MEMBER: We are charging fifty cents a barn, and it works fine.

MR. JACOBS: I would like to add one reason I think would influence farmers to whitewash their barns,—the barn being much lighter the hired men would work longer days.

J. M. Speed, of Milwaukee, then made the following address, the subject being "Cold Facts About Creamery Refrigeration."

COLD FACTS ABOUT CREAMERY REFRIGERATION.
By J. M. Speed, of Milwaukee.

Mr. President, Members of the Wisconsin Buttermakers' Association, Ladies and Gentlemen: Perhaps no single phase of the successful production and marketing of the product in whose manufacture you are so vitally interested, is of as much importance as refrigeration. First because it actively enters into the very making of the product itself, and secondly, because it preserves and keeps in a marketable condition the product after it is made.

It is only in the last few years that the value of Mechanical Refrigeration as applied to your industry, has become an important factor. This was undoubtedly due to some of the early experiments along these lines, which did not prove absolutely successful. However, it has now been several years that the experimental stage has been passed, and so many of you among us have installed equipments that are giving entire satisfaction, that I can safely say that there is no problem in the art of refrigeration, be it large or small, that deals with the dairy interests, that can not be and have not been successfully met by the manufacturers of refrigerating machinery. Many failures have been caused not by lack of adequate equipment, but rather by a misunderstanding as to the application of the equipment.

To my mind, the most necessary requisite for successful operation, lies in the refrigerator itself. Any good machine properly constructed, and with the necessary amount of piping and tanks, will produce the required refrigeration for which it
is figured. It remains therefore, for the refrigerator itself to
preserve this refrigeration, to bring it to the food products in
the best possible manner, to automatically remove from these
food products the gases that arise therefrom, replacing the same
by fresh cold air, free from impurity and dampness. This must
be done in a natural manner, through means of proper circula-
tion, and adequate insulation. You all know that the tendency
of warm air is to rise, and therefore in constructing your refrig-
erator, you should assist nature’s tendency by making the circu-
lating system in such a way that the warm air will be assisted
in its tendency to obey nature’s laws. In rising, this warm air
naturally must be displaced by something else, because under
natural conditions, there can be no vacuum, and therefore, as
this warm air rises, it must be displaced by cold air coming from
above, and in so doing, a natural circulating effect must contin-
uously take place, carrying with it the heat gases and moisture
and depositing or absorbing them on or through the cold sur-
faces of coils, tanks, or ice, from which surfaces they eventually
find their way to the outside through the melting or defrosting
into the refrigerator drain.

The proper proportion of hot air and cold air flues must
be determined in each individual case, and are absolutely con-
trolled by the area and the cubical contents of the space to be
cooled, together with a practical application of conditions.

In taking up this subject, I am going to discuss the value
of refrigerating machinery, and it occurred to me in surveying
the situation, that I could best sum up the advantages, by get-
ting from you who are users of both Mechanical Refrigeration
and Ice, your experiences, and your figures of production, power
expense, and costs, and to this end, I sent out 150 questionaires,
from which I now quote.

Questions Asked of the Users of Ice.

What is the size of your refrigerator? .........................
Maximum pounds of cream you cool daily? ..................
Do you pasteurize? ........................................
To what temperature do you cool with water before using ice?.. 
What is the average temperature of your refrigerator?.....
What power have you?.....Motor?.....Engine?..... H. P.?..
What was your total power or coal bill last year?............
What was your ice bill last year?............................
How far is your ice hauled?...................................
Do you ship in C. L. lots?...................................
If not, how often do you ship?................................
What was your total make last year?.........................
What is your average shrinkage per tub?....................
Did your ice ever run out before the hot weather was over?..
If so, where did you get it?..................................
How much did it cost per ton?................................
Name of Creamery?...........................................
Location?......................................................

_Questions Asked of the Users of Mechanical Refrigeration._

What size machine have you?.....How long in use?........
What is the size of your refrigerator?........................
Maximum pounds of cream you cool daily?...................
Do you pasteurize?............................................
To what temperature do you cool with water?............... 
At what temperature do you keep your refrigerator?....... 
Is your brine tank in the refrigerator?.....................
How many ripeners have you?................................
How many churns?...........................................
How many separators?......What capacity?................
What power have you?.....Motor?...........................
Engine?......................................................
H. P.?.......................................................
What size boiler have you?................................
What steam pressure carried?................................
Have you separate power for Ice Machine?................
If so, what H. P.?.........................................
Is power heavy enough to run all machines at one time?....
Average daily hours of Ice Machine operation?.............
Maximum hours?............................................
How is time divided if machines are not all run at once?
What was your total power or coal bill last year?
What was total power or coal bill before having Ice Machine?
How much was your ice bill before you had your machine?
What was your total make in corresponding years?
What is the annual upkeep of your ice machine equipment?
Have you saved in help?
Have you saved in time?
Do you now ship in C. L. lots?
Did you before?
What saving in freight rates on account of C. L. shipment?
Has your shrinkage been less?
Do you prefer the system to using ice?
Did you have trouble in learning how to operate machine?
If so, what was the nature of the trouble?
Name of Creamery?
Location?

Some of the questions that I have asked were largely for my own records, and do not enter into the results of this tabulation. I have averaged the figures obtained from this information, and will present them to you at this time. The averages for users of natural ice are as follows:

Average number of lbs. of cream cooled per day 4340 lbs.
Average temperature of refrigerator 53.2 F.
Average horse-power 11.6 H. P.
Average cost of power $154.90.
Average cost of ice $124.20.
Average shrinkage .575 lb. per tub.
Average number of 60 lb. tubs of butter made yearly 4516.
Average cost of power and ice per tub 6.2c.

In this average cost of power and ice per tub, I have not taken into consideration, the depreciation of the ice-house, which is ever with us, the cost of handling this ice in your creamery, the cost of sawdust, and the additional work required of your buttemaker and his assistants, or the labor of your patrons who may be hauling this ice for you for nothing.

As against this cost of refrigeration per tub incident to the users of ice, I am showing you the averages for the users of machinery, which have been compiled as follows:
Average tons of refrigeration required 3.8.
Average lbs. of cream cooled daily 4130 lbs.
Average horse-power required to operate creamery 1455.
Average temperature of refrigerator 34 degrees F.
Average cost of power $393.00.
Average shrinkage per tub .3 lb.
Average operating cost per tub 8.9c.
Average number of 60 lb. tubs of butter made yearly 4250.

If you will compare these two sets of averages, you will see that the cost of power and refrigeration per tub, for those using ice is 6.2c, and the cost per tub to those using refrigerating machines is 8.9c, and if we will take again our average creamery producing about 4250 tubs of butter per year, and multiply the total number of tubs produced, by the average cost per tub, you will find an apparent balance in favor of the ice users of $150. But gentlemen, have I not forgotten something? Let us look at the little item of shrinkage. Behold, the ice user acknowledges a shrinkage to him in pounds, of .575 of a pound per tub, and in compiling these figures I have not taken into consideration those whose shrinkage was over three-fourths of a pound per tub. And how many among you do not at some time put a pound to a pound and a half extra over net weight, to take care of this item, and can you wonder at this, when the average temperature of an ice cooled refrigerator is 54 degrees F. No need of me telling you why this shrinkage. The law allows you sixteen per cent of moisture. Why not keep it in your butter? You can,—if you keep your refrigerator at the proper temperature, and have your butter firm and cold when it is packed into your refrigerator cars, from a refrigerator whose average temperature is 34 degrees F. or lower, as my gathered data has shown.

Let us then again sum up the situation. Our average of tonnage required for 4250 tubs is 3.8 tons. Let us give the manufacturer of the ice machine the benefit of the doubt, and be extremely liberal in our estimate of the cost of such an equipment. Assume it costs $1400.00.
10 per cent depreciation amounts to $140.00
6 per cent interest 84.00
Upkeep 7.00
At 8.9c per tub for Mechanical Refrigeration 378.25
Shrinkage of .3 lb. per tub for 4250 tubs = 1275 lbs. at 30c per pound 382.50

$991.75

So much for Ice Machine users.

Now for the others. We will assume that our average ice house will cost $500.00, liberal enough you will allow.

10 per cent depreciation $ 50.00
6 per cent interest 30.00
Upkeep 10.00
At 6.2c per tub for manufacturing cost 263.50
Shrinkage of .575 lb. per tub for 4250 tubs = 2444 lbs. at 30c per lb. 733.20

Cost for users of ice $1086.70
Cost for users of Mechanical Refrigeration $991.75

Difference in favor of Mechanical Refrigeration $94.95

One-half of those answering our ice machine question blanks are pasteurizing their cream, but I did not receive a single reply from users of ice who were so treating their raw material. Had the same number of ice users pasteurized their product, the cost of manufacturing per tub for them would have been far in excess of the average given, because the additional cooling necessary, would have required twice the operating time and nearly double the ice. And gentlemen, I am of the opinion that you will soon all be obliged to pasteurize your cream, and then in order to keep down your bacterial count, you will have to cool your cream in as short a time as possible after heating.
I have been extremely liberal with the users of ice, in this proposition. If I were to correctly give you their costs, I would have to add the hours and hours of extra time necessary to cool their cream. I would have to add the hours of time and labor put in by the buttermaker and his assistants, and I would have to add a good many dollars for the slop, dirt, and muss that each day will have to be cleaned out, in order that your product may live up to Wisconsin standards.

There is also another question that I can not take up completely at this time, but which affects a material saving to you, and that is by having a refrigerator large enough, and equipment adequate so that you can ship your products in car-load lots instead of locally. But if you will figure these items up for yourselves, you will see how much additional saving they will bring to you each year, and you will undoubtedly agree with me that if your butter can be held for a long time, by means of Mechanical Refrigeration, and be in as good condition during that time as when it was made, that hundreds of dollars per year can be saved on this item alone.

I want to again call this fact to your attention, that whether you are a user of ice or a user of machinery for cooling purposes, the most important part of your equipment lies in your refrigerator. Do not allow yourself to be prejudiced by the fact that you have heard of someone who has a cement cooler which works perfectly, and do not think that saw-dust or mill-shavings under certain conditions can be used for insulating purposes, and that they will be adequate for your requirements. Such is not the case, for good insulation, properly applied, and a scientific construction of your refrigerator to get good circulation, is after all the primary requirement for any kind of successful cooling.

The methods that the different manufacturers of machinery may have for installing their equipment may vary, but the representative companies have standardized their equipment to a considerable extent, and their methods of installation should be very similar.
There is nothing extremely difficult to understand about a refrigerating machine. The compressor is only a pump. The manufacturer who sells this compressor does not manufacture the cold. The cold has been manufactured by Providence during the Winter months, in extracting from the waters over and under the surface, the heat that it has absorbed from the sun and other sources, during the hotter months. All that the compressor does is to transfer the heat that is in your product and the heat that is transmitted through the walls of your refrigerator to the cooling water that runs through the condenser pipes, and in so doing, it gives up its heat gathered from these sources to the condenser water, raising it in temperature, but not in any way changing its character. This heat is brought to the water in gas form, under pressure, by the compressor. The water in the condenser pipes extracts the heat there, and changes the gases to a liquid, still under the same pressure. This liquid then flows to the storage tank or receiver, and from this is allowed to escape through a very fine opening in a valve (called Expansion Valve) into the coils that do the cooling. The small opening allows the liquid to enter the pipes in a spray form and it rapidly evaporates, and in so doing again possesses the power to take up the heat that the water has absorbed in the condenser. The compressor gathers it from the pipes. These pipes are in the room and tanks to be cooled, and in this way the process is a continuous one. The only thing necessary for operation is a supply of cold water, and the power to operate the machine. From time to time the ammonia or other gases used by the machine may have to be renewed, on account of deterioration or leakage, but that amount is so small that it can be neglected. A hundred pounds of ammonia costs but $27.00 and lasts on an average for two or three years. The brine that is in the tanks, and which is pumped through your ripeners to cool the cream, is made of a calcium chloride solution, and stays constant, and ought not to be renewed oftener than once in four or five years.

I could take up your time indefinitely, giving you facts and figures and arguments, as to why every creamery should have
the most modern and up-to-date equipment for refrigeration. However, my time is now up, and I trust that my efforts have not been in vain. I will be glad to answer any and all questions that I can, pertaining to this subject.

I thank you!

An open discussion was then called for by the President.

DISCUSSION.

**Member:** I will ask in case that the refrigerator machine cools in the same temperature with the refrigerator as with the ice would it cost any more?

**Mr. Speed:** If you were using a refrigerating machine you wouldn't want to have an average temperature of 52 degrees.

**Member:** No, but would it cost any more money?

**Mr. Speed:** I can't answer that. I wouldn't know how to answer it because a refrigerating machine to hold a temperature would cost more money because you wouldn't be getting any advantage of the machine; what advantage would there be if you couldn't hold your temperature lower?

**Member:** Well, I am comparing the two methods, say, that now you have the refrigerating machine and it costs a little more to run it, but is it not because you could have your refrigerator so much lower temperature that it cost in that way; it isn't so much the proper degree but that you could get more efficiency out of the refrigerating machine. I think it is a point that ought to be considered.

**Mr. Speed:** Well, I don't grasp your meaning.

**Member:** For instance, if you cool cream that has been heated to 150 and you want to cool it down to 46 right in the vat, now could you do it with the ice or a refrigerating machine. What costs the most, that is what we want to know. That is what the buttermakers want to know; what costs the most, the ice system or the refrigerating system? Say you have definite degrees 150 down to 46, what in your opinion costs more?
Mr. Speed: It would depend on what your ice cost. Some of the averages I got cost $150.00 for enough ice for the season, some cost $300.00.

Member: You used average to get your price, now use average of the ice users to get that amount of cooling.

Mr. Speed: Well, I should think it would be just about the same proposition and some are using coal and some are using wood, some pay so much for coal and some pay so much for wood, you see the difference. Of course these figures that I have gathered are not my own, they are question blanks sent out and I averaged them up, they are from your own figures, questions sent out in this state and also in Minnesota and Iowa, that I got from different states.

Mr. Storvick: What is the capacity of these creameries; are the pounds of butter about the same?

Mr. Speed: I finally averaged them up, that is, for ice users, 4130 pounds a day.

Mr. Storvick: The pounds of butter made a year, have you got that?

Mr. Speed: No, I have the average.

Mr. Storvick: In a creamery making 150,000 pounds or less do you think the mechanical refrigerating machine is advisable?

Mr. Speed: Well, that depends upon what your ice costs. It depends upon whether you have an ice house that is in good shape where it don’t take too much to keep it up. If you have to build an ice house for any creamery your ice proposition would be the largest thing, a well insulated ice house would cost you what the machine would cost. Many of the creameries in this state have an engine running a shaft, even if they want to run a water pump there, the operation saves your coal bill.

Mr. Storvick: That is what I was going to lead up to. I realize your Wisconsin creameries are larger, you have got to make comparisons on like things and the fuel cost is not such a serious problem as it is in other parts of the country, but our experience has been that in the small creameries the refrigeration system is almost out of question.
MEMBER: In small creameries here is from 50 to 150 tubs a week and hold their products for carload shipments.

MR. SPEED: That depends on you. If you are foolish enough to make a lot of butter and the market is steady, of course, if you can hold for a week or two to get a carload shipment, I should think it would pay you, but if the market is fluctuating as it sometimes is you want to get your butter to market as quickly as you can, you would want to ship every day.

MEMBER: What would be the price in putting the machine in an average creamery?

MR. SPEED: The average cost is about $1400.00. You can't average the cost because every refrigeration equipment is an entirely different proposition, one job may require a 4-ton machine and a certain sized tank, another job may require so many more feet of pipe and a different sized tank, of course, they all cost money and you can't tell. I know of jobs that have been put in for $1200.00 and other jobs would cost $1400.00.

MEMBER: How much horse-power does it take to run one?

MR. SPEED: It varies. It depends upon your condensing water and upon the pressure that you carry; if you have got good cold water and lots of it you can run a lot of water through your condensing pressure, your horse power for four tons of refrigeration amounting to about one and four-tenths per ton.

MEMBER: How about the extra water?

MR. SPEED: With water at a temperature of 50 degrees it will take about half a gallon per ton per minute, a four-ton machine, that is about two gallons a minute per four ton.

MEMBER: What do you mean by per ton?

MR. SPEED: A ton of refrigeration is a means of melting 2,000 lbs. in 24 hours at 32 degrees.

MEMBER: We have listened to one of the best papers on mechanical refrigeration I have ever heard; Mr. Speed has given us one of the best discussions on mechanical refrigeration I have ever heard. There is one other question I would like to ask and that is the cooling medium. I understand you recommend brine. There are two systems, I am not satisfied in my own mind which I would rather have.
MR. SPEED: Where you have a coil in your cooling tank you can pretty nearly drain that, you will leave some brine in there, that water will not go back into the tank, so you will lose it, consequently, you will have to do some replenishing. To give you an idea of the cooling proposition. If you take 100 cubic feet of brine it will weigh about 8,000 pounds. Now, from 8,000 pounds of brine, for instance, we will say that the brine is at a temperature of 10 above zero, after doing its cooling it will come back at 20 degrees, you have about ten heat units per pound already taken out.

MEMBER: I would like to know which is the best, to put the butter on the end or on the side of the ice box?

MR. SPEED: You will get a better circulation on an overhead ice box than from the end. The tendency of cold air is to drop. It must be carried over the other side and you have got to get a box mechanically constructed nearly perfect; you can't get good refrigeration without good circulation, you can get better with overhead than on the side.

MEMBER: Isn't there something in making the ice box? Some have them closed up on the side, they should have a return on the opposite side, shouldn't they, to get circulation, they can't get it with one opening?

MR. SPEED: On the bottom?

MEMBER: No, on the top, the cold air would go down here and the hot air come above the ice.

MEMBER: Do you need any other circulation outside?

MR. SPEED: If you have good circulation inside you don't need any other, you want to keep all the refrigeration you have got there. The warm air all passes through your door, you don't want to let it pass through any other place.

MEMBER: There is one point about having the ice on top; it is no doubt correct, but still I find among the creameries that I have seen where the ice is on top you have more or less dampness in the refrigerator. Here is the ice on top, you have the ice underneath the ceiling and you nearly always have the ceiling wet. These conditions I think are serious and should be brought
out. Be sure your refrigerator is dry and that you have good
circulation. I believe the ice is safer on the side on that account.

MEMBER: Do you mean then that if you have an inlet into
the icebox on top and also in the bottom that the cold air comes
into the bottom and goes back into the ice?

MR. SPEED: Yes sir.

O. A. Storvick, Dairy Division, Department of Agriculture
Albert Lea, Minn., then addressed the meeting as follows, his
subject being "Fuel and Power Efficiency in Creameries."

FUEL AND POWER EFFICIENCY IN CREAMERIES.
By O. A. Storvick, Albert Lea, Minn.

Mr. President, Ladies and Gentlemen: The annual reports
from creameries show that the greatest item of expense in the
manufacture of butter exclusive of labor is fuel and power. There
is no item so variable, thus it would seem that the matter is not

O. A. Storvick