ASHRAE Leadership Recall (formerly Leadership Recalled)

Transcription

Audio Interview of: Milton Garland

Date of Interview: June 21, 1986

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Bernard Nagengast

Milt, where did you receive your engineering education and when?

Milton Garland

At Worcester Polytechnic Institute. I started there in 1915, graduated in 1920, but without one year in World War I.

B. N.

What was your degree in?

M. G.

Bachelor in mechanical engineering.

B.N.

Was there any specialty at that time in refrigeration, or was it really just straight mechanical engineering? Did you learn anything about refrigeration engineering in your college?

M.G.

Yes. In a summer dynamic scores, there was a textbook on refrigeration and we reviewed refrigeration at that time, basically condenser air system and sealed tube system, as well as the ammonia system. And I would like to add to that the absorption ammonia system.

B.N.

What was different about engineering education then versus now?

M.G.

Well, as far as I know I think in thermodynamics they talk more of the basic theories, the basic fundamentals. I find it a lot of the new work, young fellows coming from school into our business and they know about refrigeration but they certainly don't have the basic background that was given to me.

B.N.

How are you defining basic background?

M.G.

Well, how refrigeration relates to the fundamentals of thermodynamics. For example, in our system we find people who know how to operate a system, they know about where the pressure should be, but in their mind they don't see that from the point of thermodynamics, and for that reason they often get themselves into operating problems. In other words, they're unable to analyze what's going on in a system. They know what they've been taught, how it should be, but when something goes wrong they're lost.

B.N.

Because they don't have the basic theory to figure out what's going on?

M.G.

That is right. That is right. When I started with Frick Company, they had a training course where you had to spend a year or two in the field installing, help installing plants, and then later on I had charge of all those people who were installing plants all over the United States, Canada, and Mexico. I had as many as 40 men in the field at one time, I can tell you out of that 40 men all of them were excellent mechanics. When a man called in and said, "look, things are not going right. Send somebody here who can help me out." Out of that whole group about a half a dozen could really do that. And that was one of my biggest jobs, trying to train these people so that they could see what's going on inside related to the thermodynamic properties of the refrigerant. You see, in the refrigeration cycle, so much is determined by vapor pressure, and yet so few people understand the process, and therefore we have a problem here. People wonder why liquid is up here in the condenser and refuses to drain down. They just don't recognize the differences and vapor pressure. The only reason it stays up there and doesn't come down here is a matter of vapor pressure difference.

B.N.

So what it really comes down to is that if you have a man who understands the theory and understands the mechanics of a system, then you've got an unbeatable combination.

M.G.

Absolutely.

B.N.

So, when you graduated from college was the Frick Company your first job? Is that where you went to work?

M.G.

My first actual experience with refrigeration was in the Navy. I entered the Navy and I was scheduled to become an officer and so we had to take training work.

B.N.

What year was that when he went to the Navy?

M.G.

That was late '17 and on into '18.

B.N.

And you said you had to interrupt your college education?

M.G.

Yes, that's right, that's why I last year. And now in the Navy they were using the same air system at that time, as well as some CO2.

B.N.

That was for safety reasons?

M. G.

Yes.

B.N.

So, then you continued on your college career. When you graduated from college did you immediately go into the refrigeration field with the Frick Company?

M.G.

Yes, yes sir. I started with Frick Company in July 1920.

B.N.

Do you feel that the reason you started in refrigeration was because of your naval experience? Did that kind of had you go in that direction?

M.G.

No. Actually, I had a very excellent job offered to me at the Worcester Steel and Wire, but my home was in Harrisburg, Pennsylvania. My father died and I wanted to be near home and so I just went out and looked for a job and Waynesboro is only about 50 miles away, so I got a job with Frick Company.

B.N.

You said when you were first joined Frick you were involved in a training program.

M.G.

Yes. Frick Company has always had training programs. With me, it lasted two years. I think the reason that I kind of advanced was I had had considerable construction experience as a boy coming after school and my talents, you might say, sort of ran towards installation work and so actually I was in training, so to speak, two or three years and then became superintendent of field installation work, which I carried on for 23 years.

B.N.

Commercial development of refrigeration really began in the 1870s. Did you know any of the first generation refrigeration engineers?

M.G.

The first generation of refrigeration engineers were basically the people mentioned in the history books, you know, Perkins, and there were several German people. In 1882 a man named Edgar Penney designed the Frick compressors. Edgar Penney never received the acclaim that he should have because the original compressors were nothing but converted air compressors, double acting horizontal type. The horizontal type never progressed as did the vertical type, because of excess clearance volume. And Edgar Penney was the man who designed the first valve piston single acting, minimum clearance volume compressor which everybody copied. York built that kind of machine after that and copied that basic design which exists today.

B.N.

So Edgar Penney was responsible for one of the great jumps in technology?

M.G.

Absolutely. It really puts refrigeration into practical use. A compressor that with high-efficiency and simple in operation and you know most anybody could run one of those machines with a few instructions and so that's really to me where the big advancement in refrigeration started.

B.N.

Did you know Edgar Penney, or had he passed away?

M.G.

No, he passed away before I got to Frick company. I never met the man, but I've seen so much of his work and how everybody positive examples.

B.N.

Who were some of the outstanding engineers that were still living when he first went to work for Frick?

M.G.

When I first went to work for Frick company there was a man named Oderman with the chief engineer and he retired. Than a fellow by the name of Small, Scotty Small was the next chief engineer and following him was Frank Zumbro, and then following him with myself.

B.N.

How did engineers do the job that then?

M.G.

Oh, engineering wise they were hard to beat because when I first started with the company and was erecting planned in the field they would guarantee that installation supplied so many tons of ice per ton of coal.

B.N.

They would guarantee it?

M.G.

That was guaranteed, and it was one of my major occupations in connection with all of those plants was to make sure that the test run was run in the customer gave and acceptance. All of those plants, I mean when we built plants for liquefying CO2 or for making up dry ice, the man was guaranteed production.

B.N.

Was there a lot of theoretical engineering done at that time?

M.G.

Yes sir. Very much so. Very much so. Everything, you might say was figured from the ground up. Today we have so many charts and tables that people work from, which is okay if they understand the limits of the charts and tables, but we're still doing much, much today that's figured from the ground up.

B.N.

I guess one other difference too, at that time there were no off the shelf components that were available from other manufacturers like there are today.

M.G.

Yes, that's right.

B.N.

And today you can go to a catalog containing condensers and evaporators and nobody was in business back then manufacturing just those things, you really had to find everything from the ground up at that time.

M.G.

Yes sir, that is right. But that is where the success came at that time, as against you might say some of the failures we see today because it's not a matter of buying a compressor, a condenser, and a receiver, and evaporator. They have to be engineered into a system. It used to be that there was the machinery and not more than 50 feet away was the operators, ice tanks and whatnot. Today we have these big food complexes that come more than a city block, and a lot of people don't begin to recognize faults of pressure drop and liquid supplies, such as dropping suction lines. I've looked at jobs just recently where the man had close to 2000 tons of compressor capacity and he was running all of that, yet the work that was being accomplished you couldn't figure it's load much over 1200 tons. The rest was all in losses.

B.N.

Very inefficient.

M.G.

Yes sir, extremely so. And I see so much of that today. ASHRAE is trying to build up a recognition that, look a package unit, factory built is an extremely efficient device because it was engineered, it's compact, and it'll do exactly what they say, but people buying components and putting them together just seemingly do not have talent.

B.N.

Perhaps because they don't recognize all the potential of losses involved.

M.G.

Exactly so.

B.N.

They see the capacity of the compressor, they see the capacity of the condenser and evaporator. Altogether and they say is this will be this must capacity and they don't realize losses in the piping or even if they do they don't realize it is as great as it actually is.

M.G.

That's right.

B.N.

When you joined Frick, what were the pressing developments in refrigeration at that time? What were the challenges that everyone seemed concerned with at that time? What was the big thing everybody was really trying to develop at that time?

M.G.

Well, now take like compounding. Textbooks, when I was in school they told of the benefits of compounding, yet most people dodged compounding because the compressors, particularly at the stuffing box were unsuited for operation in a vacuum. It was that advance of the mechanical seals, and just as soon as the mechanical seal came along, then compounding just blossomed right out and it was interesting to see the progress that was made as the various components were developed. Now like the float device. The float device, of course, it's a float type device and when we first thought about it, the whole question was how do you position, what are the rules for positioning that float, how high because you are not maintaining a true liquid level. You are maintaining a boiling situation. Vapor coming out lifts the level. How high does it lift the level? The float has no control over that. It's the rate of applying the load. So the developments were the recognition and of course, the development of the necessary formulas so that a person knew just where to position the float such that the evaporator would evaporate the liquid and not flood liquid into the suction line. Automatic controls, of course everybody wanted automatic controls, but automatic controls then and even today are extremely limited. They are limited to the design, that is if I design for so many BTUs of work at ten degrees temperature differential, but the use then uses it with a fifteen degree temperature difference, my design can fail because I haven't provided to take care of the increased vapor volume out of that evaporator. There are so many areas of that sort in this refrigeration work. I see over the years so many good mechanical engineers have a process. They come up with a chiller to handle their product. The chiller has all of the surface necessary for heat transfer, but they lack vapor volume. I run schools today, and when I tell a fellow, no look it's twenty degrees in this evaporator. One cubic inch of vapor, 238, but if instead of being a plus twenty it's a minus forty, that one cubic inch of vapor become a thousand rather than a thousand cubic inches. Now those are the kind of thermodynamic items that a designer must have very clearly in his mind when he designs an evaporator to do a certain load. You're got to have surface to get the heat transferred, but you've also got to have space to get the vapor out of there without dragging refrigerant with it back into the suction line.

B.N.

Back in the 1920s then, engineers were concerned with development of good refrigeration side controls, and also driven side controls. In other words, automatic operation. Were there any other big things that they were concerned with at that time?

M.G.

At that time there were so many new things coming along, particularly in World War II. We suddenly had requests for a lot of gun firing room designs because they wanted to fire guns at low temperature conditions and so it was not only the development of the refrigeration necessary to carry the load, but we also had to support coils and piping to withstand the concussion of the gunfire. And there was the great movement for artificial rubber, and artificial rubber making presented one of the biggest challenges that we ever ran into. There was the necessity of controlling the reaction, the latex reaction. It had to be accurately controlled at a given temperature, but there still had to be enough reserve to prevent a runaway. There were five major companies asked to present a design to do that work, and the Frick design was the one that succeeded and was patented and rubber reaction was of course something that we supplied to practically all the plants around the world. In fact, here just a few years ago we shipped a big one to Taiwan. Now that was refrigeration.

B.N.

The changeover from steam and gas engines to electric motors began in the 1890s. By the 1920s, when you first began work at Frick, were there still any steam or gas engine driven compressors being sold?

M.G.

Yes.

B.N.

And everything switched over?

M.G.

No. The change was gradual. I would say that starting about 1915, a lot of the older plants which were now becoming obsolete because of size, costs of boilers and steam and labor was going up and so really it was economics that caused people to say we'll do away with boilers and go to motor driven because it would save. At that time people wanted automatic operation. They wanted to reduce labor cost. So now you have the chance to do that electrically, which you just couldn't accomplish with steam. Diesel engines were a big thing for a period. I would say from about 1920 until the middle 1920s, there were a lot of plants installed with diesel engines, but again economics - there were maintenance problems with the engines and drive problems and so the simplicity of electricity just brought it into the field.

B.N.

During the 1920s were the refrigeration engineers concerned as much with energy efficiency as they are today?

M.G.

Yes, oh absolutely.

B.N.

How did the energy efficiency of the equipment then compare with today's equipment?

M.G.

The old equipment, in a sense, was more efficient.

B.N

Why was that?

M.G.

Because of the slower speed and lower volumetric clearance.

B.N.

In other words, you're saying that the higher speeds require the more clearance.

M.G.

We have to distinguish now. We're thinking of reciprocating compressors. The old reciprocating compressors, particularly the single cylinder single acting had the smallest clearance volume, and was the most efficient compressor. As we went to higher RPM, we naturally did it in a smaller package, but we sacrificed some volumetric efficiency in so doing, but again from the matter of economics, first costs and so forth, people were willing to go that way. Now today we see the big switch, particularly in the commercial field, into the screw compressor, and the screw compressor has had tremendous advancement in the last couple of years and we now have overcome one of its major faults. The major fault was a fixed discharge port and because the discharge port was fixed as between winter and summer operation, you had under compression and over compression because there was no automatic valve to open as in a reciprocating. When you uncovered the discharge port, you uncovered the discharge. Whatever happened inside it happened. So they whacked in you might say year round efficiency because there were so many times a year you had a systems pressure that didn't match the ability of the compressor or the internal compression of the compressor. Today, we have the screw compressor where the discharge pressure and the suction pressure are sensed and in a computer we have a program where that discharge valve opening should be at that particular compression ratio, and with necessary signals we provide a hydraulic pressure that moves our discharge port opening, so we now match the internal pressure to a pipeline discharge pressure and those machines have an extremely high efficiency.

B.N.

The fluorocarbon refrigerants were developed beginning in 1929. What were their effect on the use of ammonia in large tonnage equipment?

M.G.

From the viewpoint of efficiency the fluorocarbon refrigerants cannot match ammonia. Because of their higher density, you have to pump more pounds per ton. For example, ammonia is less than a half a pound a minute per ton. We'll say with 22 that takes very close to three pounds per minute per ton. Now, the only thing that moves a refrigerant from one point of a system to another point or moves it around in the cycle is a pressure differential created by the compressor, and so it naturally is going to take more horse power to move three pounds per minute per ton that it is to move from less than half a pound a minute per ton.

B.N.

It would take quite a while for the fluorocarbon refrigerants to begin to be used in larger equipment?

M.G.

Yes. What I saw was the claim of ammonia destroying products and some of the bigger cold storge people from the viewpoint of liability thought well we'd better go to a halocarbon refrigerant, and which they did, and that was all changed then, I would say along in the middle fifties. People in the industrial field who had gone to the halocarbon refrigerants now coming back to ammonia. Mainly on the basis of horsepower per ton performance. I remember one of our largest cold storage owners told me, he said, "We did our best. We even put on an extra man and his sole duty was to hunt for leaks, but in spite of that we would lose a charge and now we have to put in a new charge, and operating costs just became prohibitive." You see it on the Gulf Coast in the fishing boats. Fishing boats naturally all went to the halocarbon refrigerants. Immediately after World War II they jumped back to ammonia, and as the captain on one of the fishing boats said to me, he said, "When I smell ammonia, I'll grab a wrench and tighten the joint, but when we had the halocarbon refrigerants nobody knew when it was a leak and now we got out with a shipload of fish and had no refrigeration.

B.N.

How were large compressors capacity tested in the 1920s?

M.G.

The capacities were always tested on the so-called gas run around cycle. We have set up today we can test up to 2,000 horsepower with a simple gas run around.

B.N.

So they still use basically the same method of testing large compressors now as they did when you began working?

M.G.

Yes sir. Yes sir.

B.N.

There seems to be a swing back to ammonia after a long time trend towards the halocarbon refrigerants. Why do you think that is?

M.G.

Economics. Strictly economics.

B.N.

Just because of the fact that the ammonia refrigerant is more efficient and it's also less costly per pound?

M.G.

Let me put it this way. I dislike the word efficient. Halocarbon will provide refrigeration just the same as ammonia. It's this matter of pumping horsepower, horsepower per ton.

B.N.

You are the holder of 15 patents and have three patents pending. What do you feel are the most significant and important patents that you hold?

M.G.

Well, that's about 35 patents.

B.N.

Oh, I'm sorry our research is wrong.

M.G.

I don't know. The one that was most important to me and has lasted over the years was the method of computing the necessary head for a float device feeding an evaporator, but then there were many others. Now fragmentary ice, the Frick shell ice maker, there was a basic idea that was developed by another person, but they were unable to put it into a working machine and Frick Company bought this gentleman's patent and then proceeded to convert the thing into a workable unit. Now I was responsible for that development and that's a patent that I think a lot of. The work with the rubber reaction during World War II was very important and the work with the CO_2, liquefaction of CO_2 in the breweries. Now again, this was not an original idea on my part. A young German came to us and said, "Now beer has a bad taste because of the yeast odors, and if I could get somebody to work with me, what we have to do it take that CO_2 off of the fermenters and liquefy it. Now if we liquefy we can purge all these objectionable odors and taste. Of course now we're going to have to re-evaporate that liquid in order to use it then to carbonate the beer." And that's what every brewer in the world does today, but we assisted that man and patented that system, and that occurred very shortly after prohibition days.

B.N.

So we might say that that Milton Garland is the father of better tasting beer?

M.G.

Well I wouldn't want to say that because I didn't know what made beer taste bad. No, we just developed the refrigeration. Wine making was also interesting but it was a refrigeration application. I had nothing to do with the idea, but here's this gentleman who said that if I can crush grapes and then refrigerate them right down to the freezing point, I can coagulate all of the vines and now at the temperature I'll put it through a filter press and get rid of those vines and have a wine that's equal to any ten year old European wine, and it was that idea that was the birth of the big wine industry as we see it. But again, all I had to do with it was the development of one of the first plants that was installed to do that work.

B.N.

You joined the American Society of Refrigerating Engineers in 1922. How in your opinion has the society changed over the years in terms of purpose and service to the public?

M.G.

The Society has grown as was natural. I have only one criticism, and that of course is the fact that the organization has spread out. It covers so much more in the field of application, particularly air conditioning, that the original thinking of ASHRAE had sort of become lost, and that is why I am greatly interested in ASHRAE. Now, I have found in Region III, where I am the chairman, that people were very complacent because the majority are doing air conditioning work. They do a tremendous job in air handling, distribution, and water handling for cold water. They buy packaged refrigeration equipment, so really, as long as they have a device that'll do the work that they want done, their interest in refrigeration as a science really doesn't amount to much. And this is what I see that the Society is losing. We are seeing a revolution today. Now the revolution is No. 1, the heat pump and then the so-called ice storage. So now we have people who just can't go out and buy a package unit for that work. It takes separate system application, so I believe that if we keep pointing out that all of the success of air conditioning has been due to refrigeration, the manufacturers of units, water cooling units, have done a wonderful job. I wouldn't want to say anything critical of what they have done, but we have got to remember that we have the food processing industry, we have the chemical industry, all of those people who use refrigeration and now as we get into the storage of refrigeration we get back to another item. Storing ice on pipes is not as efficient as fragmentary ice. Of course, that can be questioned, but it still is a fact because when we made the old blocks of ice it took eight hours to make a block of ice. Why? Because we made it eleven and a half inches thick. We made fragmentary ice today, that's about three eighths of an inch thick and gets more pounds of ice per ton of refrigeration of per KW, simply because we don't use the time that is lost when you try to make it thicker. So you see we've come back where we've got to think again in terms of higher efficiency for getting this refrigeration that we're storing.

B.N.

The refrigerating industry began to broaden in the 1920s with the introduction of reliable household refrigerators and small commercial equipment. About all of this area was developed by new companies, not the existing refrigeration companies like Frick. I have heard that the membership of the ASRE composed of engineers from existing companies looked with disdain on the so-called engineers of this new area. Can you comment on that?

M.G.

Well, I never felt that way. The household refrigerator and window air conditioners, that type of equipment requires a production line development, and the cycle is no different but they simply had to build a product with a limited charge so that when it was set up here in the sun it wasn't going to hurt itself, and to me the engineers who developed that equipment, they developed something, I think that we people in the large industrial business didn't want to try to develop it. It just you might say, takes a little different breed of people or engineering to take an item like that and put it into a big production form and have something that's reliable. No, my hat is off to everything that they have done.

B.N.

Do you feel that there was a prejudice among a lot of other engineers at that time toward the new engineers?

M.G.

No, I never saw that. Maybe it existed. To me what existed was more a jealousy maybe because of the advancements that they were making, and I know from the viewpoint of the Frick Company, I mention Frick Company simply because it's the only place where I was that knew what was going on, we just didn't have interest in going into that small work. Our basic work was with the large commercial installations, ice cream, ice making, chemical plants, the large industrial installations, and that's where we stayed and I just have to think that the only fault that I can find is that the engineering that went into those small machines, it was the same engineering that people are using today in all commercial work. But the big difference is this: once you build one successful small unit, you can build thousands of them that way. In our work every job is a new job, it's something different. You're putting together equipment to match a requirement, and no two jobs are alike. What you did on this particular installation or this particular system design you'll do for some other system. We're not married to ammonia. We do a lot of work with 12, 22, 502, propane, propylene. We have jobs with ethane; we have jobs with ethylene; we have jobs with refrigerant 13. There isn't any of the commercial refrigerants that we don't use. But you see, this requires people who are not just tied down to one particular line of production, so I guess you might say there is a difference in the thinking of those people.

B.N.

But there is mutual respect between them.

M.G.

Oh absolutely, why not? They've don’t a wonderful job and I'd be the last one to say any different.

B.N.

What was an ASRE meeting like in the 1920s?

M.G.

Oh, they were brutal. An example: the first of the shell and tube condensers were 18 feet tall. Frank Zumbro, who was the chief engineer for Frick Company at the time ran a series of test and then wrote a paper delivered at an ASRE meeting and he showed that the same performance could be obtained from a 14 foot high condenser as against an 18 foot high condenser. Now, delivered in the ASRE meeting there was just all kinds of discussion. In other words, people would storm and say, well, anybody would know that more surface is going to condense more gas, and things of that sort. But again, here's where the thermodynamics come in. in condensing work, you condense what you sent to the evaporator. In the condenser, when it becomes liquid there's nothing to take it out of there except gravity. Now that doesn't meant that you cannot set up a condenser and cause the condensing pressure to push the liquid out, but if you do then you're operating at a pressure higher than is most economical. So with the 14 foot surface, he simple proved that we got as close a temperature differential between the water and the liquid at the outlet as was practical. Sure, you could make it 30 feet high and maybe get one or two degrees closer differential at the bottom, but there is no economics in it at all. But they were real lively meetings and they all were, you might say, one manufacturer against another. In other words, as each one came up with some new item, some new product, then they gave a paper on it. They pointed out what they thought was better than what was in existence, but then of course naturally you had this natural rivalry between manufacturers, which still exists today, but I think it's good. I do. You might say one of my criticisms of ASHRAE is now we don't dare be commercial. But how can you avoid it and should you avoid it? Sure, you don't want to permit somebody to get up there and just advertise a product. That's not the point. I say that if a competitor of Frick Company had a product that's better that she should have a chance to prove that it's better. It educated everybody that's in the room, and why not give him a little credit. He's got something better than the other folks. You read, or if you do read magazines, chemical and whatnot, you see that going on every day. You see it in medical. One person thinks they've got a better medicine than the other and tell about it and give the reasons why.

B.N.

Well, turning back to the ASRE meeting in the 1920s and really I guess your point is that they were much more lively and heated discussions at the sessions then?

M.G.

Oh, absolutely, yes. The people were always coming up with some new design, well, you take compressors, a man says well I've got an improved valve design, and we'll all have the valve problems. Everybody who had ever designed a reciprocating compressor. At Purdue they have done a lot of work on valve flutter, but you don’t hear those people at ASHRAE meetings anymore. You have to go to a Purdue compressor conference to hear that kind of stuff, and I think a lot of this got away from ASHRAE. Here's an example: we were asked could we come up with a method whereby water could be used to heat ammonia from minus 28 to plus 40. Now of course, to put water in direct heat exchange with ammonia at minus 28, you'd just freeze up the water, but we did. We came up with a double shell arrangement and it's strictly a heat transfer system with ammonia as the heat transfer medium. We take water out of the pond and run it through the wand and that causes that ammonia to evaporate and then minus 28 degree ammonia from the storage is put through the condenser and so we condense that vapor and in that way warm up the liquid that's going into the tank car. Six hundred gallons a minute heated from minus 28 to plus 40 using water out of a solar pond. Several of them have been put in since, but the point in this: ASHRAE, ASHRAE Journal, there's never been a word about it. People from the viewpoint of the ASHRAE Journal, don't know half the things that are going on in the industrial field. This was published in a chemical journal. Frick Company got an award for it but ASHRAE Journal takes the attitude that it's been published some other place, then they won't publish it. Okay, we're going to treat the refrigeration people that way. All right, but this is where the refrigeration people, I'm talking about the industrial people, kind of feel badly about ASHRAE's usage of such things. Recently, I was in South Africa, where Frick Company put in an ice making plant, a thousand tons a day for air conditioning a gold mine. That ought to be published in a big way in ASHRAE Journal. Why? Well, look, we're talking about using ice, ice reserved for air conditioning. Can you beat that, a thousand tons a day? I can't forget that that's lost to the people in air conditioning field and ASHRAE is a big air conditioning organization.

B.N.

How did your fellow ASRE members feel about the merger of ASRE and ASHAE in 1959?

M.G.

Well, they were divided. I was against it. I voted against it, but of course I stayed with it, simply because if that's the way the majority went that's the way we should go. But I know quite a few of the refrigeration people dropped outright at that time.

B.N.

Was it because they felt that they would somehow lose something?

M.G.

Yes, that's right. It was obvious that you might say refrigeration people as such, that is, as I know refrigeration people, were going to lose control, simply because there's far more people in the heating and ventilating business and always will be. To me, it's perfectly natural that the organization had grownup as it is, and the only thing I can fault is that we are not putting the emphasis on the other side of the refrigeration business as we should. That is a large industrial work. Now a president just a year ago said and I don't know whether you went to Paris or not, but I was over there, everything was about food products, food storage, preservation, and yet I don't know. I haven't gone over the program for this meeting, but here is our past president saying now we've got to put more emphasis on this big refrigeration work because I'm going to tell you, in tons of refrigeration it's terrific. When I first started, we build a hundred ton plant that was something to cheer about. A thousand ton plant today isn't anything.

B.N.

Commonplace. Well, you are 91 years old?

M.G.

Yes, sir. Well, I'll be 91 in August. I haven't quite made it yet.

B.N.

As a senior engineer, what advice do you have for young engineers in their careers in this industry?

M.G.

Well, I think it has to be determines by which way he goes. Naturally, if he is going to work for a manufacturer who is making window units and household refrigerators, I just simply say to him, "Now, look just don't go in there and be satisfied from the viewpoint that we wrap up so many feet of pipe and we attach a capillary tube to it and we put in a pound of refrigerant in it and we say that's a window air conditioner, or a household of refrigerator. Find out why that it's made that way. What are you getting out of that, and how much power are you using to do that, and are you running a machine that is wet." One of the biggest problems I have in the schools that I run today is the matter of a halocarbon refrigerant and you put a thermometer on the suction inlet and it says you have twenty degrees of super heat, but still you've got enough mist entrainment in the vapor that you don't get the net work that you're supposed to get. And you would be surprised at the number of people that are handling the halocarbon refrigerants daily and they don't recognized it. You say, look mister you ought to have a suction line to liquid heat exchanger in there. Make use of that mist entrainment. It isn't going to hurt you with a halocarbon refrigerant. Heat of compression isn't that high. But this gets back to where I started. You've got to understand the thermodynamics. Well, I hesitate to talk about it, but there was a paper written on this subject and I think this paper developed from a discussion that I had with an engineer in a plant where the customer refused to pay for it because he was not showing the product he was supposed to chill, and I was saying you're running wet, cut back on the expansion valve, and then the argument I got was now look, the thermometer suction says we've got twenty degrees super heat. You, as an engineer ought to know better. If we increase the super heat, we increase the volume, and now we're not going to pump as much. But I took him to the pressure diagram and I said now we start here at this twenty degrees super heat, follow constant line and up the discharge pressure and that says the theoretical temperature should be so much. With a thermometer placed on the discharge of the compressor is way back here. Now we go backwards on a curve when we're inside the saturated vapor line. That resulted in a paper said well even with refrigerant 22, when we had 80 degree super heat we got more capacity out of the compressor that we did when we had 20 degree super heat.

B.N.

So you're really basing the advice you have for young engineers to make sure that you understand your theory?

M.G.

Absolutely. You've got to. You don't know where you are. A fellow goes and feels a discharge and says oh, the discharge is hot. Well what is hot? How hot?

B.N.

Well, Milt, do you have any other things that you think you want to add to this interview besides all these things I've asked you?

M.G.

Well, you read over my hundred year history and you may pick out some things that you want, and I tell you what I'd like to do. I'd like to invite you to Waynesboro and spend just the best part of two weeks in one of my training schools. I don’t know whether you know it, but when I retired in 1967 the company asked me if I would start these training schools, which I did, and the idea was that in four or five years we'd have everybody trained and that would be the end of it. instead of that, year by year it gets bigger and bigger. I've had over two thousand people from every major company in this country, including two vice presidents from General Foods. They called me up one day and said, "What's in this thing?" Well, I said, "It'd take two months to tell you. Why don't you come in and try it and see for yourself?" They did, they just are continually sending people in. all the food and chemical processing people, I get them by the hundred. Before I left Waynesboro, on my neck, I got to go to Oklahoma City to run a school there and then they wanted me to go to Mobile, Alabama. I've already had one in Fort Smith, Arkansas, and Russellville, Arkansas, and a couple in California, but all I can say is this: here are men who come in there who have been in the business for fifteen years, chief operators of plants, and when they leave they say well I'm going back. I know what to do to get out place straightened up. But again, they are people who are good operators. They know what wheels to turn and where the frost line should be and so forth, but they get an evaporator here that doesn’t perform and what's wrong, why can't I get it? That thing was supposed to give me fifty tons and I don't begin to get the fifty tons. In nine cases out of ten, it was an excellent 50 ton evaporator at 20 degrees, but he's using it at minus 20 degrees. Entirely unsuited for that. See, what had happened, we have these independent manufacturers of these evaporators. Now all of them make good evaporators for thermal expansion valve use. But then they turn around and they come in and we don't want one. We want one for recirculation of flooding. Oh, well you can use my evaporator. They do. They apply them, but half the time they don't work. When I first started in the 20s, we had so called overfeed systems, pump recirculation systems. They were in use then ,as they are today. But, our fellow, when they designed them and when I went out in the field to see if our men were operating them properly, we regulated the feed to that evaporator so that the overfeed was maybe one or two percent. Today we have people preaching and pounding the table and saying you ought to be recirculating three and four times what you evaporate. Why? Well, I'll tell you why. They've taken these evaporators built with distribution system for thermal expansion work and now they put refrigerated liquid from flash drums and now they don't get distribution. What do they have to do? They've just got to increase the volume till they get such a big volume that you do get distribution. But what have you got? A two phase low on the suction line. Every pipe line that's in ASHRAE's Data Book today is based on dry vapor in the suction line. Yet we find people ridiculously today putting three times evaporation rate in that same suction line. Pressure drop? I've seen pressure drop in a plant over here in Jersey just two years ago. They bought a tremendous big Jenson ice builder. They had it for a year and never made a pound of ice on it. Why? Well, because about three hundred feet away the darned liquid lines run up over the roof in the hot sun, elbow after elbow, pressure drop. By the time it got over there all they had was flash gas. Has a suction line that we counted 29 elbows in because it went up here and there and they had to get on a pipeline here and they had to go down on the ceiling of this room here and eventually got it back. Those people bought that in good faith from Chester Jenson. It'll make the pounds of ice that they're supposed to make if they supply it with 100 percent liquid at the expansion valve, and if you maintain the suction pressure there that they call for. But when you look at the thing like that, it had some twenty pounds pressure difference between the evaporator and the compressor. And you just see that all over the country, and this is what my students are getting or coming into.

B.N.

Well thank you, Milt, for a very interesting interview.