ASHRAE Leadership Recall (formerly Leadership Recalled)

Transcription

Interview of: Roderick Kirkwood

Date of Interview: June 29, 1988

Interviewed by: Bernard Nagengast

Bernard Nagengast
You were born in St. Paul, Minnesota, but graduated from high school in Montana. How did you wind up in Montana?

Roderick Kirkwood
My dad worked for the Northern Pacific Railroad and he was transferred out to Montana in 1936 and I had my last year of high school in Montana.

B.N.
So you weren't in the area that long.

R.K.
That is right.

B.N.
That period was the Depression years. How did the economic situation at the time affect you and your family?

R.K
Like almost everybody. It had a very serious effect. There was no money to go to school on or anything like that and so it was a matter of my going on to school, how I could arrange to earn some to go on with it. So it affected my college. I didn't get the first year out of high school at all. The second year I was able to save enough so that I started at the University of Washington, Seattle, and started engineering.

B.N.
What year?

R.K
That would be the fall of 1938. My brother got quite ill and he was already attending the University of Washington. He got ill and so I dropped out of school and had to take him back to Montana because he had some operations and so on. So I didn't even finish the first quarter that year. By the time I saved enough to come back again it was winter quarter of 1939 so I got a couple of quarters in that year and then I got another quarter in the next year and the problem of starting enough to be able to afford to go to school, even with working while you are going, why, it was taught so. In any event, about that time we had the defense effort prior to the second World War. I took a summer job in Seattle with an outfit doing naval air stations in Alaska. It was a design build effort and I took a job as a blueprint boy with them and worked there for some months as a blueprint boy and became a draftsman and by the time I had saved enough money to go back to school again I had picked up the second number in the draft and

if I quit the job with the defense industry to go back to school, I would have to go into the service instead so I stayed there for a couple of years as a draftsman and ultimately a designer. I got married in the meantime and ended up ultimately in the service anyway. Originally as a combat engineer and got transferred to the signal corp. I went to Alaska for my overseas duty and after I came back I finished the Officers Candidate School and got commissioned as an officer in the Signal Corp. I went through their technical school there for officers, the electrical fundamental course which was an abbreviated electrical engineering course and ended up, I finished that up and they asked me to stay on as an instructor and I did. I finished out the War there. I got back out of the service after about three years and went home to Seattle and went to work for the Austin Company there was a draftsman/designer. I started school on a part-time basis and over the years I finally finished it that way. In the meantime, I got licensed as a professional engineer. I guess my license was in 1947. I finally got a degree in 1954, so that was a little reversed from normal.

B.N.

You were a licensed engineer before you had the engineering degree.

R.K.

That's right. After working for Austin for awhile, I worked for a consulting engineer by the name of Clarence Pangborne, and in 1952 I went to work for John Graham and Company and worked there for many years, first as a mechanical engineer and then as a chief mechanical engineer, then as a director of mechanical and electrical engineering, ultimately the director of engineering and then the direct of operations for the whole firm. I was president of the firm and I guess that pretty well covers it.

B.N.

Is that currently your position?

R.K

Yes, the firm has changed somewhat, but I am still president.

B.N.

Why did you decide to become an engineer?

R.K.

When I originally started out, I had an interest in math and an interest in chemistry and I was going to be a chemical engineer. My father worked for the railroad and I had exposure as a kid to some of the water chemists who were chemical engineers and worked for the railroad. It was considered a pretty good job. It looked like it would be a logical thing so I started out to be a chemical engineer. But after I came back from the service, I decided to become a mechanical engineer instead. I didn't really care for lots of laboratory time.

B.N.

What changed your mind from chemical engineer to mechanical engineering?

R.K.

I guess when I worked for the defense contractor, on the Alaskan base, that was mechanical engineering there and the same thing was true when I went to work for Austin Company. I was doing mechanical engineering relating to hospitals and other buildings. I guess it was never what you call a conscious intent of changing, it was just that it became the direction I was going to I went that way.

B.N.

How did you get interested in heating and air conditioning?

R.K.

That was part of what I was doing in the mechanical engineering for the defense contractors. It had to do with boiler plants and buildings both, so this involved heating ventilating and air conditioning. When I was working for the Austin Company? I got a hold of a member of ASHRAE in Seattle at that time and was able to obtain a copy of the 1939 GUIDE and Data Book from him. That was my first exposure to ASHRAE. Subsequently, I joined the Society in about 1946 while I was still in the Service. I was still stationed in New Jersey. It was called at that time the American Society of Heating and Ventilating Engineers. I went up to a national meeting that they had in New York City since I was not far from there and that was the first Society meeting I ever attended, ASHVE meeting. After I got back to Seattle, I located somebody who was in the local chapter and joined the chapter and became a participant locally.

B.N.

So the first ASHVE meeting you ever attended was one of the national meeting. What were your impressions?

R.K.

I was impressed with all the activity that was going on. The guy who was executive secretary then, Hutchins or Hutchinson, I have forgotten which. Anyway he was most helpful friendly and a lot was going on and a great deal for me to try to digest, but I was impressed with it.

B.N.

What kind of work did you go when you were working for Clarence Pangborne?

R.K.

It was heating, ventilating, air-conditioning, and plumbing systems for schools, school design.

B.N.

Was there anything significant that you can remember, anything that really impressed you particularly at that time?

R.K.

Well, Pangborne was a very experience engineer and I learned a great deal from him, in particular his application of machinery, he had been active in the business and in connection with a plumbing and heating company as well in Seattle for quite a number of years. During the war he had worked for government because there wasn't any work for private engineers at that time. So I had gotten to know him there. He was a practical engineer. He evaluated systems in an intelligent manner and we did projects and had very little problems with them. It was a good foundation in the fundamentals of doing an effective project. It gave me the opportunity for a lot of exposure. We did some remodeling jobs and with remodel jobs you go in and try to straighten out the problems that are there already as well as fix or add to the building. Those were excellent areas of learning. I think that the time spent with Pangborne was a good foundation.

B.N.

Then when you went to work for John Graham company, what type of work were you involved in with them?

R.K.

At that time, they were doing a broad practice of architecture and engineering. Actually the reason I took the job was that their chief mechanical engineer was leaving and he asked me if I would be interested in his job at an ASHRAE meeting. Initially, I didn't think I would be, but then after thinking it

over for awhile, I decided I might be. I contracted them and ultimately I got a contact back asking me to come in and talk to them, which I did. They offered me a whole lot more money than I was getting and such fringe benefits such as getting paid for overtime and having holidays paid for and even vacation. Those things you didn't get in the consulting business in those days ordinarily so it was a pretty attractive offer. But it wasn't for the chief mechanical engineers job. Instead I would be one of three participants that they were looking at to take the job. However, I would have a job with them as a design engineer anyway. I have never been afraid of competition so I took the job on the basis that I was going to end up becoming the chief mechanical engineer and did. But it was basically buildings, office buildings, and they were also into the, John Graham conceived the concept of a regional shopping mall. The first one that was ever done was Northgate in Seattle. He had done it by the time I went to work for him. So we went on from there to do a number more of those. There are over a hundred of them scattered around the United States, all the way across Canada, some over in Australia and some in England. In Canada we did them from Halifax on the east coast to Vancouver, British Columbia, on the west coast and a lot of places in between. We actually opened an office in Toronto for some length of time. We were doing all of Eaton's work. In the United States we were doing all of Allied Storage work. In those days the departments were the owners and even the developers of this new idea of a regional shopping center. That gave a fairly complex mechanical project to do and was very interesting. A number of these included Central Steam Systems and things of that kind.

B.N.

What types of challenges or problems did you come up against when you were designing?

R.K.

Originally, they were open malls, not enclosed malls. There wasn't a single building, you were designing a series of buildings. The earlier ones we used a central steam plant and distributed steam as you would in a downtown district steam heating system, metering it and so on for heat. We looked at the possibility of the same thing with chilled water for cooling, but we never did do one that way and said the system, the air conditioning was individualized. Each department store had its own refrigeration equipment. The smaller stores would end up with either small package chillers of a DX system. One of the reasons for that was that you put the electric power requirements for that on each individual tenant’s meter. So he paid his own electric bill and therefore paid for his own air conditioning operation. Steam is relatively easy to meter. Chilled water was expensive to meter in those days, BTU meters. So that is why we didn't wind up with chilled water systems. One of the things we did end up with was a problem of, particularly when we got into multi-level projects such as shopping centers in Hawaii or shopping center in Portland, we had tenants over the top of each other so they were multi-story rather than a single story project. The problem of condenser cooling became more complex and we ended up a number of those projects providing a central cooling for each building or each cluster building so that the number of tenants were served by a common cooling tower. The only part that the landlord then considered was power for running the fans on the cooling tower and the makeup water and the water treatment. The tenants each got their condenser cooling water from the cooling tower and provided their own pumps and used water cooled condensers. The pumping got to be somewhat complex because you had maybe 20 to 30 pumps all functioning in parallel so you had to be pretty careful on your pump selections and control that carefully. But it worked very well and a number of those systems are continuing to work today. But they left in the maintenance of and the electrical cost

for operating the pumps and chillers or refrigeration equipment entirely with the tenants and this left the landlords with a fair amount of complex bookkeeping. Those were some of the problems. There were a lot of interesting ones because each tenant had his own particular need, whether it was a food operation with hoods and therefore requirements for outside air or whether it was a department store that wanted to eliminate the obstruction of doors to come into it and use air curtain entrances or, in some of the cases we had major parking garages that were part of the project and the question was how do you handle the ventilation of a parking garage that covers 10 to 12 square blocks all in one structure. It gets pretty big to handle and the duct gets to be a problem and even if you leave it open pretty much in the perimeter you still end up with a problem of noxious fumes when you get back some distance when the wind isn't blowing, back some distance in from the perimeter. So we worked out a system there which I think was reasonably innovative; we used high pressure air distribution to keep the ducts down and use it as a supply system. The supply rather than exhaust so we were diluting the contaminants in the air rather than trying to suck them out. With that we were able then exhaust so we were diluting the contaminants in the air rather than trying to suck them out. With that we were able then to move air over greater distances as supplied because you can control that and where it goes and how it diffuses or spreads. I think they were much more effective and there were a number of major projects where we used that method of garage ventilation. I believe it is becoming much more reorganized recently, in the last two or three years, than it was 20 to 25 years ago.

B.N.

You said earlier that you had a lot of experience with designing systems for office buildings. Now we are reading lots of things in the press about problems with air quality in buildings, so-called "sick" buildings. Were things different back years ago, when you were first designing office buildings from the way they are doing things now?

R.K.

I think that we anticipated smoking in the buildings when we were designing then because the majority of the people smoked in those days and on that basis we used fairly generous quantities of outside air as minimum outside air. With that we didn't have any so-called "sick" buildings. There was enough outside air so that the odors were dilutes. I think one of our earlier high rise buildings was the _ office buildings in Honolulu and at that time most of the buildings in Honolulu had been handled by package units in one form or another and there was very little in the way of major office building air conditioning. On the Ala building we used a double duct system and provided for humidity control under a light load condition by using reheat within the central equipment. It was, as far as I have been able to determine, the first truly centrally air conditioning major office building in Hawaii and the humidity control we provided allowed us to handle the thing in comfort even in their very humid climate and the so-called tropical weather when the trade winds are not blowing and the humidity simply builds up and usual the buildings were very uncomfortable and they smelled badly from the buildup of mildew. This building is till, after all these years, functioning effectively and it doesn't have mildew problems. The building was interesting from the standpoint that we also used complete solar control on the exterior. They are vertical louvers and the vertical louvers are conditioned by the sun as far as the light sensitive controllers are concerned. The building was done about the mid 1950s. so it is not a young building, but it is still functioning. We looked at the exterior or the building and the possibility of changing the skin on the building and giving it a different look three or four years ago and actually after we went

through all this the owner elected to stay with the operating louvers that we have on there at the present time. These are designed so that they move with the sun, they are vertical and protect the windows from any direct solar. On the other hand, they overlap enough so that they never close tightly and so you don't have a problem with somebody who has kind of a phobia over being boxed in. you can still see out through them even when they are essentially fully overlapping to keep the sun off the windows. They work very well and very effectively and decided to keep the exterior rather than change it even after more than 20 years of operation.

B.N.

You had said that the earlier systems provide ample amounts of outside air for ventilation purposes. Do you think the reason why lately many buildings are in trouble is because that the amount of outside air has been reduced to the point where ventilation is not sufficient?

R.K.

I don't think there is any question that is a major part of the problem and this had been in the name of energy conversation, the concept to reduce the outside air as much as possible. This reduction is both on the heating cycle and in the cooling cycle because in both cases it impacts the energy. I think it is the fundamental reason for the problem of "sick" buildings that we hear about these days compared to what they were before. But there are other problems besides just the outside air. The air distribution system, the attempt to control system, the humidity control which allows or may be even precipitation buildup of mildew or mold in the system. All of these are potential parts of the problem of making a sick building.

B.N.

You served as president of ASHRAE from 1973 to 1974. What was your presidential theme?

R.K.

I don't remember a theme offhand.

B.N.

What do you feel was your major accomplishment during the year?

R.K.

I think the major accomplishment without any question is the fact that we were into a period of long lines of people waiting at the gas station to try to get gasoline and so the energy crunch was the thing that was on everyone's mind and I think our big accomplishment in the year was to prepare and issue for review by the reviewers ASHRAE's standard 90. This was done in a very short period of time. It was done between a winter meeting in Los Angeles and the summer meeting in Louisville. It was done with volunteer labor with no government contributions towards our cost whatsoever. In order to accomplish it we had to raise the dues by better than 50 percent for everybody in the Society and that was just to give us enough money to pay for the printing costs and things of that king. The individual members of the various committees who worked on this paid their own way and volunteered their own time and we had tremendous effort going. There were thousands and thousands of hours that went into the preparation of that on a crash basis. We accomplished that and got it out before the public. I think it was an effort of monumental proportions. Normally our standards take much longer to prepare, even just updating old standards take more time than that. But in this case everybody got in because it was an emergency situation and helped and we did it in much less time. We did a very effective job I

believe. We got back lost of comments from reviews and ultimately edited it into a document, but the amount of distance we covered before we got the first draft out even was really almost unbelievable.

B.N.

Had there been any thoughts that you know of before the emergency happened to put together such a document?

R.K.

The impetus came from the National Council on Building Codes and Standards, had asked the Bureau of Standards of the U.S. Federal Government to prepare a set of regulations or standards for energy conservation. They had made an attempt to prepare such a standard. I, as president of ASHRAE, had volunteered our help to assist them. Their response was that they would like us to review the draft that they had and comment on it. So we obtained some copies, a relatively small number of copies before the winter meeting and mailed these out to the chairman of all of the technical committees so that they had copies of them, but there were not enough copies to mail to all the members of the committees and on top of that there wasn't enough time so that they would have been able to do much with anyway. So we had a major meeting at the Los Angeles Winter Meeting of the Society to consider this proposed Code. There was a great deal of controversy within the Society at that time over the code as a standard and I guess that the crux of the meeting we had in Los Angeles subsequent to the issuing of that first draft copy of what their standard turned out. At that meeting we had a lot of people that were very distressed because they thought we were trying to railroad this thing through ASHRAE without its normal checks and balances and we had a rather wild and unhappy meeting in Los Angeles. The major proportions with the people from all of our technical committees and the people from the Bureau of Standard-and get them to understand that they were not asked for ASHRAE to rubber stamp what the National Bureau of Standards had done. What we were asking for was a response as quickly as possible so that we could give them the benefit of our input and keep this standard and something that we could live with. The end result of the meeting was that the National Bureau of Standards took their product essentially back home and looked it over in light of all the comments that they got out of the participants in that meeting in Los Angeles and decided that there was no way there were going to be able to turn out such a standard. So they contacted me and asked me if ASHRAE would take over the process of turning out the standard. I agreed that we would but I wouldn't agree to the fact that we would simply take the standards they had prepared and modify it in a minor manner and make as ASHRAE standard out of it. What we did agree to was that we would take the work they had done on the standard and use that as reference material, but we would write the standard to suit ASHRAE not to suit the National Bureau of Standards. They agreed with National Council of Building Codes and Standards being intermediary so we had some mix-up and some cross purposes, but we got that straightened out and we did agree to proceed with the standard. By the time we got that far it was May or there abouts and that was when we started on the project. We had to try to get it out and we set ourselves a goal of about 60 days to get it out. We didn't quite meet that but we came pretty close to it. And that was in spite of the fact that it could coordinate with IDS as a co-sponsor of it and that AIA initially, they wanted to be a co-sponsor of the standard and they were editing and providing a chapter in it on the envelope or enclosure of the building. Subsequently, they withdrew from the standard. They felt it should only be indicated as being principles or practice or something like that and not a standard. We felt strongly enough that it should be a standard and we stuck by out guns. Anyways, we

worked through the problems with the AIA and all of our own people and ended up with a draft which was sent out for review and there were a lot of review comments back and those review comments were all reviewed and responded to or the standard was modified. It was fairly extensively modified. Ultimarely, we ended up by issuing and ASHREA Standard 90.75. I think it was the right was to go. I don't think I have any regrets whatsoever over the fact that we went that way rather than making it principles and practices like the AIA wanted us to or recommended practice of something of that kind. Certainly it stopped the proliferation of regulations that were going to hit us otherwise because there was somebody with authority speaking in the terms of energy conservation. I think it was a very good effort, tremendous proof to the initiative and effort put forth by our members. There is no question that it was the high point of the year. We did a lot of other things, but that was the high point.

B.N.

What were the feelings that the time on the energy crisis? Was there an expectation that this was just going to continue and get worse or was there a lot of pessimism about this?

R.K.

Yes, there was a great deal of concern about it, but I think that my message to the Society was that we know how to take care of energy, we know how to control it and I believe from all of the information I had that we could save, conservatively we could save at least 50 percent of the energy that was being used in buildings by doing an intelligent job of applying the knowledge we had at the time. I attempted to get Senator Jackson in particular of Washington State, who was a pretty powerful senator at that time, I tried to get his backing and he was headed in a different direction which was developing new sources of energy. He wasn't really interested in conservation. So we were unable that year to get much help out of the Federal Government in pushing forth this concept for energy conservation. Subsequently, the product we did turn out and the impact it had had over the years has been certainly great enough to be more than what we expected. The standards we set up at that time for energy efficiency of equipment and things of this kind were looked at as being pretty far out. What we did was we set up a challenge for the manufacturer and they have more than met that challenge on almost every case. All of this was rewarding as far as I was concerned on a personal basis. I think it was probably one of the biggest, most intensive efforts ever mounted by an Society or any other nonprofit organization. One other aspect was that the Board of Directors was very seriously concerned about doubling the dues just to handle this wild problem, but I ultimately prevailed upon them to do so and it would provide enough to do the publishing and the issuing of the standard for its staff review. The ultimate publishing was also allowed for, or at least some of the money was agreed would go for a public relations firm to be our source of publicity on the fact that we did have people who knew how to conserve energy. The cost of their work was included in the dues increase. I think it worked well. ASHRAE because almost a household word whereas it had never even been heard of before that. ASHRAE was knows by ASHRAE members and that was about it. This way we were talking to the whole country. That was important at that time. We established an energy conservation committee in each chapter that was used to promote energy conservation, by talking about it and telling the local press that there were people who knew how to conserve energy and it wasn't necessary to go out and get some new contractor from Podunk to come in and tell them how they ought to conserve energy in their buildings. This message got through all right and we have never had any real challenge since that time

about who was in charge of the energy conservation efforts in the country, who was providing the major input to it and ASHRAE has.

B.N.

I notice from your biography that you were involved in the space needle as supervisor of mechanical and electrical design. Can you share your experience working on that project?

R.K.

That was sort of a fun project from the standpoint that everybody wanted to see it built, even the building department officials. We had a significant bad time with the electrical inspector and we were able side track that problem but basically it was as simple as the Seattle World Fair. I think it was a pretty effective one. It had a lot of attention while it was being built and a good attention during the fair but it is still and operating entity and still making money for the owners in Seattle the present time. It had our second revolving restaurant on the top of it. The first one was over in the office building, which I mentioned before. This was the second one. The only complication with a patent is that it gives you a ticket to fight between attorneys that you end up paying for and on that basis we didn't really task everybody to task over patent infringements. There have been a number of infringements since then. In any event, it had a unique thing about being a five story building that was essentially 600 feet high. It had how to handle fire protection in it and we worked it out with the fire marshal. We did end up by sprinkling the entire building. We had a revolving restaurant which is a major feature and still functioning ok. I guess we had some sun control on the outside of it, but of course that sun came right on into the dining area even in spite of a sun control. When the sun angels were low and so on it was not a moveable sun control, it was fixed but it did provide a reduction. It was sort of interesting from the standpoint that the people were moving around through the sunny side of the building while there were eating. We had to have a temperature control system and an air conditioning system that would be able to keep them comfortable regardless of which side of the building they were on. We did this as a combination of fan coil units and the central air handling system for the whole restaurant area. Part of the reason it was fun was because a lot of manufacturers wanted their equipment to be in the space needle and therefore they offered a very good deal to our owners if we would use their equipment. On that basis we did end up using equipment that was essentially contributed as a probably below cost basis.

B.N.

Of all the engineering projects that you have been involved in over the years, what do you think are the most challenging?

R.K.

Well, it is hard to tell you which one. There were a number of them that were interesting. Some of them were places where you could use a relatively simple solution and other cases were complex. I guess that one of them that was in interesting project was Sea Life park which is a marine animal exhibit over in Hawaii. In this one, we worked out a salt water system in which we took the water from the ocean and ran it through the project in order to maintain a salt water condition that the fish and animals would have lived in if they had remained in the ocean. To that we added what amounts to a theater and a viewing facility for the public so that they could see this thing and appreciate it. By those, what I mean is, that we had included in a porpoise theater in which porpoises actually preformed a number of feats. The side of the tank toward the audience is glass so that people could see what was going on beneath

the water as well as above the water from their seats. I don't know of any place else that has anything like it but it was an interesting project. We had a lagoon tank as they called it which was a large tank and in that tank we were running enough changes of sea water through it so that we anticipated being able to grow coral in the tank. Coral is very sensitive to any kind of change around it. Growing up in captivity was something that hadn't been done before. I guess part of this thing is that one snowy Sunday afternoon in Los Angeles, it really did snow, I worked out the whole sea water system for the project in a free hand manner and it ultimately went in that manner. We refined the design some but it went in that manner and it worked and worked effectively. I guess the part that made it interesting is that I got a letter back after it had been in operation for a year from the owner and his point was that he had been comparing labor requirements between his project and others and Marine Land of the Pacific in the Los Angeles area had nine full-time operating people operating the salt water system and the plant on the Sea Life Park. The owner said that to operate his salt water system he didn't even have one full time person and he was very pleased at the operating costs on the basis of the simplicity of it. That project, I submitted that to the actually specifying engineer for their awards program and got an award for the project.

B.N.

What year was the project designed and when did you get the award?

R.K.

I guess it would be about the mid 1960s. What we did with the system essentially was to use Weir boxes, use Weirs as a means of distributing the water among the tanks and from tank to tank. Weirs were used back in the days of ancient Egypt to distribute their water and their irrigation systems. Weirs are used in a lot of places but they are not very often used in what appears to be fairly sophisticated systems and this was a sophisticated system. But the Weirs did their job very and once a Weir is timed to a proper height to allow the flow to come over it into wherever you want it to go you don't have to do anything else with it. It can keep on functioning like that for years. It there were solids, dead fish or solids that end up in the water, those can screw up a valve very badly as far as what it does to the flow through the valve. But in a Weir they just flop over the Weir and that is it. So it kept it clean and it kept functioning and it was a good enough job so that the specifying engineer gave us an award for it. That was an interesting job. Not a high tech job, but an interesting job. On the other hand, some of the stuff we have done for Boeing is pretty high tech; hospitals have to be high tech. We have a fair amount of experience in that. We did a facility for Boeing in which they manufacture all the plastic internal panels for the 747 and this was to be an automated manufactureing plant. It gets pretty hairy when there are this many different shapes and forms and so forth that can end up in an interior for something like a 747. We had clean rroms because when they are finishing these panels they have to have no lint or just or anything else getting into the finishing operation. We had special drying ovens. There were some hood, there were curing ovens as well as drying ovens and we had to receive all the products, provide an automated arrangement for creating it from a raw product into the functioning pieces and further than that to finish them so that they would be appropriate for the interior of a 747. So there were a number of challenges. Is that enough? We could go on and on. There are all kinds of things, whether they are induction systems or double duct systems and what to do when you have a laboratory facility and how you handle it, all of these are different challenges, fir protection. I fired a prototype for GSA's program for fire and life safety in buildings. It was at the Federal Office Building in Seattle. That was one of our

projects. We implemented all the things that have been talked about at a couple of conferences on smoke and fire control in buildings. We developed them into reality there and the building was designed accordingly. It ended up being an asset to the Seattle skyline, a pleasant building from grade level, but a major step forward in the design of facilities for human occupancy from the life safety standpoint. This is where we first came up with the idea of taking elevators all back to one floor during a fire emergency with prerecorded announcements telling the occupants of the building what floor to go to and where to stay and so on as well as providing control of smoke by pressurization of areas and negative pressure in other areas so the smoke wouldn't flow through the building. We had a full energy management system in it and that was very early on for energy management systems. It had a complete combustion sensing system throughout the building. It was reviewed very carefully by a lot of experts. The VA went out and did all kinds of measurements on it and so on to see how well it was working. A lot of people investigated it very carefully and came to the fact that it did work. So it was a protype. Since then a lot of major buildings are patterned after it. We have subsequently done a number of additional life safety systems for high rise office buildings and each one more sensitive than the last one. But you have to be careful you don't get them so complicated that nobody can keep them operable. Some control was pretty much unheard of back when we were working on this to control smoke. It is now an established practice in almost every major high rise. Required generally by code but sometimes simply by practice. I could ramble on. I have tried to stick to those that basically involve heating, ventilating, and air conditioning but we could talk a lot about the other disciplines. When you bring it all back together when all these things have to go into each building in order to make them work. That was one of the advantages of working with Graham was that we had all of those disciplines in one team.

B.N.

That you very much for an interesting interview.