ASHRAE Leadership Recall (formerly Leadership Recalled)

Transcription

Audio Interview of: Carlyle Martin Ashley

Date of Interview: June 28, 1988

Interviewed by: Bernard A. Nagengast

Note: Mr. Ashley had been given a list of discussion topics prior to the interview.
Only part of this interview still exists as audio.

Bernard Nagengast

This is an interview with Carlyle Ashley conducted for the ASHRAE historical committee for the leadership recalled program by Bernard Nagengast on June 28th 1988.
Regarding Carrier's unit conditioner.

Carlyle Ashley

I decided to go into the manufacture of relatively small equipment and to build up a line of equipment that would have eventually been handled by dealers and distributors. And I was just married at 1926 and shortly after that Dan Lyle called me in and asked me, told me that they wanted to design a unit air conditioner. This was not a room air conditioner. This was a unit air conditioner.

B.N.

Which was to be used for commercial purposes like storage?

C.A.

Yes largely for small, small storage in places of that sort more than anything else. Some small manufacturing and the capacity of that was 2500 CFM that was the first one that we built. Later we built a little larger one. And I was given the job of doing that. And I was imbued at that time and ever since really with the idea that you ought to economize as far as you could on the use of energy. And I always have felt that way. And so what I designed was called the Centrijector unit. And it had a very interesting - it was about, about 2 feet square and vertical about 7 feet high I guess or a little over 6 anyway - and a fan in the top with a motor drive and then directly below the fan I carried an extension shaft and I had a fairly good sized thing. I think it was around 3 inches maybe. That dipped - went directly down as a, as a element went right into the water at the bottom. This was a spray unit, it was not a, not a coil unit at all. As a matter of fact at that time particularly in Carrier I think, and maybe in some others too, we regarded spray as being the, the thing rather than, as a matter of fact we didn't have much in the way of coils other than just the bare surface except for Aerofin that was a very new thing at that time. And so the thing that I designed had an element that was about an inch and a quarter maybe or something in that sort of diameter at the bottom. And then tapered up to about 3 inches and when you rotated that it would pick up water from the bottom and deliver it up to the top. And up at the top I had a series of sprayer nozzles mounted on arms and playing backwards. And the spray nozzles as I remembered it handled water at about 40 pounds pressure. And the thing, the whole thing rotated and the spray while it was delivered at very high velocity. Actually it wasn't very high when you considered the rotation. So it produced a rather intense spray. And the result was you got a nice spray in there at a very high efficiency relative to most of the spray. It was about I think, I don't remember whether it was, let's say it was around 50%. It might have been a little less or a little more. About 50% of the energy of that, we had no pump on it at all this was the, for the whole thing you see. And that, we sold a fair number of those. They were, they were designed to be stamped out. And they worked quite well. The main problem, and I guess, I guess I was a little young to, to realize that initially, well I knew that we had a problem but I didn't really get a complete solution for the problem. And that was that the, you had a bearing of course in the bottom, we used lignum vitae initially.

B.N.

What was that that you used?

C.A.

Lignum Vitae.

B.N.

Which is - what's that?

C.A.

It's a wood that is a very dense wood. And it was used in many situations for, as underwater for lubricants for bearings. Umm we had, we really had a bearing problem on the thing. And so eventually we did get away from that design. But it really went really well and it did introduce uh the company to the small operator, the small dealer. Prior to that most of the jobs were, were large jobs. I remember going down to a candy factory in Pennsylvania somewhere and one of the , one of the problems that we had here is that you had a long room and we had to distribute the air for that and then I realized also that we had to an air distribution problem as well as the problem of the unit itself. And so over the next few years I, I made up a rather detailed study of how to distribute air. And at that time we had, I don't remember what they call the outlet, essentially what it was, was a thing that you, most of the ducts that you had in those days were bare ducts, rectangular and this thing sat on, on the sides of it and it had about 2 or 3 movers or fins on the inside of it to redirect the air in the right angles to the duct.

B.N.

Almost like scoops in the air stream.

C.A.

Yeah. Well there wasn't a scoop, it didn't go into the air speed.

B.N.

Oh ok.

C.A.

But it was built on the outside of the stream but it had a, it had a uh on the outside had a place where the air didn't come out at all. I remember there were blank spaces and then the air came out in two or three places. And one of the interesting projects that that I worked on, on that, I had the, I developed the idea that if I could, could just let the air come in to the top and the bottom of these little places in between the, the, the slots where the air came out I could get better distribution than I could with the outlet itself. And so I built up an elaborate system of testing and so forth. They, they, the testing, the way you tested it was very interesting if you heat or cool the air and then deliver the air to the room you can tell what the mixture or room air and air from the outlet is by measuring the temperature. A very simple way of course but it, it's very good too. And so I ran a series of tests on it and then I tried it without any, any of these additions that I put on, results were exactly the same. (Laughs).

B.N.

Which surprised you huh?

C.A.

Well a little bit yes. But I realized that, well I realized that I began learning about air flow and distribution and so forth. And I realized that the air was being sucked in, that is, that you have the jets here and sort of a v- envelope as they went out, they finally merged together but in the space between those the air would come in between them anyway. So you really didn't need to have a guide for it because the air came in, in any case. And so it, that was one of the early lessons.

B.N.

Back when you were talking about the unit conditioner then, how long was that manufactured before it was discontinued?

C.A.

Uh well…

B.N.

And when was it first put on the market actually?

C.A.

I would say that, I think it was put on the market either in 1927 or maybe 1928, I'm not sure. I guess 1927, maybe late 1927. And it was sold, I don’t remember, of course shortly after that you had the Depression and it was sold into the Depression I would say. And then everything collapsed pretty much.

And that was sold by the so called standard products division or is that something different?

Yes, I think that was it. At a slightly later date, and this was around 1929 or '30 Carrier organized a, started to organize a dealership and a distributorship to go along with it. I think they organized a distributorship first and then the distributors go the dealers. And there were many distributors in 1950, 1060 who were the same people who had been gotten originally. There was a very able organizer and sales person that developed that organization and it was one of the big money makers for Carrier because I mean it, you had the standard products division and then you had the special designs that were handled by the Carrier engineers directly you see, see Carrier started out as an engineering contracting company and originally they didn't design, didn't have anything to offer, they bought practically everything outside. Maybe I ought to go back to the beginning of your, of the questions you have.

B.N.

Ok, we can start out that way and I guess the first question was when you were growing up were you interested in mechanical things?

C.A.

Yes, very much so. Well I thought I had your things here but I don't seem to find them. Well, I don't know what happened to it. Well that's alright I can use your other copy here. Uh, yeah and I made all kinds of, I had all kinds of ideas. When I was between 6 and 10 for instance. And there's an interesting thing that I might make an observation on that happened years after that when I was, I would say it was around 1950. We got interested in trying to look for somebody who was creative and try to find the people who were creative, as distinguished from maybe highly intelligent but not particularly creative. And we got a psychologist, an industrial psychologist from Syracuse University because at that time we were at Syracuse, and he rummaged through his greatest tests and finally selected something that he thought might bear on the problem and we gave it to some of our employees. And then at the same time we rated the employees on the basis of productivity, on the basis of creativity and we tried several tests and tried to determine what it would be. Well, the results were completely negative. I mean I shouldn't say negative, they were neutral, we got no indications from the tests of anybody in the organization that could correlate with creativity. And in thinking later of how do you recognize somebody who is creative, I think there is a very simple answer. You ask him or her what they did between the time they were 6 and 10 or between the time they were 10 and 16, what their activities were , whether they, what kind of interest they had and that will separate them out. Because you will find out that the people who are creative later were creative as children.

B.N.

And so that brings us back to you. Were you interested in mechanical things as a child?

C.A.

Oh yes very much. Yes. I'll tell you something that you might find of interest. My mother and aunt and uncle grew up in the town of Angola which was west of Buffalo by about 30 miles, 20 or something to 30 and Willis Carrier, Mr. Carrier's father grew up in the same town. Willis was somewhat younger than my mother and considerably younger than my aunt and uncle. But they were very good friends and so it was quite natural, we lived in Washington when I was growing up, and it was quite natural that when he came down to Washington for visiting that he should visit us. And he looked at the things that I had been working on and he told my mother and father, he said "Don't allow him to stop being creative and be careful to be sure that this creative talent is not lost." And I am sure that he thought he thought back to the time when he was a boy too. And my grandmother encouraged him greatly to go to Cornell. He was very poor, his father was a farmer and it was in a bad time of the generation, of the century. But in any event she recognized his talents and when he finished the academy, the equivalent of the high school there he started teaching for awhile but she encouraged him to go on and get a college degree. He didn't have any money but he went to live with my uncle in Buffalo who was a veterinarian and he went to high school there and got extra training that allowed him to take the high school, the state high schools examinations that qualified him for a tuition scholarship. Then he went early to Cornell and took a training course on things that make___ in connection to a cash scholarship. So he had a tuition scholarship and a cash scholarship and he worked, I think he waited on tables to some extent. Later he worked with a new organization that provided laundry service to the students and that service incidentally is still continuing at Cornell. It had grown considerably in size and so forth and they do other things too. He was not necessarily a founder but he was one of the first people in that organization and so he finished his college organization and then went to Buffalo Forge Company directly from Cornell. And one of the interesting things about that is that within a year after, well within a year after he had gone with Buffalo Forge he persuaded the management to let him design and build a test laboratory where they would run tests on the equipment. The trouble with Buffalo Forge Company is that they had no information on what the performance of their equipment was. It's unbelievable that that is the case. So he started out with that and within three years or maybe four, no I think it was 3 years, he got the basic concepts of air-conditioning. This is almost unbelievable in relation of what you get today. And yet, it you look at lot of new things that are being in the processes of developed, there are a lot of things that are being worked up and developed in peoples garages.

B.N.

That's true.

C.A.

And so really, on the forefront of development, it is not an unusual thing to find that kind of thing- that are done by people in high school or college kids or people of that sort. And I dare say that every one of these people you find is a highly creative person.

B.N.

Well one thing that you just told me that I thought that was interesting that I didn't know and that's that your family then played a part in the fact that Willis Carrier decided to become an engineer because of the encouragement from your grandma.

C.A.

That's right, we certainly did.

B.N.

That's amazing. Well, coming back to you again, I take it you would characterize yourself in the area of the creative person from what you did as a child.

C.A.

Definitely. I still find as a matter of fact that I think in a different way than most people do. I find it a little hard sometimes to adjust and I find it hard to explain too because fundamentally I'm a problem solver. I know how to solve problems. I can solve political problems as well. Not myself, but I can see how they can be solved. I can solve problems in almost any field if you like, if I have the facts and know what the human relations are I might solve that too. But this is part of being creative. And in other words you are a problem solver.

B.N.

Well have you been able to analyze more of what it is that makes you different, in other words how do you think differently?

C.A.

Well, most other people are not problem-solvers. That is what it amounts to. I mean when… well let me illustrate it. When somebody states a problem, I don't care whether it is in engineering or something else again, I begin to think of solutions to the problem and generally, if I was asked to, I could find half a dozen or a dozen solutions for it. But I have one other characteristic that some of the people who are maybe creative too I think do not have, I have a critical sense as to which problems are practical and which problems are not - I don't mean to say that all the problems I solve are completely practical but you throw out the ones which are obviously impractical you see. And a lot of people, I've run some competitive tests with other people who are good problem-solvers, who are creative too, and generally I find myself in thinking of this or that kind of a solution, I find myself throwing out the ones that are so obviously impractical that you might just as well forget them. Well a lot of people put these things in and I don't know, I don't know what the difference is there.

B.N.

For some reason your illustration makes me think of Washington, DC and the people there where they have a tendency it seems to come up with solutions to problems that are very impractical at time and they don't reject them they put them in__

C.A.

That's right. Well, of course, I found that in competing with other people, I put down a shorter list than most of the people, but the list wouldn't contain any of the wild ideas that they had you see and I don't know what the reason for that is except that I tend to think of whether the thing is completely impractical or not. I am willing to give it the benefit of the doubt. But when it gets too wild I throw it out.

B.N.

Well why do you think you became a creative person? Do you think it's something you were born with it?

C.A.

Well let me put it a different way. I suspect that as babies or as small children there are a lot more creative people than grow up. And I think the process of education is part of the problem. That is, it beats the creativeness out of a lot of people. They are intimidated. If they are creative they tend to be oddballs and they try to avoid that and in the process they lose their creativeness. I don't know. This is just a guess but I think that is what happened. I think that is what Willis Carrier meant when he told my parents about me - not to lose it in the process of education.

B.N.

Well when did you decide that you wanted to become an engineer? And why did you decide?

C.A.

Well of course, I remember very well of the visit of Willis Carrier that day.

B.N.

How old were you at the time?

C.A.

Oh, about 7 or 8. He was down to promote or display some of his equipment. At I think an International Hygiene conference if I am not mistaken. We went down, they had a building where they had some things on display of different sorts. And he had a spray-type humidifier, an opposing spray, some with air flow and some that went against air flow and an eliminator to eliminate the spray prevent it from coming through in the fan, and he had the fan on the discharge. He had some ribbons to show the air flowing up at the end of it and he had a door, sealed door that you could close and had gaskets around it so that you could seal it. I don't remember whether he had lights inside it but the lights shown in it so you could see the sprays going in there. I was very much impressed with that. I thought that this was something that was practical that he had done himself and so I was a great admirer of Willis Carrier and always was. Later I learned that he had some flaws but he always was from the standpoint of his ability to think creatively, he was always greatly admired by me. And many of the things that I had been working on were mechanical in character. When I was in high school I spent a couple of years in Nashville, Tennessee and I got started late in grade school, but I skipped two grades when I was in Nashville. So I came back to Washington and went to high school and I was only just 13 when I went to high school. I graduated when I was 16. During these two of the last years, some friends of mine and I formed a radio club. That was at the time when the Fleming tube, that is the vacuum tube was just developed and initially we used crystal or silicon or __ something of that sort and a__ going down to it to be able to receive messages. There was a timer station over at the island across the river in Washington. And we hooked up our radios to that and we wound our own coils and practically made the whole radio. We could hear their station. Of course it was sending codes and I never did learn to read signaling codes, never did achieve that. Kind of an oddball characteristics, I couldn't do that. But we were very much interested in radio at that time and my friends, well some of them went to MIT. My mother and father, my father had graduated from Cornell and my aunt and uncle had gone to Cornell and my mother of course was a special student at Cornell, and then my father got a doctorate out at Stanford, he was the first doctoral candidate. But it seemed very logical to go on and take mechanical engineering. I knew the dean of engineering there and the former dean who acted as president for a year or so.

B.N.

And this is at Cornell?

C.A.

At Cornell. And I admired them so when it came between choosing between mechanical and electrical, I decided that mechanical was the right thing to do and I was interested in the mean time in joining with the Carrier Corporation. So, does that answer your question?

B.N.

Yeah. And I can see why you would have done this with your association with Carrier prior to that time. When you began working at Carrier did you for see that air-conditioning would become the large industry that it has become?

C.A.

Well, yes, I could see it. Of course, at that time all the jobs were special but it was evident that there was air-conditioning to be done all over. Of course, refrigeration was really part of the mix to some extent because it was necessary for dehumidifying or nearly necessary. They did use some well water on some of the initial designs. For instance, I think the first air-conditioning unit that Willis Carrier built used well water.

B.N.

At __ plant?

C.A.

Yes. And they used quite a bit of well water. But really at the time that I joined it they were trying to use more and more refrigeration which in those days meant they used ammonia or CO_2 or very small plants maybe SO_2, but there were a lot of handicaps about that. When I finished high school, I finished when I was 16, and I think a little immature even at 16 and my parents felt that I needed a little time between the time I went to college and the time I finished high school and so it was arranged that I work for Carrier for a year, between 1916 and 1917. The first job that I was assigned to started in I guess June or July in a tobacco curing job, a shaded tobacco curing job in Connecticut. It was a very interesting project. They had these hands of tobacco, the shade tobacco was the wrapper type for cigars.

B.N.

And that was what type of tobacco?

C.A.

Wrapper that went on the outside.

B.N.

But what did you call it?

C.A.

Shaded tobacco. They grew it in shades. They had over the whole field, they had sort of like cheesecloth, and then down the sides as well. The tobacco was very carefully picked and they had long sticks with nails sticking up either both ways on the sides. The people that picked it would stick the stem on the nail and they would have two or three leaves on each stick and then they would take it and put it in big sheds that had louvers on the side of it through which the air could pass for drying it, curing it finally. The farmers had to adjust the louvers according to the weather outside and a lot of it didn't work very well. What they were trying to do was to substitute curing by air-conditioning. So we ran a whole series of tests, there were three of us. The other two were college students. Actually I knew just about as much as they did. We ran wet bulb tests and dry bulb tests and adjusted the chambers in which the leaves were tested. When the university started up again, we had done most of the work during the summer, when they started up again but they had to back to the university so I was left all alone to finish the thing up. And I ran some of the tests on a 24-hour basis. I had to run tests to measure the tests every hour. During the night I would set my alarm clock for the next hour and lie down on the tables that they had for sorting the tobacco and fall asleep. At the beginning of the next year after this project was finished I went to Buffalo and worked directly under Willis Carrier and Willis was a hard taskmaster and he insisted that you do things right. One of the things that he maintained, and I agree 100% with him, was that you should think in terms of fundamentals. In other words, you shouldn't think in terms of empirical-type things, you should go back to the fundamental laws of nature and then develop your ideas from those rather than from something intermediate between. I think because he could think in fundamentals was one of the reasons why he had great confidence in what the performance of his equipment would do. And later on he brought some of the engineers and the Carrier Corporation together to see to what extent they could think in fundamentals. He asked them a series of questions which they could solve easily if they could think in terms of fundamentals, but they would find difficult if you couldn't, and a lot of them flunked. But at any event, it was a great experience to work directly under him. I would do some of the test work that he wanted to do I remember working in a macaroni factory and running a test down at Jamestown at the time we were there we worked in Buffalo, but running a test on a parkland down in Jamestown, I think that was another one that we tested east of Buffalo. All of it was very educational to me. So that was the first experience that I actually had in doing work. I think I was reasonably qualified to do the work that I was selected to do. Let's go on to the next issue.

B.N.

You, no doubt knew many of the early industry pioneers. There is a lot of information on Willis Carrier, there is little on others. Who of the other industry pioneers did you know well enough to tell us something about them besides Willis Carrier?

C.A.

Well I knew quite a few of the Carrier engineers but very few of the others of the same degree.

B.N.

Who are some of the people who stick out in your mind?

C.A.

Well, A. E. Stacey.

B.N.

What was his full name?

C.A.

Alfred E. Stacey, I don't know what his middle name was. And A.C. Buensod was the man who supervised the tobacco work.

B.N.

Well, talk about Stacey for example. What can you tell us about him?

C.A.

He was a very meticulous person and a very kind, personable sort of a person. He had some creative ability but he didn't compare with Willis Carrier in respect to that. He did have, he actually had some patents and did some design work out of Princeton, atmospheric cabinet, that was built for testing, humidity testing on different varieties, I think was his work. I think he did some control work. Personally he was a very pleasant person and very kind and approachable and very satisfactory. I knew his wife as well, very well, and after I started with Carrier after I had finished college in 1924, I worked directly under Stacey for a couple of years and largely running tests on different materials. Well, I did a lot of things and a number of them were not under him but I reported to him for the first two years in any event and he was a very pleasant person. Buensod was quite a different personality.

B.N.

How is his name spelled?

C.A.

A.C. Buensod. Uh, Alfred I think it was.

B.N.

And how was his last name spelled?

C.A.

B-U-E-N-S-O-D. Buensod. And later on, incidentally, Buensod and Stacey formed the Buensod and Stacey Company. Well, I guess it still operates, but it was quite a factory in the air-conditioning. That occurred- Buensod's specialty was tobacco, cigars and cigarettes and so on. During the period that I knew him, I worked for him in '16 and Carrier did a lot of business in the tobacco field, in the processing of tobacco because it needed a certain humidity and temperature and so on. It was largely handled by Buensod. But when the Depression came along there was not very much work in the tobacco industry and I guess at that time he was separated from the company and stated his own firm. I didn't know much about the firm but I judged that he was one of the prime, certainly one of the two prime movers in the firm, and the other was Stacey. Both of them were very able people. I think in the firm that they started, I don't know that they were the originators of it but they were identified with the two conduit air-conditioning systems, that is, one would be cooling the other would be heating. They installed a lot of those, particularly in manufacturing plants where they wanted to get accurate control of the relative humidity as well as temperature. Well, does that give you enough on them?

B.N.

Yeah that's enough on them. Who else.

C.A.

J. I. Lyle who was president of Carrier, or chief executive officer at any rate, maybe he was treasurer, but at any event he was CEO for all practical purposes except when it came to technical matters and then Willis Carrier was the head. J. I. Lyle grew up in Kentucky and he was a Kentucky gentleman of the old style. He was a very fine salesperson. And as I say he was an old style Kentucky gentleman, a very able person and a very polite, he had a very high regard for the family and considered that the members of the Carrier Corporation were part of his extended family and he treated them that way. When the Depression came along and Carrier sank lower and lower because they had lost a lot off business then, he found it very difficult to adjust to that situation. He didn't want to fire anybody. He didn't want to do some of the things that were obviously forced on anybody to do at that time. Willis Carrier was more realistic about it than Lyle. But eventually he was forced to do that and take other compromises. I don't mean to be derogatory, I mean this was part of his character. He hated to fire anybody. He was a great deal like out present President. He valued friendship. I remember a number of times I attended parties at his house. He would give a party on New Year's day generally, and a beautiful party, a very fine party. As I say, he was a very fine person and able, but he had some weaknesses. And the weakness were in a sense his strength too.

B.N.

And do you remember if he contributed anything as far as any type of outstanding advances in the industry or anything.

C.A.

Oh yes, I am sure that he did. His advances were not so much his own contribution but the arrangements that he made and the sales that he helped to promote. One thing that was very interesting that occurred shortly before I came with the company after college was that Carrier decided, first they bought a small place, or rented a place in Newark and prefabricated a good deal of the duct work and some of the equipment that was necessary for their custom-made jobs. And this was done much better in a sheet metal shop than it could be done on the job. They of course would send brakes and shears and things of that sort out to the job as well. Then they made a very momentous decision, this was I think decided somewhere in the neighborhood of 1920, they decided that they were going to go into manufacturing. And one of the things that caused that is that Willis Carrier had been bothered for a long time about the weaknesses of the refrigeration. The refrigeration had been, the ammonia refrigeration of course it was poisonous and it had to be put through cooling coils, direct expansion cooling coils and water and then the water had to be circulated and the CO_2 was highly inefficient. So the combination of those two things meant there was really no good refrigeration to go along with the air-conditioning. You had the well water but the well water temperature in most places was too high. So he began to think about the process of refrigeration and he concluded that if he could design a machine that would work at a pressure below atmospheric pressure, even if the refrigerant was toxic it would not get out into the space and therefore it could be made acceptable to put this refrigerant machine in the various places where it was needed to provide cooling for air-conditioning. So, on that basis he conceived a refrigerating machine that could meet these demands. What he was visualizing was the, originally the chlorinated hydrocarbons such as, well a good example of that would be carbon tetrachloride. That wasn't a good refrigerant but there were other refrigerants that had much the same character of quality. And so he had to handle a large volume of the gas at a low pressure difference and so what he did was to go to Germany where they made centrifugal compressors and arrange to tie up with a Germany company. He designed the seal. Most of these compressors were for air. They adjusted the design to the refrigerant properties which were different. Then Carrier designed a seal to go along with it to prevent the air from getting into the refrigerant and getting out and then designed a water cooled or condenser water cooled condenser and the evaporator to go along with it and he had a refrigerating machine. This was done just about the beginning of the '20s. Then they purchased in Newark a factory and started manufacturing - of course they made the duct work and prefabricated material of that sort, they had purchased, continued to purchase casings and the standard material from Buffalo Forge and I guess continued to do that. In any event, they made some fabricated duct work. The primary reason that they shifted over was because of the centrifugal refrigerating machine. About the same time a man by the name of Larry, oh I'll think of his name in a minute, got the patents on a machine to make crimpled fin Aerofin wound around the tube. And you see before that the heating and the cooling tubes either were done with pipe coils or cast iron, great enormous heavy things.

B.N.

I think the name you want is Soule.

C.A.

Larry Soule, that is right. Larry Soule. That's funny too because my grandparents are named Soule.

B.N.

The spelling of Soule is S-O-U-L-E.

C.A.

That's it. And so you were asking about J. I. Lyle. That is Joel Irving Lyle if you want the name, but everybody called him J. I. What he did was to negotiate with the fan companies and the heater companies to manufacture Aerofin coils, heating coils primarily, and Carrier would manufacture those in the north factory. This was quite a coup because they bought stock in the Aerofin Corporation, they owned it jointly. Carrier had the license to manufacture it, we had the relationship with Soule and with the Hungarian who had designed the manufacturing machine to make the surface.

B.N.

Who did Soule get the patents for the ___?

C.A.

He was a Hungarian and I will think of his name in a minute. It's a very common name in Hungary. If you think of a common name that's probably right.

B.N.

I don't know any common Hungarian names.

C.A.

In any event, this was an older man but very smart, I mean very smart as a tool designer. Later on he did a redesign of his fin tool and stretched the outside of it so as to cut down on the amount of corrugation that was necessary on the inside. It made a much better fin. I'll remember it in just a minute. I have a delayed memory.

B.N.

Ok keep on.

C.A.

Yeah so in any event that gave Carrier a big entre into the manufacturing with a centrifugal machine and the Aerofin. Later on J. I. Lyle negotiated another thing. Logan Lewis was another man that I knew very well and Logan had been doing some work with theaters and he air-conditioned a theater out in California and previously we had handled in the first place the cooling water temperature was about 50 degrees and the idea was that you sprayed water into the air then of course, then the air temperature became 50 degrees too. At that time they didn't like to handle 50 degree air temperature and so they were troubled by that. As a matter of fact, some of the jobs that were installed did use 50 degree air temperature coming out of the humidifier. Then they heated the air with steam heat. Of course, that was obviously a very inefficient way to do it. They thought that they couldn't distribute air below about 60 or 65 degrees.

B.N.

Why did they think that?

C.A.

Well, because they hadn't yet been successful in doing it. All of the work they had done was with distributing air, this was for comfort conditioning now, it was at higher temperatures. They used the distribution from the ceiling. Incidentally, over at this new place, the place is very drafty and I notice that they have got ceiling ones too.

B.N.

Are you talking about the Congress Center?

C.A.

Yes, have you noticed that?

B.N.

No, I haven't been over there.

C.A.

I was up there at the place this morning and I had to move away from this thing because it was too drafty and that's inexcusable. Because we know better than that now. But they dumped the stuff right down there at low temperatures.

B.N.

So they made the same mistake that they were making 75 years ago.

C.A.

Yeah, right. And they thought that they needed a higher temperature in order to get proper distribution. So, what Logan Lewis did was to say, why don't we take some return air from the room and we will bypass the humidifier. Well, he got a patent on that.

B.N.

That is the so called bypass method?

C.A.

That is the bypass method. He got a patent on it. J.R. Lyle negotiated an agreement with all of the current air-conditioning companies, I think it was in the late 1920s if I am not mistaken, under what was called an Auditorium Corporation of something of that sort. And-

B.N.

__ auditorium __corporation?

C.A.

The essence of the thing was, this actually would not be legal today, but the essence was that it was sort of an agreement to control the business. In other words, for one thing they charged a royalty for it on a seat basis. This was done largely for auditorium, theaters and movie houses and so on. They charged a fee for it and I think it was distributed to the various companies again you see, but that gave them each a license under the auditorium patent. In a way it stabilized the industry. They didn't attempt to do any rank control or anything of that sort but it recognized that to some extent it served as a standardization program as well. It was operated exclusively by the companies in the business and eventually the patent was thrown out. It was disqualified but I think they continued the auditorium corporation for a while after that if I am not mistaken. But of course without the patent it didn't have as much force as it had previously because other companies had come in and copied the bypass method. So those were some of the people. I knew Logan Lewis as well and I knew Mr. Smith, M. S. Smith, I rode into work with him, I didn't have a car until about 1929. I didn't feel like I could afford it.

B.N.

What did M. S. Smith do?

C.A.

He was the treasurer, a very tight treasurer. He was a very effective person as a treasurer, he did a good job. And then the other people I didn't know quite as well. Most of the other people who had formed the company in the first place were sales engineers. They had training from Willis Carrier on how to design jobs and take the air-conditioning equipment that was available and make it run for the various jobs that were available. And let me see… I'm sorry to be so slow about…

B.N.

Well that's fine we've got plenty of tape.

C.A.

Heckel. Ed Heckel was one of them.

B.N.

That's H-E-C-L-E?

C.A.

H-E-C-K-E-L. And Murphy. I think it was Ed Murphy. And Lyle had a younger brother who didn't come up nearly to his stature but he preformed, he was a sales engineer. Also, incidentally, he participated in working out the specifications for residential air-conditioning at a later time. I think it was E. T. Lyle. E something or other Lyle, Ernest. I don't remember his middle name. There were a couple of others that I can't identify right now.

B.N.

One name that I see come up in old literature periodically who apparently was quite a pioneer of his time was Walter Fleisher.

C.A.

Oh yes, I knew Walter Fleisher fairly well. He was part of our competition and a very able guy.

B.N.

And did he have his own company or-?

C.A.

Yes he had his own company.

B.N

And he was a what, I suppose a consulting engineer?

C.A.

Yes, I would guess so but I think, I am not sure whether, I think at a later time they manufactured as well if I am not mistaken.

B.N.

What can you tell me about him?

C.A.

Well, of course, being the competition he was the enemy you know. He was a very smart individual. He made a lot of contributions to the things. I am not sure that I can name specifically the contributions but he was a big factor in the air-conditioning field. Then of course besides air-conditioning there were a lot of companies in the refrigeration business, there was York refrigeration. In 1930 Carrier absorbed two other companies. One of them was Brunswick-Kroeschell. They manufactured both ammonia and CO2. The Kroeschell Company was out in Chicago and the Brunswick Company was in New Jersey. I will think of some other names of the manufacturers. But there were several manufacturers. Some of them originally had made ammonia absorption machines as well as compressors. A number of them have continued on. I think there are a few left that still manufacture reciprocating compressors and do a good job of it, at about the same time that Carrier took over these two companies. We also had the Depression at that same time. DuPont came up with a Freon refrigerant. Prior to that Carrier had used methylene chloride and what we call dichloroethylene which was, we called it dilene but it was dichloroethylene. There was two isomers of that but they mixed fairly well. We used the dilene first and then we used the methylene chloride. Methylene chloride was…

B.N.

Carrene #1

C.A.

Carrene #1, that is right. I remember being invited to attend the presentation by DuPont of the refrigerant 12 was the one they started and Mr. Carrier immediately saw that the same kind of a situation could work for a lower pressure refrigerant so he went to DuPont and said, "Can't you manufacture something that has a pressure below atmospheric at ordinary temperatures. So that was the origin of Carrene #2.

B.N.

Which was refrigerant 11.

C.A.

Refrigerant 11, right. That was used for, well it is still being used I guess. It was a very satisfactory refrigerant. Of course, it is relatively nontoxic. In the 1930s I was invited to various demonstrations down at __ Point in Delaware. There was a good deal of opposition to the refrigerants initially.

B.N.

To the fluorocarbon.

C.A.

The fluorocarbons refrigerants and one of the things that they did at that time, there was hardly anything in the way of safety standards but the New York Fire Department did have some safety standards. They set up a typical sized kitchen, about the same size and put some burners on this and released the Freon 12 in the thing and they presently got hydrofluoric and hydrochloric acid with a little phosgene mixed in with it. They made a demonstration of this and said sure it was safe ordinarily but when you burn it, it is a very toxic material. It posed a real problem for DuPont and they got busy and demonstrated a whole lot of different refrigerants using guinea pigs and rats and one thing and another and they spent a lot of money on it. That was during the '30s. They finally went out for the things that ran in places where people are congregated. But, they set up a lot of restrictions on it too.

B.N.

I remember finding a record at one point in my travels, it happened to be in a library, but it was a report on the opposition to the Freon refrigerant. It was done in New York City and the engineer who was in charge of the opposition you might say was an engineer by the name of Edward T. Williams from New York City.

C.A.

That's right.

B.N.

It was a very extensive thick document trying to report the Freon refrigerant as dangerous.

C.A.

That's right. They didn't give up easily. Actually as it settled down the ammonia did continue to be used in industrial jobs. But the Freon refrigerant took over almost completely in jobs that were sensitive to individual people. Of course the Freon refrigerants had the advantage that they could be used in direct expansion whereas the ammonia system couldn't really. They did have some direct expansion chillers but they were a hazardous thing and if you had anything like it in the present that they wouldn't be allowed at all.

B.N.

Of the various other people that you knew in the industry whether it be air-conditioning or refrigeration, is there anyone else that sticks out in your mind of people that you knew as far as ___ competitors.

C.N.

I recall Garland.

B.N.

Milt Garland?

C.N.

I think so.

B.N.

He's still, in fact he was at your luncheon today.

C.A.

Yeah but he was from that period. I think if anything he is a little older than I am. I'm 89. 88, I'll be 89 in August. He was a very fine person. He was in one of the conventional refrigeration systems and he still is.

B.N.

Yeah, it was Frick Company.

C.A.

Mel Frick, that was one of the names I was thinking about. There's a couple others that I forgot. I knew some of the people in other companies. In York, I have forgotten the head of the York Company now. If you mentioned him I would remember his name I'm sure. Actually, some our competitors were taken over by Carrier in 1930. For instance, there was another man from Kentucky. He was the one that started F. Paul Anderson award and I can't remember his name.

B.N.

Uh, maybe from Henry Vogt Machine Company?

C.A.

No, no, he was from New York Heating and Refrigerating Company.

B.N.

The only person I can think of off the top of my head was…

C.A.

He was the head of the-

B.N.

Uh, Thomas Shipley?

C.A.

No, Shipley was York heating, I mean York Refrigeration. I didn't know him well. In fact, I am not sure I ever met him. I'll probably think of him but he is the one that gave the money to start the F. Paul Anderson. See F. Paul Anderson was the dean of engineering at Kentucky. A whole lot of the early leaders came from Kentucky. They apparently had a very strong mechanical engineering program. Many of the people I knew were from Kentucky. I would say a good share of the people that Willis Carrier organized originally when he was with Buffalo Forge and many others beside that. How's your tape coming?

B.N.

We're getting done near the end of side 1. We're not quite there yet.

C.A.

What is that a two hour tape or something?

B.N

Uh, no in fact I'm not sure how long it is. Theoretically it is 90 minutes but actually on this tape speed it is much longer.

C.A.

Yeah, well I can tell you a lot more about some of our competition later on.

B.N.

You're talking about many years later?

C.A.

Yes. This would be probably mainly in the 1950s which is still quite a ways back.

End of the Side 1: Last 4:32 of tape is all jumbled.

<u>Transcription of missing audio</u>

Leadership Recall interview with Carlyle Martin Ashley continued

(Note: The audio of this part of the interview no longer exists)

This is an edited copy of the original typed transcript done in 1988, converted to a Word document using OCR,

January 2015.

C.A.

Yeah well, I can tell you a lot more about some of our competition later on. This would be probably in the 1950s which is still quite a ways back, but part of the reason that I can tell your more about it is that during that time among other things that I was a specialist in, I was a specialist in noise control and that seems funny for the a guy who can't hear very well but I really took advantage of it. I guess for 20 years starting in 1930. I was the specialist in Carrier on sound control. I started under Ned Stacey's guidance when Carrier had a job out on Long Island with a movie company and we didn't know a thing about sound then and we hired Verne Knudson who was, incidentally he was also the first president of the Acoustical Society which was also formed in 1930. He was very sweet and a very good and able one. He set us up in a test program for running tests on duct sound absorbers. You would laugh at the equipment that we had. It was very crude even in 1930. We didn't have any sound level meters or anything like that. They did have an audiometer which you had a buzzer and an offset earphone and you adjusted the buzzer so that you could just hear it, I guess it was in the noisier environment. I have forgotten just what it was matched or - but that was all that we had except for the fact that he set us up in the electric type of sound business. He came originally from AT&T and Bell Laboratories. He was good at that as well as acoustics. But it was really laughable. We didn't even have a good detector for the thing but we made a lot of measurements under very adverse conditions and then in - I learned starting with 1930 and 1937 - and in 1937 MGM decided that they were going to build 10 sound studios. They gave us very rigid specifications and I got a call for going out to California to design that sound system for it. Verne Knudson in the meantime was at UCLA and he was - I think he was dean at that time, we got a little help from him, but what I learned in the meantime gave us most of what we wanted to do. We got a graduate student of his.

side 1 ends

One of the people that assisted me very much on the job was a graduate student of Verne Knudson's by the name of Ray Edwards. For quite a long time he has had his own company in New Jersey, Edwards Engineering. Ray was a very smart cookie but he didn't like the constraints of being in an organization so he started his own and he particularly didn't like the head of our engineering department. Well in any event ...

B.N.

When you say you developed the sound system for it, what do you mean by the sound system?

C.A.

I mean the sound control for - you see, these enclosed studios developed an enormous amount of heat from the lights. Particularly at that time they had to use a lot of lights and the place would be unbearable without air-conditioning so they all had to be air-conditioned - and the problem was to provide the air-conditioning that didn't make a lot of noise. It was a really challenging job. They had the specifications down to about 300 hertz and then a slightly better one from 300 hertz down but it was a tough job to meet. Actually we didn't have the information that was necessary to meet it. What I did was to use the information that we did have to design a system that I was pretty sure would work. It did. What we essentially did was to put plenums on the side of the air-conditioning and line it with a Rockwool. I learned later that I probably over developed/designed it. It worked. That is the important thing. But out of that, with Ray's help, he came back to work for us for several years. The first job I gave him was to put together all the information we had on noise control and write up a manual of how to design equipment from the standpoint of noise, and he did it. I think you will find that manual is still pretty good in spite of the fact that we didn't know really any of the fundamentals of noise control at all. Then later on we employed Bolt, Beraneck and Newman who were specialists in the development of theoretical sound and noise control and who had done a job during World War II in the field of submarine noise and radar or sonar. That was a very interesting story in itself, the development of sound control and it is sad to think but today, as I understand it, they practically dismantled the sound laboratory at Carrier. I remember very well when I went to Syracuse, we occupied the Franklin Automobile Factory. We employed some of the engineers that had worked for Franklin. One of them said that he had worked on improving the manifold but they had a new design, an excellent design. I think they said it produced 15 horsepower. Of course, that is a different rating from the present one anyway. From Franklin's point of view this was a revolutionary design and so what Franklin did was to fire about half the research department and say we don't need them any longer. I'm afraid this is what is happening in the sound field today, that they feel that they don't need them any longer, but this is not true.

B.N.

Let's hope they don't end up like Franklin.

C.A.

I was very impressed at that time by the results of Franklin and all over the factory there were signs that said something like "Remember that this is a quality product." And it was a quality product. It was a good car, an excellent car. They have a rally every August of Franklin cars. It was a good car but it wasn't the car for the future.

B.N.

Your biography lists you as being in charge of the development of the home heating and cooling system in 1929. The “weathermaker” concept of a hot air furnace air-conditioner combination that is widely used now and taken for granted now but was a revolutionary idea in 1929. What can you tell me about the history of this development.

C.A.

Acutally the start of that was about 1926. At that time you had practically no natural gas as natural gas was limited to a very small area. So the gas furnaces had to use manufactured gas and it was quite expensive. My recollection is that it was a dollar a thousand cubic feet. And I think the cubic feet at that time had a 520 BTU per cubic foot, about half of what it is for natural gas. Then when you think of the change of the value of the dollar this was terribly expensive. I think Lyle who was responsible for the management of the - he wrote the specifications and so on for a home gas heated air-conditioning unit. He specified that the unit should have a performance of about 90 percent. You can't design a gas fired unit that has a 90 percent efficiency without getting condensation. At least it is very difficult and practically is impossible. What happened was that the first time around the ? was swamped by the people who were involved the in it. They didn't have proper material to resist the corrosion of the gases. The other thing about the gases was that they didn't do a good job of removing the sulfur so there was a lot of sulfur in the gas as well. In any event, I got the specifications and I think it was either 1927 or 1928 because we took quite awhile to design the thing. I got the assignment to do a job that would give them a permanent unit. At the time we knew that about the only thing that we could use in the way of material in the condensing second section of unit was stainless steel. We spent a lot of time with the people from the stainless steel companies who had surprisingly quite a lot of information and finally selected a steel made by Allegheny. Then practically the whole system had to be done from scratch. We designed a furnace, that is a combustion chamber, to feed into a heat exchanger. The combustion chamber was designed out of ? and nickel - high chrome stainless steel to resist the high temperature. So what we finished up with was a double unit. One part of it the furnace, the combustion chamber would be better to say, was one material and the heat exchange part was a series of a flat plates. One part of the problem was that the burners that we had at that time were cast iron billboard burners. When you turn those off, the gas that was in the cavity of the burner continued to burn and finally it burned back and you got a loud pop and he said that wouldn't do so we had to select other types of burners which we did. Really, it was a quite novel design. There was really nothing like it on the market.

B.N.

The final version that you designed did have an efficiency of about 90 percent.

C.A.

Yes. I think about 90 percent. Actually I think acutally we got maybe a 91 percent but we had to feed back a certain amount of the warm air in order to carry up the existing flues. Besides that we had to specify that the smokepipe be made of ceramic and that any condensation that you got would be arranged to drip back into the base of the pipe rather than into the surrounding material. So that was the first one and quite a few of them were installed. I have no idea how many.

B.N.

Your version did use not use power draft of any kind.

C.A.

That is right. It was a natural draft. You have to remember that a lot of the things that are available today were just not available then. For instance, today you can design it with tubes and fans and so on. We didn't have that capability, partly because we had to use a natural draft but also we were not really equipped to do a fin tube job at the time so it was an expensive job but it was a good job.

B.N.

How much thought was given at the time that you were designing this with the idea of adding cooling to it?

C.A.

We did provide for cooling. What we had was a cooling unit that could be - this thing was quite a large unit. We didn't skimp for cellar space. Incidentally, at that time the thing that they were replacing was an octopus gravity furnace so we had plenty of room by comparison and we didn't skimp for space.

B.N.

Was it a forced air furnace?

C.A.

Yes, we had a blower. There was a thing that we attached, I think on the end of it as I remember with a cooling coil and then at the time that this was first designed, we either had to use well water or ammonia or refrigeration as a basis. Later you could use Freon. I think most of them were used with Freon but we had Aerofin coils in there for cooling in a separate unit. I don't think there were very many that bought the separate unit but it was available.

B.N.

What I had read about it in Ingel's book - it said that the early ones were not available with the cooling attachment and this was sold later on?

C.A.

Yes, I think that is right. Once Dupont had made the Freon announcement we got busy right away. By that time we had gotten the junction of the Brunswick - Kroeschell Company and the York Heating and Ventilating Company. I remember talking to one of the people that was commissioned to modify the ammonia compressor and pointing out to him that the art well would require, should really require a larger valve than the ammonia because of the higher density. I don't know whether they did actually put a larger valve on it but they should have. There was some adjustment some time along there. They also had a flexible seal. You see, the ammonia compressors all had packing glands and they were just a packed gland with a packing material and lubricated. Then along came the seals that sealed against the surface. Rotary mechanical seals. The seals themselves weren't rotary but in any event it was against the rotating surface. And we quickly adopted that and I just don't remember when that arose but it was close to the same time. What we ended up with was an ammonia style compressor with a rotary seal. We had a considerable amount of trouble with the early seals. There is one other thing that was of some interest. This I guess is partly my mistake and partly others, but one of the problems that we had on the stainless steel was that if you did welding on the sheet the welding cooled slowly and you developed a different characteristic of steel that destroyed the stainless steel. It caused an inner crystalline corrosion of the steel. What we had to do to avoid that was that we first welded these up and then sent them down. There was no place that had a large enough furnace in our local area so we had to send them down to Allentown to get to annealing furnace. Then they annealed and then they were brought back again to the right point. One of the difficulties was that a certain percentage of these were not properly heat treated and I presume that what happened there was that they stacked these things together and some of them didn't get properly heated. So we had quite a time with that. Some of them were fine but it all depended on where they were in the furnace. It was not an unmitigated success but we learned a lot from it and there are still a few around.

B.N.

Although you started in the air-conditioning business as an engineer in 1924, you didn't join ASHVE until 1931 and you didn't join ASRE until 1937.

C.A.

No, that is not right. I joined both of them in 1931.

B.N.

Why did you wait so long to join?

C.A.

Well, that is an interesting thing and maybe I was at fault. I did do some work for ASHVE during that period but I wanted to join when I could join as a full member. I was born in 1899 and I guess, and I don't know why they delayed until 1931 but in any event, I joined as quickly as I could when I got to be a full member.

B.N.

So you had age limitation?

Yes, you see you had an age limitation at that time. I don't know whether they still do or not. I don't really think they should. *I* think it should be qualified in other ways.

B.N.

How was the Society different in the 1930s from now?

C.A.

It was very different. I think it was around 1923 or '24 that ASHVE got its laboratory started and they began cranking out results and Willis Carrier was involved in that but there were some other people who were involved in sort of a joint combination of people from different companies that felt that we needed a lot more data and that if they supported ASHVE it would be recognized as a more unbiased result and something that would be worthwhile to do. So the laboratory was started and they ran a whole series of tests. One of the first things they were interested in was get an answer to the question "What is a comfort temperature?" Unfortunately, the method used to do it was flawed so that all of the first section of the test at the ASRE laboratory had to be thrown out. I think it was well into the '30s before the flaw was discovered and corrected. The reason that it was flawed is that they had two environments. One was in a higher humidity room than the other or a lower temperature or whatever and the people would start perspiring in one room and then go to another room. Of course, as it evaporated they felt much more comfortable. The other thing is that they were very naive. They thought that the engineers could write a description of how to do this thing instead of the psychologists. They didn't quite know what questions to ask of people and they tended to bias the thing by the questions they asked. Later on we found that you needed to get an industrial psychologist on the job to find out what questions to ask and how to set up a scale comfort. That was done later on but not initially. They ran a lot of other tests besides that, I don't recall them. In spite of the flaws in it I think the early laboratory did contribute a whole lot to the industry and to the Society.

B.N.

You wrote an article entitled Air Change, One Major Criterion, in 1941 and it seems that this industry had gotten itself in a bit of trouble by maximizing recirculation of air so much that there are air quality problems in many modern buildings. Do you have any comment on the evolution of the concept of indoor air quality during your career?

C.A.

Yes, somebody had written a paper on air change and I wrote that largely to knock down their thought basis, and I would do the same thing today. I will tell you why. During the late 1930s or early 1940s, I can't think of his name now, he has been dead for a long time, but a man at Harvard ran a series of tests on odor, body odor, and he set up a scale of measurement and he did an excellent job. He ran a series of these tests and wrote a paper on it. I looked at the test and I said well - I wrote him a letter, I said that the trouble with these things is that there is another factor in there that has to be considered and I think the factor is the amount of space per person. I gave him my reason for it. I said I suspect that the odor from people is an ephemeral odor and gradually disappears. And he accepted my comments and ran another test and proved that that was right. Essentially what I am saying is that the air change ought to be on a per person basis, but even then, you take the museum there with that high space. You are never going to get any trouble there even if you stop air circulation because the number of people in relation to the total volume is small and what it amounts to is that the turnover of air per person, that is, the volume that you have per person makes the space very good simply because of the ephemeral character of the bodily odor. Of course, that is not true of cigarette smoke and there you have to be much more rigid. There was quite a little work done in New York State studying the odors in schools. I have forgotten the name of the man that gave that but he specified 30 CFM per pupil, but you have to remember that most of those pupils didn't take a bath over once a year or something like that. They were very smelly and that is not suitable today. Those are some of the observations. Now, there is one observation that we made shortly after we got to Syracuse. One of the office buildings that was set aside as a separate building had its own air-conditioning and there is another message I am going to give you on that. It had an outside air opening and a return air opening going to the air-conditioning apparatus and then it delivered air to a bunch of induction units which I designed in the meantime and then into the rooms. Well, the thing was quite tight. It had gloss black walls and no windows and yet we hadn't noticed any particular objections in the same amount of odor. A number of us were talking at lunch one day and we wondered whether we really needed all that outside air. What we did was to close the outside air damper without telling management or anybody else about the thing. We said we would wait and see whether they object to it, and we never got any objection to it. Now, there is one thing that should be qualified on that. We did have a very good method of circulating the air that came into the room so this was good when you consider the fact that, and we don't know, we are just speculating as to how much air leakage there was in the building. But the fact of the matter is that we didn't get any complaints. I am well aware that you generally don't get complaints immediately when there is something worse. You have a gap between things that are objectionable, but these people were working in this space and if the thing had been bad they would have noticed it. My own feeling is that the local circulation pattern is probably much more important than the amount of fresh air you have. I don't mean to be dogmatic about it but my own belief is that there are very few places where they are really suffering from lack of ventilation and there are a great many places that have entirely too much ventilation.

B.N.

That is an interesting comment.

C.A.

As I say, you have to think of the local circulation as well as the other. Here is another interesting thing that happened and I meant to make a strong suggestion about this and never quite got around to it, but you know the inside cooling systems that they have now where they have the overhead duct and throttle the air ? The trouble with those, and I pointed this out when they started to make it but they didn't take advantage of it, because I knew what would happen. The trouble with those is that as you get less and less load in the building the amount of air goes down and down and down. So finally what you are dealing with is a stagnant air and there has been a lot of complaining about that. I know how to fix that.

B.N.

How?

C.A.

The answer is really quite straight forward. There are two ways of doing it. One is to put a few outlets that connect directly to the air supply to supply a certain amount of air at a high velocity and this will make up for the lack of air movement because it sets a lower limit on the amount, but it shouldn't be so much that you will get a lot of over cooling. The other way of doing it is to design an outlet for the air that you have so that as the air quantity goes down the velocity goes up.

B.N.

So in essence you are saying again that it is important to have the local air movement.

C.A.

Yes, very definitely. To a certain extent, particularly when you don't have much in the way of heat coming into a building. To a certain extent a person is enveloped in his own breath and what you need is to get a feeling of comfort and movement of air away from the individual, hopefully up or down so you don't give it to somebody else.

B.N.

Perhaps it is unfortunate that we got away to a great extent form the older idea of supplying constant volume variable temperature.

C.A.

Yes, that was very expensive. I support the variable air volume thing. I think it is a good thing, but I don't think the execution of it is good because of the lowering of the air circulation. It doesn't have to be that way. You can get a lot of air circulation with a small amount of air.

B.N.

Simply by using high velocity and inducing flow?

C.A.

That is right. I think as far as this particular article is concerned, the thing I was against was that x-raying is not the right way to measure the amount of ventilation. Partly because of the differences in the building and partly because of the difference in occupancy. The right way to measure ventilation is in terms of CFM – fresh air. And if there is smoking going on then you have to have a higher value. Otherwise, the amount that you need is very low. The fact of the matter is that except for odor you could have a CFM per person of 1 and be perfectly comfortable. And that is an inordinately lower figure. As long as you get local air circulation you can go down to a very low figure. I wish we could get that message out to the industry because it is a fact and a whole lot of what is now said about ventilation is simply not so because they are confusing the ventilation in and out with the local air circulation.

B.N.

It seems historically that originally when the concept of ventilation developed around the turn of the century, it seems that it was more along the lines of what you were talking about, the specification of CFM per person.

C.A.

A lot of people have recognized that CFM per person is the right way to do it, but you will find that in spite of that that they write it as air change and it doesn't make any sense. That was essentially what I was saying in this article.

B.N.

What you were saying in 1941 is still true today and probably more so.

C.A.

Even more so because the quality of the indoor air is better. There is a diminution of the amount of cigarette smoke. So actually if you don't have cigarette smoke 5 CFM would give you very satisfactory results.

B.N.

On the other hand we compensate for the lack of cigarette smoke with the building materials odors.

C.A.

You know, the right way to do that is to require that all materials of that sort be pre-vented, I mean they be kept in a warm chamber to vent out the vapors - I mean it is a crying shame to just specify something like that and then bring it into a living area.

B.N.

No common sense involved.

C.A.

But it really should be a matter of legislation on something like that.

B.N.

While we are on the subject of air, a common air distribution duct design method is static air regain. I understand you played a part in developing that method.

C.A.

Yes, not only that but I tried to defend it here. (note: A paper was presented

at the meeting and Ashley went to the presentation to discuss the

differences he had with the author.)

B.N.

What is the history of that?

Well, I don't know exactly but Willis Carrier had a hand in it. Typically, and what you recognize as being important is when you design an extended duct system with a lot of branches the air velocity at the fan would be at maximum and then when you move away from the duct you should reduce the air velocity. Partly because of the noise, but mainly of preventing too much buildup. If you take a duct of one size and cut that to one-half in size, you should have a lower air flow simply to keep the pressure down due to friction to the same value that you had before. Essentially, all of the existing systems of duct design use a system like that. In the olden days the principal one was called an equal friction approach. In other words, as the duct size went lower you had to decrease the velocity to keep the friction the same. The thing that Willis Carrier recognized is that when you do that, you have a decrease in the velocity, you get a regain of a portion of the velocity pressure between the two different velocities. I don't know, because I don't remember talking about that, but, lets say the efficiency is 50 percent. It will certainly be higher than that so lets build - lets say we will regain 50 percent of the amount. The thing stood there for quite a long time and there were various people estimating various estimates, but none of them went over 75 percent. I began to think more analytically on the problem. I don't know what triggered it but I knew that the velocity across the duct varies from the maximum in the middle to a very much smaller amount at the outside. When you take air from the outside of the duct you get the smaller and lower velocity of that air. The thing that I picture first is that if you put a collar around the duct then you can put some holes around the periphery and draw air into the collar and then put a connection on the discharge of the collar. Substantially all of the air would be drawn from the periphery of the duct. Of course, as you draw more and more air in obviously some of the air would be drawn from farther in. That was a rather crude vision I had initially. After looking at some of the test data that we had I concluded that the air that was drawn into an ordinarily right angle outlet from the branch outlet - most of that is drawn from the outside. Part of the reason for that is that the high velocity of air in the middle isn't pulled in because it is easier to pull the air from the sides. This is not perfect. It is not nearly as good as the first analogy that it draws from the complete periphery, it still is pretty good. So we began to look at this thing analytically and you have to remember that the typical velocity that you are talking about is a mean velocity for all the air and the velocity of the air in the center can go up as high as 20 percent than the mean and

then the velocity at the edges goes down somewhere around 40 or 50 percent below the mean. What it amounts to is that if you pull only a small amount of air from the periphery you are getting a much larger amount of air that continues on down the main than you had before. In other words, if you assume just for the sake of argument that that carried none of the air with it, it is obvious that if you kept ten percent of the air out then the velocity of the remaining air would be ten percent more. Obviously it is not that, but it is probably in the neighborhood of an increase of five percent. So, on that basis I calculated that for taking a small amount of air out the amount of air that would - the coefficient of performance of the main part of the duct would be over 100 percent. The 100 percent is defined by the mean velocity not by the peak velocity. Actually I figured it might be as high as 135-140 percent for a very small amount of air. Then as the amount of air increases that drops off - but the fact of the matter is that in any practical situation you very seldom decrease the velocity by more than - probably 10 percent or 20 percent at the very outside except at the very end of the duct. What it amounts to is that we are dealing with is a static pressure regain that instead of being 50 percent is nearly 100 percent. We wrote a paper on that in 1956. So far as I know, we are the only ones who have written a really analytical paper and also given experimental results, which we did in that paper. The thing that we showed, admittedly the test results were not as good as we would liked to have had, but the results that we got showed that way out the performance was still about 90 percent. The interesting thing about it is that since then the Russians have run a lot of tests on the pressure drop in mains and the pressure drops in branches. The latest data the Russians show that for a 20 percent drop in velocity you have a 200th of a percent drop in the total pressure. That doesn't mean that you only have a 200th velocity in the static pressure reading because the static pressure reading is only from the initial velocity to a somewhat lower velocity. What you can calculate is that it is the equivalent of about 95 percent instead of 50 percent and that is the principle role that I have had in it. The other part of the thing is this. We found, this was done primarily in conduit work that Dr. Carrier ran, and we found that ? a whole series of branches coming out from the conduit that the pressure drop of the branch correlates very well with the static pressure. In other words, instead of correlating with the total pressure drop it correlates with the static pressure drop. We showed that in our paper as well. What that means then is that to the extent that you can do that, it means that if you manipulate the size of the duct in such a way that you maintain the static pressure substantially constant in the main duct and if you have a duct velocity that correlates with the static pressure then you can put a whole bunch of the branches off of the duct without dampers and if you want to demand the same amount of air off of each one of them you will get the same amount air. This is an ideal condition and it may not actually work out. Part of the reason may be because you have different requirements for different levels. In any event, that is really the basis of the principle. We are not claiming that this is equally true for all branches and for all types of branches. In any event, it is something that can be worked out. You can actually, with the data that is available today, you can calculate how much difference there is and what this intolerable difference is without having to take specific action. When we first put this out, what we were concerned about mainly was making something that was simple to calculate and simple to put in and we were not too concerned with optimizing the system. The thing that was simple was a right angle outlet, just a straight outlet. That works very well, but on the other hand, it has a rather high resistance as though you have tipped the outlet at an angle. Unfortunately, if you tip the outlet at an angle you don't get quite as good uniformity in the static pressure. I still think it has value. The thing that the speaker at the Sunday program was talking about was that the static pressure gain is the worse thing that you can have. Well, they are not right. But more than that, the fact is that if you lower velocity in a main and do the kind of calculation that they are doing which on the basis of total pressure and use the figures that are in the data book you automatically get the static regain whether you think you have or not. This is a preferred method that the Society is recommending. What it amounts to is that all of these people are benefiting to whatever extent that it is available in recovering static regain. As I say, the recovery value is in the order of 90 to 95 percent. Does that help to give you some figures. Unfortunately, our friend quite disagrees with that. I talked to him for about three hours the other day and I think he might be a little bit more inclined...

B.N.

He needs to read your paper.

C.A.

There is something very strange about that. I mentioned the 1956 paper and he pulled out a copy of it and it looked pretty tattered to me but he failed to mention it in his paper, either in his specific comments or in the references. Furthermore he failed to mention the fact that the Russian information, well it is not put in the form of static regain, it is really identical in the results.

B.N.

It probably wasn't mentioned because it just proves what you were saying.

C.A.

That is the point I think. Incidentally, he said that he was working on that. So he must have been fully informed of the thing. He was from Russia and he said that he was working on the material that we printed. The material is quite good. I think it is just regular ?

B.N.

Several years ago you wrote an article "Our Industry Needs Creative Minds." How would you update your thoughts on that subject today?

C.A.

I still think that they need it. Actually, there isn't very much scope available for the use of creative minds.

B.N.

What do you mean by that?

C.A.

What I mean is that - take the situation I was in for instance. After I came with the company in 1924 I was still only the second person in the research department. We have been talking about the fact that a lot of the technology was pretty primitive then and there were a lot of things we didn't know. As time goes on you get more and more information and you have more refinement of your equipment and to a certain extent that requires a different kind of a person. I don't mean to say that there isn't some real important creativity, but I have a feeling that I would not be very happy in the Carrier Corporation today because if I was working in a technical field I would probably be put in a relatively narrow slot. They are not doing much of any research today or at least a minimum amount. You see, I was telling you about sound - sound was just one of the various things I worked on. I worked on air flow in buildings and I got the compliment from some of the people in the field - I wrote a manual about how to design a system so that you don't have drafts and so forth. I made a design of an outlet that allows you to do that. They can't do that today. The thing that I am saying is that the things that were possible then are pretty much done. It would be fine to have more creative people but I am afraid you wouldn't keep some of the people in some of our organizations.

B.N.

What you are really saying is that even though there would be and are creative minds they are being stifled by the corporate environment.

C.A.

That is not necessarily all the case. Of course, there are people in the universities too that are doing it. But they certainly don't have the wide scope that I had. I was very unusual in that respect, but even so to, some extent they are going to have to work on relatively less challenging jobs as I see it than the people in the past have had to work on because the industry matured. It is a natural characteristic of the industry and so what you find is that most of the more creative people move on to an area where the industry is just beginning.

B.N.

On the other hand it would seem that there still is a great opportunity for creative minds to apply the existing technology. For example, when you had talked earlier about Willis Carrier and development of the centrifugal compressor, - well he applied technology from Germany.

C.A.

That is true, but as time goes on you get this kind of application and so, maybe I am wrong about this but there certainly is a need for creativity. The question really, perhaps, is how much creativity and will you be able to keep creative people happy. If the problems that people are working on are not really sufficiently creative then you are going to have them looking for another job. They won't have the challenge. I don't know exactly what the answer to that question really is but I think to some extent that we have to recognize the creativity required is perhaps of a somewhat finer scale than it was in the past. By that I mean, they concentrate more in one area and become highly skilled in that area but don't really expect quite so much in the way of results. It is hard to tell. It is a problem to keep people who are creative and still have them satisfied with the work they do. There is another comment that I would make. I think that quite a bit of what we take as gospel is not right. I was talking about ventilation, that is a good example of that.

B.N.

About the idea that the air change is ...

C.A.

Well yes, but more than that, that even the air change per person is subject to - it all depends. Look at the situation that you have got in the inside spaces where they have these VAV types. They are probably supplying enough air to provide ventilation on that but they are not satisfying people. The reason they are not satisfying is because they are not specifying enough circulation. What I am saying is essentially that you have to do some rethinking of the whole process and that part is - what you really what you need is sort of an agnostic. I mean, you need people to question the things that everybody takes for granted. In that respect I think the creative people can make a big contribution. I think if they start asking questions about these things they are going to find that a lot of the answers are not correct. Incidentally, that is the way the new concepts, new inventions.... You were asking another question here about what my thoughts were on the invention that I had. I have 67 U.S. patents. This ought to be emphasized because I think some of our people, when they just say patents cheat a little bit, they put in the foreign patents and foreign patents don't count. Some of these are joint patents but not very many and some of them are not in the field of air-conditioning. But most of those are - there are not very many good patents you know, not very many good inventions. Maybe one in 100. Your question led me to think about the various ones that I have had. I have had a number of patents on systems. Of instance, I had done an interesting study on steam jet refrigeration for railroad cars. Another thing that we did much later than that was a fresh water recovery system based upon freezing. This was a complete system. So there have been a number of ones based on the systems but I think one of my patent ideas have been based on a section of a system. I got to thinking about which ones are still being used. I will give you another interesting example on a system. At one time there were a lot of ? freezers. A good friend of mine, Crosby Field, had a patent on those and I took a look at his patent which consisted of your defrost system. You have a cylinder or a square tube and put refrigerant pipes on the outside of it. You defrost it and then you chop it off. I took a look at that one day and I said I could do a lot better than that because what I could do would be to have the pipe made of stainless steel which is low conductivity material and then I put pipes around one area and then another one and that formed the basis of a Carrier - what do they call it - well it had a form similar to the latest. It was different in diameter with a slim waist. What we did, the ice on the inside would accumulate just around where you had the ring of frozen pipe. When it got to a certain point you would defrost it and these would drop off and you wouldn't have to have a cutter or anything. I don't know why they don't manufacture those today they are very good. Crosby was very mad at me for patenting something in his field.

B.N.

He probably was especially mad when Carrier decided to manufacture it.

C.A.

He was a good friend and it didn't last. There were two things that were interesting that I felt that I contributed a lot to. The first one was the so-called Conduit Weathermaster. Actually, Willis Carrier was the designer of the Conduit Weathermaster System but I designed the key element to the thing which was the induction unit.

B.N.

What do you mean by the Conduit Weather Master system?

C.A.

The Conduit Weather Master system is a system that is designed for larger buildings. It is put in hotels and put in office buildings and so on. The operative element of the thing is an induction unit in the individual spaces. If this (pointing to the room AC unit) was a thing like that you would have a unit that was considerably smaller than that, but an induction type unit and the air from the central system would blow into nozzles in the system and induce air from the room and blow it into the space and you would be a lot more comfortable than we are now.

B.N.

You were providing a sufficient air volume…

C.A.

Yes, it goes up and then circulates around again and it has a vertical movement which is very important. The history of the induction nozzle goes back a long way and Willis Carrier participated in that. He developed a nozzle for circulating air among various ceramic things or various other things that are in a tunnel. About 1926 somebody got the idea of putting a very slim horizontal nozzle in the space between studs and then you would put below it a heating coil and the air would be drawn up through the nozzle and then discharged at the top and some of the air or more of the air would go through the heating coil then you would have some air being supplied as well. The idea of that was that you could supply the cooling air that was needed for doing the cooling job as air to the nozzle and then the heating air would be supplied by the steam heat or hot water heater coil. That thing first off was put between studs. Then they decided that to get access and so forth it would be better to put it in a cabinet under the window. I was assigned about 1930 to design a weathermaster system of that sort. That was fine except that they specified that they wanted to maintain the induction but they wanted to also be able to change the volume of flow which is certainly desirable because you don't know how much flow you require. We went ahead and designed it but what happened that was when we had these things adjustable so that you could move them back and forth you had to protect the ends of the things and it made a lot of noise and that limited the amount of pressure you could put behind it. We actually built and sold I would guess maybe 20 or 30 or 40 thousand units like that in the early 1930s. Then as the Depression deepened we didn't sell as many. The trouble with that was that it was noisy. I began to think more about it and I began to think about the problem of high buildings. The cost of square footage is high and what you really need is a very small duct supplying a small amount of air and the small amount of air is really all that you need from the outside of the building but you need more air to get the necessary cooling. But if we put in a water coil then we can change the water temperature from high to low and get the cooling that we need. I tried to interest Willis Carrier and I guess he probably had so many thoughts on his mind that he couldn't be very well influenced. The reason I tried to do that was that this was a radical proposal at the time and I knew that it needed his blessing to go ahead and do it. We got to talking about the thing and I said there ought to be some way of getting a high induction ratio for which we need a high air velocity and not making all that noise. I got to thinking about the things that you blow on that don't make much noise. I said, supposing your took a glass tube and heated it and drew it down a little bit and cut off the end, so we tried that and it worked. You couldn't hear the noise at all. We thought it might be just because we just have one and if we had a'whole bunch then it might make noise because of interaction. So we designed an induction unit. The first unit was acutally built with a whole series of glass tubes and we put them in some sort of a cement and then had spacing. We had a double row of the nozzles - we had a spacing in between and then another double row. These were calculated to reduce the induction ratio from about 3 to 1 at a much higher velocity than we had used before. We tried those out and they worked fine too. We left it for the moment because we were frustrated, we didn't know how to use it. Then along came the requirement for a room air-conditioning unit and I knew from my noise experience that it was going to be a really tough job to get a satisfactory noise level. The thought occurred to me - why the heck can't we put this induction unit in the thing instead of just a regular plenum. Initially we built one that was in a cabinet form rather than through the window. We went ahead and designed that and we got a patent with Sam Shawhand (?). I got a patent on the results of it. This was about 1934 or 1935. For two years we sold this and quite successfully as an induction unit but then they switched to the window unit, the competition did, and we felt that we were forced to do it too.

B.N.

Who was the competition?

C.A.

The other people that were building it.

TAPE 2 side 3

To continue on this, this thing was run for a couple of years and then abandoned simply because we couldn't get it into the space that was required, we couldn't run it satisfactorily. We had to accept the larger amount of noise that the other made but this was substantially quieter. Then it was abandoned for several years. Then we went up to Syracuse in 1937. They had the problem of supplying air-conditioning to the office building and I suggested that we take the units that we built for the air-conditioning unit. Why don't we put those in the office building and try it, so we did. The circulation of this was very nice in the room. It delivered air to the ceiling and across the ceiling and blew air up from the bottom. Then we got one job that was very experimental and put it in an apartment building in Washington. We had all kinds of trouble with it. We had leakage, the installation was very poor. We had leaks in the air and the water got out of it and so on and it was a mess. That was the time Willis Carrier got interested in it. I tried earlier to get him interested in it but he did get interested and he said, "Well, you are doing it all wrong." But he took the unit and used the unit. Then he designed a system to go with it. So I take credit for the unit but he takes credit for the system. So that was that.

I think I had better call it quits at this time.

End of Interview