor. With this draft well established, fresh air will be drawn into the barn to replace that drawn out. In order to prevent warm air near the ceiling escaping through the fresh air flues and thus reversing the system, the openings for the intake flues are located outside as near the ground level as possible.

Size and Placement of Flues

For the best results the barn should be tightly constructed, and the in-takes and out-takes should be of matched lumber or of cheaper material but paper lined. The foul air shafts must open near the floor, preferably back of the cows, while the fresh air in-takes should open at the ceiling, preferably in front of the stock.

From tables compiled by King it has been determined that two outlet flues of one foot by two feet will suffice to remove the foul air from twenty cows. No out-let flue should be less than 12 inches by 24 inches inside. The in-take flues may be smaller, tho the combined area should be twenty per cent. larger than the out-take flues. All flues should be well distributed in the barn so that the fresh air will reach all parts and the foul air be all removed.



Method of Equipping Barn With System of Ventilation
—Drawing by R. E. Hundertmark.

BUILDING THE TWO-STORY DAIRY BARN

Depth of Excavation

The excavation for the walls need be only deep enough to go below the frost line, generally two or three feet will cover this. The trench need be but the width of the wall, but should the soil be of a loose nature, the trench must be wider so as to accommodate the necessary frame for the cement. At the bottom of the trench, and at the inside of the wall a three-inch tile should be placed so as to draw off any accumulated water.

Foundation and Wall.

When stone is plentiful, this will be the cheaper material for the foundation and wall, otherwise a solid concrete wall will be the cheaper and usually the more permanent. The foundation can be carried up and constitute the wall of the stable. Inch boards and 2x6's used later in the structure, can be made into forms into which the concrete is poured. Allowance should be made for doors, and air flues, and these should be placed before the cement is poured into the forms. When the wall is partially completed the window frames may be put into place, the form carried on up and the whole well filled and tamped with cement.

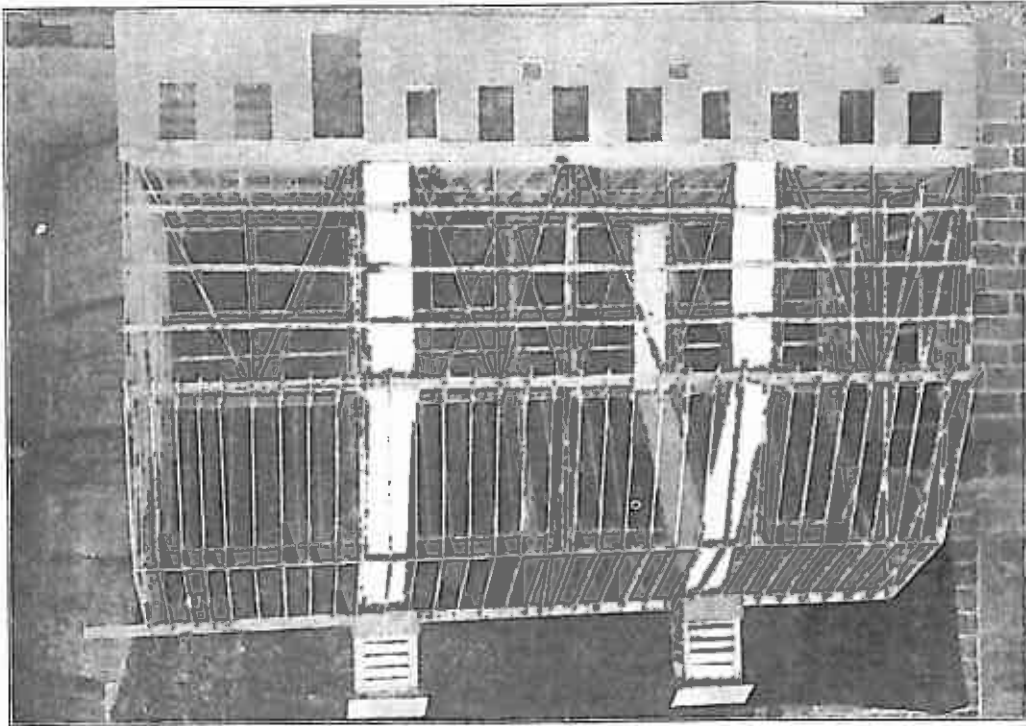
Floor

After the completion of the walls the floor may be laid. Opinions differ as to the best material for flooring dairy barns. Whatever the material used, it should be sanitary, durable, comfortable to lie on, easy to clean, and not too expensive to construct. Plank flooring does not answer the purpose; cork brick seems to do very well, and is being used quite generally. Concrete is the standard material for barn floors, though objections are that it is cold, being a good conductor of heat, and when wet becomes slippery, and further, it is not very comfortable for cows to lie on. These objections can be largely overcome by surfacing the concrete with plank.

The Fill

When preparing the basement previous to the laying of the cement, a fill amounting to ten or twelve inches of

Side View of Barn
Model constructed by R. E. Hundertmark.

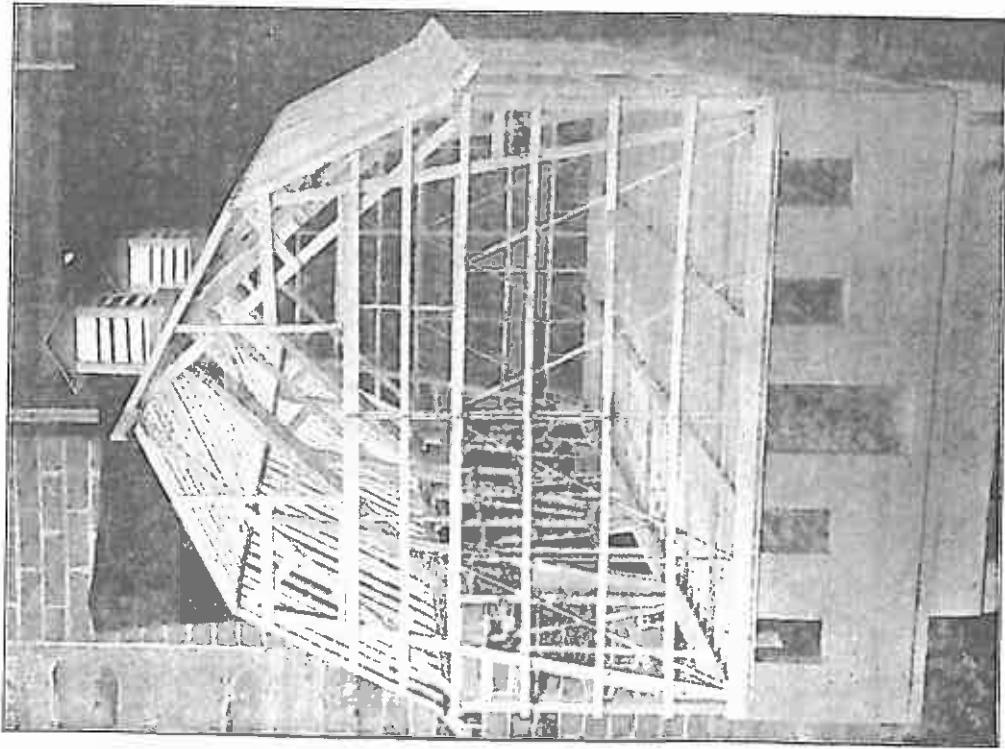


crushed stone, gravel, sand or cinders should be made. In this, a few inches below the surface, two rows of tile should be laid at equal distances from the side and connect with the tile that has been previously laid at the walls. The floor is now ready for the concrete. Four inches of concrete has been found to be of sufficient strength for stable floors, and the mixture may be of the same as for the wall, five parts of finely crushed stone, two parts of sand, and one part of cement. In laying, this should be well tamped and finished with a float.

Laying the Concrete

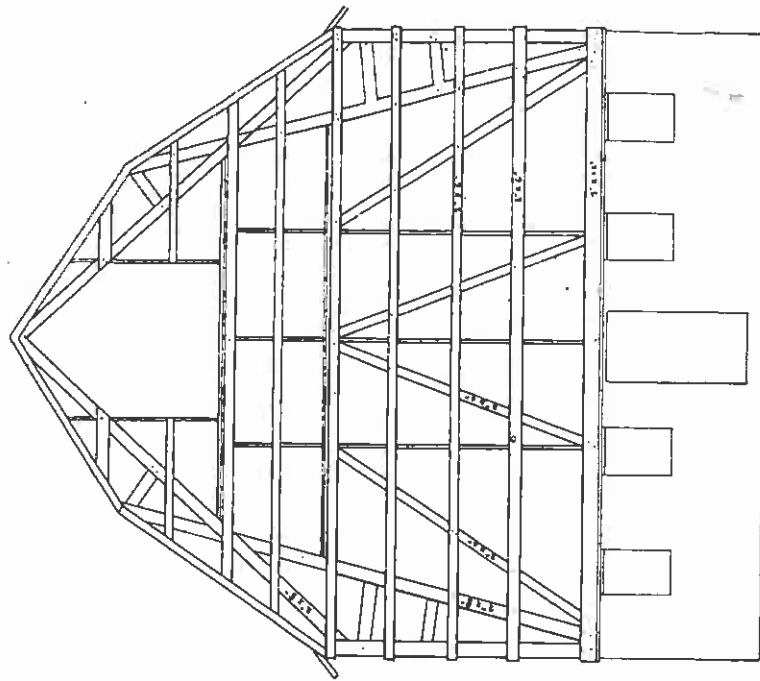
It is often best to start the concrete at the wall first, and in doing so a chalk line can be marked at the proper height on the wall for the cement. At each end mark off five and one-half feet to the edge of the gutter. In this embed two rows of planks, end to end, with blocks between at frequent intervals so as to keep the planks the same distance apart. The upper side of these planks should correspond to the upper surface of the concrete in the alley way. The same holds true for the side of the gutter towards the cow platform. By making a V shape on each side of the gutter with the plank as one side and the adjoining portions or edges of the passage way and cow platform as the other sides, and then filling these with cement, the sides of the gutter will be made, and when the forms are removed the bottom can be filled with concrete to the required depth.

After having constructed the alley way, gutters, and enough of the cow platform so as to get the general level of the floor, the curb for the stanchion should be next constructed. This can be made by placing two rows of two-inch plank end to end, the inner plank four feet six inches from the gutter, so that after the concrete has hardened, the curb will be four feet eight inches from the gutter. The height of the curb should be six inches above the level of the floor. Very often it is desirable to bolt stanchions to a two by four on this curb. In this case eight-inch bolts should be placed at frequent intervals in the soft concrete of the curb so that the scantling can be bolted tightly to the concrete.



End View of Barn
Model by R. E. Hundertmark.

If it is the plan of the builder to install one of the various makes of patent barn equipment, the two by four will not be necessary, but in its place are embedded anchor plates for the stalls and stanchions. While these latter are commonly used, the two by four will be found desirable rather than bolting



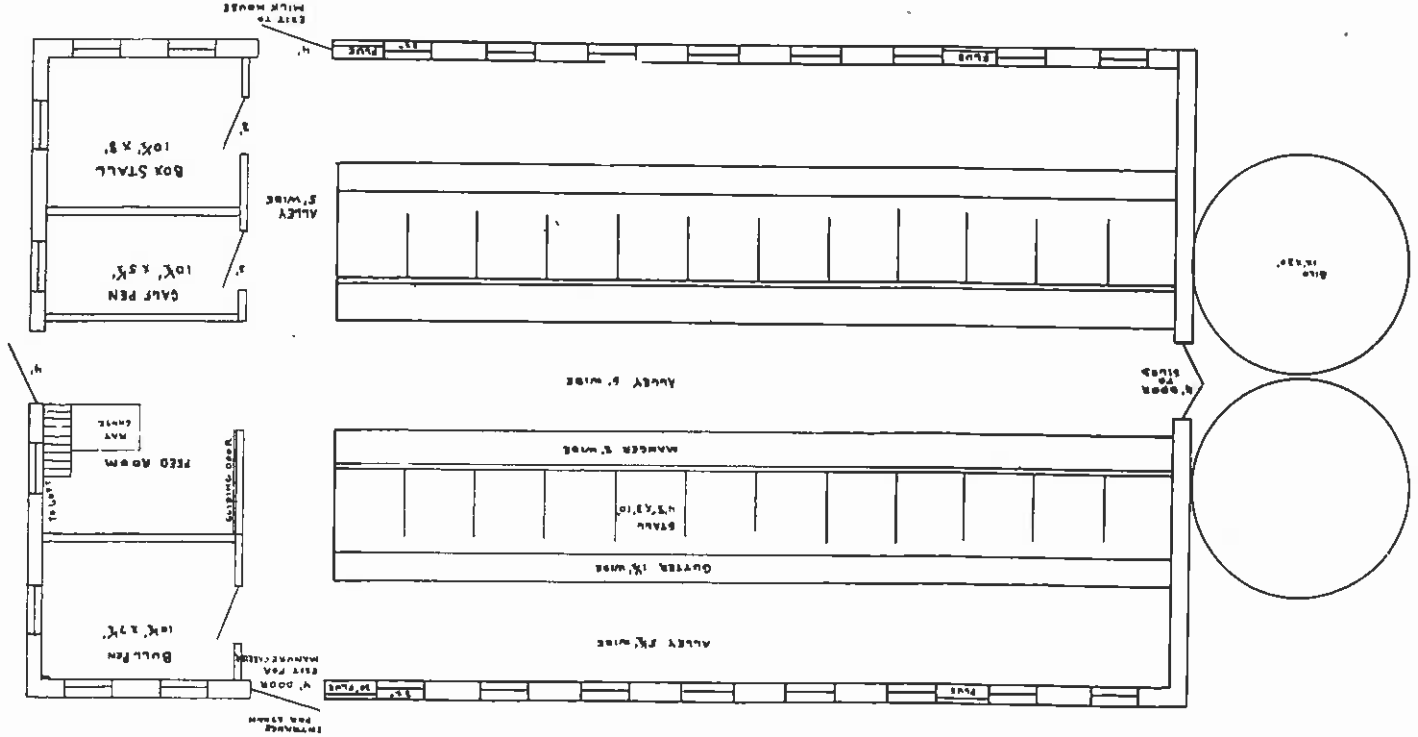
End View of Barn—showing construction
—Drawing by R. E. Hundertmark.

the stanchions to the cement on account of the fact that the lower stanchion bolts often work loose and require considerable work to replace.

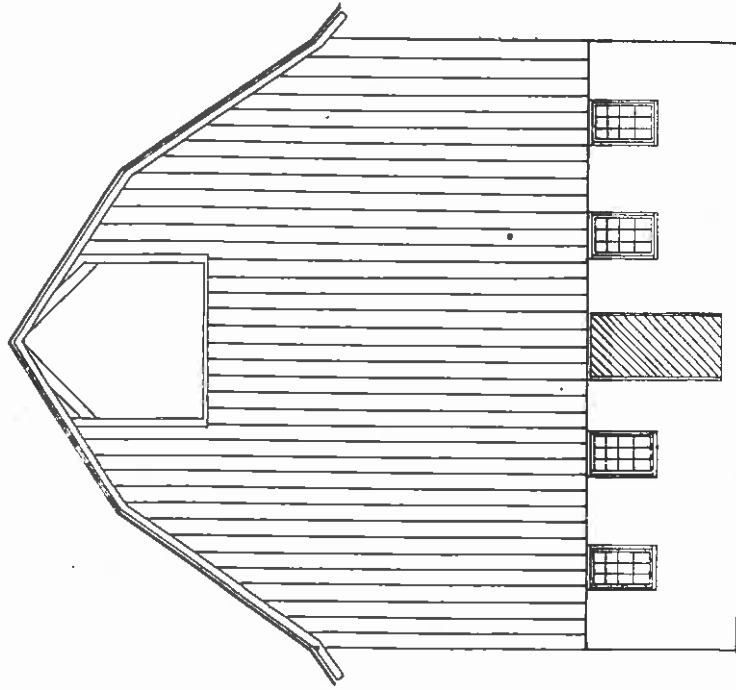
The Superstructure

The advantage of the plank frame of construction are many, and its use has entirely superseded the older style of timber

—Drawing from model.



frame. When economy of lumber, labor of construction, strength of frame, maximum storage capacity, economy in filling and removing hay and straw are considered, there is no question but that the plank frame or one of its modifications is the more suitable. In the type of barn here illustrated the timbers used are 2x6s, 2x8s, and 2x12s. All girders,



End View of Barn—showing barn with vertical siding, also door for hay

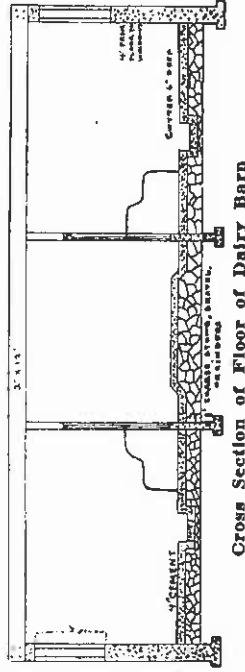
—Drawing by R. E. Hundertmark.

ers, trusses, rafters, and plates are made from one of these sizes. Girders built up of planks are not only cheaper, but retain all of the strength of the original timber.

Method of Construction

In general, the method of construction is as follows: After

having built up the two longitudinal girders of three pieces of 2x12s with properly broken joints and placed on good supporting posts, the floor joists are then put in place. The longitudinal girders are placed so that the span will be broken at equal distances from the sides, and enabling one to place the supporting posts at the curb and in line with the stanchions. The first bent or truss is then constructed and used as a model, after which the others are made similar to it. This having been done, the first truss is then placed so that the ends rest in a position so that when the bents are raised the ends will occupy their permanent place. By the use of a gin pole and a rope with a supporting line on either side, the bent can be raised into position, after which it is braced with the girders so as to be self-supporting. The remaining bents are then raised, the girders put into place followed by the upper and lower purlin plates, after which the rafters



Cross Section of Floor of Dairy Barn

and roof boards are added, which are followed by the shingles and siding. The simple construction of this style of barn necessitates but one good carpenter to oversee the work. The trusses can be raised into place with three or four assistants and a team of horses, thus obviating the necessity of twenty to thirty men.

Material Necessary for Concrete Work

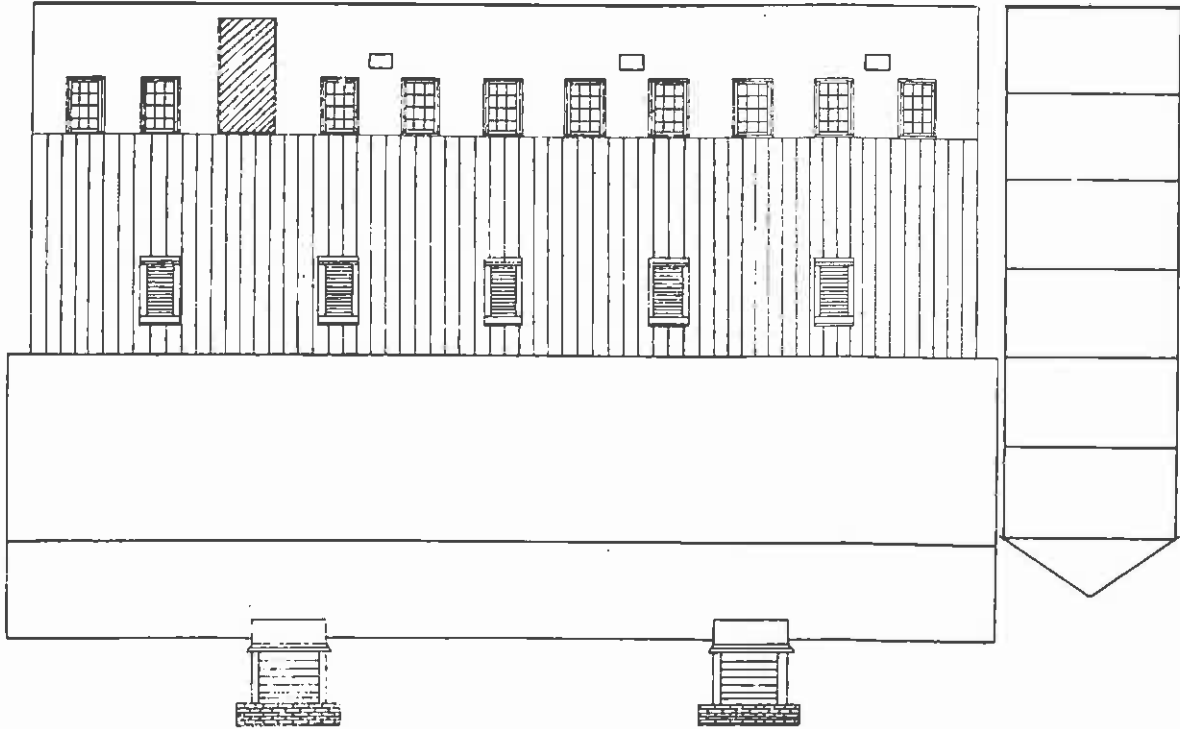
The entire wall of the stable, if solid, will contain 2000 cubic feet of material. From this should be deducted the space occupied by the doors and windows, which totals 384 cubic feet, thus leaving approximately 1616 cubic feet of ma-

terial for the wall. For a floor four inches in thickness and covering a surface of 2108 square feet, there would be necessary 703 cubic feet of material; adding this to the amount necessary for the walls gives a total of 2319 cubic feet, or 86 yards of crushed stone and sand.

Bill of Lumber Necessary for Construction of Barn

No. of Pcs.	Thickness..	Width....	Length....	Purposes for Which They Are to Be Used	No.	Ct.	Ft.
32	2	12	16	For 2 girders built up 8x12x64.....	1024		
16	2	12	16	For double sills on sides.....	512		
12	2	12	12	For double sills on ends.....	288		
20	2	8	17	Used double on the 5 bents.....	459		
20	2	8	30	Lower long braces on the bents (double)	850		
10	2	8	28	Upper long brace used single.....	373		
24	2	6	18	For braces on sides and ends.....	432		
14	2	6	16	For studding ends and sides bet'n braces	224		
10	2	8	16	To cut out for short tie braces.....	213		
16	2	6	16	For double plates on 2 sides.....	256		
20	2	6	18	For girders on ends of building.....	360		
12	2	6	16	For girders on gable ends of building..	192		
24	2	6	12	For studding and plates on gables.....	288		
10	2	6	16	To cut up for braces.....	160		
16	2	6	16	For purlin plates.....	256		
66	2	6	16	For lower sections of rafters.....	1056		
66	2	6	14	For upper sections of rafters.....	924		
6	2	12	16	Ridge pole for hay carrier track.....	192		
2	2	2	20	Ridge pole for hay carrier, end section..	64		
33	2	6	16	Dressed on four sides for rafter ends...	528		
4	2	6	16	Dressed on four sides for end rafters...	64		
4	2	6	12	Dressed on four sides for end rafters...	48		
				Matched 2-inch stuff for floor.....	5500		
				Matched stuff for cornice.....	732		
				400 linear feet of fascia strips			
				30,000 shingles			
				24, sash 12 light, 8x10			
				Frames for 24 windows			
				Frames for 4 doors			
				9000 linear feet for 1x3 ribs for roof			

Side View of Barn
Drawing from small model by R. E. Hundermark.



BARN EQUIPMENT

The term "barn equipment" is applied to those appliances that are installed in the stable of the barn in order to facilitate the work with the dairy stock. Equipment of this kind is made up of swinging adjustable stanchions, mangers, manger partitions, stall partitions, feed carriers, litter carriers, and other similar appliances.

From the standpoint of the dairyman, modern barn equipment is desirable in that it serves to lessen the time necessary to take care of the stock. Besides this, proper barn equipment is labor saving to a great degree, the barn can be kept cleaner and more sanitary with less work. Good barn equipment benefits the stock in that it will be housed in a more comfortable manner. There will be less chance for the cows to accumulate filth on the flanks, and the general health of the herd will be better. Barn equipment, properly used, will tend toward the production of more milk, a more uniform supply of milk and better milk.

The modern barn equipment has served to make the life of the dairyman a happier and more profitable one, and has helped to place the business of dairying on a higher plane.

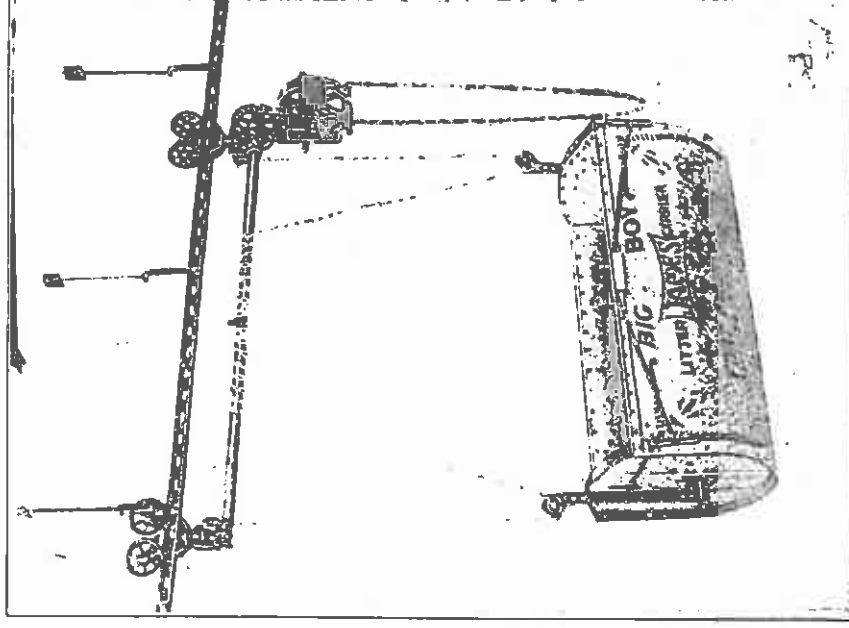
Methods of Handling Manure

The Wheelbarrow—The old-fashioned method of removing manure from the stable is by means of the wheelbarrow. This is a slow, laborious method, and if persisted in, tends to result in a continued loss, due to the waste of time in accomplishing a certain amount of work.

The Patent Litter Carrier—The litter carrier has been developed in order to lessen the labor connected with the removal of the manure. The track for the litter carrier can be conveniently placed, when the tub is lowered from the track, it can be readily filled. When the carrier has been filled, it can be easily raised to the track and then run out at some distance from the barn and the contents dumped.

The Patent Dredge—Some dairymen have installed a patent dredge which operates in the gutters back of the cows, serv-

ing to scrape off all the manure, both solid and liquid, to large tanks at the end of the barn. From these tanks pumps



A Good Type of Litter Carrier

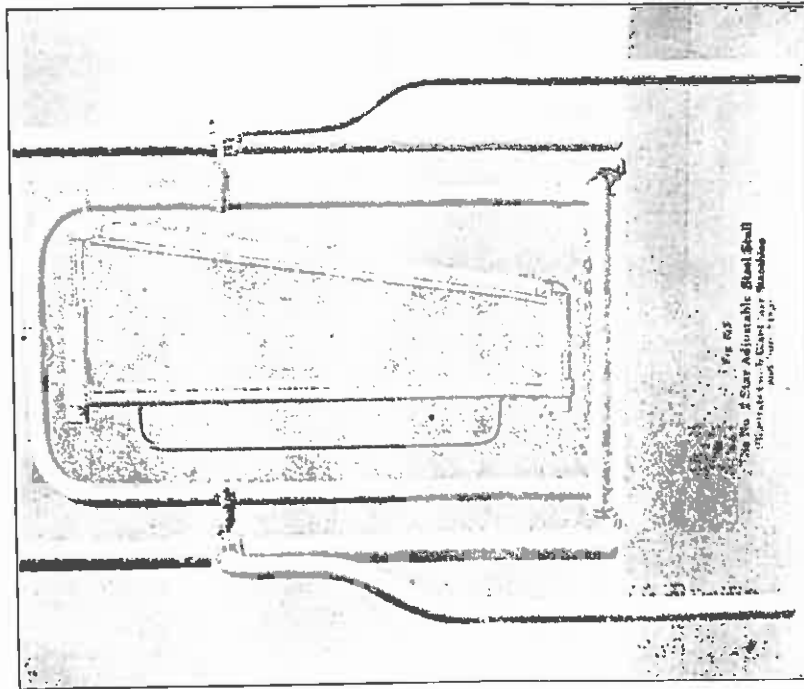
serve to elevate the manure into wagons, after which it is hauled to the fields. When the dredge system is used the gutter of the barn is covered with a grating, thus serving to keep out all straw or other matter which might tend to clog the system.

The Cesspool System—A method of removing the solid manure by means of the litter carrier, and then allowing the liquid to drain into cesspools, has been followed to some ex-

tent. The advantage of this lies in the fact that the gutter tends to remain fairly dry, thus allowing one to remove the solid manure with the carrier, after which it is dropped into the spreader and then applied to the land. The liquid in the cess pool must be pumped into wagons made for that purpose and then spread on the land.

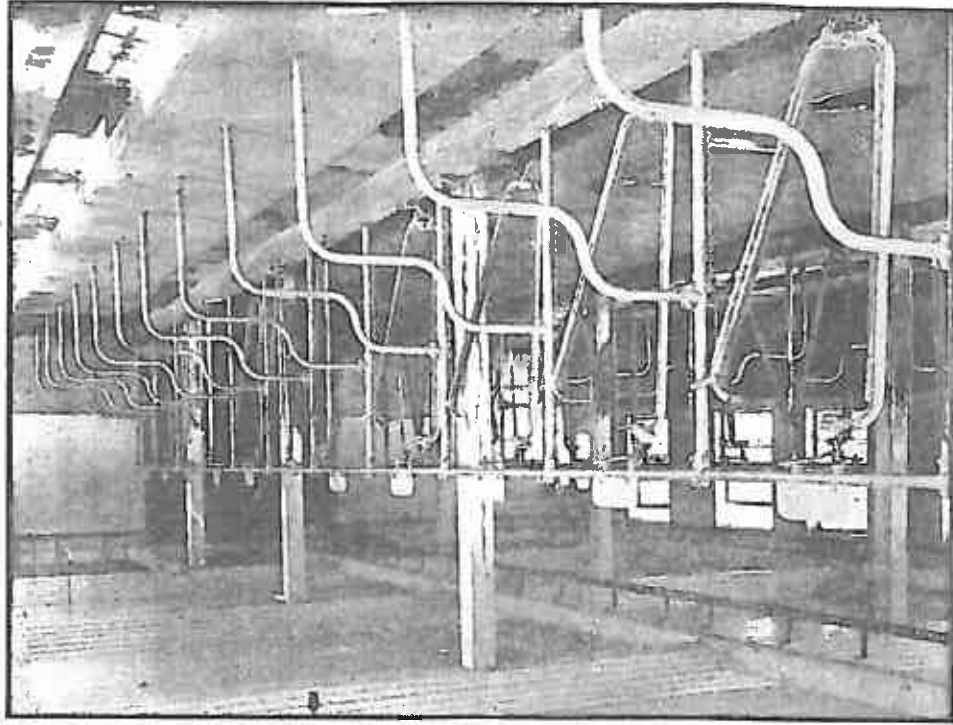
Stalls and Stanchions

The cow stanchions and stalls must serve the purpose, primarily of tying the cow, and keeping her in the proper place. The stanchion and stall should serve to keep the cows com-



The Proper Stall and Stanchion Keeps the Cow Comfortable and Clean

The Interior of the Dairy Barn, State College of Washington Showing concrete floors, stalls and stanchions



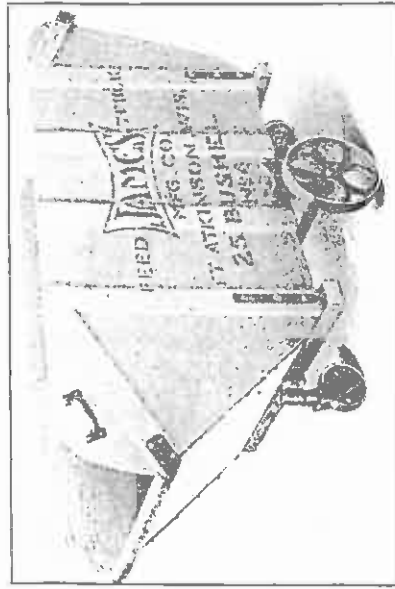
fortable, they should allow the cows some freedom of motion, and also help to keep the cows clean.

Home-made Ties—Before the advent of the modern stanchion, and stall, home-made ties were widely used. The early tie and stall was unsatisfactory in that it allowed for no adjustment to suit the size of the cow. Besides this the wooden stanchions were uncomfortable, the weaker cows never received sufficient feed, while the larger animals received more. This method of tying stock often resulted in the animals becoming very much soiled with manure. Present day ideas of sanitation do not allow this.

Swinging Stanchions—The modern swinging stanchion has eliminated many of the unsatisfactory features of the wooden stanchion. The modern stanchion and stall serves the purpose of tying the cow and besides this gives the animal liberty so that she will not be uncomfortable at any time. The stanchion prevents accidents in that it ties the stock securely. It can be aligned in such a way that the same stall will do for either long or short cows, and in neither case is there much opportunity for the cows to become soiled.

Feed Carriers

It is as necessary to equip the barn with a truck to assist in getting the feed to the cows as it is to install a litter



A Good Style of Truck, Used to Carry Feed to Cows

carrier in order to remove the manure. There are two kinds of trucks that are used for the purpose of getting feed to the cows, the wheel truck and the track carrier.

The wheel truck is used in those cases where it is impracticable to place a track carrier and where the situation would easily permit of that kind of carrier. The carrier operated on the track is widely used. The feature favoring this arrangement is that it is interchangeable with the litter carrier and the same kind of track can be used for either one. Another feature of the track carrier is that it is off the floor and it can be moved easily.

MILK HOUSE

A milk house in which the product from the above described barn can be properly handled, need not be of elaborate construction, nor very costly. The milk house here described is 12x24 feet in size, with the floor plan so arranged that the boiler and wash room is partitioned off from the remainder of the building. The essential features in any building of this kind are the facilities for rapid handling of the milk, and the elimination of contamination. The proper situation, ventilation, ease of cleaning, and rapid removal of waste, are the essential points in the construction of a milk house.

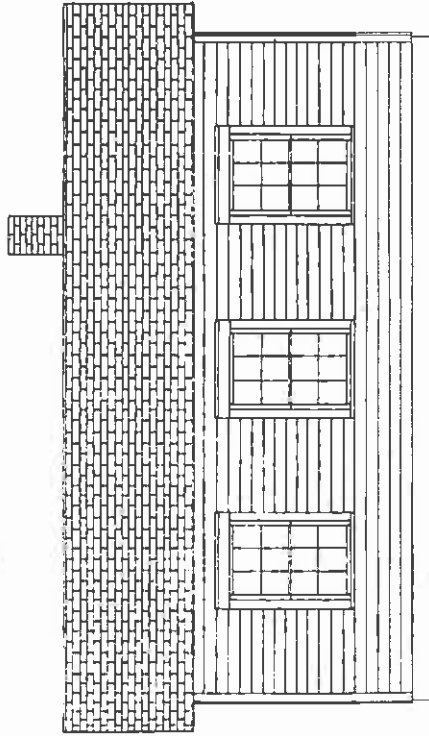
The Site of the Milk House

The milk house should be located on that side of the barn farthest from the entrance used by the cows and as far away from the compost heap as possible. If it is possible to locate the milk house on the same level as the barn, that arrangement will be found desirable in transporting milk to the milk house. The prevailing winds should be away from the milk house rather than from the barn to the milk house. Other buildings adjacent to the milk house should not be permitted. This is necessary on account of the danger of contamination. There should be suitable drainage away from the milk house. This will be found desirable in order to remove the waste from the milk house as freely as possible. It has been the custom to locate the milk house at least fifty

feet from the barn. This has been advocated as a sanitary measure. Since the well equipped milk house is equipped with a boiler, this is undoubtedly a wise measure on account of fire protection. However, the location of the milk house at a distance of fifty feet from the barn should not be necessary as a sanitary precaution, as the barn should be kept in such sanitary condition as not to require this.

Light and Ventilation in the Milk House

The disinfecting action of sunlight should be taken advantage of as much as possible in the construction of the milk house. The windows should be arranged on all four sides of the house so that the sunlight will strike every part of the



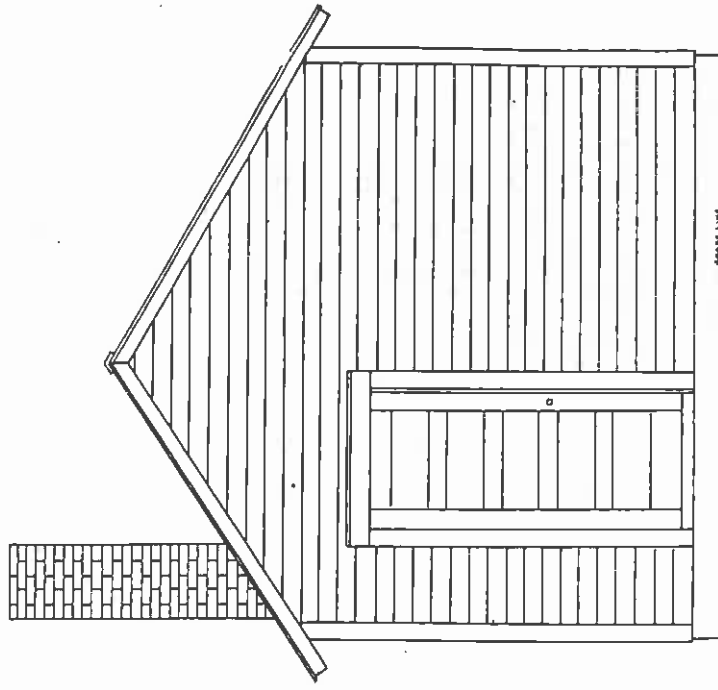
Side View of Milk House
—Drawing by R. E. Hundertmark.

interior at some time of the day.

Sufficient ventilation can be provided for by sliding windows. A vent in the roof will be found to be desirable. This will remove the steam that arises during the time that the utensils are being sterilized.

Cleaning Milk House and the Removal of Waste

Without building the milk house too elaborate, it is desirable to have the room in which the cans and other utensils are washed, separate from the room in which the milk is



End View of Milk House
—Drawing by R. E. Hundertmark.

handled. This will assist materially in putting out a better quality of milk and is also desirable in that it is an easier matter to keep the building in a sanitary condition. The situation of the boiler should be as far away from the milk room as possible. This is necessary from a sanitary standpoint.

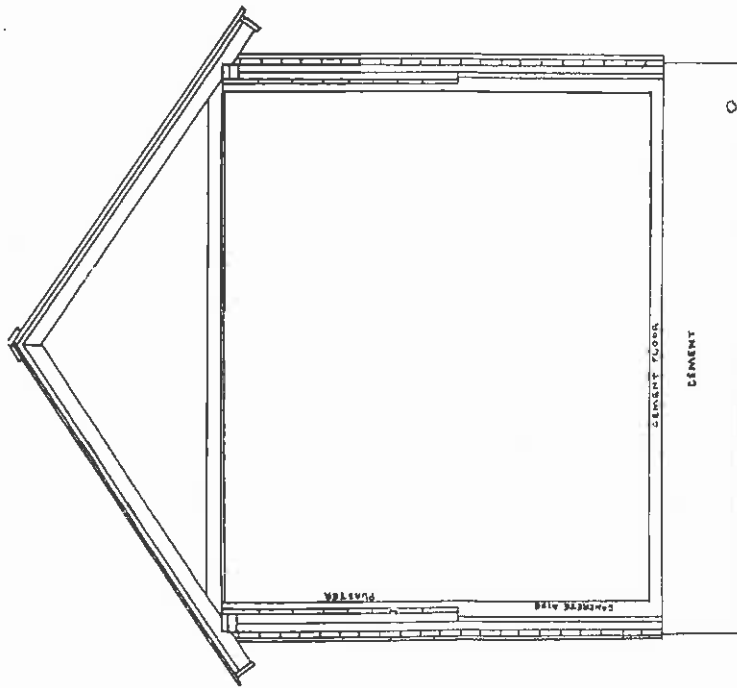
Cement construction is desirable wherever possible, and floors should slope to the drains so that the water will run off quickly. The drains leading from the milk house should be not less than four inches in diameter.

Milk House Equipment

The equipment to handle the milk from the barn described above will consist of the following:

3 covered top milk pails	.....@	\$	2.50	\$	7.50
1 milk cooler	.....@		35.00		35.00
10 ten-gallon cans	.....@		2.50		25.00
5 five-gallon cans	.....@		2.25		11.25
1 twelve-bottle tester*	.....@		14.00		14.00
1 cream separator, turbine, 700 lbs.	.....@		110.00		110.00
1 boiler	.....@		125.00		125.00

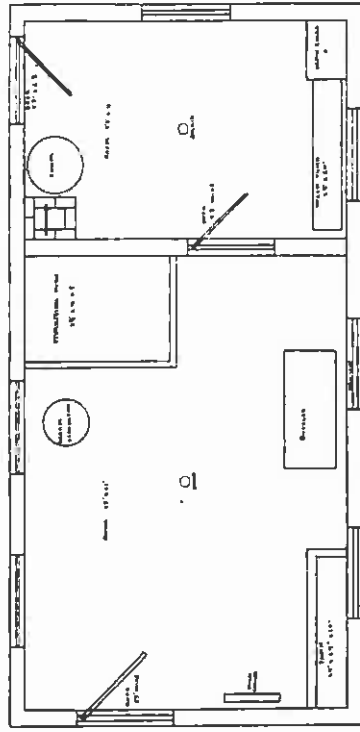
*See Pop. Bul. 75, State Agricultural Experiment Station, Pullman, Wash.



End View of Milk House—showing construction
—Drawing by R. E. Hundertmark.

Construction of Milk House

To construct milk house lay out the foundation, then dig trench twelve inches wide and about twelve inches deep, and put up forms six inches above ground so that the foundation will be 12x12x18 inches. Then fill the trench and form with concrete, using five parts coarse crushed stone, two parts fine crushed stone or sand, and one part Portland cement. When this has thoroughly hardened place four-inch tile inside of walls to suit drainage as per floor plan, and then fill up inside of walls with either clay or cinders—preferably cinders, and tamp thoroughly.



Floor Plan of Milk House—showing location of equipment
—Drawing by R. E. Hundertmark.

To put up frame, first put on a sill around wall of 2x4 edge-wise, also cross sill 16 feet from front of building, allowing sills to come 7/8 inch from the outside of the wall, and then double across to rear end, and eight feet on each side. After this take 14-foot studding, cut from same, one piece 8 feet 8 1/4 inches long, and one piece 4 feet 7 1/4 inches, spiking the short piece onto the long one. This will require 32 pieces, and will constitute the studding for the front room. The rear room will require 22 pieces cut 8 feet 8 1/4 inches. Put these in place, and then put on a double plate all around, using for the same 6 pieces 2x4x16, and 6 pieces 2x4x12. After this, side up the building, setting window and door frames, which should

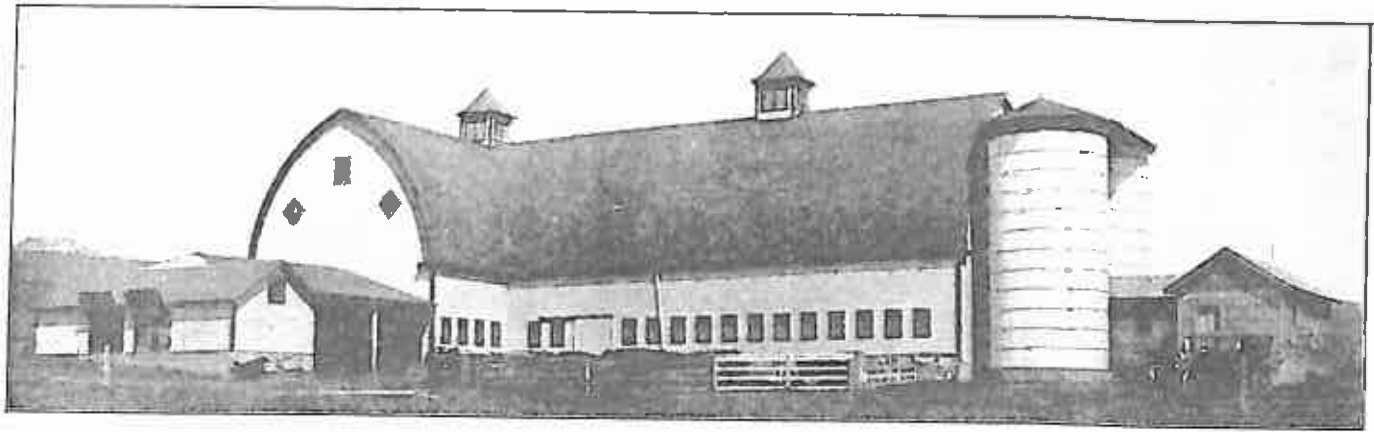
have 6-inch jambs. Then put on upper joists 2x4x12, 16 inches on center, and after this put up rafters 2 feet apart, and then the roof.

The chimney should be put up before the shingles are laid. The inside of the front room can then be sheeted as far as the studding is single. The concrete floor can then be laid, making this 2½ inches thick of same mixture as was used for the foundation, finishing with one-half inch composed of 4 parts of fine stone or sand, and 1 part of Portland cement trowelled smooth. After this put up form 4 feet high all around room. This will allow for an amount of concrete equal in thickness to the studding used. Fill this with a mixture of 4 parts of fine sand and 1 part of Portland cement.

The balance of the sides of the front room can then be entirely sheeted, after which the room should be lathed, placing lath on the sides perpendicularly, and allowing them to lap over the cement a few inches in an irregular manner. This room can now be plastered, using two parts of sand and one part of Portland cement for the lower section, and a good hard wall plaster for the balance of the room. The boiler room should be ceiled all over. The windows and doors can now be cased in, and the room is ready for the fixtures. These specifications are based on the supposition that studding will be sized 1½x3½, and all lumber dressed to 7/8 inch.

Bill of Material

8 yds. coarse crushed stone @ \$1.....	\$ 8.00
5 yds. fine crushed stone @ \$1.....	5.00
13 bbls. Portland cement @ \$2.50	32.50
32 pcs. material 2x4x14, 229 ft. @ \$17 per M.....	5.08
11 pcs. of material 2x4x18, 132 ft. @ \$19 per M.....	2.30
25 pcs. of material 2x4x12 ft., 200 ft. @ \$17 per M.....	3.40
15 pcs. of material 2x4x16 ft., 160 ft. @ \$17 per M.....	2.72
1000 ft. sheeting @ \$13 per M.....	13.00
700 ft. drop siding, or shiplap @ \$20 per M.....	14.00
3500 shingles @ \$2.50 per M.....	8.75
500 ft. ceiling @ \$35 per M.....	17.50
40 yds. lath and plaster @ 30c yd.....	12.00
6 windows, 12 lights 10x12x12 @ \$1.75.....	10.50
1 door 3x7x1½	5.00
2 doors 2 ft. 8 in.x1½ in. @ \$2.50.....	5.00
6 window frames, 6-inch jambs, @ \$1.75.....	10.50
3 door frames, 6-inch jambs @ \$1.50.....	4.50
2 pcs. finishing lumber 7/8 in., 14 ft., for ridge, @ \$40	
2 pcs. finishing lumber 7/8x6 in., 14 ft., for ridge, @ \$40	
4 pcs. finishing lumber 7/8x4 in., 10 ft., for corner, @ \$40	
4 pcs. finishing lumber 7/8x3 in., 10 ft. for corner, @ \$40	
250 linear ft. 7/8x 4 in., for casing, @ \$40.....	1.64
25 lbs. 20d spikes @ 3½c per lb.....	3.36
25 lbs. 20d nails @ 4c per lb.....	.88
15 lbs. galvanized shingle nails @ 5c per lb.....	1.00
10 lbs. 8d casing nails @ 5c per lb.....	.75
3 lock sets @ 60c.....	.50
4 pairs 3½x3½-in. hinges @ 15c.....	1.80
280 bricks @ \$10 per M.....	.60
280 bricks @ \$10 per M.....	2.80
Total	\$175.08



Dairy Barn of H. H. Curtis, Pullman, Wash.—Note the silos, milk house and manure shed