ASHRAE Leadership Recall (formerly Leadership Recalled)
Transcription

Interview of: George Lof

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Interviewed by: Robin Adair

Robin Adair

Greetings on this Friday afternoon, March 22, 1996. I'm Robin Adair, the historian for the Rocky Mountain Chapter of the American Society of Heating, Refrigeration, Air-conditioning engineers. We are lucky today to have with us Mr., Dr George Lof. (Ed. Note: Lof is pronounced "lerf") Dr Lof has conducted, consented to participate in the leadership recalls interview sponsored by the American Society of Heating, Refrigerating, and Air-conditioning Engineers to preserve some of the history those individuals who have made substantial contributions to our industry. Dr. Lof received the F Paul Anderson Award from ASHRAE in 1999 for his outstanding achievements in our fields of endeavor. How are you today Dr. Lof?

George Lof

Fine thank you Robin.

R.A.

Would you mind giving us a brief biographical sketch of your life? Where you were born and where you were raised and some of your background, family size, early schooling, etc.

G.L.

Well I'm a Colorado native and lived most of my life here. Born in a town which at the time I was born was a sleepy village, and now is a booming resort. Aspen is one of the ski capitals of the world. But it was kind of a dead mining town back when I started. The town had two doctors, one of whom was my father and we lived there for a couple of years. I lived there for a couple of years and then the family moved to Denver and I had a brother and my father practiced medicine here in Denver where I grew up. And after going to public schools I went to University of Denver and was interested in chemical engineering. I got a degree in chemical engineering and then went on to MIT for graduate work in the same subject. And in, I guess it was 1940, came back to Colorado and started teaching chemical engineering at the University of Colorado in Boulder where I stayed for almost ten years. Then transferring to the University of Denver where I had had my initial training and was on the faculty there for several years. And then I moved on to some commercial work and later became associated with Colorado State University in Fort Collins from which institution I retired a few years ago. Now most of this time that I was doing professional work, it was in heating a building in the field of heating buildings using rather unconventional energy source, that is solar energy and that's been my principle. Specialty, research specialty, now for most of my life.

R.A.

I see. When did you first get started in the, into solar energy what was the, when did it first enter your life and start?

G.L.

Well I think my first exposure to it was at MIT where my professor, for whom I was an assistant, developed the first solar heated building anywhere. Hoyt Hoddle who was professor of fuel engineering built and operated and tested a solar heating system which proved to be the forerunner of almost all solar heated buildings from then on. So I became interested in that subject then even though I wasn't directly connected with the project. Then when I came to the University of Colorado in the early 40's, World War II, there was some concern that fuel shortages might develop in the US if our imports were badly restricted by the war activities. So the federal government sponsored a project at the university that I fell heir to, to develop a solar heating system employing warm air as the heat source, which was the common, was and is the common heat source for residential buildings in this country. And over a period of several years then we developed some new technology in using a solar heated air for residential buildings. So I guess you could say my first real work in solar was there at the university.

R.A.

What got you interested in the engineering aspect, you know the heating business as opposed to the chemical engineering? Just the way things worked out or?

G.L.

I guess it was circumstances. Of course, I think all engineers are kind of closely related

R.A.

That's true.

G.L.

The studies that we make, heat transfer, fluid flow, they're quite common across all engineering branches and so it was sort of a natural to get going into more of the heating and ventilating technology then test tube chemicals. And that's what the source of the research support was that I had, was in this field. And that somewhat guides your efforts.

R.A.

Well it certainly does. Did you have the natural inclinations as far as liking to fix stuff and repair stuff or hobbies.

G.L.

I think that was part of my upbringing, the idea if something doesn't work try to find out why it doesn't work and see what you can do to fix it. And there were a lot of the solar things that didn't work and so it was a challenge to get them fixed.

R.A.

And seems like that's true with every new technology. There's a certain amount of it that just doesn't seem to work the first time. What were the main challenges that you faced in the field of solar engineering?

G.L.

Well, perhaps not necessarily in this order but certainly true was a general skepticism that solar was good for something like this. Of course everybody knew you could get sunburned with being out in the sun and that it made the plants grow but the idea of heating your house with the sun that was pretty crazy. So certain amount of skepticism was one factor that had to be dealt with. But the application of

fundamental principles of the transfer and fluid flow was just as valid in solar as in designing a furnace or heat exchanger and when that technology was applied, as my students and I and my colleagues attempted to do, I think we were able to get sort of the art of solar heating moving in the direction of science and engineering of solar heating.

R.A.

I see what seemed to be the, were political factors and world conditions a major impetus for the solar energy research?

G.L.

Well that has been up and down over the years and it seemed to be heavily influenced by international events. As I said in the early 40's there was some interest in developing an alternative to fuel use just in case there was a necessity for it. But after the war was over the interest disappeared and I would have gone to completely other fields except that a company that supplied some of the materials for this development, a glass company, was interested in the potential of a new product, solar collectors. And so they sponsored this work for quite a number of years, the American Window Glass Company. But as I said the national interest had almost disappeared. Well then, I don't know just what year, but another international event, 15-20 years later threatened our fuel resources and the government became interested again. And national science foundation sponsored work to get solar used, if necessary. And then there was another decline. And then the wars in the gulf and then Vietnam and so forth. Each time was one of these big disturbances there were funds available to support research and development which at the, in the 70's and 80's actually led to big commercial application of solar energy for heating buildings. And the government actually provided subsidies or assistances to homeowners to buy solar equipment, install it, and use it. And that program went on for several years. But then again it appeared that our fuel situation was not critical and natural gas and oil were plentiful and cheap and the incentive programs were discontinued and solar again became of historical interest more than current application.

R.A.

Well, what's your feeling about the eventual use of solar energy, you know, in years to come?

G.L.

Well I think that there's no question that somewhere down the road our resources of fossil fuels are going to become more limited. And as they become more limited they get more expensive and as their cost goes up the competitive picture in solar improves. And so I have no doubt that sometime in the future, solar energy will be widely used for numerous applications and one of the most practical probably is space heating for residential buildings because they have large roof surfaces which can capture the sun, enough sun to heat the building. And if you provide the necessary hardware and have some means for storing it so that it can be used at night when you don't have any sun there is going to be, I'm sure wide use of it. It's going to vary in different parts of the world. Some parts of the world it probably will be much more widely used than others, where fuels are expensive. Even today fuel prices in Japan are three to four times what they are in the US and so we would expect in a country like that that they would be earlier users on the large scale than we are in the US. But eventually it'll be used everywhere.

R.A.

Could you give us just a brief description of those types of solar collectors that were the most efficient? I know a few of us had been exposed to many types of solar collectors and manufactures claims but you've been right in the middle of it and have had a chance to really examine them not specifically by perhaps manufacture but is the type of collectors that seem to be the most efficient.

G.L.

Well, when you talk about efficiency in a solar collector what you're talking about is absorbing as much of the solar energy as possible and losing as little heat as possible during that process and the most commonly used collectors for the temperatures that space heating requires, and also some cooling systems require, a simple black metal surface covered with one or two layers of transparent material such as glass will absorb most of the solar energy that's striking it, 90 percent and the transparent surfaces reduce the losses of heat. So that you can get overall efficiencies of 50 or 60 percent in the conversion of the energy in the solar radiation to heated water or heated air. Now if you put a vacuum around this transparent surface or you provide a vacuum around the black surface you can reduce the losses because heat doesn't conduct through a vacuum. And there are some collectors called evacuated tube collectors which do just that with glass tubes containing no air and containing black surfaces inside through which and adjacent to which fluids are circulated, either water or air. You can pick up nearly all of the heat that's absorbed and get very little loss because just like a thermos bottle you don't lose much heat through the vacuum. So the evacuaed tube collectors are quite efficient. That permits them to operate at much higher temperature, if that's what you want. And some cooling equipment, absorption chillers for example, which ASHRAE members know all about, they require temperatures of around 160-200 degrees Fahrenheit to drive them and with an evacuated tube collector you can get those temperatures at good efficiency. So there's an application I think that we can expect to see in the future for cooling purposes, efficient high temperature collectors widely used.

R.A.

That's great. From a cost standpoint of course, I imagine there are quite a difference in cost between the flat plate so to speak and the evacuated tubes.

G.L.

Well, there is some difference. Usually the more sophisticated the design the more expensive it is to build but even there, there's not very wide differences in equipment cost and when you figure the greater yield, the greater output from the efficient systems the total cost of the heat that you get is not greatly different in these systems.

R.A.

I see. Do you recall some of the people, individuals that you work with in the field of solar energy that were prominent and played a big part in the development of the science?

G.L.

Well yes. There are many friends that I have and have had in this field. The International Solar Energy Society was organized early on in the 40's and 50's and with technical members, mostly engineers and scientists. And we would meet every two years and present the results of our research, published papers and so on. So I had the privilege of knowing most of the leading solar specialists from all over the world and in other countries some of them even perhaps excelling what we were doing. These people were outstanding. Australia, the Soviet Union, France, England come to mind right off the bat. I

don't mean to, Japan also very widely recognized as leaders in the solar field. So, and I still have a number of friends in these countries getting about to my stage of life too.

R.A.

I see. What do you think, what events do you think have caused the greatest change in our industry? You've mentioned the various political problems as far as threats of fuel supply but are there any other things that you recall that have had a pronounced effect on our industry as a whole?

G.L.

I think there's been a number of important developments through the years. You might characterize the industry at the very beginning as hardly worthy of ASHRAE interest because they, the basic technology certainly wasn't as sound as ASHRAE was used to with good design of heat transfer equipment but with standards that are recognized by various organizations, including ASHRAE. Solar hadn't reached that point yet. But as the technology was developed and when industry started to use the technology that was probably the first turning point when equipment was actually sold to customers and not just being tested in research labs. And then organizations like ASHRAE began to take note and move toward product improvement and standardization and general acceptance by the public. Now there was another organization that was established early on and that was the organization for the solar industry. The solar industry has its own industrial organization and it also has a solar rating activity. So now if a manufacturer wants to have general sale of his product and to have it recognized, it goes to the Solar Rating and Certification Corporation where it is evaluated, tested and the results reported and the equipment is then certified as being warranted or tested to certain standards. So the long answer to your question is improvement in the products and recognition of those improvements through ratings and the final point and in this connection is that presentation of these results at national meetings. ASHRAE of course has had several symposia on this technology and the results of this work become available to the literature and to future users.

R.A.

You have, of course, written many, many articles with regard to solar were energy. How many articles do you suppose you developed over the years?

G.L.

Well not my own work exclusively but with colleagues and students with whom I've been involved in training, over two hundred papers in the literature that relate to solar equipment and solar heating, solar technology.

R.A.

Well it's certainly understandable why you have received awards for your outstanding contributions. What advice would you give to a young person entering HVAC field?

G.L.

Well, probably the first advice I give is don't get involved with solar right now. That's a little facetious but not entirely so because right today the urgency of using solar isn't there because of our abundant supplies of fuel and a young person, and we have a number of them at Colorado State University, where I'm still connected with the solar energy applications laboratory there. These graduate students are doing their research on solar heating technology and hope to be applying that in their professional work when they graduate. The number of manufacturers of this equipment now is very limited and so I guess my advice would be, yes go ahead and do a good job with your training in heating and air conditioning

engineering. Be prepared to go into numerous applications, not just solar but other engineering disciplines that would use the good basic training you have. And if you find opportunity to continue research in solar, you may be able to get support for that and finally if there is a change in the fuels picture, you may be a very much needed person in the commercial end of this business.

R.A.

That's true. I wonder what is your opinion with regard to photovoltaic systems and their future?

G.L.

Well that's a field that I haven't been in but I've certainly watched it. Photovoltaics of course is the use of solar energy for direct conversion to electricity by means of semiconductor devices. Almost magically the solar radiation falls on a thin wafer of silicon or some other material and an electric current flows that can be then used for operating any electrical device. Electric lights, a TV set, a motor, what have you. And the photovoltaic process is being used widely now in specific applications. Central station power is not being developed to any significant extent by this process because it's expensive. Why is it expensive? It doesn't cost anything to have an array of silicon panels out there giving you, quote free, unquote electricity. But the cost of the hardware initially is high. And of course you have to consider that in figuring the total cost of the energy that's produced. But for small scale applications you've seen highway signs being lighted by photovoltaic panels. Well why is that a good idea? Well it's a lot lower cost to do it that way than to build a power line maybe a mile or two that would have to be used otherwise. So in areas where the availability of central station distributed power is poor, photovoltaics certainly can, well are already being applied. Now what's the future I think you asked. I think the future is very promising for two reasons. First, the cost of making this equipment id continually coming down. Improvements in the technology are resulting in further reductions in cost, increasing in efficiency and increases in efficiency and greater durability, in other words the products are being steadily improved. And it's fairly new technology so I think we can expect continued improvements. A second reason for my optimism is that the worldwide situation, much more so than in this country, would indicate large uses for rural areas where central station power's not available. And in China for example even in the smallest villages people want a TV set. Well they can get a TV set but they can't get the electricity to run it because the electricity power line may be 20 miles away. But with a small photovoltaic panel that TV set can operate and I think we'll see wider and wider application of photovoltaics in the small scale applications. And then finally as that market gets big enough the costs will come down to the point where eventually I think central station power, at least in certain areas where fuels are expensive, will gradually come in.

R.A.

That's interesting. Well it certainly is the a challenging thing to consider as our population increases and our fossil fuels diminish, certainly we're going to have to have something to replace it and that seems like a good source. Did any humorous events take place in your developments of solar energy in the past that you might share with us?

G.L.

Well there probably been a lot that my memory doesn't recall. One that is kind of ironic rather than humorous is, relates to how I got started in this field. When I mentioned that World War II, an office in Washington, put out an invitation to work on solar heating. One of the people in that office had a, what he thought was a correct recollection of a former professor or an associate at a university here in

Colorado. And he suggested to his management in Washington and they followed his suggestion that this invitation to work on this project of developing solar heating be sent to the University of Colorado where he thought this former professor or friend was and was still teaching. Well actually he had the universities wrong. It wasn't the University of Colorado where his friend was but that is how the invitation came to the university where I had just started to teach. And the official of the university, knowing of my slight connection with solar energy at MIT, when this invitation came in, he passed it on to me and said do you want to work on this, and I said oh yeah that sounds very good. So by mistake I became acquainted with this technology in a direct way.

R.A.

That's great. That's great. What other interests or hobbies do you have?

G.L.

Well photography for one. I've been a photographer all my life. I used to do my own photofinishing and I have tons of negatives buried at my home that I'll probably never look at. And then when color came along I gave that up to, not knowing the technology that field. So that's one area. Mineralogy. I'm a mineral collector. Fascinated with geology in general and I guess things that my children were involved in. Model airplanes and beyond that, actual real airplanes. I haven't been involved in aviation myself, well I did early on and got to be a little private pilot but hadn't carried it on. So I'd say quite a variety of hobbies through the years.

R.A.

In your model airplane experience, did you ever venture over into the construction of rockets?

G.L.

No, no not rockets. I think that came along a little after I was involved with the models.

R.A.

I see. Are there any other points, peoples, or issues that you'd like to address before your closing remarks?

G.L.

Well perhaps the connection between the solar technology and ASHRAE is worth a little comment there. I think the average member of ASHRAE, if there is such a thing, is not particularly concerned with this way of heating and cooling and air conditioning a building. But the fact that ASHRAE has been interested in it as a society and has fostered work in the field and has invited the reporting of results at their conventions and in their publications I think is, well it's gratifying to me. And I think to those of us in the solar field, I think gives us a little more dignity than we otherwise would have. The cooling aspects of solar particularly would be I think hard to convince people, would even work if we didn't have some substantial backing from an organization such as ASHRAE. So these relationships I think are important and I appreciate greatly the interest and continued support of an organization like this in my work.

R.A.

Well on behalf of ASHRAE I certainly do thank you very much for consenting to give us this interview. I'm sure that everyone will find it interesting and entertaining and very informative. And I thank you again for taking the time to be with us. Thank you.

G.L.

Oh thank you very much enjoyed it.

R.A.

Thank you.

G.L.

My pleasure.