for in unity there is strength. And in this way only can Wisconsin maintain her supremacy as a dairy state.

So I want to say to you buttermakers,—be loyal to your calling; be loyal to your patrons, and your patrons will be loyal to you. Let us all be loyal to our community, loyal to the state, and loyal to the government. It will result in mutual happiness and prosperity. (Applause.)

CHAIRMAN: Fellow Buttermakers, I most heartily endorse everything Mr. Weigle has said. I know that he has been with us but the trouble is that we have not been with him, that is where the trouble lies. I received a letter from Mr. Weigle, I think, if I remember rightly, it was dated May 29th,—I received it on the 30th day of May or the first day of June,—in which he referred to the coming National Convention to be held at Minneapolis. In that letter he said, "Wisconsin is out for the banner, Wisconsin must have it. Wisconsin will have, Wisconsin, the greatest dairy state in the Union, has never had this honor." He also asked my co-operation in the matter of offering any suggestions as to what was best to do to secure it. I wrote him I knew of no suggestions I could offer at that time. I really believe we are going to have the National in this state the next meeting. We don't want some other state to come in here and take that away.

The next on the program is "The Cause and the Prevention of Mold in the Creamery," by Prof. E. G. Hastings, Madison.

CAUSE AND PREVENTION OF MOLD ON BUTTER.
By Prof. E. G. Hastings, Madison.

As far as I am aware, no data have been collected as to the loss occasioned by moldy butter. The frequent appearance in the dairy press of statements by men in contact with the market, however, would lead one to believe that the trouble is of considerable economic importance. At the recent meeting of the National Creamery Buttermakers' Convention the statement was made that where one complaint on quality had been made during the past season, 1916, ten complaints on mold had been reported.

To the maker who receives a report that his last shipment showed a heavy development of mold and that he has been cut several cents a pound, the monetary side of the question looms large. No matter how large or how small the loss, it is a needless one and one we can and should prevent.

Many misstatements are made in regard to the cause of mold. These misstatements arise from misconceptions in the minds of the writers. I quote from the "Man on the Street" (New York Produce Review)—"It (mold) may come from tubs, liners, damp refrigerators or poor refrigeration in transit."

PROF. E. G. HASTINGS

Again, "A receiver had much trouble with moldy butter from an Iowa Creamery. He wrote the manager about it and soon had a reply that the directors knew it was moldy and that it would probably continue so until the old, musty, damp refrigerator was replaced by a new one that was now being built." So long as we believe that poor refrigerators are the direct cause

of moldy butter, the trouble will probably continue. It is true that low temperatures, both in storage and in transit, tend to restrain the growth of molds, but to say that these conditions are the cause of mold is wide of the mark.

The spores or seeds of the molds are widely distributed and are to be found on or in practically every material. They are to be found in the tubs, on the parchment paper, in the cream, and in the finished product. The number present will depend greatly on conditions. In case the mold spores have been deposited with the dust that has settled onto the tub or paper, the number is certain to be small. If conditions have been such as to permit the growth of the mold on the tub or paper, spores will be numerous. with increasing numbers of spores or with the presence of the vegetative growth itself, the likelihood of trouble is greatly increased. It is probable that conditions that will prevent the germination of the spores, will not restrain the growth of the vegetative cells, as will be discussed later.

Three conditions are necessary before growth of molds can take place, namely the presence of food, moisture, and air. The molds as a rule can use the most varied materials as food, hence they are to be found growing on wood, as in our butter tubs, on paper, as in the case of the parchment used for liners and wrappers, and indeed, on most every material, when sufficient moisture is present. When the air is saturated with water vapor, a condition that frequently obtains in the summer and in our creameries at other periods of the year, enough moisture will be absorbed by wood and paper to permit or mold growth.

An essential condition for the growth of all molds is a certain amount of atmospheric oxygen. Different kinds of molds can grow in varying amounts of air. Due to this requirement of the mold, we find the growth in the case of butter limited to the surface or immediately below the surface.

What are the conditions existing in a tub of butter? Due to the packing, a film of water is forced out of the butter and forms a layer between the tub and the butter. This water is gradually

lost by evaporation and air is drawn in to take its place. We now have all the conditions necessary for mold growth, food material (wood, paper, and butter), moisture, and air. The mold spores will always be present, and the question may be asked, "Why does not all butter mold?" This can be easily answered.

If the tubs and paper have been so stored that no growth of mold has occurred on them, or if the cream has been so handled, that no growth of mold has taken place, there will be no vegetative growth of the mold on the paper, tubs or in the cream. There will be present only the spores that have been deposited with the dust that has settled onto these materials. Under these conditions, it is not likely that *salted* butter will develop mold. This is due to the fact that the brine has a restraining effect on the germination of the mold spores. If growth of mold has recently taken place in any of these materials, even to a very slight extent, it is quite certain that the same amount of salt that would prevent the germination of the mold spores will not stop the further growth of the vegetative cells present on the paper and the tub. This fact emphasizes the need of storage of such materials under dry conditions so that no development of mold is possible on them.

The effect of salt in the prevention of mold can be well illustrated by a comparison of the conduct of salted and unsalted butter on storage. Several months ago some butter, churned in the University creamery, was sampled. A portion was removed before the addition of salt. To the remainder an ordinary amount of salt was added. In every instance the unsalted butter has become moldy, while the salted butter has remained free. The mold in this instance develops just below the surface of the butter. It is thus evident that the maker of unsalted butter is in far greater danger of having mold develop on his product than is the maker of salted butter.

Among the processes used in the prevention of mold are rubbing the tubs with salt or filling the tubs with brine. It is certain that these processes have a restraining effect on the develop-

ment of the mold spores, but they have no destructive effect on the same. Mold spores placed in saturated brine for 48 hours on removal grew as well as though they had not been so treated.

Paraffining tubs does not allow the mold spores on the tub to come in contact with moisture and air, hence they cannot develop. The process, if carefully carried out, should prove effective as far as the tub itself is concerned. It may also prevent trouble from liners due to the fact that water will not be absorbed from the butter, leaving an air space between tub and butter. In the paraffined tub this space remains filled with water, beneath the surface of which molds cannot grow.

Such treatments that tend to prevent the development of mold may be of value, but can never take the place of processes by which the molds on the tub and paper shall be actually destroyed. A number of substances have been suggested and recommended for the destruction of mold spores on tubs and liners. As has been stated, a saturated solution of common salt is not effective. Boric acid has been suggested. A saturated solution two per cent, did not destroy mold spores in 48 hours. Formalin is objectionable on account of its action on the skin and its expense.

Trials were also made with bleaching powder or chloride of lime, as it is frequently called. This contains hypochlorite of lime and when the powder is stirred with water and the insoluble part allowed to settle, a liquid having a greenish color and a pungent odor is obtained. The solution has marked disinfecting properties under certain conditions. Its action on mold spores is given in the following table. The figures given as to strength of solution refer to one part of the dry powder to 3330 parts of water, etc.

Table I.—The Effect of Solutions of Bleaching Powder of Varying Strength on Mold Spores.

Time of exposure	Strength of solution 1-3330	1-16,550	1-33,330
3 min.	+	+	+
5 min.	+	+	+
10 min.	—	—	+
15 min.	—	+	+
20 min.	—	+	—
30 min.	—	—	—
60 min.	—	—	—
120 min.	—	—	—

+ = mold spores, not killed
— = mold spores killed

As will be seen from the table, the bleaching powder in the strengths used was effective in destroying the mold spores. Bleaching powder costs about 15 cents per 12-ounce can. If used in such strengths as to be effective in 10 to 20 minutes, the cost per tub would be approximately three-tenths of a cent. If used in such amounts as to be effective in 30 minutes to one hour, the cost per tub would be reduced to 0.03 to 0.06 of a cent. These costs have been calculated on the supposition that each tub would be filled with the solution which would then be thrown away. The use of a vat in which the tubs, loosely nested, could be placed, together with covers and paper, in the solution would reduce the cost very materially.

The mold spores are very easily killed by hot water or steam, far more easily destroyed than is commonly believed. Trials with the same mixture of spores as was used with the bleaching powder were made with results as given in the following table.

Table II.—The Effect of Hot Water on Mold Spores.

Time of exposure	Temperature 122°F.	131°F.	140°F.
1 min.	+	—	—
3 min.	+	—	=
5 min.	+	—	—
7 min.	+	—	—
10 min.	+	—	—
15 min.	+	—	=

The results of this work agree with those obtained by Ayers and Thom.

It would seem that the most effective way of destroying the mold and the mold spores present on tubs and liners is to place them in water heated to 150 degrees F. or above for a few moments, just before they are to be filled with butter. A tank 18 inches deep, 18 inches wide, and 8 feet long will take 7 tubs loosely nested. It would seem that such a process would be less expensive, involve no more time and labor than is required in the use of any chemical and be certain in its results. The paper and covers should be treated in like manner. It seems to the writer that the more the buttermaker relies on plenty of hot water steam, and the scrubbing brush in all his work, and the less use he makes of disinfectants, common, well known substances such as bleaching powder, or commercial products, the better he will be off both in pocket and in the quality of his product.

The following summary may be given: Unsalted butter is more likely to develop mold than is salted butter. The cause of the trouble may be vegetative growth or the spores present in the cream, on the tub or on the paper. Treatment of tubs and paper in such a way as to destroy the spores, will not insure freedom from trouble. To the treatment of these materials must be added the pasteurization of the cream.

In the case of salted butter it seems probable that mold usually is the result of vegetative growth present in the cream or on the tub or paper. If only mold spores are present, the salt is likely to prevent their germination. The tubs and paper should

therefore be stored under such conditions that moisture cannot be absorbed and thus opportunity be given for mold growth on these materials. In order to insure still more perfectly against trouble, the tubs and liners should be placed in water heated to a temperature of 150 degrees F. or above for a few moments. And as a still further precaution it is well to pasteurize all cream and thus destroy the mold spores present therein. The maker should not think that because no mold is visible on the paper, that no growth has occurred. The vegetative growth of the mold, i. e., the part that corresponds to the body of a higher plant, is usually colorless and would not be noted on such substances as wood and paper. The color shown by most molds is due to the spores which are produced only after some vegetative growth has taken place. The maker who thinks no treatment of paper or tubs necessary until visible growth is noted, is likely to have trouble. (Applause.)

CHAIRMAN: Are there any questions to ask?

We will now listen to the Report of the Resolution Committee.

MR. KEPPEL: The Resolutions have been amended to read as follows:

RESOLUTIONS.

Resolved that we extend to the Sparta Advancement Association the thanks of our Association for the many courtesies and hearty welcome given us;

Resolved further that we extend our thanks to Mayor F. P. Stiles for his kind address of welcome;

Resolved further that we particularly extend our thanks to Mr. S. E. Oakes for providing conveniences for our meetings and for his untiring efforts for our comfort and pleasure which make us feel that Sparta is one of the finest places in which to hold a convention;

Resolved further that the thanks of the Association be extended to Prof. R. A. Moore, Prof. E. H. Farrington, and to Prof. E. G. Hastings of our state university, and to Hon. G. J.