is the proper way of proceeding. I do not care whether they will go into the factory or into the law schools or into the medical schools or into the ministry, or wherever they go, there is no training that can be better for them than that training, and if they are to remain on the farm, there certainly is no training better for them than that, that they can have the power and the habit of reading out of God's book these great lessons that He teaches.

Prof. Glover: I believe I owe Wisconsin an apology for not mentioning the fact that they have agricultural schools, but you must not forget that other states have them, too, perhaps I can inform you that Illinois has them, but notwithstanding, agriculture is not taught in common schools to any extent.

Mr. Monrad: I believe I was the first to urge the teaching of agriculture in common schools some fifteen years ago, but not in the way that it has developed lately. I urged at a convention in Minnesota the introduction, as I called it, by insinuation, and I protested against the later development when they went to introduce it by getting out a special text book on agriculture. I want the agriculture to be insinuated into the other text books, so that the mind of the child will be drawn towards the farm, instead of towards the city. I want to stand right there.

President Aderhold: This is along the line of school work, and our program is too crowded to admit of discussing the subject any further.

CARE OF STEAM BOILERS AND ENGINES.

G. H. Benkendorf, Madison, Wis.

The subject "Care of Steam Boilers and Engines," which was given to me by your Secretary, Mr. Baer, is indeed a very wide one. It is one that may be divided in two parts. The first and the more important part may be called "The Care of Steam Boiler," and the second "The Care of the Engines." On each of the subjects volumes upon volumes have been written and hence in the limited time which I have at my disposal can only just touch upon the outer edges of these vast subjects, pick out a few points here and there, as a person walking along an ocean
beach can pick up only a few of the many beautiful shells and pebbles which he sees.

In the evolution of man from savages to civilized life we find there is a continual tendency toward a more perfect division of labor. There was the savage that could make a more perfect bow and arrow than his fellow beings. Nature had given him a talent for this work. He could select a better piece of wood, than his brethren. He loved his work and in this way became a bow and arrow maker. He traded the products of his labor for food, clothing, etc. It was better for the whole tribe that they had a party who excelled in this line of work. Later on, probably another savage commenced to make arrows, etc. Competition began and the one that could produce bows and arrows cheaper and better than the other party got the trade.

So man has developed along all lines, and by this distribution of labor, has made it possible to produce a better product and cheaper than before.

Take it in our own line—we know that cheese used to be made in many, many homes, but the tendency of specialization entered this field, as all others, and we find men gradually getting more and more milk from their neighbors. The small factory appeared and soon we find men that did nothing but make cheese, because by so doing they could do the work cheaper and turn out a better article. Other factories starter around them seeing if it would be possible to better the quality of their goods, so they could find a readier sale of their products of manufacture, and at the same time, try and see if they could lower the cost of production so as to allow a larger margin for profit.

Thus we see how natural it was for the cheese industry to drift from the kettle, on the kitchen stove stage to the self heating vat basis, and now to a basis where we find the factories equipped with boilers, to furnish steam, and engines to do part of the manual labor.

We find however that new duties are now thrust upon the operator of a cheese factory, if he never handled boilers and engines, he must learn or feel the truth of Huxley’s inflexible law of the “Survival of the Fittest” for some other man will come along and as the expression is, crowd him out.

The boiler in the cheese factory has come to stay. It is a necessary adjunct to every well equipped factory. To assist the operator the engine is gradually entering the factories, to help in the manual labor, such as grinding the curd, pumping water, etc. It is very evident therefore that all that expect to stay in
this line of work should become familiar with at least the elementary details concerning the care and operation of both steam boilers and engines.

Let us take up the subject of boilers first because it is the more important. For my part I use to be of the opinion, when I was small and inexperienced, that any one that could shove coal could fire a boiler, but the engine with all its rapid motion bewildered me. This is the usual delusion and the quicker it is dispelled from the minds of all the better. It is the boiler that needs the attention. Upon the care bestowed on it, to a great extent depends the success of the factory.

There is a book entitled, "Put Yourself in His Place," and so let us put ourselves in the place of a young man that has just been employed to operate a factory. He goes into the factory which he may be totally unacquainted with. What should he do? We shall discuss just his duties with reference to boiler and engines as outlined by the subject assigned me.

The first and most important thing to do is to get acquainted with the water supply and the method employed in feeding it into the boiler, for when the water is low, steam up, milk coming in, there is not much time left to study the piping, valves, etc. And as low water is the great cause of boiler explosions it behooves him to be careful. We often hear such words as "inexplainable," "mysterious," used but the word "negligence" sounds harsher, but comes nearer telling the truth of the "mysterious" "inexplainable," calamities, so destructive to property and fatal to human life. Therefore under no conditions should he attempt to take charge of a plant and fire up until he is perfectly sure that he can feed water into a boiler at a moment's notice.

If he possibly can it is his duty to see that the boiler is clean before firing up. Even if the boiler is new and just came from the factory, there may be bits of wood inside which may by floating get into the pipes. Small bolt heads, bits of iron may also be in the boiler and might cause serious trouble. It is labor well spent to attend to this.

It would be foolish for him to neglect inspecting the safety valves, pressure gauge, blow-off, etc. Under no consideration should he take it for granted that everything is O. K. simply because his predecessor says it is. If he has not time to clean the boiler before taking charge he should do so as soon as possible. He may find a wheelbarrow full of sediments in the boiler, which of course had better be taken out. He may also find a
great deal of scale in the boiler and this brings us to the question of scale, its prevention and removal.

We hear a great deal about the evils of incrustation, especially in regard to the economy of having a boiler perfectly free from scale. While there is no question as to the injurious effects of scale, especially if the scale is very thick at places, there is a gross exaggeration of the difference in the amount of fuel consumed by a boiler having \( \frac{1}{8} \) of an inch of scale as compared with one perfectly free from scale. As scale is a non-conductor of heat there naturally would be some difference but not the enormous loss that some agents for patent boiler compounds would have us believe. In fact a thickness of scale of \( \frac{1}{32} \) of an inch or less if spread evenly over the entire interior is held by some high authorities to be beneficial, for it guards against the corrosive effects of the water.

The scale as is well known is the deposit from the water, and which adheres to the inside of the shell and surrounds the tubes and braces of the boiler, therefore it is advisable to use, if obtainable water for the boiler which is free from carbonate of lime, which is the most common source of scale. Therefore rainwater or soft water is the ideal water to use, but as most of us must use other water, we usually resort to a chemical treatment of the water to keep our boiler clean.

There are many kinds of boiler compounds on the market for this purpose—slippery elm, saw-dust, potatoes, lye, salsoda, etc., have been used under certain conditions and with certain water will give satisfaction, but with most of us the most satisfactory chemical is the common, ordinary salsoda, or carbonate of soda, obtainable at any supply house, at the low price of two to three cents a pound if bought by the barrel. It is cheap and also very valuable for the washing up around a cheese factory or creamery. It also has the advantage of overcoming any grease that may be in the boiler. Another advantage is that it has no effect on the iron, unless it is impure. This is an important point for many compounds on the market while they will remove the scale, will also effect the iron, so as to be positively injurious. For the ordinary boiler one-fourth of a pound a day is amply sufficient. All compounds should be fed regularly and a small quantity at a time rather than in large amounts, just once or twice a month.

To prevent the accumulation of dirt in the boiler it is very important to blow off some of the sediment as it settles to the bottom. This should be done every morning before firing up, as the water is then quiet and the sediment will have gathered
over night around the blow off pipes. Sometimes in case there is a vacuum in the boiler it is necessary to open some valve to let the air overcome this vacuum so that the water will pass out better. Another advantage of blowing off in the morning is that it cleans the blow off pipes of any sediment which may have collected in it, thus assuring a free entrance to the boiler of any water forced in by the injector.

Very many make the mistake to fire up first and get the dirt in circulation before blowing off. It can be seen, that while it does some good to blow off an inch or two of the water, still not as effective as the first way mentioned.

Another point that I want to dwell upon is the matter of blowing off a boiler for a thorough cleaning. This should be done frequently, say once or twice a month, depending on the amount of water fed into the boiler and converted into steam. The usual way is to allow the steam to get down to about 10–15 pounds pressure, and then open the blow off valves. Some even blow off at 30–40–50 pounds pressure. This surely is positively injurious to a boiler and makes cleaning very difficult. The great trouble from blowing off at any pressure, arises from the fact that the walls of the boiler are very hot and will bake on any dirt or sediment remaining in the boiler, the very thing we are trying to prevent. It is far better to allow the boiler to cool and then allow the water to pass out for then the dirt that remains in the boiler will stay soft and can easily be washed out with a hose.

Another cause of great mischief to the boiler is what is termed external corrosion. We quite frequently see a water tank over a boiler the leakage of which getting on the iron swoon causes corrosion to set in. This is quite dangerous for it soon weakens the boiler plate at these places. Sometimes we see where the boiler is covered with rust due to the rain coming down along the outside of the chimney. This could be very easily remedied by placing a hood over the opening. Under these unfavorable conditions the boiler will very rapidly deteriorate and in a few years a new boiler will be necessary which expense could have been saved by a proper care of the boiler.

We sometimes see upright boilers left for the winter with a lot of ashes underneath them which absorbs moisture from the air, thereby causing severe corrosion where the ashes touch the iron plate.

One of the disagreeable features of having to work around a boiler is the attention the flues require. Owing to this they
are very frequently neglected, not being cleaned as often as they should be. All of us know that a boiler will steam easier if the flues are clean and if we have a good draft. It is strange that we hear so much about the loss of fuel if we happen to have a little scale around the flues, and hear so little of the tremendous loss caused by the flues not being clean. Soot is a non-conductor of heat and as it fills up the flues seriously retards the draft. Then in addition we have the corrosion effect of sulphuric acid in the soot which attacks the iron.

To illustrate the loss of fuel where the flues are not kept clean I will cite an experiment conducted by an establishment when they burned 1,000 pounds of coal a day. It took fifty per cent longer time to raise the steam when the flues were swept once each week than when they were swept three times a week. The amount of fuel was reduced from 1,00 pounds a day to about 600 pounds, thereby affecting a great saving. A saving which inside of a year would amount to a neat sum of money.

The saving of this vast amount probably was not due to the soot just being a non-conductor of heat but more likely that because the flues were clean there was a better draft.

The matter of draft is of vital importance. In the process of combustion the carbon of the fuel unites with the oxygen of the air. If the union is complete, that is if there is enough oxygen present the gas given off is \( \text{CO}_2 \). That is one volume of carbon unites with two volumes of oxygen. The heat given off by the combustion of one pound of coal where the product is \( \text{CO}_2 \) is about 14,000 heat units. Suppose we have a poor draft or do not give enough air to the fire only one volume of oxygen will unite with one volume of carbon, the resulting gas being \( \text{CO} \). If we burn a pound of coal under these conditions we get only about 4,000 heat units or less than one-third the heat obtainable by proper firing. It is strange, then that there is such a variation in the amount of fuel consumed at different times? Is it therefore not advisable to take out the ashes from under the grates so the air can get to the back of the grates as well as to the front, at the same time saving the grates from being destroyed? Is it strange that the fire will be hotter when the clinkers are removed from it thus allowing the air to get to the fuel? Can a person get good results when the coal is piled on so thick as to stop all passage of air? Is it economy to have chimneys just about one-half as high as they should be? Care, however, must be exercised so as not to furnish too much air otherwise the surplus will take a lot of heat up the chimney.
which represents a loss. To avoid this the fire should be fired so that there are no holes in the bed of coals and that the bed of coals is not too thin. From this we can see that the man in charge of a boiler can do much toward cutting down the expense account of a plant. He must use his head as well as his muscles. A man cannot be judged a good fireman simply because he can shovel coal. In case of an emergency, such as low water foaming he must know just what to do and have decision enough in his make-up to act at once. If he has low water and is wise he will not rake out the fire, thereby giving the fuel the oxygen necessary for a rapid combustion, but instead will dampen the fire with dirt or wet ashes. You may say, if he is careful he will not be caught with low water. Very true but with all things that a cheesemaker must look after, it may happen to the best of men.

Should there be two men working in a factory let just one man attend to the boiler. The old saying, "Two cooks spoil the broth" is particularly applicable here. One will continually think the other is tending the boiler and it is just a question of time when there will be a serious accident.

Let us turn our attention for just a few moments to the engine. In the ordinary cheese factory it will probably be of a simple slide valve type. It may be new or it may be one that has seen service for many years. There are several points which he should observe before starting. He should see that the governor is in good working condition and that the belt running the governor will transmit the power required. It may be too lose and slip continuously. To observe this is very essential. The governor should be one that if the governor belt flies off or breaks, will stop the engine automatically. A severe accident may be averted in this way. Owing to the fact that the operator cannot always be near the engine, no other type of governor should be in a factory.

One of the most perplexing and at the same time annoying things around the factory is to have an engine that pounds. Why does an engine pound? This is indeed a difficult question. It may be that the bearings, etc., are too loose, but the chances are they are too tight.

I, for my part believe that more engines pound because some part is too tight than too loose. It may be that the clearance is not right, or the engine out of line. To locate a pound in an engine is no easy task. A person can stand beside an engine and hear it pound, and imagine it is in several different places,
but when he tries to apply the remedy, ah! that's a different story. It requires patient, systematic work but the satisfaction and piece of mind it gives a person to locate a serious pound is surprising.

It is a good policy once in a while to take the cylinder head off and give the inside a good bath of kerosene to clean out the old gum, especially is this advisable if a poor grade of lubricating oil has been used. This cleaning may also reveal some creases or scratches in the cylinder. Should there be some they should best be remedied by applying graphite and oil to the inside, which graphite will get in the scratches and cause the inside to be almost as smooth as the original cylinder.

There is an old saying, "Let well enough alone" which every person should heed, but it should not be an excuse for shirking our duties. It does not mean that we should never examine the bearings to see if they are too tight or have grit in them. It does not mean we should never take a proper position, having the proper lead at each dead center of the engine, for by watching the lead carefully we may be able to have a smoother running engine and incidentally save an immense amount of steam.

To let well enough alone does not mean that we should neglect the appearance of the engine and allow all the drip from the steam chest and cylinder to drain on the floor, making an oily mess around the engine, instead of piping it to some convenient drain.

To take care of a boiler and engine requires attention to the small details. How much better does a boiler and engine appear if kept clean, with a clean floor around them, and really how long does it take to keep things clean? How much better does an operator feel if after trying his safety valve each day and his water glass several times each day, to know they are in good working order?

In closing let me speak just a few words in regard to his duties just before he leaves his factory. Of course, he has his boiler full of water which is proper, he has shut off the main steam valve and drained the pipes and engines, etc., to prevent any serious trouble in case of cold weather, let him then take a glance around and see if everything is safe from fire. Many persons apparently delight to have a lot of unsightly oily rags or waste lying around. Burn them up. Now waste is too cheap to run the risk of a serious fire. If you have received a lot of slack coal to burn, keep an eye on it. Of how many fires, do we read in the dairy papers, of cheese factories or creameries
burning, that may not be traced to carelessness on the part of somebody. A defective flue, a bearing not oiled, the coal banked against a hot boiler, matches scattered promiscuously, some oily waste in a corner among some old kindling: A fire starts in the absence of the operator and the factory is destroyed. He is required to make an explanation and tells the same old story in the same old way,—"I don't know how it happened. When I left the factory, the last thing I did was to close the fire and ash doors and the fire was out anyway."

Poor man! He may not know exactly how it happened, probably not until he has shuffled off his mortal coil will he find out he true cause of that fire. After the long and tedious journey he arrives at the pearly gate. His card is sent in and without the usual delay he is at once ushered into the presence of St. Peter, sitting at his desk in his gilded office with beautiful pictures hanging profusely on the walls. After a few words of greeting, for St. Peter is noted for the cordial receptions he accords Wisconsin Cheesemakers, he invites him to sit down while he beckens his clerk to bring the record book for Wisconsin Cheesemakers and upon receiving it turns to the index and soon finds his account. Adjusting his gold rimmed spectacles he carefully glances over the ledger and says, "Very good, my friend, very good. Your record shows you always kept your whey tank clean. You fired economically and kept your engine and boiler neat and tidy. You paid by the test and your tests and weights were honest. You nearly always turned out extras and only received a cut in the price once or twice and I see that you got a high score at Milwaukee in 1905. I see you treated your wife kindly and confined your smoking within the proper limits. In fact, you have a very good credit side, but I see charged up against you that you were careless and allowed the ashes to accumulate thereby burning out the grates, and that once you had a defective flue in your factory and in your absence the factory burned down. I am sorry but under the circumstances I cannot do better than give you a seat in the 21st row from the front, and while you may be able to plainly hear the celestial choir, still I would rather were it in my power to do so, give you a seat on the front row along with Mr. Baer, Mr. Aderhold, Mr. Luchsinger, and other prominent cheesemen from your state."
DISCUSSION.

Mr. Scott: I understood Mr. Benkendorf to say in his paper that rain-water was preferable for use in the boiler, as it does not form scale, is that right?

Mr. Benkendorf: It is the best water we can use, because it has no carbonate of lime.

Mr. Scott: In the city of Sheboygan a short time ago, one of the best engineers told me that there they have to alternate using rain-water. They had to use rain-water because they could get it cheaper, as they have to pay for their water, and that rain-water gradually spoiled the boiler, it soon wore the boiler out, and it was found so in the city of Milwaukee. The two big concerns that used rain-water had to cease doing that, they had to alternate, they could use the rain-water, but had to use different water occasionally. I speak about it because it was brought to my attention, and some cheesemaker might have rain-water and spoil his boiler.

Mr. Monrad: In what way would it spoil it?

Mr. Scott: I could not say, it corroded it; the boiler gradually grew thin and gave out.

President Aderhold: Mr. Benkendorf, have you ever heard of such things?

Mr. Benkendorf: I said in one place that it seemed as if some little scale in the boiler is very beneficial; if the scale is not very thick it is beneficial, not over 1/16 inch. It is beneficial because it prevents the acid that is in the water from affecting the boiler plate. Otherwise, if everything is all right, rain-water is the ideal water with us, and in the northern part of the state we have a soft water which is a very good water. In the southern part of the state we have this limestone water, and it is not so good, hence we have to resort to chemicals to get rid of the lime.

Mr. Scott: I understand that was the fault, and this gentleman whom I am speaking of said he could not explain it, but he said the boiler seemed to be eaten away inside and gradually grew thin, and all of a sudden it would go to pieces.

Mr. Benkendorf: Most of the corrosion is caused from the outside. There will be some water leaking onto the boiler from the outside, it may stand in some part of the building where the rains can get on, but most of the corrosion is from the outside. In my experience there is a lot of sulphuric acid in the soot, and that affects the iron.
Mr. Luchsinger: I want to ask Mr. Benkendorf whether I am right in gathering from what he said in his paper that ordinary sal soda is just as good as anything to cleanse the scale in boilers.

Mr. Benkendorf: Of course, the best way will be to have your water tested to see whether it is really carbonate of lime that is causing the trouble. I am assuming that to be the fact, and in that case sal soda is the best thing that I know of. We have made something like one hundred experiments in testing different chemicals and we have gone back to sal soda; it is the best and the cheapest.

Mr. Moore: I would like to ask Mr. Benkendorf if they have ever used buttermilk or whey to try to get the scale off the boiler.

Mr. Benkendorf: I did not hear you.

Mr. Moore: In my travels as inspector I came across a factory in Grant county, where the water is very hard, and the buttermaker had been using for quite a period of time, buttermilk to get rid of the scale. Now the action of it was simply this, that it caused the boiler to foam, and it would break loose the scale and it could be all blown out when the boiler was blown off. Now, I know that is so, for it has been used in some creameries. I know of one case where the milky water that was used in washing the butter (on account of the pump being broken, or something of that kind), in order to save the water it was used in the boiler and just as soon as enough of it was in there it caused this foaming of the boiler, and when the boiler was cleaned out, to the surprise of the maker, the boiler was just as clean, practically, as a new one, and if some makers are troubled with limy boilers, a little whey, of which they have plenty, will help them out.

Mr. Scott: I know that to be a fact, and I know it to be a fact that I ruined an engine for that very reason; I put it in and the boiler foamed, and the foam carried all this scale and cut a horizontal engine so that it was an oblong; I had to go to work and take that all out and put in new rings, and have them bored out and true them; it did that in the space of two minutes. I would not advise any one to use buttermilk in a horizontal engine.

Mr. Moore: Mr. Scott could have obviated that by turning on the steam valve and letting the steam into the sink, the object would have been attained and the engine would have been preserved. It is not necessary to start the steam out of the boiler, but the engine, if you start it out quickly into the wash sink, or into a basin of hot water, you will attain the same result.
Mr. Scott: If you are working the engine for all it is worth, it will gradually draw moist steam, and if you have anything at all that will make the boiler foam, it will tend to injure the boiler. My idea is to keep anything out of the boiler that will make it foam while using it.

Mr. Moore: I do not want to put it in unless I want to clean the boiler out.

A Member: I think the gentleman said in his paper that the pounding of an engine was hard to be discovered. I would like to have him tell how to discover it.

Mr Benkendorf: If a man is sick, he asks the doctor to tell him what is the matter. The only way is to apply the remedy here and there. You can always tell,—a man in my experience has to experiment, I could always pick out the students that had a great deal of experience and those that were just beginning to have experience, those without experience could locate a pound at once, without any trouble, but those with experience could not do it so fast, but when it came to locate the point really, that was a different question, because it is like a will-o'-the-wisp, you think it is here and it is not there, it is somewhere else and it is a very difficult thing to locate the pound of an engine, and if you can locate it, it gives you some satisfaction. You will have to apply the remedy slowly.

THE VALUE OF COMPETITIVE CONTESTS.

J. G. Moore, Madison, Wis., President Wisconsin Butter Makers' Association.

The competitive contests as a factor in improving the quality of butter and cheese has passed the experimental stage. The idea of a monthly scoring contest, I believe, is an importation from Denmark, where the government has placed its seal of approval upon it. It appropriates the sum of ten thousand dollars annually for this purpose and has a system of judging whereby the butter or cheese is scored by three or four sets of judges acting independently of one another.

In connection with this, it has what is called a "surprise call" where the makers are compelled to send in their exhibit from