ORAL HISTORY: Gwen Hays

About Gwen Hays

Gwen Hays was born in Malone, New York, the daughter of music teachers, and in 1950, her family moved to Pennsylvania. Graduating high school in 1960, Hays looked to further her interest in math by studying engineering, but found it difficult to find a school which would accept her course of study since she was a woman. She attended the University of Pittsburgh – the only woman in an engineering department of 1,500 – and graduated in 1964 with a degree in electrical engineering. After receiving her degree, Hays began working at the National Security Agency where she became interested in computers and software design, and then went to Westinghouse in 1966. While at Westinghouse, Hays worked on computer-aided design, and helped design computer languages such as Ada. Hays was also involved in radar development during her career at Westinghouse – such as Electronically Agile Radar (EAR) – and was program manager of projects such as High Energy Laser Radar and Acquisition Tracking System (HELRATS) and Quiet Radar/Multi-Role Survivable Radar. Hays retired from Westinghouse in 2001, and has a new career has a llama farmer with her husband.

In this interview, Hays talks about her long career as an engineer, and the struggles she had as a female engineer. Defying expectations, Hays discusses the difficulties she had in finding a college to attend, and then in being taken seriously in the workplace. Hays also talks about the various projects she took part in at Westinghouse, and the move from engineer to management. The atmosphere of Westinghouse at Baltimore is also covered, along with Hays's ideas about company loyalty and how things changed when Northrop Grumann took over. Her participation in IEEE – joining AIEE and IRE in the early sixties as a college student – is also discussed, as well as stories about unions, technology within industry and even industrial espionage. Hays also talks about various colleagues she had at Westinghouse including Dave Mooney, Bill Skillman, Harry Smith, Paul Pan, Kathy Brackett Pearson, Jon Squire and Wayne Fegely.

About the Interview

GWEN HAYS: An Interview Conducted by Sheldon Hochheiser, IEEE History Center, 17 February 2010

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Interview

Interview: Gwen Hays

Interviewer: Sheldon Hochheiser

Date: 17 February 2010

Location: The National Electronics Museum, Baltimore, Maryland

Background, Education and NSA

Hochheiser:

Okay, this is Sheldon Hochheiser in the IEEE History Center. It's the 17th of February, 2010. I'm here at the National Electronics Museum in Baltimore with Gwen Hays. Good afternoon.

Hays:

Good afternoon.

Hochheiser:

If we could start with a bit of background.

Hays:

Okay. I wanted to be an electrical engineer as a young woman, and there weren't very many of them.

Hochheiser:

Yes.

Hays:

Since I graduated from high school in 1960, my college choices were limited. My first choice was Clarkson but they didn't allow women until 1975. My second choice was Carnegie Tech. They would let me take classes, but my degree would have been from Margaret Morrison, the "ladies" school. As a matter of fact, when I went to the University of Pittsburgh, where I ended up, I was the only female with 1,500 men in the engineering department, the first one there.

Hochheiser:

Can we back up? Were you born and raised in Pittsburgh?

Hays:

No. I was born in Malone, NY at the New York border, 65 miles south of Montreal, and my parents were both schoolteachers, both musical. Back then, a young lady was expected to become a teacher.

Hochheiser:

Right.

Hays:

Fortunately, my mother understood I had zero patience, and that I therefore would not make a good teacher. My father was disappointed that I did not become a music teacher.

Hochheiser:

Yes.

Hays:

I liked math. I would always bug my mother to give me numbers to add, and it wasn't until about the sixth grade that I ran into a math teacher who said, "I'm not sure what engineers do, but I have heard that the Pennsylvania Turnpike was designed by a female engineer, maybe you should be a female engineer." My parents moved to Pennsylvania in 1950. We were in the motel business, and when it came time to choose a college, as I said, it was difficult because of a number of them not taking women. But I went down to Carnegie Tech, ended up over at Pitt, and the Dean of Engineering at that university said they'd never had a female engineer there, but he didn't see why not. And he said, "What kind do you want to be?" I didn't know there were multiple kinds. I was from Northern New York and rural Pennsylvania, before TV and he said, "Well, do you like math or science better?" And I said, "I think I like math better." He said, "Well then you should be an electrical engineer." And that's what I became. I would say about 90% of the people in the engineering part of the university thought I shouldn't be there, that I was taking a seat away from a man, that I would merely get married and leave. The Dean of Women at the University of Pittsburgh told my mother that she was embarrassed to have one of her young ladies be in engineering. And everybody thought that I would quit. But I didn't. I stayed. I graduated in 1964, and I spent 37 years working as an electrical engineer/software designer/manager. But the first place that hired me was the National Security Agency. Back then it was known as "down the road" because of classified work. I had lots of interviews from a number of companies, but they were looking to see if a female engineer had two heads.

Hochheiser:

They were not serious about wanting to hire you.

Hays:

Right. And I remember a wonderful interview I had with Electric Boat, and I really thought it was great, and when we were finished the man said, "You will make the best secretary. You will understand everything your boss says." I'll bet my long blonde hair added to the confusion. At the Agency, one of the best things that I had was an introduction to computers.

Hochheiser:

You did not do any computer work while you were at Pitt?

Hays:

When I was at Pitt we had analog computers.

Hochheiser:

Okay.

Hays:

We had just started with analog computers and patch board computers. I saw the first transistor in one of our labs in about 1962. It was a potted green size about 1/2 inch high by 2 inches deep by 1/2 inch wide with leads out the bottom, and we were fascinated with this thing called a transistor. Forty years later, there have been a few things done to/with it.

Hochheiser:

[Laughter]

Hays:

But the Agency was at the forefront of computers.

Hochheiser:

Right.

Hays:

Now you just had John Gregory who was in here before me. He was also working on the forefront of the computers with the big vacuum tubes. And so I came onto the scene just as computers were developing. It's been a huge growth and learning process. There was a time when in order to program a computer we had to flip switches at each memory location, and then we went to plastic templates that we put under the switches and pushed all the switches up or not together at each location, and that got us really good, and then we got to where we had paper tape, and we could load in from paper tape, and then of course we came to the punch cards, and the IBM punch cards, and the keypunch operators, and something that people don't even know or see today.

Hochheiser:

No, certainly not today. So you went to the NSA from college?

Hays:

From college. When I graduated, like I said, most of the companies didn't take a female engineer seriously because they thought we would be trained in three years, and then leave, get married, and they'd have wasted that training. You come 30 years later and you find out that Harvard Business Review now is saying that you shouldn't stay any more than three years at any company. You should be looking out for yourself. I think that's a mistake. When I finally went to Westinghouse, we were loyal. I mean, I had the circle bar W in the middle of my forehead. And when I started at the Agency I was working as an electrical engineer.

Hochheiser:

Right.

Hays:

I was designing hardware to do digitization, taking the analog, and then I started using the first computers. They had a PDP-4 and an SDS-910. They were the kind where we put in the boot programs with switches. I started to simulate what you would get back from a target, like an airplane if a radar beam hit it. And it was called Electronic Intelligence (ELINT). ELINT was a top-secret code word back in those days. And so I

started as a hardware engineer, but I got totally fascinated with what you could do with computers. And it was through that fascination that I really did a lot of my first work in software.

Going to Westinghouse

How I ended up at Westinghouse was that my first husband worked at Westinghouse in electronic countermeasures. I would drop him off on the way to work, and then I'd go on down the road to the Agency. And one day in a snowstorm I said, "This is ridiculous. Why don't I just go to work for Westinghouse?" And so I set up an interview at Westinghouse with Earl King in employment. When I arrived, Earl wasn't there that day but by luck a man named George Shapiro, who I wish you could record, but he's dead, was there.

Hochheiser:

Yes.

Hays:

I looked lost in the employment office, and he said, "Can I help you?" And I said, "I want to work with computers and computer-aided design, and this is my experience." I had my five-minute elevator speech, they tell you to have, ready.

Hochheiser:

Right.

Hays:

I had that ready for him. And he said, "Okay, I'll hire you."

Hochheiser:

[Laughter]

Hays:

And that's how I ended up at Westinghouse. I then called him my Indian Father. He became a great mentor. Once again, there weren't very many women in the design

world. When I got to Westinghouse I started creating what was called computer-aided design. And I started a simulator program called LOGIC. And at that point we were beginning to have the mainframes. We had a UNIVAC 1108, and we would be able to put our inputs written in Fortran IV via punch card decks. We had to handwrite in Fortran on a form then turn it in to a keypuncher. A keypuncher would punch it, and then punch it again to validate it. We would put a wide line mark across the whole rubber-banded deck of cards, because it might not come back in the same order. We'd put the deck in a bin, and it would go over to the big mainframe, get run, and get delivered back. We'd have, like, a one-day turnaround for one run of the program. What a difference today when I can carry around in my pocket what we had in the mainframe.

Hochheiser:

Right.

Hays:

And the stuff that you see out here in the Museum on AWACS, wiring wrapping boards, logic, that was the first when we started using the computers to help us design. And I thoroughly enjoyed doing that, and we had a lot of success with that. That created a lot more accurate systems, because now we didn't have the human error of having to do 2000 wire wrap connections manually.

Hochheiser:

Right. But you were already at the punch card stage when you arrived at Westinghouse.

Hays:

By the time I got to Westinghouse in 1966, they had a mainframe computer. And we had the punch cards. Now, we also produced a lot of punched paper tape for numerical controlled machines. One of my favorite stories about the AWACS system, which was called Overland Radar Technology, the ORT program when I started, is: a man came by and asked me to produce a deck of cards to cut slots in some antenna waveguide for a program. I had been there maybe a year. And I produced a punch tape for him, and he went away. I've tried to remember the man's name, and I think it was Ernie Death but it might've been Phil Hacker. I produced this punched card deck that was about, maybe a half-inch thick. It was not a very thick one, because it didn't take much to control an NC machine to cut the slots in the wave-guide. After he took the paper tape away, I didn't hear anything from him again. And I was doing other simulations, and it was about two

years later that he came back and he said, "You remember that slotted thing?" And I said, "Yeah, sort of." And he said, "Well, we won the program." And I think that it was about 1969, I'm going to say, that became AWACS. I dug through my desk. There was no configuration control back then, and I got the deck of cards back out, and created now a full scale set of slots, that became the Ultra-Low Side Lobe miracle antenna of Westinghouse that went on to AWACS. AWACS has been a big, big success for the United States, but also for Westinghouse. And it's been one of the best examples of how many times a program could be almost killed, and then make it through again. But I've always thought it funny that that little deck of cards that was in my desk was how we got the antennas built.

Hochheiser:

[Laughter] And that you had kept it for two years with not hearing anything.

Hays:

Right. Right.

Hochheiser:

[Laughter]

Hays:

Well, I mean, it was just—you throw it in the desk and——engineers tend to be pack rats if you've noticed.

Hochheiser:

[Laughter] So do historians.

Hays:

Right. Right. And I still have a bunch of Mylar tape, and a few punch cards, and a spindle from a keypunch machine in my memorabilia box. [Laughter]

Hochheiser:

As long as you're not going to try to find a machine that can read them today.

Hays:

Oh, no, no. One of the things that I've been surprised at is how fast storage media become obsolete. You save something on a floppy disk, like a Wang—I remember when Wang machines came in. Wow, that was a big thing. Try to get a Wang machine disk read now. And now we have these little USB memories that are like a hard disk, hanging on our key chains.

Software Engineering and Ada

Hochheiser:

When you started at Westinghouse how many software engineers were there?

Hays:

I think there were about seven of us. Jon Squire was my supervisor at the time.

Hochheiser:

Yes.

Hays:

And there was, like, Doug Lingle, John Stuelpnagel, Bob King, Leo Kossa and me — software engineering wasn't known as software engineering.

Hochheiser:

Right. Were you programmers? Or coders?

Hays:

We - no, we were electrical engineers because there was a man named Johnny Pearson who was the engineering czar at that point, and he did not believe in hiring any engineer without them being an electrical engineer. Years later when I started having large groups of software engineers which was—by the time I became the software manager of Electronically Agile Radar Software Group— I needed to hire people who knew about compilers, who knew about software, and Johnny didn't understand that

electrical engineers didn't want to do that, plus the universities were now graduating experts in software. But that was just a transition that we suffered with for a while.

Hochheiser:

Yes.

Hays:

And I remember very well the first day that I broke it to the people who had been building computers, like John Gregory that you just had in here, and John Murtha, that we were going to go from Assembly Language to a higher order language, JOVIAL, because I didn't have enough people to do the Assembly Language. We were having too many errors with it. We needed to get our productivity up. And they told me that it was going to be over their dead body. Murtha said, "The only intelligence you have is feminine intuition, and that isn't worth a damn." So that's the kind of transition problem that people who are going on to new things will run into.

Hochheiser:

Yes. Right.

Hays:

I just was talking to John Gregory on the way out. We later did a new computer language called Ada. I don't claim to know anything about it anymore because of some of the things that happened. How Ada came about is that in the Electronically Agile Radar program, the Air Force from Wright-Patterson Air Force Base insisted that Westinghouse sign up for failsafe software. Well, we all know about software, and things can go wrong. But it was their insistence we sign up for that. And I said, "Well, if we're going to sign up for that then we have got to have some way that really puts some rigorous testing on everything, puts some rigorous documentation. We've got to just take everything to another level." A man named Colonel Bill Whittaker and I started out with a concept of DoD-1, a language that was going to help airborne radar go toward failsafe software. And then it went on to have competition, we had four competitors, and we ended up naming it after Lady Lovelace. But it was intended for use in airborne radars. And the government, having paid for it, then thought, well, it's wonderful. We'll make everybody use it. Unfortunately some of the people that were in the finance divisions, and some of the people that really wanted to use databases hated it. It wasn't designed for them. I think that we're smarter today. There is no such thing as failsafe

software. We can get a lot closer than when we were doing Assembly Language or doing our switches.

Hochheiser:

Well, when was this development of Ada?

Hays:

I'm going to say that we started in about 1975. I worked on EAR from 1974 to 1980.

Hochheiser:

Okay.

Hays:

So it was about, I'd say, 1975. We had done the JOVIAL (J73) which was the first higher order language that we went to, and we had been using JOVIAL, which was a nice step up from Assembly Language, and a lot of the computers that we were using back then were airborne processors. As a matter of fact, Westinghouse wasn't even allowed to call them computers because we were not in the computer business. But you couldn't go out and buy an IBM to fly.

Hochheiser:

No, you've got the—

Hays:

Right.

Hochheiser:

[Interposing] You've got the weight and size limitations in an aircraft that you don't have in a -

Hays:

[Interposing] In a data processing world. And there weren't PCs. As a matter of fact, we hadn't even had the real-time terminals yet.

Hochheiser:

Right.

Hays:

I remember the first real-time terminal that we got installed that connected our East building where we sat, to the mainframe in the Central building, so we wouldn't have to ship decks back and forth.

Hochheiser:

And about when was that?

Hays:

I'm going to say 1970, maybe. Well, I remember when we got that first one installed, and we didn't know what to do with it. We had been taking these decks back and forth for so long, and Doug Lingle, who I think is still around; I don't know if you're interviewing him.

Hochheiser:

Not yet.

Hays:

He decided to write a program to see how we would use it, and what he created was a slot machine. And a lot of innovations now are being developed by people doing games on computers.

Hochheiser:

Right.

Hays:

And they go, "Oh the gaming is really pushing the change of computers," and I go, "We did that a while ago." [Laughter]

Hochheiser:

Right.

B-7G

Hays:

My interest has always been in research and development, and I would always want to do the first of something, and then after we proved that we could do the first of something I'd let somebody else take it into production. I was lucky enough to have been in an engineering company at the time with Harry Smith that was being driven by new things for the Department of Defense. We had a man called Dr. [Paul] Pan who was very good at getting Research and Development funds. It was a high time for engineers doing new stuff, and I was so lucky to be there. I watched us go from a little computer built on a couple of boards to being where we are today. One of the first programs that I worked on was the B-57G. The program was called Tropic Moon III.

Hochheiser:

Right.

Hays:

Very classified. And the thing that we were really contracted to do was to change the control systems on it.

Hochheiser:

This being the B-57 bomber?

Hays:

It was a bomber, yes. It had been in Korea, and it was going back to Vietnam. And they brought it in, and I did the software to change the controls from analog to digital. It was a fun thing to do, but nobody knew we were doing it, because it was so classified. But the interesting thing about it was after that era, it came back and it was assigned to the

Kansas Air National Guard. So I got to go to Topeka, Kansas, where wind never stops blowing, and go up in the belly of the B-57G, and we changed the software in the computer. We had this computer that was, like, one foot wide by one foot high by two feet long, core memory. We put it down into what we call the wine cellar of the old B-57G, and we changed out the software so that it could be used for navigation by the Air National Guard. So here we are back—I'm going to say ten years later, so this would be '76. We had to revert to paper tape because that's the only way you loaded it. You'd load it in the lab, and then carried it out to the flight line, and if there was any power glitches when you put it into the aircraft you had to start all over again, because the core didn't hold the memory. [Laughter] Some of the old systems really had to be handled carefully, including the paper tapes. Now, there's still people, as I understand it, supporting some of the old Assembly Language on AWACS, and I find it interesting that once it's put in, and once it's debugged, if it's not broke we don't fix it. But we don't have anybody that knows how to do it anymore either.

Hochheiser:

That happens with all sorts of technologies I think.

Hays:

Right.

Becoming Supervisor and the Union
Hochheiser:

At what point did you move from being just an engineer to being a supervisor?

Hays:

Okay.

Hochheiser:

How did that come about, and how did that change what you did?

Hays:

Right. As I said, I started at the Agency being a hardware designer.

Hochheiser:

Right.

Hays:

And then I got enamored with computers and decided that I wanted to use the computers to help me design things.

Hochheiser:

Okay.

Hays:

So when I came to Westinghouse, I wrote a software program to simulate designs. Bob King had been doing a software program for wire-wrapping boards and doing that aspect of it.

Hochheiser:

Well that must've been at the very beginning of computer-aided design.

Hays:

There was no computer-aided design when I came. At first there had been a little bit done with wire wrapping on the boards. And I added a whole number of computer-aided design programs. We gave lectures. I taught in the evening school, how to use the simulator, how to use something called Assign. We created the Computer Aided System. I became known as Mama CAS, for an obvious reason besides my long blonde hair.

Hochheiser:

[Laughter]

Hays:

We had a drawing package too, but we had difficulty with the union in taking jobs away from people that—that might be a side issue that would be interesting. One of the keypunchers, Mary, that we had, was so good she would debug my programs as she was

keypunching. And I was becoming a supervisor. One of the things is if you were a really good designer, back in the old days they'd put you in as a manager, and that's not very smart, but that's the way things were done. Anyway, I thought that she should be a programmer, but she was in the union, and you don't change sides, so she was not allowed to become a programmer.

Hochheiser:

She was not allowed to leave the union?

Hays:

[Interposing] Not allowed to.

Hochheiser:

And become a programmer?

Hays:

No.

Hochheiser:

That's interesting.

Hays:

And those were the days of the union. I don't know if we want to divert, but I will tell you another story on the union situation. I mentioned that my first supervisor was Jon Squire, an absolute software genius. I don't know if you've interviewed him yet, but I'm sure you will.

Hochheiser:

Not yet.

Hays:

He lived on Coke and cigarettes. This was back when there were like five of us in software engineering, and he would call home - my home - at 3:00 in the morning to ask me some question about a variable. My husband would more than likely take the call because I'd be sound asleep, but I would tell Jon the correct answers, and then in the morning my husband would say, "Jon called again last night, and you worked on this." Anyway, one day I came in to work in a pantsuit. Back then, you know, we'd been wearing miniskirts that were short, short - way too short. But the pantsuits had come along, and so I wore a pantsuit in. But it turned out that you were not allowed to wear slacks, according to the union, at Westinghouse. So I get a union grievance because one of the ladies in the union had gone to her supervisor and said, "I want to wear a pantsuit like Gwen." And her supervisor said, "It's illegal." So Jon, my dear supervisor, brings out the supervisor manual cradled on both arms, which is in a three ring binder, and it's got all the revs on top of it that he's never filed, because Jon's a software blue sneaker genius. And he said, "You have got to look through here and tell me where it says that you can't wear that pantsuit." And I was like, sure. So anyway, I went to the interview for the grievance, and I must admit that I was a bad girl. I wore a very, very short miniskirt. And I told them, "You know, I have to go up and down all these open stairwells to go up to the radar antennas, and I'm tired of doing it in these short skirts. Don't you think it would be better if I did it in slacks?" And they allowed as how yes it would, and so the rule got changed. I now look back, and realize that it was a slippery slope because then we went to casual Fridays, and then we went to casual Wednesdays, and now finding somebody in a coat and tie is a unique situation. The unions really did control a lot of how we did things, what we could do, who could do what. We were in the East building. If we wanted to move something to the West building it had to go through three different hands. East building took it to the edge of the East building. Central took it to the edge of the Central building. Then West building handled it in the West building. And so there were things like that that happened that I don't think happen anymore. I don't think it's quite so nonsensical. Anyway, we'll get back to how I went from being an engineer to what else I did.

Hochheiser:

One question. The engineers were not union? Which is why that woman you wanted to make a programmer couldn't make the move?

Hays:

We were not union.

Hochheiser:

[Interposing] Because that would be moving out of the union.

Hays:

Right. But we also, as engineers - could not keypunch our own cards. Because it was the union's job. And I generated a software package to draw drawings of the schematics of the boards automatically from the computer. The draftsmen are union. So we ran into some places where the computer took jobs away from people.

Hochheiser:

Right.

Hays:

Now it gave people more time to do more inventive things, but it was in that time when people were going, wait a minute, you know, what job's it going to do, where's this computer going, is it going to just completely take everybody's job away. And it was serious times in those times that - are these computers going to be good? So anyway I did the computer-aided design stuff, and then we had these little computers beginning to be used in our products.

Hochheiser:

[Interposing] Sure.

Hays:

I started on a program for NASA that we put in a little processor we called the ABC. I think we had, like, 15 instructions and a no op. I remember the no op (no operation) was the most wonderful thing. And I learned that you could control much of a system through a computer. And that got me onto the Electronically Agile Radar Program, on which I led the software development for it. And that was where I made the major pronouncement that we were going to go to higher order language that was an absolute no-starter. But we eventually did it.

Hochheiser:

And that was JOVIAL at this point?

Hays:

That was JOVIAL J73. And that was when program managers back then, and on EAR that was Bill Jones, learned to hate the news that we were going to have a recompile, because recompiles created more problems, and it was in the days when compilers didn't do any type checking, didn't do any of the stuff that we did with Ada. We would put in patches and put in patches, and then there would come the day when you had to go through a recompile. And they would know that they'd lose, like, a week to retesting when we did a recompile, so -

Hochheiser:

But you had to do the recompile.

Hays:

We got to the point where we had to do the recompile. I have another interesting story from the early days. Unfortunately I don't remember the man's name (Warren?). He was in the ECM department. We had won a contract for an ECM pod. And it was going to be controlled by a small processor. And they weren't quite sure what this computer was going to do. So they did all the testing of the pod, and then he came to me and said, "Okay, we want to plug the computer in. We've got to ship tomorrow." He got the shock of his life when I said [to] him, "You've got another three months of testing. You've got to put in the software and do the integration testing. You've got to do all that before you can ship." They didn't know that. I mean, it was literally that strange back then.

Hochheiser:

Yes.

Hays:

And so now everything's all controlled by computers. Okay. So I became the software manager for the Electronically Agile Radar, and that was a big program for advancement at Westinghouse. It was the first that we had controllable modules for the antenna. We could steer each module separately. The AWACS had been slotted, the antennas. And we had computers that we could do some control with. And it was a big learning process for a lot of us. And we now could better do this stuff called built-in test and fault isolation testing.

Hochheiser:

Yes.

Hays:

On AWACS we had worked on it, and learned a lot but not had much success, mainly because there wasn't a good way of testing or a good way of controlling the hardware. You really needed to be able to stimulate and receive back, and without a lot of computer control it was hard to do it. On EAR, we got to the point where we had some test languages, some more procedures, and we learned on that. On the EAR program, I learned that I liked management. I had about 15 young engineers working for me in software. We had good times. We joked that our configuration control was a mayonnaise jar. Configuration control hadn't quite happened yet. Jon Squire and Craig Duerling wrote our own compilers in order to be able to interface with our custom built processors. I started campaigning to become a program manager as opposed to just a software development manager. One, because I had gotten so much flak from having too advanced ideas. There are useful degrees other than electrical engineering in spite of Johnny Pearson. There are things other than Assembly Language in spite of John Murtha. I mean, I just had to continually fight to get the next new thing put in. And so I decided that if I was my own program manager that then I would do that. Plus, I found that, being interested in new things, that after I'd done something for about four or five years I wanted to move on.

HELRATS

Wayne Fegely gave me my first program to manage. It was called High Energy Laser Radar and Acquisition Tracking System. HELRATS.

Hochheiser:

And about when was this?

Hays:

1980. The full system was to go in a KC-135, with Hughes building the laser, and we were building the acquisition and tracking radar.

Hochheiser:

Was this for the U.S. Air Force?

Hays:

The U.S. Air Force Weapons Lab, right. And I learned a lot from that program, both in how to manage people (Clem McCleand and a great bunch of guys), and interface with the financial systems (Dave Sartorio was wonderful and patiently trained me well) at Westinghouse. I went and got an MBA. I had an EE. I realized that I didn't know much about management, and I better go take a MBA and I learned a lot from that. But I also learned that the buck stops at the program manager. We took the radar out to North Oscura Peak on White Sands Missile Range to test it. That location allowed us to look out over the desert floor. And it was great fun. They would fire BAT missiles at us, and we would track them, and -

Hochheiser:

You were up in the KC-135? Or -?

Hays:

No, we were on the edge of a big mesa, so we were on the ground. But it was like we were in a KC-135.

Hochheiser:

You were on the top of the mesa.

Hays:

Right. And we could -

Hochheiser:

[Interposing] - the missiles were shooting up from the -

Hays:

Right. From the ground.

Hochheiser:

From the ground.

Hays:

Right. So it was like you were in an airborne platform. Without having to be in an airborne platform. And we were definitely not in good facilities. We joked that the dorm that we stayed in was the North Oscura Peak Hilton. It was an interesting location with the rattle snakes and what haven't you. But anyway they would fire the BATs and one of the BAT missile crashed into the side of our mountain below us, which was a little exciting. But my worst day on that program was when I was back in Baltimore, and I got a call, and Lloyd Chastant said, "We fried the radar." What do you mean? It turns out that they had a large electrical storm, and there was a bolt of lightning that fried the radar. Fortunately, we had a brassboard testbed back at Baltimore, and we got it going. The radar that we designed and built to do the tracking, which was, again, you know, the early days of radar worked beautifully, but unfortunately Hughes never got the laser part working, so the HELRATS airborne laser laboratory never did go anyplace.

Hochheiser:

So you were involved on the radar side.

Hays:

[Interposing] Our Westinghouse team built the radar that did the acquisition and tracking.

Hochheiser:

Were you working, then, with the radar group at Westinghouse to do this?

Hays:

[Interposing] Yes, this was with the airborne radar group at Westinghouse. A guy named John Stuelpnagel had been the program manager. And so I took over from him as a good training process. The next program I started on my own. But John had gotten HELRATS to where they were beginning to test it. And so I got to come in in the middle of it, learn from what he had done, and work closely with the hardware people.

Hochheiser:

[Interposing] Because there's a whole bunch of different things besides the software.

Hays:

Right, right, right. Oh yes, software, there was another guy doing the management of that. And now I got to learn about transmitters and receivers and antennas and processors and maintenance and reliability and what happens when you have a lightning strike with an electronic system.

Management, Quiet/Radar/Multi-Role Survivable Radar
Hochheiser:

So by this point, you've moved out of programming directly into more general project management.

Hays:

Right. EAR was my last software job. I started out at Westinghouse doing computer-aided design. Then I started having software engineers working for me that were doing software for, like, the pods, and different radars. EAR was big enough that I was over the group of all the software engineers who did the programming on EAR.

Hochheiser:

Right.

Hays:

Although John Squire, my supervisor, would still call up at 3:00 in the morning sometimes, with questions about LOGIC or Assign, etc. Because I was the only one who knew what that variable was or why I had programmed it that way.

Hochheiser:

Right.

Hays:

And somebody's trying to run the LOGIC program, and it comes up with a bug. And I still - that's another fond memory that I'd forgotten about —my husband and I had traveled a lot on pleasure. We would take 21-day trips to different countries and stay in the country. I came back one time, and Jon came to me and said this program says "Mac in big trouble, Mac in big trouble." And I said what? He said, "Well, it hasn't worked since you've been gone. What's going on?" And it turned out that I never did know what happened. I had had a branch that had - if it's equal or greater than zero, it goes here. If it's less than zero it goes there, and so there was a point in the Fortran code where you should never get to. In my whimsy, I had put in a write statement in that location that said "Mac in big trouble," because if you ever got there, indeed the subroutine Mac was in big trouble. Well, unfortunately it managed to get there the whole time I was on vacation. So then I did go into program management, and got to work with all our wonderful engineers. Westinghouse at that point had a lot of IR&D funds from the government. We had the best A/D group in the world. I understand that it's now been sold and we don't have it anymore. And we had geniuses in the antenna sections. We had geniuses in systems engineering. Dave Mooney - there's another person I wish you could interview. Dave Mooney had infinite patience, and he would explain things to me, because here I am, a young program manager, and trying to understand what's going on. Dave said to me, If you learn what tuning a CFAR, constant false alarm rate, is about, you can do the radar. It's about that simple." [Laughter] I know, yeah right. And so he was a big help. I have another quick side story I have to tell about Dave Mooney. He was an absolute genius. He was the guy who really made the pulsed Doppler radar work. He was the one who really made AWACS work. Just a total genius and very, very nice guy. At his retirement we had a big party, 300 people or so, big area. And everybody stood up and said how wonderful he was. When it's his turn to stand up and talk, we're all expecting these great words to come out of his mouth. And he said, "I know that you all think that I have been coming in to work every day because I love working on radars." He said, "I now want the truth to be known. I'm coming for the bridge game. Life is a game. Bridge is real." And then he sat down. That's what he said. And we were like, what? But that's the kind of person he was. And so he helped me a lot. Then after HELRATS I had a number of other development programs. Bistatic Alerting and Cueing, Advanced Airborne Surveillance Radar, etc. The next big program that I managed was Quiet Radar/Multi-Role Survivable Radar. It was the most fun program ever for me. I had a bunch of young eager systems engineers, Bill Skillman from AWACS fame and a smart marketing person Debbie Calhoun. I had a female engineering manager who was a genius.

Hochheiser:

Who was?

Hays:

Kathy Brackett Pearson. We learned about an RFP coming out of the Army for a program called Quiet Radar. And it was supposed to come up with a scheme by which anti-radiation missiles could not detect the radar's signature to locate where it was. Detecting the radar's signature was what I had been doing in the Agency a few thousand years ago. We wrote a proposal to the Army that was so good that we won the contract. And I was amazed. Westinghouse was amazed, because we were an Air Force company.

Hochheiser:

Right.

Hays:

We didn't know much about the Army. And I didn't know what a FLOT was, forward line of troops. I didn't know what MOP IV gear was. There was a whole lot we didn't know. I started checking to see if we had a systems engineer who knew about the Army. Luckily Wally Hoff had just hired Clyde Humphrey, a 20 year career Army guy. Quiet Radar was the one in which we chose to deal with continuous wave, CW. It was a new, new thing in radar for us, and Bill Skillman, who is another name that you know of, came up with a coding technique, and that was our first real fun program for me, because it was a use of an old technology. I mean, they started out with CW in the beginning and then went to pulse, and so that was -

Hochheiser:

And now you're going back to CW again.

Hays:

Right. And so we did that. And that was when I really learned to understand what the antenna people could do, what the processor people - we had a lot of that, and we had a lot of good technology for that. The next phase became the Multi-Role Survivable Radar. We also won that phase and I became known as MRS. R. But eventually Raytheon reclaimed their rightful Army program back. And then I went on to manage some other programs. I just was more away from the engineering and more into management.

Hochheiser:

With each -

Hays:

Successful program. Now, I was always doing research and development. Once in a while I'd have to go back and help on an AWACS or, like, B-57G came back from Vietnam, and it's now got to go to the Air National Guard, and I'd go play with that. But each time I was doing more. The most unique thing that I turned into a product for Westinghouse, not the size of an AWACS, but it really turned into a product line was something for wind shear. Dick Linder was our president at the time, and he landed at the BWI airport while a wind shear event was going on. And it was not a comfortable thing. As a matter of fact, that same event had turned over a tractor-trailer on the Baltimore Beltway. And he came in and said, "There's got to be some way that we can detect this stuff, so we don't have to be landing planes in the middle of it." He went to our boss, Kelly Overman, and said, "Let's start up and figure out how to get a radar that detects wind shear in commercial airplanes." Kelly gave me a small budget, and a couple key people including Walt Patterson, and we started out. It was such a uniquely different radar for us. We had been working in detecting returns from point targets measured in dB. Now we've got to do dBz, volumetric. We've got to detect rain. We've got to detect airflow. I came up with a couple systems engineers that could learn something about it. And our hardware designers had to learn about commercial radars. We'd been building military systems with military qualified parts. So I went out and bought a Bendix commercial radar and brought it in to our lab. And our engineers looked at it and said, "That thing won't fly." I mean, they just - it was such a different mindset.

Hochheiser:

For commercial radar from a military radar.

Hays:

[Interposing] Commercial radar from a military company. And our military radars were, you know, million dollar things. And here was something that had to be $100,000, because it's got to be cheap. It's got to go in the front of commercial airplanes.

Hochheiser:

Right.

Hays:

And we ended up in about six months designing and building this commercialized military radar. Bob Jelen was my savior engineering manager. We didn't - I didn't get them all the way from military, but we got a lot closer. And of course it was quite higher performance than what a commercial Bendix would be because of our STALO (Stable Local Oscillator) and A/D technology. I named our program WXMR. It was a take-off from Harry Smith's WX50 nomenclature and the idea of a Modular Radar to be configured for multiple applications.

Hochheiser:

Right.

Hays:

And one of my big scary times was when it came time to test the wind shear radar; we had to take it someplace that there was wind shear. We discovered that Orlando, Florida was the best, better than Denver. Denver has rollers coming off the mountains out there but they're not consistent. The afternoon thunderstorms in Orlando are pretty consistent.

Hochheiser:

Right.

Hays:

I remember sending Bob Caruso, who was my lead systems engineer, and about 14 software engineers on a BAC 1-11 into danger. Mike Eide was the pilot. Mike Eide, bless his heart, has been a super hero in a lot of my flight tests. And I sent them off. We didn't have enough money to do it. I sent them off to Orlando, and I went to Africa on vacation so that Kelly Overman, couldn't find me to say, "You can't do it because you don't have enough money."

Hochheiser:

[Laughter]

Hays:

And I said to Mike Eide, "Can you take our big BAC 111, good for testing, but not going to be very aerodynamic in wind shear, because we don't really know what wind shear is, to Orlando and hunt for wind shear?" And I added, "You're going to have these guys onboard. You just can't risk their lives. Do you know what the BAC 1-11 is going to do in wind shear?" He said, "I don't know but we'll do our best." So they went down to Orlando, and in a week they saw at least two wind shear events every single day, and the exciting thing is that they also saw a dry wind shear event. There had been rumors that wind shear could happen without there being rain and without there being a storm. What happens with wind shear is a big cold mass of air piles up, up there, and then it punches down through the clouds, sprays on the ground, and creates strong winds. As you come into the event, you hit strong head winds, and so therefore you cut back, because you're coming into this high wind, and then when you cut back, you go into the next, other side of it, and it's blowing the other way, and it just slams you into the ground and it kills you. There's a lot of it in the air too. As a matter of fact, some of the airlines still have airborne wind shear problems. But anyway the BAC 1-11 performed, and we proved that there was such a thing as a dry wind shear event. The radar alarmed, "There's a wind shear event ahead, there's a wind shear event ahead." The pilots and everybody are going, "No, the radar has a bug - it's clear air." But then about that time they saw the plume hit a lake, and they could see the spray on the lake happen. And the radar was right. There had been a dry wind shear event. And so that was a very exciting time.

Hochheiser:

Yes.

Hays:

We learned a lot after we had done the radar about the finances of getting into the commercial business. We really couldn't compete with the Bendixes. They had bundled software, bundled hardware. They can give the radar away for free and bury the cost in all the radios. Also there became the issue of if the commercial airlines knew that they might be going into an event, and didn't tell their passengers, and something went wrong, lawsuits would happen. So the product that we generated ended up on all of the Air Force planes, because it could save lives, and they didn't have to worry about the lawyers. Marketing renamed the radar MODAR and it went on to have lots of other applications, and it's still being derived from. But that all came from Dick Linder landing in a wind shear event at BWI.

Hochheiser:

When was this?

Hays:

WXMR brassboard program, 1989. From that we built a radar we named MODAR and used it for a proposal for the Low Power Color Radar (LPCR) for the Air Force. And then it became the ESAS modular family.

Japanese Technology, Industrial Espionage

And MODASR came from that, but that was a digitization of the ASR-9 we worked on -

Hochheiser:

ASR-9. What's that?

Hays:

Westinghouse has been in the air traffic control area with the FAA for a long time but it had never been worth the extra advanced development money. If you're at the airport you will still see an ASR-9 old antenna flipping around. We had never gone to a digital system. By never upgrading our system we created an opportunity for Raytheon to get a competition started for a modern ASR-9. For that proposal, my team was trying to apply the digital processing and the digital work that we had done on the airborne side to the air traffic control. Unfortunately - Westinghouse had a problem. And I think a number of companies have a problem, especially back then. Not invented here. The ATC management stopped our MODASR effort after the Critical Design Review. Westinghouse lost to Raytheon.

Hochheiser:

Yeah.

Hays:

I have a story on that. When Tom Murrin was in Pittsburgh, he was enamored with how the Japanese would build technology that we couldn't. They put more components on a

printed wiring board than we could. They had track density higher than we did. Tom wanted us to go over there and learn how. He got a group of six of us including Naomi McAfee that you are recording tomorrow, and John Gregory that you recorded today, and sent us over to Japan in June 1982. Hitachi agreed to host us. And we were treated royally. They met us at the airport, and they took us around in a bus with lace doilies on the headrests, and they showed us the processes they were going through. We toured their plant. They gave me some drawings of the boards with Hitachi proprietary on it. And one day NEC - Nippon Electric Corporation - sent a man to take me over there. Just me, because I was the radar person. Over to their facility to see something they had. And we went over, and there was this marvelous demonstration a lab technician had set up for me, and it was showing where they had this coating on something, and it was putting a notch in the spectrum at X-band. And it was, like, whoa, what is this? And he was explaining to me that they were painting this coating on the outside of structures on ships where the computers were in the ships, to keep the radar from affecting the computers. My mind's buzzing, well, okay, but I can think of some other things to do with it. And so when I came back I went to Dr. Pan, who was our IR&D guru and excitedly told him what I had seen. Dr. Pan said, "You didn't see anything. Forget about it. Don't say anything about it." It was highly classified here in the states. Westinghouse did eventually get into the coating of ships to protect them from radar detection, but we didn't do it successfully. Anyway, back to going over to Hitachi and not invented here. About the third day in Japan, when we went down for breakfast in the hotel there was a note waiting for us. The gentleman from National Advanced Systems who had been traveling with us as liaison was gone. He had left and gone to Germany, and we were on our own. It turned out that that day in California the FBI had arrested about six Hitachi people for stealing IBM's secrets. There were six of us in Japan, and we were not stealing secrets, but I had Hitachi proprietary drawings.

Hochheiser:

Which had been given to you by Hitachi.

Hays:

Which had been given to me by Hitachi. I tore those up. I flushed them down the toilet. When we came outside the hotel there were press everywhere, police everywhere. We didn't know why they were there. We didn't care. We got a taxi, went to the airport. And we were a very happy crew to get on that airplane and come home. We were in the wrong place at the wrong time. So we didn't really get as much information as Tom Murrin wanted us to have. About a year later I bought a PC board from Hitachi, and got it in for my engineers to look at. They didn't want to have anything to do with it. Not

invented here. And so you could get something for them to look at or come up with something - and we had that problem with going to commercial, and we had the problem with getting the higher density; our engineers knew the best. But in 99% of the cases they did, and in particular our A/D, STALO and antenna technology that were just outstanding.

Hochheiser:

A to D?

Hays:

Analog to digital. The ability to change analog into something that we could then process. And it goes back to that old CFAR. The constant false alarm rate [Laughter] is what it takes to make a radar work. And so it's been a very, very interesting career. I got to be an engineer and stay with the technical the whole way through. When it was the ATC I was talking about, and we're bouncing all over, but the air traffic control we stayed with what we had known, and our competitors went ahead of us and did the digital, and we eventually lost the contract because we - in a couple cases - stayed with what we had known. And so in some cases, like I would say on the Multi-Role Survivable Radar, we had a big advantage because Raytheon had been doing business with the Army forever. And we came in with a brand new way of doing it. So if you have nothing, you can sometimes come in. And so it goes back and forth.

Hochheiser:

And I imagine since you were mainly an Air Force shop -

Hochheiser:

[Interposing] The shoe was on the other foot. The other -

Hays:

[Interposing] The shoe was on the other foot, and eventually -

Hochheiser:

Another contractor was the outsider -

Hays:

[Interposing] Right.

Hochheiser:

-who could look at it fresh.

Hays:

Right. And eventually Raytheon came and got MRSR back from us. And also, that program was one of the first times that I found out about industrial espionage. We had a big, big win party for Quiet Radar. For us to win this Army contract - we had a big party. It was at the Safari Club at a hotel here in Baltimore. And at that party, there were two guys there from Raytheon. And I, you know, said, "Hi, how are you, and who are you, and what's going on." And they said, "We have worked with the Army and we wrote the proposal for Quiet Radar that we lost and you guys won, and we wanted to meet you guys and see who these people were that won this program." They were up front about it, but here they were attending a party at the hotel that was, in essence, finding out what we had proposed, and, you know, talking to people. That was an "aha" moment for me. And one of the other things that I learned about espionage is there was an advantage to being a blonde female sometimes. At airports, I could sit next to the Raytheon engineers or the Hughes engineers and learn a lot just sitting there, because they'd talk shop and wouldn't think about, you know, this female sitting over here might understand what they were saying. [Laughter]

Sale to Northrop Grumman

Hochheiser:

[Laughter] What was, what was your reaction to the sale of this division to Northrop Grumman?

Hays:

Not good. I knew that Westinghouse was in trouble financially. I also knew that Westinghouse Defense was not really Westinghouse. Even though we as Westinghouse Defense loved Westinghouse; I had a circle bar W on my forehead. I loved Harry Smith. I loved the technology we were doing. Even George Westinghouse, who I think started something like 60 companies, did the ideas, and then he'd move on. And so we weren't

as important to Westinghouse as we would like to have thought. When [Douglas] Danforth, who by the way also raised llamas, and I raise llamas now, started to pay attention to Wall Street, and started to go away from what's good for everybody, including the employees, and just focus on Wall Street, he made a mistake. Defense started being more of a cash cow to help. So when we got sold to Northrop Grumman, I was afraid that the engineering days were going to be gone. But I didn't realize how much they were going to be gone. I sort of saw them as being the roller-bladers from the California coast versus us four-wheeler skaters from the east coast. And I didn't quite understand Jim Roach - who came in as our boss. And there was a lot of the research and development money that disappeared. I never quite understood him, but I felt very much vindicated when after President Bush made him Secretary of the Air Force, he was forced to resign when he got in amongst the media people who shed some light on what he was doing. It became obvious that his practices were not the way to do business. When he came to Westinghouse he had that same mindset, and it was so different than the paternalistic environment we had had. We went through a very good time with the likes of Harry Smith and Dr. Pan. Dr. Paul Pan knew the right people, knew how to get us good technology money. Knew good research money, and we gave the government back many, many times over good reward for that money. But that era went away. I think if I had to blame it on anybody I would say it was Harvard Business Review. When they published that it was no longer good for anybody to stay with a company for more than three years that really did away with concerns and confidence for the company. No one felt driven to just do one more A/D bit, or create a better wind shear radar. That was a mistake in my old-fashioned opinion.

Hochheiser:

Yes.

Hays:

The people that I worked with through the years, we loved working. I mean we'd do anything for Harry Smith, and he'd come down to the lab and show interest in what you were doing, and he knew people's names. I call it management by walking around. That was my style of management. We took care of each other, but we also advanced technology and careers. The mindset changed when Northrop came in. Now, it was probably needed because Defense was something that the overall company had been using more as a source of cash. And of course now we know about the financial mess these days that cheap money can cause, and of course that's part of what went down with Westinghouse was the cheap money. But that wasn't the start of the downfall. The

start of the downfall was when we started to focus on the owners or the shareholders as opposed to the employees. It should've been an equal share, in my opinion

Hochheiser:

Mm-hmm. But you remained here for about five years after Northrop took over.

Hays:

Yes. I would still be here, I believe, working for Westinghouse if it were still Westinghouse and there was somebody like Dr. Pan. But when I had a couple discussions with Jim Roach, I was uncomfortable. And so I decided that I would keep my head down, and I would work until it was time for me to retire in March of 2001. And I stayed until it was time for me to retire. But I was focusing also on my next career. At the time that we were working on our last couple years here that we knew was going to happen, I started volunteering as a gatekeeper at llama shows, to see whether or not it was indeed a good business, whether it was a fad. Danforth, of course, had done it before us. If I had been longer away from retirement, I think I would have gone to another company, because it was such a different environment than it had been. I think it was about that time that we sold off the A/D business. We had a number of technologies that the customers had to come to us to get. The ultra-low side lobe antenna back in the AWACS days, and those slots that I cut with those punch paper tapes and the A/ D technology which was what allowed us to do the CW work on the MRSR. And the stability, the STALOs, that let us do wind shear. So we had a big advantage with the development of those technologies. When we started doing it differently, then - of course, now big companies have bought big companies, and I remember talking to somebody once and I said, "Didn't you used to work for Singer?" And he said, "Yeah, I worked for Singer, and that was bought by Unisys, and that was bought by such-and-such [Laughter] and it was, like, six different companies.

Hochheiser:

Yes.

Hays:

And so that doesn't allow for a circle bar W to be in the middle of your forehead, and the loyalty that you have, and therefore, I think, get the better product. But it was wonderful. I got to see computers from patch boards, analog, to where there's, you know, now more sitting in this little thing beside me than we had.

Hochheiser:

Yes.

Westinghouse Memories

Hays:

I got to see radar development and the geniuses of radar development like Bill Skillman and Dave Mooney. I got to go from bits to Assembly Language to higher order language. It was really a great time. And I guess that's what happens when you get old. You look back and go, wow, was I here for that technology?

Hochheiser:

Well, of course, it also is what happens when you sit down to what we've been doing. [Laughter]

Hays:

[Interposing] We're doing, right, right, right, right. Oh wow.

Yes. But one of the frustrations I find now is that there was a time when I knew everything about a computer, how it worked, what was going on, what it was doing, etcetera. And now you've got this little iPad that's got 1100 applications and 100 - and, you know, it's just amazing.

Hochheiser:

It is.

Hays:

I don't know how it does it. [Laughter]

Hochheiser:

[Laughter]

Hays:

And I'm like, wait a minute. And so, and like I said, I started with - I saw the first transistor. A green potted transistor, and then I was putting VHSIC, the Very High Speed Integrated Circuits in MRSR, so I got to go with, with that, and now I understand they're doing the same for some of the motors and some of the analog stuff that's going into microns, and that's super fun. And we're transporting energy and - so there's a lot to be done. But we had a good time, and I'm glad that this is being done because there really were some major sacrifices made. Like those guys that I put on that BAC 1-11 to go down to Orlando. They risked their life in a lot of ways. I get chills talking about it, but I knew when I left that that was an iffy, iffy thing, and when - when we came back, it of course had 100 mothers and 100 fathers. And our manager was on 60 Minutes with it. And thank God it was successful and nobody was hurt.

Hochheiser:

Yes.

Hays:

But there were some serious sacrifices - I remember the people who were the very first on the AWACS plane to take off. Doug Lingle was the software guy. The pilot held the aircraft on the ground taxiing just as long as he could before he took off. There were people who thought that the aircraft would rotate under the dome as opposed to the dome rotating. Think about being that software engineer, on that first flight taxing, and it's not - it's not taking off. It's not taking off. And nobody told you that the pilot was going to hold it on the ground until the last minute, and then it takes off. You know, that took brave people.

IEEE Participation

Hochheiser:

To switch gears a little bit. Could you say something about what involvement you have had over the years with IEEE?

Hays:

Yes.

The IEEE was a great organization that helped me a lot. As I went into engineering at the University of Pittsburgh, I didn't know about engineering. I knew that I could not be a music teacher, and I knew that I couldn't be a math teacher. I didn't know what an electrical engineer was, but hey, it sounded fun. The majority of people thought I should not have been in engineering. But there was an AIEE Organization that I could learn from. I joined. I eventually became president of that student branch at the University of Pittsburgh, which was in 1963 or so.

Hochheiser:

You became head of the student branch of AIEE at the University of Pittsburgh.

Hays:

And that should have said back then that I liked being a manager and go do stuff, you know.

Hochheiser:

[Laughter]

Hays:

But that group was a good support group. I was also a member of IRE. As a matter of fact, I still have my little wonderful pin from IRE. It's got a nice little circle on it and I love it.

Hochheiser:

Right.

Hays:

And so in college those organizations were of use to me because I was a female and hadn't known about engineering - I had not been a ham radio operator.

Hochheiser:

Right.

Hays:

And a lot of the men had.

Hochheiser:

Yes.

Hays:

So they had an advantage that I didn't have. Then when I started doing the computer-aided design it was sort of a unique computer-aided design. I mean, I started that with something called the simulator, called LOGIC, and then it developed into a full blown system. There was a guy Carl Bork who said, "You should write that up for the IEEE." And being an engineer, I can't write. Never could, English wasn't interesting to me. But publishing sounded like fun. I had to rewrite it like 18 times in order to get it in the publication, but I can still remember the first article that I got published in the IEEE Transactions was like, whoa, I really can do something. So it did a lot for my confidence, a lot to go on. So it's been a good organization for me. I had difficulty with the IEEE for a number of years. All of the letters would come to me as Mr. **Hays**. And I would write and say I'm a Mrs. But it took them, I'll bet, ten years before IEEE realized that there were females. And then when I got here at Westinghouse, we eventually had the Society of Women Engineers.

Hochheiser:

Right.

Hays:

And, you know, more good came from that organization. But it's amazing. I suspect a lot of people don't know it wasn't until the riots of the seventies that we knew being discriminated against as women was wrong. We got paid three-quarters of what men did, but we were so tickled to have a job and be doing this really exciting work. And IEEE was one of the ones that helped: all right, you're in IEEE, you're an equal with the rest of them. And like I said, I got published in the Transactions. So it's been a good thing. But once we left Westinghouse, my husband is also a radar engineer, once we became llama farmers, we totally, totally changed our focus to that.

Hochheiser:

Which makes sense.

Hays:

But it's amazing how much technology is needed as a farmer too. Doing analysis of what they eat, analysis of your hay, and fecal floats, etc. You do stuff that's related to the engineering world. I no longer am a member of IEEE.

Hochheiser:

Yes.

Hays:

But the benefit really of AIEE was to give me a way to become connected in with engineering. Very valuable to me.

Westinghouse Baltimore Atmosphere

Hochheiser:

How would you describe Westinghouse here in Baltimore as a place to work? Camaraderie, social life, things like that?

Hays:

Well, I can only speak of when I was here.

Hochheiser:

And that's all, of course, what I'm asking you about.

Hays:

Right. It was wonderful. And it started at the top. I still remember when I was on B57-G. As a matter of fact, I was changing the navigation panel from analog to digital using a little processor. And then we took it out and the pilots tested it, and they didn't like it because it was 2 and then 3 and then 4, and they had gotten used to using the scrolling from 2 to 3 to give them information. Okay? Digital took that away. And so I had to

figure out how to make a digital system look like analog, because they wanted that information. And I'm down in the lab one night, working at 7:00. There was a rush to get the plane to the field so we worked all hours. I mean, you wanted to work because it was fun. And Harry Smith comes along, and he's, you know, "God." He said, "What are you doing?" I said, "I'm trying to do this navigation display, to tell you what altitude you're at." And he said, "Well, show me." So I started the program and my airplane took off and immediately dove to 500 feet under the ground. [Laughter] It flew at minus 500 feet, and obviously had a bug. But he just thought that was wonderful. He talked to me, and I remember that to this day. It was that kind of environment where people cared what people were doing. It was paternalistic, but yet you had to compete. You had to work.

I have a story that if I did it today I would get in real trouble. When I was over the software group and we were just starting doing software for different airborne platforms or small platforms - I had about 20 people. I had one particular black gentleman who was not performing. He just wasn't doing anything. And so I got mad about it, and I said to him, "You will come in and sign in with me in the morning, and you will have a debrief with me at the end of the night, and you will sign out at night, and we're going to do that, because you're going to get some work done here." And he was "rwar rwar." But after about three weeks of this, at the evening debrief he said, "My wife said that I must've gotten a new job or must've done something different because I'm so happy." She said, "You used to be just a grouch all the time, and now you are so happy." He said, "Thank you." It turned out that by focusing on him and making him understand somebody cared, he turned out to be a really good programmer. Now, of course, if I did that today, because I had 20 employees, and I was not doing the same with everyone else -

Hochheiser:

Yes.

Hays:

But people did that for you. I mentioned that George Shapiro hired me when I was in the employment office, by accident, etcetera. He was a big help to me. He would put in a good word for me; for a female to become a program manager at our company was - you know, who's going to trust you and who's not. And so there'd be people who helped you. Pete D'Anna was a favorite boss of mine. On MRSR I had a female engineering manager, a female mechanical lead, and me. And an irate manager came in to my manager, Pete D'Anna, and said, "Where did you find those three broads? They're

getting stuff through the factory when I can't." And Pete said - and later told me he said - he said to the guy, "You just made my day."

Hochheiser:

[Laughter]

Hays:

Westinghouse Defense was wonderful. I didn't at the time know how separated we were from the Westinghouse Corporation. We were this great wonderful thing. But we weren't really part of that company. Until Jim Roach came in, I didn't know any better. We thought it was wonderful, and we got to do technology. But when he came in his personality that later showed up was a change of time.

Women in Engineering

Hochheiser:

You described how when you, when you started, you were the only woman in the EE program.

Hays:

Right. 1,500 men and me.

Hochheiser:

And you. And I assume when you came to Westinghouse there were similarly few.

Hays:

I think there were three. I know you're interviewing one tomorrow, Naomi McAfee.

Right. She was there. She was in reliability and maintainability. She was a very good engineer, but because she was in a support area she was allowed to be. You know, the females don't take on the major things. I took on - I wanted to become a program manager. That's taking on man for man.

Hochheiser:

Right. That's mainstream, that's not staff.

Hays:

That's mainstream, right. And so it - there was she, and I think there was somebody over in Tech Pubs. I have another story that when I came in I sat out in the bullpen. Back then it was bullpens, you know. 100 people all at those old metal desks. Jon Squire's desk was across from me. He was my supervisor. But he wasn't there, because he worked other shifts.

Hochheiser:

[Laughter]

Hays:

Ben Vester's secretary came out and sat down with me, about the third day I was there, and she started to explain to me what the rules were, how I was to dress, and what I was supposed to do, and all this stuff. And I said, "I think you're confused. I'm an engineer. I'm not one of the secretaries." And she said, "Well, you're a female. You're under me." And I said, "Well, I don't dress like a secretary, and I don't, you know" - so it turns out that she went back in to her boss, Ben Vester, and said, "You've got to get rid of this one, she's a troublemaker and she's not going to be any good." I didn't know about this until a win party maybe five years later when Ben came up to me and he said, "I've got to tell you something." And I said, "What?" He said, "My secretary, third day you were here, said I had to get rid of you because you were a troublemaker." And he said, "I've been watching you ever since then." Now this is, the big boss.

Hochheiser:

Right.

Hays:

And he said, "I wish I could hire three more like you." Yeah. But that's the way it was. When I came in there the head hen took care of everybody.

Hochheiser:

Yes. Since it was so unusual a company didn't really know what to do with a woman engineer.

Hays:

Right.

Hochheiser:

Is it fair to say that the number of women grew as things started to be somewhat different?

Hays:

The number of women didn't really grow. I'd say that we maybe had 15 when I left. I mean there's not been a lot. What made the difference was if you produced. If you worked and you produced and you were good - and we used to joke that we had to do twice as much as the men. But you got accepted. Because it was an engineering world, that if you were doing good and working hard they stopped seeing you as a female. You were an engineer. And I'd say that Naomi would say the same thing, that she became one of the engineers.

Hochheiser:

Yes.

Hays:

A few years later when Susanne Jenniches was hired, she really started cracking the ceiling. She said that to go as high as she did, you really had to develop rhino hide, because taking the path that she did, she had to take a lot more slings and arrows than I did. Because I tended to be down in the engineering world working with the engineers, and as long as I was producing well, I was one of the guys. But we never did get a lot of women. And I think it's because we were in Defense too. It's the Johnny Pearson you have got to be an electrical engineer mentality. Even though it changed with time some of it still was there.

Hochheiser:

That would make sense, and though IEEE has done all sorts of things, the percentage of women in IEEE has never been as much as 10%.

Hays:

Right. Well, we had an engineering society here in Baltimore that had a beautiful mansion that had been left to it down on Charles Street. And when we became the Society of Women Engineers, we wanted to go join the Engineering Center of Baltimore. I still remember another young lady and I went down to talk to these people, and it was like sort of the old IEEE. They were, well, this is a men's club, and we don't want women in here. And it took us a good while to become members, and then after we became members we wanted to put our plaque up along the wall where all the other ones were…. Oh Dear!

Hochheiser:

Yes.

Hays:

I have another funny incident, I don't know how much you want to hear this, about being a female. When I was doing the computer-aided design, we had a need for a high precision plotter to plot the boards. And I had heard through some people we knew that Algorex up on Long Island had a good plotter. So we signed up to go up, fly into Islip and go down to Algorex. I think three of us went, but I was the manager of the group. When we landed, the company's owner picked us up in his car, and it was, like, "murmur, murmur" between them. I said, "Is there a problem?" Well it turns out he had set up for us to go to his club for lunch. His club was a men's club. No women allowed. And the decision-maker from the company who's come to look at their stuff is a female. Oops. So what they did is they let the men off in the front, and they drove me around back, and I went in through the kitchen, and they joined me in the back table. I didn't say anything so my voice would be unnoticed, and I had lunch at the men's club. Okay? So then we get back to the plant, and there's some more "murmur, murmur." What's going on? Well, it turns out that they had set up as demonstrations the plotting of nudes in order to show the plotter's capabilities. Oops. The key decision-maker is a female. And I said I don't care, just show me. I want to know what it can do. And so I got to see all these wonderful plots of nudes. But it was those kind of things that - you know, back then… We did buy the plotter, by the way, and it was very good, and we made a whole lot of boards from it. Things changed after the riots in '70s when we began to say, wait a minute. We deserve equal pay too. Being discriminated against is wrong.

Hochheiser:

Right.

Hays:

But I'd say to this day women engineers are still expected to have two heads. You know? It's just not that often that - and I can remember a number of times when somebody would say, "Oh, and what are you?" And you say you're an electrical engineer, and they go, "I wish I hadn't asked that question, because I don't know what to say now."

Hochheiser:

I suspect sometimes male electrical engineers in the wrong environment will get the same kind of answer. [Laughter]

Hays:

Right. Oops, another nerd here.

Hochheiser:

Yes.

Hays:

And in the early days of our software we were a little bit like the blue sneaker software types that led to the Internet, etcetera. But we were more electrical engineers as opposed to software engineers. So we weren't quite as hippie or bohemian as I would say as the ones who went off, the Jobs, Gates, etcetera that created the -

Hochheiser:

I suspect that's probably also related to your being in the defense part of the business.

Hays:

Right. And everything being classified. A lot of it, a lot of the work that we did was classified. I would say that the one big thing that I would give Westinghouse credit for,

and Dr. Pan credit for, is the advancement of technology that was done by this company. It really did advance electronics from antennas and processors and STALOs through an era that I don't think is going to be seen for a while. And unfortunately, as some of us joke, the Russians didn't turn out to be very good enemies. They just stopped being enemies.

Hochheiser:

It took a long time.

Hays:

It took a long time. And I was lucky enough to have - again, I said I did a lot of traveling. I went to Russia in 1979 on a personal pleasure trip for 21 days, and the 1980 Olympics were coming up. And so they were allowing us to go everywhere, and it was really wonderful to be there. Even though I had clearances that made it a pain, I went. I got to meet female engineers over there. They were in a better situation than we were in a lot of ways, because at that time in Russia when you were born you knew what you were going to be. You didn't have to figure out what career you were going to do. You were going to be a skater or an engineer or, you know, whatever. I got to talk to a female engineer, I went to her apartment. I got to talk to them because it was coming up on the Olympics and they were going to be nice to us. And I said to her, "Doesn't it seem odd to have put all of this beautiful decoration and everything in an apartment that you don't own?" And she said to me, "Don't pay your taxes for two years, and see who owns your house."

Hochheiser:

Yes.

Hays:

It's amazing. And it's changed from there. This is another aside, we were just on a pleasure trip in some of the used-to-be-parts of Yugoslavia, and we were in Bulgaria recently and we took a cruise down the Danube. One of the travel guides said we're really in a conundrum. We don't have the answer, but under the old system we had no goods but lots of money. Under the new system we have lots of goods but no money, and we're trying to figure out which is best. She said, "My one problem is, is that under the old system it would take four years to get a car. You'd get on the list, and you'd get a car in four years, and you had the money for it." She said, "Now there's no hope of

ever getting a car. The cars are here, but I have no money." And so they're really going through some confusing times. And the other thing I commented on about careers is that now they don't know the day they're born what their career's going to be. Now we say that's good because it's freedom. But it's a different world for them.

Hochheiser:

Well, of course if when you were born it was determined that you would be a music teacher -

Hays:

Yes, I would've been a disaster. Total disaster. My father had a band. He had all that music. I got none of it. I got the math. I was lucky I had a mother who said this kid can't be a teacher because she has zero patience, and is not going to get any. She was right, I haven't ever gotten any. I still don't have any patience.

Hochheiser:

[Laughter]

Society of Women Engineers

Could you talk a little bit about your involvement in the Society of Women Engineers?

Hays:

Yes. I have had a good education from dealing with other women. I'll back up a little bit. When I went to Pitt, there was me and 1,500 men. The dean of women was not pleased that one of her girls was an engineer. And so I decided to join a sorority. I joined Delta Zeta. And I learned a lot about how to interface in society. The clothes that I came with were country clothes. I learned about how to dress, and as an engineer I pretty much tossed it aside, but I learned a lot of that.

Hochheiser:

[Laughter]

Hays:

And it developed me as a person that I would not have been as an engineer. The same happened with the Society of Women Engineers. It was a group of women that had been through the same process that I had. I became president of the local group and had a lot of parties at my house. It was a way of learning more about society and how to work with society that you wouldn't get through the engineering channel. And like I said, the men, when I got in college, had been ham radio operators and had talked to each other and had this social interaction, although engineers I think tend to be nerds and antisocial in some aspects, but they had that development that I as a woman didn't. And the Society of Women Engineers was a very good education for me. Now, I also learned that times change. When I first was working with the Society of Women Engineers, we decided that we needed to let young girls know that they could be engineers. And so we would go out, individually we'd go out and talk to these schools. For a couple years I really enjoyed it, because I'd go to about fifth, sixth grade, a good time, and I'd start out with "Do you know the difference between an engineer and a scientist— a scientist comes up with this fancy material, and an engineer figures out how to use it." And that was good. But after, I'd say, about five years, the question started to be "Does an electrical engineer have a better expense account than a mechanical engineer?" And I realized, okay, the kids are now getting smarter than we are, and they know what's going on, and we no longer needed to let women know. The time had come. I would say that it was about the late eighties when women realized they could be anything they wanted. It didn't mean that you weren't going to get a lot of guff and have a lot of hard times, and you had to do work but at least you could be anything you wanted.

The Engineering Profession

Hochheiser:

Well at this point my cards are basically all about face down, so is there anything you would like to talk about or add that we haven't discussed?

Hays:

[Laughter] No, I think that I've pretty much covered everything. I loved being an electrical engineer. I think that engineering is one of the best things for maybe middle-class people to get into, because in four years you can have a good degree, and you can get a job. And then while you're working and being paid you can decide what you really want to be. A lot of my sorority sisters that graduated in psychology soon realized that there's a lot more they've got to do before they can even get a job. They've got to go for the PhD. And being able to be an engineer and get the degree in four years, then I

could also decide, do I want my master's degree to be in engineering, or in my case - I like management - go into management. And so it's a good base degree for anybody who can do it. I realize that there are people who like me, I cannot be a musician, I don't have that talent but if you've got some of it, it's really a good first level. So, thank you, it's been wonderful.

Hochheiser:

Well, thank you.

Hays:

I love the fact that the IEEE is capturing some of this, because it was a unique time. And some of the geniuses really worked long hours; took a lot of risks. There were times when we were up in the roof labs and the radars would be testing and rotating around, and they would blip the computers and we'd go, that's a lot of radiation. And we don't know all of that stuff that did to us. But people did it. And like I said, the one that I remember the best was wind shear, sending those guys down there. But we had others before that, and going out on the tarmac at Topeka, Kansas for putting the B57-G computer back in was an experience I care not to ever duplicate. [Laughter]

Hochheiser:

[Laughter]

Hays:

But thank you very much.

Hochheiser:

My pleasure.

Hays:

I appreciate this being done.