Milking Machine Function - Systems Analysis and Possible Relationship of Milking Machine to Mastitis

John C. Dahl, *D.V.M.*
President
Dairy Equipment Co.
1919 S. Stoughton Rd.
Madison, Wisconisn 53701

I started my career with Strep agalactiae. And then became interested in staphs and recently we have had an interest in the coliforms. We have a dairy herd, and like so many of you who may be involved in agriculture, we know there is a lot of money in agriculture because we put a lot of it in there! We have had some problems in our dairy herd with coliform organisms. We have about 90% of the animals with a leucocytes level (reading on a WMT) of under 100,000. I think we have a population that is very susceptible to acute infection, and, if our management falls apart, we end up with an acute case of mastitis. This can be embarrassing–I would guess we lose about three to four animals a year. We have made arrangements with the rendering company to pick those animals up after dark! Dairy farming is tough–I have worn different hats over the years. I practiced as a veterinarian for 15 years–I can say I won my spurs there, and became involved in our dairy farm in 1966 and 1967. In the last few years I have been in industry, but I can tell you that, in my opinion, far and away the most difficult role in this dairy industry lies with the dairy farmer. So this afternoon we should all be thinking in terms of what we can do to assist that dairyman. It is a pretty tough job. We have five fellows working on our farm and our farm manager puts in 14-16 hours a day, seven days a week–he is a pretty stressed individual. We have to be sympathetic with him. Our management is good I would say. Good five days a week–the only problem is we don't know which five days in the week are going to be good! And so we slip on our management and say, "Well, we should become more efficient–we should do a better job on the farm." And my own opinion is that we are doing a pretty good job in agriculture. I know they are going to tell us tomorrow that the dairyman has to get more efficient; agriculture has to become more efficient, and as I have worked with veterinarians, in industry etc., I don't regard efficiency all that highly. For example–presently in our own plant we are improving our efficiency and recovering lost time by 20%. What does that mean in a work force of about 400 people? We are going to lay off about 20% of the people. If all of industry became 20% more efficient than we have been, what kind of a layoff would we have? How many unemployed would we have? So maybe we have to be content with loafing along at something less than total efficiency–we'd have the unemployment role so high we would all be working to support the ones that are not working–so we might as well have everyone working at 50% and everyone doing something. It is like the endocrine system, you come up with a quick answer but what really annoys me is when they say the farmer should get more efficient–that just plain burns me up!

I am going to speak primarily on the milking machine, but I always feel I would like to divest myself of that interest just a little bit because I think I have a reputation as the guy who cures all mastitis problems with a milking machine! In fact, we started out with a primary interest in the bacteriology of mastitis. In Wisconsin that really represented an interest in *Strep. agalactiae.* We based our program originally on the diagnosis of *Strep. agalactiae,* and I was collecting Hotis samples, transferring on to blood agar, and then the identification and treatment of all the infected quarters. We did run into a number of herds where we did not seem to make much headway–Staph problems and some others. Following the original work of Schalm and the California Mastitis Research Team, we became interested in the milking machine and tried to tie that in. If we do a good job in sanitation, cut down on the number of organisms in the area of the teat orifice, we are going to do a better job. If we do a super job in our sanitation, we may live with pretty inadequate systems. So the whole thing has to tie together and I want to talk a little bit about that. We want to tie in what we really know about the milking machine. For over 10 years we have been doing a lot of talking (15 years I guess on the role of the milking machine). We started out, I remember, when we said that most pumps in the early '60's would deliver about two cu. ft. of air per unit. We thought that was not enough so we came up with some pretty high air flow rates and we suggested you should have four cu. ft. of air for the New Zealand standard, four cu. ft. of air per unit for buckets, and we ought to have eight cu. ft. of air per unit in pipelines and parlors. People said, "My God, what

are you trying to do? Get the thing up in the air?" "How much air flow do you want?"

If you look at the standards and the optimums proposed by the American Association of Bovine Practitioners, you will see they are talking about 25 CFM per unit-pipeline or parlor-as optimum. So we have trebled those air flows and what we thought was excessive only 10 or 12 years ago. So what are we really trying to do? Well, going back and thinking in terms of the milking machine-the way they work basically-what we are trying to do with that milking machine is always move milk from an area of high pressure to an area of low pressure. We start that out in our preparation of the cow for milk letdown. As we start out the pressure in the gland is approximately atmospheric. After we prepare the cow, we build up a positive pressure in the gland and that loose sphincter old cow will start milking as soon as she hears the pump start, or maybe even by noon she is dripping. We will build up a positive pressure so that there is enough pressure gradient across the teat sphincter; open the sphincter and start to milk. Now we can get that milk out a lot faster if we open the sphincter wider for a longer period of time-and we do that by applying a negative pressure below the teat-a vacuum-and that's what we create with our vacuum pump. So we create a vacuum and move the milk out more rapidly. Interestingly enough, when we first started and I talked to one dairyman who had a bucket system-I thought it was a fairly optimal bucket system-he said, "We have got some problems here. I think this particular liner does not milk my cows out as well as it should do." So I talked to an engineer at DECO and I said that we would take a look at our inflations to see if the inflation was adequate. Now this was a fairly high-producing herd of cows at the time-that was up around 16,000 lbs., and back in '62 -'63 that was pretty good. So he viewed our own training film which we used for a presentation to dairymen, etc. What impressed him as he watched it-while in the open phase of the liner, the milk moved out of the gland into the liner-was that the milk did not move out of the liner until the collapsing phase of the liner. He said "That's wrong. That milk should be moving right through. As the liner opens that milk should move right through because as the liner was closing, the liner then was compressing-bringing about a positive pressure and was forcing the milk out of the stem of the liner into the claw." He said, "That's wrong. When the liner is open, that's when it should be moving through." So what's the problem? Well, going back to the literature, Phillips, many years ago, published a paper in which he said that when the liner closed it compressed everything within it, and when it compressed it would force the milk out. On the opposite phase-when the liner opened, it created a vacuum. Now milk moves from the area of highest pressure to lowest pressure. When you open that liner, you create a vacuum-and what was happening, the liner was opening and creating a vacuum, and that vacuum was greater than the vacuum existing in the stem of the liner and in the claw. We had a reverse flow of milk in the stem of the liner back against the teat orifice. He further showed that if the liner had crept up and closed the annular folds and started to compress against the teat wall, it built up a high pressure against a small orifice. And you know what that constitutes-that constitutes a jet and carries bacteria into the gland. It has this capability of not only injecting from below the teat into the teat-but from the teat into the gland. Researchers at NIRD have shown again that it may damage tissue-teat tissue itself-and also that it can propel bacteria back to the teat orifice. Now, what they have said essentially is that if we ever superimpose an acyclical fluctuation on to a cyclical fluctuation we are going to increase the incidence of new infections.

On Tri-Vet Dairy Farm-which is ours-we have a 2" low line curb-mounted weigh jars and 12 units. We wanted the option to milk either into the low line or the weigh jars and we have that option. For the most part we milk through the jars, except on the weigh days, or with a fresh or treated cow-then we would hold it in the weigh jar. Folks out west have always been kind of adamantly opposed to the use of weigh jars, but it is interesting to see more and more weigh jars as you travel on the West Coast. Now, preparation of the cow for milk letdown is very important and the extent to which you want to involve yourself in towels, and all the rest ot it. All we do is wet the lower surface of the gland and teats. We are going to get into some proble (s I think as we go into more and more stimulating stalls because if you take a cow that is very dirty, put her through a stimulating stall (in fact, they are not wash stalls, they are stimulating stalls)-and you get a lot of water on her, you bring in a cesspool on four legs and you get a seepage of all that coliform-laden water coming down the cow and into the top of the liner and possibly gain entrance into the teat liner and be injected into the gland. So, we really don't want to wet the whole cow-just the lower udder surface and the teats. At one time we used to go through this procedure of individual cloths for each cow when they were washed in between milkings and we felt we had a good rough surface for stimulation, plus a sanitized cow. My own impression now is I would use my hand to remove any dirt and physically let the water carry it away and I would not bother with any sort of a wash towel at all. I think the actual physical removal, and the flowing of the water, is adequate to use in terms of preparing the cow for milk letdown. You can use a strip cup if you wish-I think you should draw off the foremilk, that milk which is highest in bacteria and leucocytes and properly done you will observe the character of the milk and withhold that milk from the milk supply. I don't think it is totally necessary that you use a strip cup. At the mastitis seminar I heard people speak of different ways-one fellow carried a part of an inner tube over his arm and just squirts it onto

that-another instance where they just put a plate on the floor and fire the milk on the floor and take a look at it as it goes across the plate. The strip cup is a little cumbersome and if you are going to try and milk as many cows per hour as we would like to do now, I think these other methods are preferable. My own preference is just to direct the milk onto the floor of the parlor.

Drying the gland is extremely important and we should keep getting back and telling the dairymen that this is the thing to do. We don't want to wet that cow down excessively-we want to give her a little time to drip dry and then we want to thoroughly dry the gland before applying the unit. This is a step that is not followed out very well at all, but it is a worthwhile step-it furthers the stimulation of milk letdown and then we are going to apply that unit to a dry gland and, as Dr. Newman pointed out, it is going to help us control the coliforms. As to the importance of machine-stripping-I think it is important in about

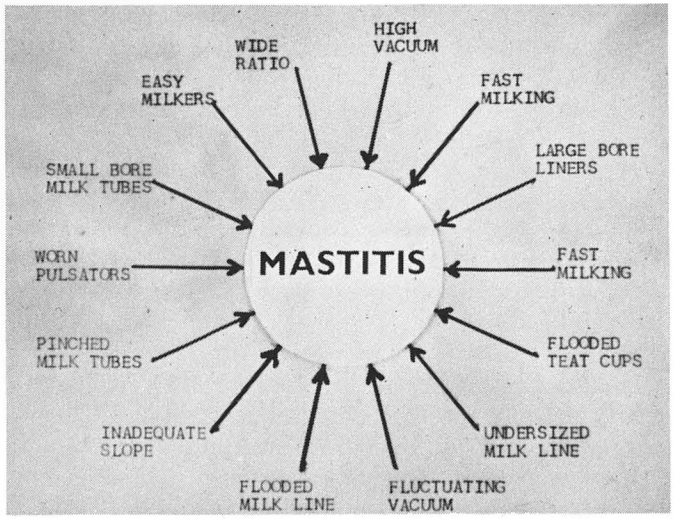

Figure 1: Factors predisposing to mastitis.

five out of 100 animals and this is interesting as we start to move into automated milking systems. I believe every major manufacturer today is coming up with some sort of an automatic detaching device. About five out of a 100 will not milk out adequately with a takeoff unit-but 95 out of a 100 will! So you're not going to schedule your whole operation around the "pathological individual"-we'd call those 5% "pathological" and if you want to keep them in the herd all well and good-otherwise you better let them go because if you start to automate these systems we do have easily the capability of moving 100 cows per man-hour through a parlor. That is substantially better than the 30 we were doing 10 or 15 years ago on a good farm and in many parts of the country today.

Now, teat dipping is, of course, most useful but I always like to say something negative about teat dipping. I would rather have a good healthy teat end than a sterile teat end if it resulted in dehydration of the tissue in the area of the teat canal. I'm not totally sure what this problem is, but I know we are going to see it about November or December on through January, February, March and April-and then we'll be out of the woods again! We start getting these calls from dairymen and veterinarians saying that the milking machine looks to be tearing the ends out of the teats-talking about scabby teat ends, etc., and it's dehydrated tissue for the most part. We did have one instance on our own farm where it was directly attributable to the teat dip-we ceased using the teat dip and within two weeks the lesions had healed and we could just pick them off. We then sent a portion of that material over to the Ames Diagnostic Laboratories and they used it and reproduced the lesions in their herd. There are very many things attributed to this-not only the teat dips, but also the environmental humidity, over-milking, vacuum levels, etc. So we will follow what has been suggested-that it's a virus. It starts out almost like a cold sore on the end of the teat-the tissue is edematous, then ruptures. It is difficult to clean and you would end with a 10-fold increase in the numbers of new infections with these animals. Right now we are using the teat dip that I'm perfectly sure does not have bactericidal properties, but has a good cosmetic effect. We have healthy teat ends and we don't have problems. I know teat dipping is important-but not to the point where you get into problems with the teat ends-then you really have trouble!

I think the paddle test is a most useful test-we use it on our herd and all of the herds I ever worked with. On mastitis control programs I insist that we draw individual samples on all of the quarters. I never bothered to read it in gradations-I just read it as negative/tracer/positive-I don't really care if it is a million or 14 million-she has a problem and that is all I am out there to identify. I love the Wisconsin Mastitis Test because you can draw a composite out of a bucket or out of the weigh jar and have these samples brought in-you don't want to violently

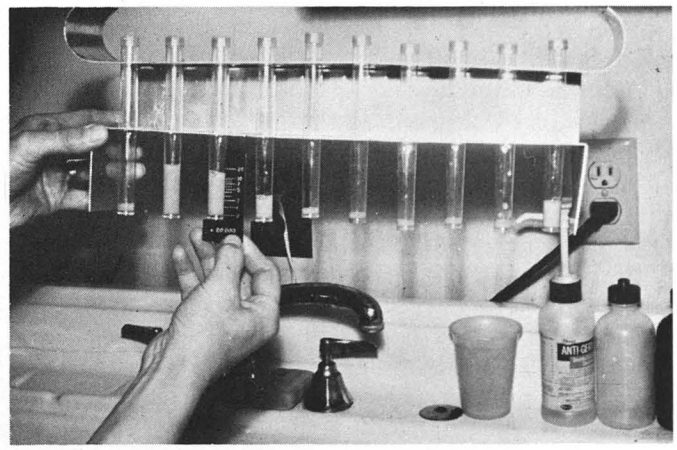

Figure 2.

agitate them-bring them in as fresh as possible-then you have your multiple dose syringes and you can do this in your own lab-taking equal parts-it's a quantitative test-two ccs of each reagent and the milk and then rotate gently-invert it sharply for a specified

length of time and then take a look at it. *(Dr. Dahl showed a slide of the Wisconsin Test.)* What we are looking at here is the farthest tube on your left would be under 100,000 and we have one with a couple of million. As far as I am concerned, if the bottle is empty, you do not have a problem and if it is full you have a real problem–I don't really worry about the regression curve. Again, I am identifying a problem. So here we have two million in the one instance–the second tube on the left and then we have a million and then about 500,000–we have five that are under 100,000 and one about 500,000–so we have four cows here we need to look at more closely. In my experience–in going back and culturing very many of these individuals (if not all of them), as well as the negatives, if they are negative, you really don't have anything going there and if they are positive, then you do. Almost invariably, if you have followed good culturing techniques you will recover pathogens from those quarters.

I like the milk production graph. After our charting the animal came in at 60 lbs., she spiked up to about 62 lbs.–she should have followed that normal descending level of production. However, she did not–she dropped off very markedly. She had Strep-*agalactiae* in the right rear quarter and the left front and we can now follow through and say she should have been to 59 lbs.–she was at 45 lbs. which is a deviation of 14. We multiply this out by days of the month–420 lbs. deviation and we can follow this right through lactation and what this really is costing us. It's been my experience–not alone in veterinary medicine, but computerized printouts, all of these things you are not handling or making the entry yourself, you don't get nearly the information out of it as if you were putting it down yourself and following it on through. We find this in our business. Our computers are a great tool, but if we don't do it manually we certainly do not use the material nearly as much. I have heard colleagues say that in some herds they have worked with that at least 50% of the fresh cows had to be treated because of a high incidence of metritis. These animals will get off to a slow start if you don't do something about it.

I still favor culturing–as I indicated–if you want to scream at the Wisconsin Mastitis test then take the sterile sample! I wouldn't change my own approach to it. I think blood agar is the best we have available and it certainly is the cheapest. I did a lot of work with different agars and the selective media. I found that while they were selective to inhibiting the pathogens they did to quite an extent also inhibit the pathogens I was looking for in the form of Strep *agalactiae* primarily. So I like blood agar–it grows almost everything and it is easy to read. No veterinarian can tell me that it is too costly to set up a laboratory–it cost about $8 and that was for the wafer-type thermostat of the chick incubator. The Hotis test is pathognomonic for Strep *agalactiae.* Minnesota used to have a very high incidence of Strep-ag and all you had to do was dry your samples in your Hotis vials and set it on the hot water radiator overnight and read it in the morning! You had a built-in incubator and this thing would really grow. Strep *agalactiae* is a big problem, with 50% of the cows in the state of Wisconsin infected in one or more quarters. I always get a kick out of it when they tell me the dairy industry of the future is going to be in the south because they buy most of their replacements out of Wisconsin! Well, you can figure that out pretty fast–if 50% of our animals are infected in one or more quarters and we're selling them south, we are not that stupid–we know which ones to sell! So if you didn't have it before, you have it now and that is something we have done for you!

I have a lot of concern about what antibiotics are going to be available to us. I think I could practice quite comfortably as long as I had 100,000 units of penicillin to inject into enough quarters because my experience with Strep-ag and penicillin was that if I could go through and treat three times at 12-hour intervals I would have at least a 90% cure rate in almost any herd and then come back three weeks later and pick up the rest. Penicillin is extremely effective by itself against Strep-ag and I continue to think antibiotics are basically useless, but if you are selling them they are a dandy thing because anything you can sell is good! What are we going to do about staphs? I'm going to try and control them. Primarily my experience is that the super jobs, in terms of your sanitation, will help you immeasurably. Teat dipping certainly helps with the staphs. We went through our herd and found that if we had cows with between 100,000 and 300,000 leucocytes we would have many of those quarters harboring *Micrococcae, Lactobacillus,* and some of the creamy species. I think that leucocyte levels of between 100,000 and 300,000 depressed secretion by about three pounds per day. If you want to get all of those cows down with leucocyte levels under 100,000, you better know you are going to have a susceptible population. Unless you are better managers than we are, and you can make sure you have good management seven days a week, you will have your share of problems. But you could probably make the same arrangements with the rendering company that we did!

Escherichia coli is an interesting organism–most frequently it is a contaminant. I would have to have a high leucocyte level as I would with Staphs and a long recovery with the organism before I'd say that I had a coliform infection. When you open the incubator door, you will never forget the smell. I remember it so well because in the 4th grade we had a kid there that wore the same sneakers all summer and never changed his socks either and every time I open the incubator door I remember him and wonder how he is doing. We go through three full diagnostic procedures–California Mastitis test, blood agar, and the Hotis test and then we make a summation of those three tests and suggest treatment. In 1960, a dairyman told me that he thought he was spending too much money on strainer pads. He was using six strainer pads a milking for 32 cows. But he didn't

think it was all that many because his neighbor had 28 cows and he was using seven strainer pads! We went through his herd and treated all of the cows. In one month's time we had him down to one strainer pad and he was perfectly delighted with the results. So certainly now we know more about the economics of what this disease costs us!

I really favor milk production graphs and I think the dairyman should be entering these. You can go with a printout on your computer but there is nothing like entering these on to the graph and working with them. A computer printout just too often is not checked. There are other things that are more important and they don't read it across. If you put the figures in, you scratch, and you take a look and make the calculation of the deviation and it is going to sink in a whole lot more! I really think we should emphasize that you have to involve people if you are going to get a response. You do it all for them and it will not work. Give them a computer printout–essentially that is all done for them and it will not work. We have had this experience where we are trying to get our labor reporting on to a computer printout and the best we could get it down in the shop would be 48 hours after the fact and where we are now working we have installed a system whereby we can report back to the foreman what transpired in the previous hour. So, we are right at the date. This is all done manually and we do not expect to put it on a computer. The greatest reason it worked is because people are involved in working with the figures and there is an effort involved. I don't care what your program is, if you do not involve the dairyman he has to do some scratching and it is going to take some work–but if he is not involved, your program is not going to work.

If you ever want to know what the dairy equipment company–how they are advising their dealers in terms of installations, drop me a note and we will send you some of these sheets. If you are not familiar with the figures I suggest you refer back to the AABP recommendations because literally we just took their recommendations and put them into a format for our own company use. It seems to me that if all of our dealers were putting in systems that conform to the minimums or optimums suggested by the AABP we would reduce a lot of arguments. And, furthermore it is interesting the way these things do take place. I remember some years back when the first figures put forth on milking machines consideration by the AVMA were lifted from Noorlander's work and after that Noorlander started to quote the AVMA on recommendations! That was a little bit embarrassing. Now the AABP has come up with these recommendations and we're simply saying that they are acceptable to us and we will adopt them for our own consideration. Now we like to know the dairyman's name, who is the veterinarian involved, if it is one of our own people making the system check–dates, and whatever other information is necessary. Let's take a look at how good this checkout system is. The No. 1 thing to check out is the vacuum pump performance. Here I'm not going to talk about the water seal pumps because I am really not familiar with them–they are primarily more in the southern areas–but this is a rough rule of thumb. If you want to go into a barn and wonder if this system is adequately pumped, take a look at the horsepower rating on the motor. You cannot move more than about 20 CFM's per h.p.–New Zealand standards–and if they have a five h.p. motor, the total capacity of that pump properly pulling would be about 100 CFM. So you can use that as a pretty rough rule of thumb if you can get the dirt off the motor you can take a look and if it is 20 CFM per h.p. and that's pretty standard with all of the vacuum pumps. It takes a lot of work to move 20 CFM. We should put down the actual make and model and the h.p. and how you are reading it and the American or New Zealand standard. Now checking the system out, this particular system has two PVC lines on the far side. Now the one line goes over to a moisture trap serving the milking side of the system and the other PVC line goes over to the moisture trap serving the wash manifold and the side of the system. The 1½" galvanized stub pipe coming out of this other end is a line we cap for this purpose but which goes over to the pulsated side of the system. So we would like most of these vacuum reserve tanks to have three leads coming off so that we could set up in this fashion.

We check with the air flow meter right at the pump. We want to know what is the pump capacity right at the pump. And from that point we will be back down a system to find out what sort of efficiencies we are gaining. *(Dr. Dahl showed a slide of an air flow meter that will measure 99 CFM. The top ring lets in one CFM per unit and the lower ring 10 CFM.)* Let me caution you when you are going to check these systems open your air flow meter before you start up the pump. I tell you what I did one time–I went with Hinman system and it had a releaser on it. I put my air flow meter on "closed" and turned it on and let the vacuum level build up and it turned the releaser inside out! That was an hour before milking! Now that is embarrassing! And it is pretty hard to fix a releaser once you've turned them inside out!

So you open these vacuum gauges and then you gradually start closing the orificies until you maintain a vacuum level of 15". Then you count the orificies and we can say that in this pump we are moving in 100 CFM or whatever it might be.

Vacuum balancing tanks are now becoming quite popular–we should note the location, size, type of drain, and location of the drain. We have a vacuum balancing tank. There was 500 CFM on this particular system–pumps hooked into a common header and then coming off with a PBC line into the balance tank–those two larger PVC lines going out to each side or going down the moisture traps serving each side of the parlor, is a separate system. Then we have coming out of each end of the tank, separate lines which are going to serve the pulsator side of the system. PVC of this would be about a schedule 40–it's

a good line to use. Most dealers do not have the equipment to properly thread and work with 2½ or 3" galvanized so they would use PVC. The only thing you can run into is that many times it is glued together as a continuous line and so, how are you going to check any place in it? You may use rubber collars, but very often it is hard to get into. Now you will note on the top of that vacuum balance tank, there are eight regulators. Eight or ten. We usually figure one regulator for each 50 CFM. In my opinion, the greatest benefit of the vacuum balancing tank is that it is a handy place to hang pipe and it is a good place to put the regulators. Because regulators used in this industry are not really that critical of an instrument. We have always thought that a regulator should sell somewhere between $15-$30 and so for that type of money you are going to get great sensitivity. If you put them into areas of great turbulence, putting two or three into a common pipe, 1½" or whatever, then you get a lot of turbulence going through those and they tend to hum. When you put them separately on to a vacuum balancing tank you make a pretty good instrument out of your regulator. This, in my opinion, is the chief gain made–to improve the performance of the regulators when you place them on to a vacuum balancing tank. Again, you also keep extraneous matter from going over into the pumps and that is another useful point. But the balancing tank doesn't really do as they claim or as suggested–it does not really balance the vacuum. We have regulators coming to the market selling $300-$500 to maintain a more stable vacuum. They are pretty critical instruments. Perhaps the industry is ready for that.

How do we measure the system capacity? Sometimes you may have a flapper valve on the end of the drain which leaks if you shut off the sides of the system going over to the pulsator to the wash and check at one point on the reserve tank, you can determine whether or not you are maintaining the pump capacity. If you are moving 99 CFM on that pump, then you should only lose about 1 CFM at that point. If you are losing very much there, you had better check to see if you have a gasket which is slipped over because you really should not have much air flow loss just from the pump to the tank. Now this is coming over and measuring as a moisture trap. A moisture trap serves the wash line side of the system. These are fairly common installations now incorporating two leads–one to the milking side and one to the wash side of the system. We will see it more commonly as we start to put in wash-in-place manifolds.

Here what we have to do is close the regulator. If you are going to start measuring air flow you have to make sure that air is entering only through the air flow meter and sometimes it is difficult to find the regulators. I have been in several barns where the line has gone up into the ceiling of the milkhouse and they had a regulator up there, and it takes some sleuthing to find out where these regulators are, but you have to close all the regulators. All the air has to be coming in through the air flow meter. A good installation is not too long, no leaks–that if we were moving 90 we wouldn't expect to have a drop of more than nine so we would be about 80 cu. ft. of air measuring at that point of the system. There is a red light there and that is your particular instrument so that it would measure the pressure gradients across the air flow indicator and if you were letting more than eight cu. ft. of air into the system, which would then be decreasing the amount of air coming in through the regulator, this red light would come on. We had one of those in our barn and I suggested to our milkers that with the proper handling of the unit, we would not have those red lights coming on. When we installed it, a red light was coming on each time they transferred a unit. I told them they were handling the units carelessly and they should spruce up and the next time I came back they went through a whole milking without the red light coming on. Now that's really progress! Well, you just have to wonder–they just took the bulb out and that fixed that problem!

Now here's measuring at the receiver jar and if it's acceptable and if you can get into the receiving jar, all well and good, and you can check at this point for measuring your vacuum reserve. Talking about vacuum reserve, we would have all the pulsators in place and operating but the units closed and then we would see whenever we got 10 pulsators we figured two cu. ft. air per pulsator entering so that would be 20 CFM and we would not like to have less than 50-60% total air flow entering of the pump capacity. Because if we can maintain and reserve air 50-60% of the pump capacity, we figure we have adequate air reserve. You have to be careful–you see that's a glass

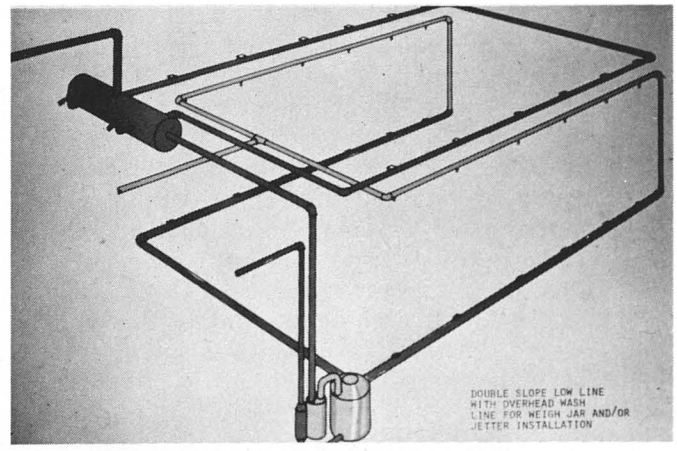

Figure 3: Double slope, lowline with overhead wash for weigh jar and . . or jetter installation.

tee and a glass jar and when you start pulling out of the top of that jar of that glass tee–if it's stuck and you wrench it around and break that glass tee, there probably isn't another one within 50 miles–so again, when you start taking these systems apart you want to be pretty careful because your intentions may be pretty good but if he can't milk for a while, he'll be upset.

Another showing of the air flow meter–another place you might like to measure and it's John Woods' preference, I know–to measure at the end of the milk transport system rather than at the receiving jar. Now you are actually moving the air that is going to be traversing that pipe on its way back to the vacuum pump and if you can just disconnect the line at this point, put your air flow meter in, then you are going to be measuring the air flow that you are having effectively over that system from the farthest point removed. This would be my preference; however, sometimes you are going to have a hard time getting there and with welded lines you are certainly not going to get in there.

I would like to consider here the vacuum supply lines and the pipeline (or milk transport line itself). Generally speaking, one to three units if we are using

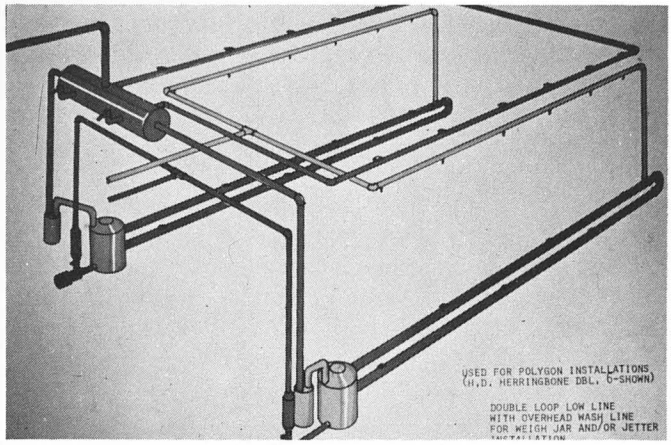

Figure 4: Double loop lowline with overhead wash line for weigh jar and. . or jetter installation.

1-1/4" line with a single line coming out from the vacuum reserve tank over through the pulsator to the moisture trap. We would like to have a 1-1/2" line. With four and eight units, generally speaking, the pipe size we are going to use is 1-1/2" and when we get to 9-12 units, it is 2". I really think that a dealer could inventory just 2" of lines and fittings and be in good shape. The price differential, in my mind, does not justify using anything less than 2" but we will get into some situations where we will use less and it would seem to me for just plain inventory control, it would be reasonable to go 2" all the way. We have the vacuum pump and then it says "vacuum pump filter." This is a small unit with a filter and it will separate out extraneous matter that is coming in through the line because there are a lot of milk fumes and whatever else coming back–it will keep that out of your vacuum pump so it is a good way to protect the pump. Also it has good leads and is another handy place to hang pipe. We come on over there from the vacuum supply line to the vacuum balancing tank and from the vacuum balancing tank to the blue line represents your pulsated line. This is a double-six herringbone parlor so we have the stall cocks mounted on each side. Double-six herringbone set up for six units. The lower line is a double-slope lowline system so that your peak is at the far end of the line and we double-slope our milk coming so actually the milk is flowing from six units from each side of the receiving jar. You need a three-way valve for your washup so you chase the water around in one direction to clean this up. We like to move into these larger lines–the 2" line is practically standard–we have marked decrease in the use of 1-1/2" any more so we are going into the 2" line–that's pretty standard. While the 2-1/2 and 3" are desirable, they are also a lot tougher to wash. I mean a lot tougher to wash! These are inadequate for many dealers in terms of installation as they may have to have assistance from the Engineering Department to properly set up for wash cycles. You must have a good air injector system to blast that around there. Let us be enthusiastic about the larger lines sizes, but let us also admit you can double loop and double slope a 2" line and you might get a better washup than with a single slope at 2-1/2 or 3. You have to watch them. That's part of the game too.

Here is a double-slope lowline with an overhead wash line for weigh jars and/or jetter installations, while moving towards clean-in-place wash manifold. This is pretty handy and you don't have to take the units out in between milkings–just wash them in place. But then you must have an overhead line com-

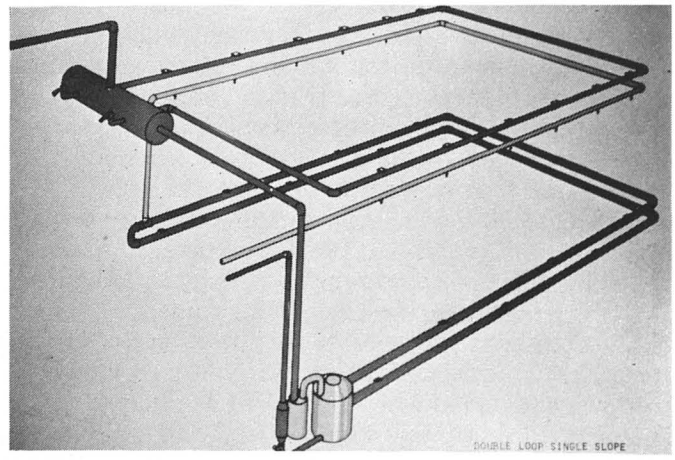

Figure 5: Double loop single slope lowline.

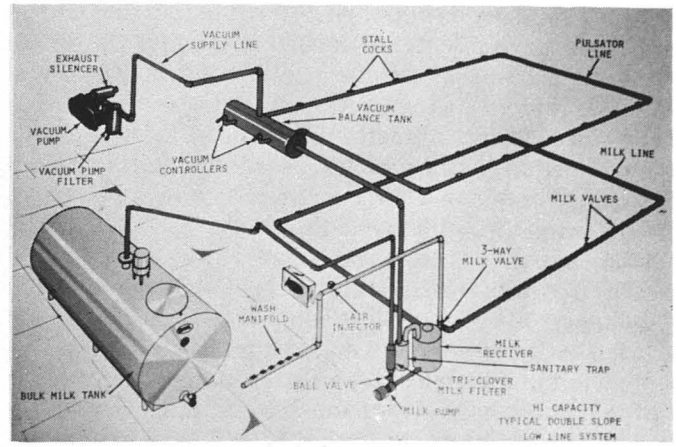

Figure 6: High capacity typical double slope lowline system.

ing from your wash manifold which will serve to go down through the unit. When you do that, you can get adequate washing, but again–if you've got a large size, low line, you are taking away some of the wallop you have in your bunching up of the air and water, and it will be more difficult to wash. What is good for milking also has to be good for washing.

In here, we are getting into a single slope double-loop lowline and this, to my mind, would not be a very adequate installation, because it is difficult to wash.

Pulsator action and milking vacuum is an important area. In other words, when we start, we've got a 15" plant vacuum and we put the unit on to the cow until the milk starts to flow. As soon as milk starts to flow, this system becomes dynamic and the milking vacuum is going to drop. It would drop, in this instance, down to about 12". So we would have 15" on the pulsated side of the system and 12" on the milking side. When a cow milks out, then of course the vacuum will return to 15" on both sides of the system. In my opinion, we talk about the desirability of lowlines and that is where we have gravity flowing the milk into a lowline–that is desirable, but you would have a hard time taking all the dairymen in Wisconsin, Minnesota, Pennsylvania, and New York and converting them over to lowlines. How good do we have to be at what we are doing? I've seen many dairymen do a good job and their systems work adequately where they had vacuum differentials as much as 3". That depends, too, on the rubber so I think lowlines are desirable, but is it the only way to go? No. It's not. You can succeed very well with modest dips and a modest dip, in my opinion, is where your vacuum differential does not exceed 3".

Now here's a very simple vacuum stability gauge, just a vacuum gauge in a rubber teat plugged into the top of a small moisture trap. You might note that the top of the moisture trap where the stainless steel line has been inserted. We have the outlet on top of the line. That's important because if you put it on the side or bottom, you will get a lot of trapping over into your moisture trap and quickly flood and get it up in the vacuum gauge or if you are using a Detco recorder, you'll get milk into your Detco recorder. Now this, in my opinion, is a very fine recorder. It's a sensitive instrument but it is tough to set up again and when I was using one regularly, if it got out of whack on me, I just sent it back to Frank Smith and had him calibrate it again for me. It works on impression paper which is a waxed base and one thing that happened to me one time–I had gone down a fair distance into Illinois and cut tapes and I wanted those tapes badly because it was one of those instances where litigation was possible and I brought the tapes back and put them on the dashboard of my car. When I got back I had wax and nothing readable and had to go back and cut those tapes again. If you are going to use a Detco recorder and you cut the tapes, look after them and don't let them sit in the sun–because you've got nothing you can use. They have to be handled fairly carefully.

Originally the dealer should discuss with the dairyman what he is intending to sell him, what they felt the vacuum pump would deliver, line sizes, etc., and after they complete the installation they should go through and check the system out in its entirety–not alone in the static but when the system is under load. After the dairyman agrees the system is complete and is operating according to the original agreement, have the dairyman sign. One month later it is the responsibility of the dealer to come back and check the system out again and then have the dairyman sign that he is satisfied and that the system is complete and operating as described. If a dealer does that he certainly has fulfilled his warranty obligations and, in essence, he is home free in terms of any further action.

Frank Smith brings together this role of the milking machine and lists all of these points that may contribute to a flooding system which brings about these acyclical fluctuations and interruptions of free flow of milk and air. High vacuum, fast milking, large bore liners, all of these are going to contribute to the inadequacies of the system. This was done simply by observation where they had plastic shells and liners and they could observe the extent to which liners flooded. In one instance, first and second calved cows–do not have that high capacity of milk flow and they were noticing that 27 and 29% of the quarters were visibly flooding. They recovered CMT scores on 24 and 29% of the animals in those strings. On the other hand when they got into higher producing animals, they were running at 45 and 44% of the quarters flooding and almost identical CMT scores. Now the one thing that concerns me about this is that I have never seen any of this work tied into bacteriological studies and I would almost be certain that if they cultured those animals, they would have recovered pathogens. In my opinion, you are not going to start finding CMT scores 500,000 and 1,000,000 where you don't have pathogens involved. In an initial culture you may not recover them but the milking machine in itself does not have the capability. It would be a rare instance where the machine had the capability of eliciting this sort of leucocyte response. What is a good flow rate? We are talking in terms of perhaps two lbs. per quarter per minute, or eight lbs.–that's a pretty high flow rate. When cows get up to that level, those are the cows we like to retain in our herd and those are the ones that are vulnerable and susceptible. Low leucocyte levels and high flowing capacity tend to flood the system and we get into our problems. Smith says that with your vacuum wide ratio or the fast milking cows–we are starting to flood the system and increase the prospect of mastitis in our dairy herds. Now one thing I did not mention is that as we are looking at these new systems we had better start changing our thinking a little bit because in the past, I remember a National Mastitis Council meeting where they suggested there should be an ordinance passed that would limit no more than two

floor pails per man and no more than three pipeline units per man–and that should be an ordinance! I'm going to tell you that today there are two dairies that I am well aware of where one man is going to be milking with 24 units and putting 500 cows through the one parlor. Another man will handle 800 cows through his parlor with 24 milking units, unassisted in the cow traffic to the parlor. Now if we are going to start putting in ordinances that restrict us to two to three units per man, milk is going to be $40 a quart! The industry has the capability and certainly it is going to become more reliable, but I would guess that five years from now the fellow will not be using 12 units–he isn't warming up! So we better be careful when we talk about restrictions we are going to place on this industry because there is a lot of efficiency that can be gained–I don't think we want to lay it on the dairyman and say to this point he has been inefficient–and we don't want to start building ordinances which will restrict possible efficiencies. They are not just possible–they are a reality right now.

Economic Benefits of a Complete Mastitis Survey

Jenks S. Britt, *D.V.M.*
Logan County Animal Clinic
RR 1
Russellville, Kentucky 42276

During a period from January 1971 through September 1974, 23 herd owners in our area came to us with mastitis problems that were about to cause them to be degraded from the milk market. In all the herds, except one, leukocyte counts were as high as 1½ million or more.

A complete mastitis survey covering machine function milking technique, sanitation, and control was conducted on the 23 herds. Recommendations for control were made from the survey's findings, which are tabulated in the accompanying three charts.

Chart I shows the results of the machine function survey. Six different makes of machines were checked. Minimum machine performance standards were taken from the publication, "Milking Management and Its Relationship to Milk Quality," (University of California Agricultural Extension Service AXT 94.) See Chart IV. The herds are listed "A" through "W" and the size of each is shown. All figures in the following discussion are based on the number of herds out of the total of 23 that were listed in the survey.

Twelve of the herds were milked by their owners, but only seven were on any type of individual cow milk weighing program. Sixteen of the herds had adequate vacuum pump capacity of at least 6 CFM (American Standard) per unit at 15 inches vacuum. Reserve vacuum of 3 CFM per unit was adequate in only fourteen herds. Vacuum recovery was checked by allowing air to enter the system for three seconds, then closing the air source. Ten herds had recovery time of less than three seconds.

Vacuum controllers were functioning properly in 14 herds and pulsators were considered acceptable in fourteen. Pulsator speed was between 45 and 60 per minute in 20 herds.

Milking Cycle Graphed

A dual-channel recorder was used to graph the milking cycle. Milk rest ratio (M/R) was between the recommended 35-65 and 65-35 in only ten herds. Twelve had adequate milk line size and only seven had teat-end vacuum within one inch of the recommended 12 inches. Thirteen herds were using narrow bore liners and only six had weigh jars, or low level lines. Fourteen herds had claw flooding problems. Teat-end vacuum fluctuations were found to be more than three inches in eleven herds.

Chart II covers six categories of milking technique that were evaluated. It shows that, in fourteen herds, there was proper pre-milking stimulation and thorough washing of udders. In 17, the unit was being applied at the time of milk let-down. In fourteen herds, the unit was being left on the cow for the recommended five minutes or less, which meant that cows were being overmilked in nine herds. Fifteen of the dairies were machine stripping their cows for 20 seconds or less and 17 were removing the unit in the proper manner. The number of units per man varied from one and one-third to four.

Sanitation Findings

Chart III reflects sanitation and control procedures. In only six of the herds were individual paper towels used for washing and drying the udders. Iodine, chlorine, or chlorhexadine teat dips were being used in only eight herds. There was a mud and manure build-up problem in nine herds. None were using strip cups while milking. All but two were doing an adequate job of post-milking equipment cleaning.

In only one herd was there dry cow treatment in all quarters, although sporadic dry treatment was used in five.

The California Mastitis Test was run on 17 herds and the results were graded: Negative, 1, 2, 3, or 4. The percent of cows showing a 3 or 4 in one or more quarters is shown at the bottom of Chart III. Quarter,