ORAL HISTORY: Ben Vester

About Ben Vester

Ben Vester was born in North Carolina and later in his childhood moved to Norfolk, Virginia. Inspired by his father's tinkering with electronics, Vester became interested in electronics. After graduating from high school in 1944, Vester went into the Army Air Corps where he went to airplane mechanic school, ending up in Alabama as a mechanic. After leaving the military, Vester went to William and Mary/VPI (now called Old Dominion) majoring in electrical power. He graduatedin 1950 and went directly to work for Westinghouse. At Westinghouse, Vester began in the Westinghouse graduate student program, then Special Products in Pittsburgh where he worked on an autopilot assignment. In 1951, Vester moved to Baltimore with the Air Arm Division, working on projects such as BOMARC radar, the Gemini program and SAINT program. Vester eventually became manager of Electrical Design and later General Manager of Aerospace. Vester retired from Westinghouse in 1984.

In this interview, Vester discusses the various projects he worked on at Westinghouse, particularly radar. Vester also talks about his experience as a manager, talking about his managerial philosophy but also his desire to remain in the 'middle' of engineering, discussing the importance of engineers as resources. Vester also describes the atmosphere at Baltimore, talking about various colleagues such as Bill Jones, Harry Smith, George Axelby, Frank Rushing and Paul Pan.

About the Interview

BEN VESTER: An Interview Conducted by Sheldon Hochheiser, IEEE History Center, 22 July 2009

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Interview

Interview: Ben Vester

Interviewer: Sheldon Hochheiser

Date: 22 July 2009

Location: National Electronics Museum, Baltimore, MD

Background and Education

Hochheiser:

This is July 22nd, 2009. This is Sheldon Hochheiser of the IEEE. I'm here at the National Electronics Museum in Maryland with Ben Vester, conducting an oral history. Good morning.

Vester:

Good morning. How you doing, Sheldon?

Hochheiser:

We can start with some background. Where were you born and raised?

Vester:

I was born down in North Carolina in a little town called Nashville. Lived there through the 2nd grade and then moved up to Roanoke Rapids in North Carolina for a few years. These were depression years and I had my first jobs there when I was 12 years old. The family moved on to Norfolk where I attended middle school and high school at Maury High.

Hochheiser:

What did your parents do?

Vester:

Well my mother, of course, was a homemaker.

Hochheiser:

Sure.

Vester:

And my father was a tinkerer, an electronics tinkerer, as a matter of fact. And the house was always full of copies of Hugo Gernsback's Radio News, and you know, that kind of stuff. Actually he told a story about years before I was born, of course, that he had used some of Gernsback's stuff and built a receiver. He ran the antenna up the church steeple and had the whole town over there tuned into KDKA, which was a Westinghouse station [Laughs].

Hochheiser:

That's right.

Vester:

And it didn't work, okay. He had to wait for another month, until the next magazine, and it had a correction---they had the tickler coil backwards on this [Laughs] regenerative receiver. He had worked for his father in grand daddy's General Store until the depression hit and wiped out grand daddy's business. So he started his own business in radio repairing and that kind of stuff. We were in great demand for Sunday dinner around town from people whose radio had quit. Daddy had a great little trick with a small screwdriver that he carried around in his shirt pocket, and a little pair of dikes. Those old sets had lots of tubes in them. The weakest things in these sets were the screen bypass capacitors, and he'd go through with that little screwdriver and find out which one wouldn't spark, and then he would cut loose the capacitor, and they were

back on the air [Laughs]. That's one of the things that I remember from then. He was quite a tinkerer.

Hochheiser:

And I guess he passed his love for things electrical on to you.

Vester:

Yes, he sure did.

Hochheiser:

So that I guess answers the question about how you got interested in this whole area.

Vester:

Yes.

Hochheiser:

You finished high school during World War II? Is that correct?

Vester:

Yes, during World War II in 1944.

Hochheiser:

Right, so then did you go into the service---

Vester:

Yes. I was in the Army Air Corps. Went in thinking I was going to pilot school but they had way too many people that they didn't have room for in pilot school.

Hochheiser:

So where did they send you?

Vester:

Well I ended up getting sent to airplane mechanic school, which was kind of fortuitous because I learned a lot about airplane hardware and systems that I didn't know before. I guess I was in the service about a year before the war ended.

Hochheiser:

Right.

Vester:

And then, of course, I didn't have enough points to get out. I was attending preflight school at Maxwell Field prior to going to B29 fire control officer school. Instead I was shipped to Selma, Alabama to serve out my time as a mechanic.

Hochheiser:

Did that help shape what you wanted to do when you got out?

Vester:

It eventually did. Although when I went to college, there were some zigzags along the way. Discharged in mid summer, my only choice for college was a community college in Norfolk, William and Mary/VPI at that time but now known as Old Dominion. I had worked as the telephone company night-time test board operator for Norfolk my last two years in high school, so I resumed that role while in college in Norfolk. Two years later I went on to finish at VPI. I wanted to take electronics, but the head of the EE department talked me out of it. First of all they didn't have many electronics courses at VPI at that time and he told me that many electronics PhD's were walking the streets---which was probably true at that time. So he talked me into majoring in power--electrical power.

Hochheiser:

Right.

Vester:

Incidentally I was actually chairman of the AIEE/IRE back there in---

Hochheiser:

The student branch?

Vester:

Yes, at VPI. So I got introduced to that pretty early too. And also I was a ham by then and also served as president of the Ham Radio Club. The ham radio stuff was a tremendous motivator during my whole life.

Hochheiser:

Right, and did you do that growing up with your dad too?

Vester:

No, I didn't actually get my ham ticket until I got in the service. When the war ended we were assigned to sitting around, and I decided I'd go and get my ham ticket. There was a Colonel on the field, Signal Corps fellow, who gave me the exam.

Hochheiser:

And so you finished up your degree---

Vester:

In 1950 at VPI.

Beginning at Westinghouse

Hochheiser:

And did you go directly from there to Westinghouse?

Vester:

Yes. What happened is I did pretty well in school, the usual honor societies and all that. But I won what was called the Westinghouse Achievement Award, and it was given every year to some student in the engineering department at VPI. So, I ended up getting floods of information from Westinghouse. I even had one of the Westinghouse district managers in that area call me and beg me to go to Westinghouse because he had got that award put in VPI and then nobody had ever ended up at Westinghouse [Laughs]. So I signed on and since jobs were scarce that year didn't even interview any one else. When I got to Westinghouse I went into the graduate student program, which is a great program because they let you move around to different divisions.

Hochheiser:

Right. So when you first joined Westinghouse you were in this program where you spent a certain amount of time at a variety of locations?

Vester:

Right. The first couple were not very interesting, so I decided to try for what looked more exciting, an assignment to nuclear. So I signed up to get a Q clearance, which takes a long time to get, and while I was waiting for that I took an assignment in something called Special Products.

Hochheiser:

Which was in Pittsburgh?

Vester:

In Pittsburgh. And it was a little side place. The idea was the Research Lab guys would come up with some new idea for a product, Special Products would try to promote it to the point that they could get a development contract or get something started---which was a pretty good idea actually.

Hochheiser:

Was there a particular product you were working on?

Vester:

When I started out, I had this student assignment. I had no idea that I was going to stay there. But I went in and they were working on a new type of jet airplane autopilot using three rate gyros instead of the single vertical gyro which had been used for slower, less agile planes. I walked in the door and in less than an hour they had me working on a piece of this autopilot that they had to flight test in about a month. It was actually plenty interesting---the little flight controller box that the pilot flies the plane with. They needed a little servo to drive the controller to a position that matched the position of the plane's manual controls, so there would be no transient when they switched the autopilot on. I couldn't believe I was going to get a chance to design this. And we got it going---used something called a micropositioner relay and with some finagling on a lead network managed to stabilize the servo. It worked great in flight test----and I was hooked by then, of course.

Hochheiser:

So you never went into nuclear?

Vester:

No. The flight tests went well on this first prototype and we got a contract for a few autopilots for the F94---was called the W3A. I designed the magnetic servo amplifiers for that. The W3A worked well enough that we got a new $200 million contract---a lot of money back then---to make a version of this autopilot, called the E-9, that was going to go in all the F-84's. And I ended up as an engineering group leader on the E-9, and was responsible for the design of a box, the M4 box which had the three rate gyros in it and also all of the servo amplifiers.

Hochheiser:

Now as a group leader, did that mean you now had people reporting to you?

Vester:

Yes, for technical direction on the design---but it was not a management position.

Air Arm Division

The big contract award led the company to move the whole operation to Baltimore and built us a new plant---the Air Arm Division.

Hochheiser:

Okay. So about when was that, when you moved to Baltimore.

Vester:

1951.

Hochheiser:

So you weren't in Pittsburgh very long then.

Vester:

Right. Just long enough to have our first daughter [Laughter]. Incidentally, one of the key figures in the team who came down here was Sy Herwald. Dr. Herwald was our first Engineering Manager.

Hochheiser:

Here in Baltimore?

Vester:

Here in Baltimore. He immediately got us setup so we could get into night school at Hopkins. And he was the kind of guy who showed up at 2am in the morning to see what was going on. And I learned how valuable the boss showing up at times like that for the people that are really motivated. We had a problem getting the E-9 gyros built in the new plant because nobody in manufacturing had built anything with such precision before. The factory didn't believe our tolerances. At one point we convinced the superintendent of the factory to visit the small Westinghouse facility in Pittsburgh which had made the gyros for our previous autopilots along with me to see if they could help us. The superintendent, along with one of his honchos and me piled into his big Buick, and headed up to Pittsburgh. But we soon stopped for a beer. After a few stops, I concluded these guys knew every barmaid on the way to Pittsburgh. About half way, I talked them into giving me the car keys. When I drove into the hotel at a very late hour

our rooms had been taken and we had to share a room. While the Pittsburgh machining facility couldn't do the job themselves, they offered to send some skilled machinists and quality control guys to show our machinists how to make the parts. And I had two new friends who helped me push things through manufacturing from then on.

Hochheiser:

And eventually the factory managed to make them to the tolerances?

Vester:

Yes, and I learned a lot about how factories worked and the men that manned them. The factory was turning out a few units and we started flight testing.

And it wasn't like the F-94 results at all. What was different was the F-84 had what's called an infinite boost hydraulic system which doesn't give the pilot any force feedback from the valve. So on the F-84 they had to put a spring-loaded thing in there to give you some feel. And General Boyd , who was in charge of the program, wanted it adjusted to suit him, and that turned out to be enough stiction so that the servos couldn't handle it. A young engineer named John Knight---a MIT grad---was working the problem with our mockup of the system which included all the real hardware from the autopilot and the F-84---with an analog computer tied in to simulate the aerodynamics---a very sophisticated setup for those times. I'm pretty sure Herwald was the driver behind that since he was a recognized expert in the field. He taught the servo course I took at Pitt and we used his book for the course. Any way we were sure that the problem was the non-linearity of the spring loaded feel thing. John dug deeper and found there was another non-linearity in the autopilot that we didn't know was there. It was in the wire wound potentiometer that followed the motion of the airplane control surfaces. So we went into overdrive and I personally designed and built an infinite resolution magnetic pickup to try---and it worked in the mockup. We rushed a set of pickups through the model shop and then they actually flew us out to Wright Field, and our pilot actually talked his way into letting us land at Wright Field at 1:00am in the morning. Which was good because we got past having to get in through the gate and all the other rigmarole.

Hochheiser:

Right.

Vester:

But we ran out of time. We got the stuff installed just before Flag Day and they took the airplane away from us because they had to put it out for display on Flag Day. The company even flew a corporate VP out to plead our case---but to no avail. And we were sure it would have worked. But it was a lesson hammered home---that you better look at it from the customer's viewpoint and not give them reason to cut you off. Any way I had to come back home and face all those people in the factory, you know, who I had spent a lot of time with trying to get stuff made. It was pretty tough. Real tough.

Hochheiser:

Did you tell them that the project was cancelled?

Vester:

They already knew. And it was cancelled on Flag Day, which as it turns out is my wedding anniversary day [Laughter].

Hochheiser:

You're not going to forget that day.

BOMARC Radar

Vester:

No, no. [Laughs] So the big question the company had was, what do we do with these guys? And since I had established myself as fairly competent in the magnetic amplifier field they had a spot for me. Westinghouse had invented the Hipernik material around 1950 which made magnetic amplifiers practical, so we had a jump on the world use for a period before it was released to the public. The tape wound toroids had an almost perfect rectangular hysteresis curve which lent itself to use as a high power controllable switch. And in more recent years we see the same technology base used for hard drive memories. Anyway a fellow in England published a paper in 1951 that used Hipernik cores in sequence to progressively sharpen pulses to get a large radar pulse to drive a magnetron. One of our development engineers had picked this up and had built one of these for a new radar we were proposing for the BOMARC missile---the radar that became the DPN-33. When I joined the program they had progressed to the point where they would make a bunch of toroidal coils and---

Hochheiser:

But only occasionally would one set be good enough to work.

Vester:

Would work, yes. To meet MIL specs it had to work over a wide range of voltages and that was a real challenge. I did manage to solve the problem with a different circuit arrangement and Westinghouse decided to patent it since it used their Hipernik cores, I guess. It also offered me a good subject for my Master's thesis at Hopkins.

Hochheiser:

And so your whole group moved over with you?

Vester:

Well, no. They were spread all over the place because we had other things going on at the time.

Hochheiser:

Sure.

Vester:

And of course when the company moved this aerospace group from Pittsburgh to Baltimore to form Air Arm, they also moved the surface radar division, which had been in Baltimore for a long time, out to the airport alongside Air Arm. So then all of a sudden I'm in the radar business, and being a ham, and knowing a fair amount about communications electronics and that kind of stuff, at least from a practical standpoint, plus my Master's program courses I could hold my own in some ways. Since I had been promoted to supervisory engineer in the autopilot program, I assumed the same role in BOMARC in the electrical engineering section there.

And so we pumped out the first BOMARC radars. Now that was a very crucial program probably for both the airborne and space stuff we did in the years to come. BOMARC was a very advanced missile. It used ram jet engines, of all things. It may be the only living example of a ramjet program that succeeded [Laughter]. It had very high vibration. It was very hard to make stuff that would live in the environment. A number of the companies who took part in things like the launching equipment---for example, Moog in hydraulics etc---became leaders in later space work.

Hochheiser:

Now how closely did you work with other groups here at Westinghouse who were doing pieces of the BOMARC radar and then with other contractors?

Vester:

Okay, that's a good question---one that hadn't occurred to me. First of all, we had not yet adopted a matrix organization. So the electric design and the mechanical design sections line-reported to the BOMARC program manager. The engineers in those two sections were permanently assigned to the program for the duration of the program, and were located across the hall from each other.

Hochheiser:

Right, so there was a program manager on top.

Vester:

Yes.

Hochheiser:

And who was that?

Vester:

Well, there were several. We actually had two retired Marine Colonels in sequence, first was Cliff Parody who was more technically qualified and more of a consensus builder. Next was Joe Dickey who was more top down oriented and after he adapted to being talked back to by an unruly bunch of engineers, did well.

Hochheiser:

So there were several groups working on different pieces of Westinghouse's part of the BOMARC project?

Vester:

Yes, there was a model shop, and an engineering lab organization, and the factory had a large group of people assigned to the program for build and test. At that time we had no antenna design in house so we bought the antenna dishes from Sander's Associates. My group was responsible for the antenna and microwave stuff, the receiver, and transmitter, so we handled the Sander's subcontract. I believe our Surface division had a separate contract with Boeing for BOMARC ground equipment.

The second generation BOMARC radar, the DPN-34, was something completely new, a Pulse Doppler radar system. There had been experimental PD work done before, but this was the first production system. That was quite an experience.

Hochheiser:

In what way?

Vester:

Well, it was the first of its kind. We had an advanced development group under Harry Smith's guidance who created the first breadboard models of the system. And Harry was a talented entrepreneur who sold it to Boeing---got them to put it into their missile. Operationally it offered full down-look capability for the BOMARC, something no other missile or plane had. Pulse Doppler radar required unbelievably stable local oscillators (STALO) and receivers with extraordinary intermod capability to pick up very weak target signals buried in very large ground clutter. We finally got it to work. But significantly we got it to work in a ramjet vibration environment, and that really gave us a leg up in future competitions for Pulse Doppler systems. You don't think of microphonics being a major problem, but when extreme signal purity is the game you have to control mechanical resonances all through the system.

One other thing I should mention---I always felt that the technicians working on the program were in some cases more important than the engineers [Laughs] and so in addition to trying to hire the right kind of engineers out of college, we really did try to reward the guys without a degree because they were such a key part of making all that stuff work.

Hochheiser:

So you were working on the BOMARC project for a fair number of years.

Vester:

Yeah---that's right.

Hochheiser:

Between the two generations?

Vester:

Yes, up until oh 1961, somewhere along in there.

Hochheiser:

And did your role change over the years? Did you become more of a supervisor?

Vester:

Well, yes. I spent pretty close to 15 years at the supervisor level, and that was fine with me---kept me close to the engineering work I loved. As a matter of fact, Dr. Herwald early in the game asked if I was interested in being submitted as a candidate for a Harvard Business School thing they had for guys with potential. I said no way. There was a guy in the plant who had gone that route and I said "no way I want to be [Laughs] doing what Jack's doing." So I really was an engineer at heart, and that carried on right up until I walked out the door in 1984.

Hochheiser:

Well that's good, to do what you want to do---

Vester:

Yes. And I still moved up through the ranks eventually but with a better than average grasp of what went on at the lower levels.

SAINT Program

The next assignment I got was for a program called SAINT, which was a satellite interceptor. You probably never heard of it.

Hochheiser:

No.

Vester:

It didn't last very long. It got started at RCA in Boston. One of the guys there was a high profile, big science type, so they won the contract for this thing. I was assigned since they were going to use the BOMARC pulse radar---a tried and true machine with an inventory already available. So I became head engineer on this. And what happened is that RCA had to eventually look at what they were doing, and they came out with some real cost numbers and I guess the Air Force bailed out. It didn't last very long. But it was pretty important to me in a way because when we finished the two BOMARC programs, somebody decided to put me over in Advanced Development. Don't know who it was, but in any case I was now the Supervisor of a small development group with several projects going on---one of which was a rendezvous radar conceived by an engineer named Elbie Green.

Hochheiser:

Right.

Vester:

We were coming up on John Kennedy's "going to the moon" pronouncements. And McDonnell Douglas who we had sold a lot of radars to for their airplanes and so forth, and I don't know for sure but I think they probably knew we were in the SAINT program, which had just been cancelled. Anyway, they were setting up to do the Gemini program, to basically prove that you could rendezvous in space along with doing space walks outside the spacecraft. Anyway, I was asked to go out to McDonnell Douglas, and it was such a low profile visit I went without the usual local marketing guy. So I got in there talking with a young engineer named George Scism. He had a spec. for a rendezvous radar he wanted to show us and solicit comments.

Hochheiser:

George what?

Vester:

Scism.

Hochheiser:

How do you spell that?

Vester:

S-C-I-S-M. Scism. Anyway, a very bright young guy, and I started to show him details of our concept for a cooperative rendezvous radar using a transponder on the target vehicle. And he said wait a minute and he went and got his boss. And his boss came and I went over it again for him. And I went through a couple of bosses until we got to Ray Hill, who was the head of Avionics. And I was, you know, a 32 or 33 year-old young fellow. It was a little above my experience level [Laughs].

Anyway, they really got turned on by what we had, and it really was a cute idea. As a matter of fact, I used to carry this little---where is it? Let's see if I've got it here. This is a little dipole spiral---the ones used were about the size of a CD disk with a printed circuit spiral on it. The idea was you use one of these to transmit through and use as reference on receive and a coupla' more, one in each axis and as you rotate these things you advance or retard the phase of the received signal thus measuring the angle of the target in two axes. It is basically a two axis circular polarized interferometer. It's so simple, very small. It's got tremendous appeal. And the other thing was, due to the fact that I had worked on the autopilot stuff, I knew a little bit about the problem---the fact that we went from vertical gyros for slow airplanes to rate gyros for fast jets---that this

was going back to the old slow stuff. Just a range measuring and a pointing angle measuring system was quite adequate for the job.

It turns out that a couple of guys at MIT, Sears and Feldman, had written a classic paper on rendezvous, and they had sort of captured the rest of the industry; it was sort of a gold standard. But I convinced Ray Hill because Ray had worked on autopilots, and he saw that this simple thing was what you need. So anyway they changed their specs to accommodate our system---basically it made it very hard for anyone else to compete. This was going to be a very light thing that fit right on the nose of Gemini.

George Axelby and Gemini

I promised to tell you a story about George Axelby who gained fame for his work in IEEE on feedback control systems. One of the things that we had done to promote our little radar was send a few systems guys out to San Diego, to General Dynamics and they were trying to make the arguments we just talked about. And the G.D. guys said "we know you make good radars, but leave the systems to us, okay." [Laughter] So they came back with their tails between their legs.

This thing was progressing along to where Gemini looked like the program was going and it was getting funded. Dr. Von Braun had been fighting to make the moon mission a direct ascent mission without rendezvous. All of a sudden, he came out with a public announcement, which was in all the newspapers, that we're going to have to make a state of the art improvement in radar to make the rendezvous possible. So here we are with this little simple thing and here's the Sears/Feldman indoctrinated people. So shortly after Von Braun made his announcement---I'm not sure who scheduled this visit for us---it probably was McDonnell. But we had to go down to Huntsville to talk with Von Braun's system engineering group run by a guy named Fred Digesu, D-I-G-E-S-U, I guess it is. So having been snubbed by the systems guys at San Diego, I decided to use a secret weapon there at the plant, George Axelby. And at that time, George, in addition to working for Westinghouse, was also the editor of Feedback Controls Magazine. He was a guy with some stature.

So I took George down with me, and I'll have to tell you what happened at the meeting. We marched in and sat down, and a young lady came in and unfolded her steno pad. And I thought, my God, they're going to take a short hand transcript of the meeting. We'll have [to] be careful what we say. So we go through our song and dance and George gets up. George is a---you ought to meet him sometime. He's still here in Baltimore. He's a real "aw shucks" kind of guy, but very credible. So when we got through with our pitch and answered questions, all of a sudden here we are with these

high powered systems guys at Huntsville, and they turned to this girl that I thought was a secretary, and say "what do you think?" And so she tells them what the answer is. [Laughter] It really was an extraordinary moment to me, one I'll remember for a long time. But she said they're equivalent. You can measure the target angle and range over time and calculate from the data what corrections to make.

Now we had it. We did make the radar. It was the first digital radar. This is back in the early 60's.

Hochheiser:

Now you're moving from analog to digital?

Vester:

Well yes.

Hochheiser:

With the Gemini project?

Vester:

Yes. All the measurement data was in digital format. The range was measured by a digital counter using a clock rate of 1.000 mhz. The master timing unit we made for Apollo was basically a digital thing, with clock speeds in the kilohertz range.

Hochheiser:

If I can back up, do you recall the name of the woman at that meeting in Huntsville?

Vester:

I never knew it. I wish I could find out.

Hochheiser:

It's interesting because as I'm sure you know there weren't that many women involved back then.

Vester:

Yes. Well as a matter of fact, we had some pretty good women engineers at the plant back then. Naomi MacAfee headed the Reliability/Quality stuff at the plant and was the highest ranked female in the corporation, I believe.

So anyway, a week to ten days later Von Braun retracted his radar statement. [Laughs] And so the program moved on. We had a great team of guys for the program and were making schedules. Lockheed was making the target vehicle but were having big schedule problems, so McDonnell asked us to make a little satellite with the target electronics and the antenna in it---it was dubbed a Rendezvous Evaluation Pod---so they could carry it into orbit on the Gemini and try out the non-docking part of the mission. That was made and used for a mission before Lockheed got well. McDonnell decided they needed a communication link to send digital control messages to the target, so we cobbled together a mod to jitter the transmitter pulse back and forth for 1's and 0's to send messages with and added a little circuit on the target receiver to decode it. Needless to say, McDonnell was very pleased with our extra work.

Hochheiser:

Were there any noticeable differences between working on a project for NASA versus working for the military?

Vester:

Not really. Not really. The big difference on the Gemini was we had a very small group of dedicated guys---best of the best. The importance of this job to me was to sort of get my head above the pack a bit because it was successful. I did get listed in the Laurels For The Year in Aviation Week's December 1985 issue for the rendezvous work.

Hochheiser:

Sure.

Vester:

But the other thing of more importance is that it got us into the space game. And this whole reliability kind of stuff for manned space flight really is almost a religion kind of thing. You no longer have random failures. They've all got a reason they failed and you better find out what it is. And since the guys who worked on these programs moved off to other programs, the reliability philosophy started to permeate into the airborne products.

Management Position and a Lost Contract

Lets see, where are we now? I had pretty well finished that project and they had---

Hochheiser:

Finished the Gemini work?

Vester:

Yes. The company had decided to reorganize the engineering department into a different format, into a more matrix type organization. So I ended up as Manager of Electrical Design and P. J. Miller as Manager of Mechanical Design. Both sections served all of the programs.

Hochheiser:

So now you're head of Electrical Design. You have responsibility for people who are doing the electrical design for a number of programs?

Vester:

Right. Now there's a smaller group that's off in advanced development that's playing around with making onesy, twosy kind of things. Once a production contract was obtained, the electrical and mechanical design groups finalized the designs to meet Mil specs, etc. and prepared the drawings, test requirements, etc. that the factory would use to build stuff.

We had won contracts for all of the F-4 radars for both the Air Force and the Navy. And we had projects going for both a pulse type radar, called the APG-120 and then the AWG-10, which was a Down-Look Pulse Doppler radar for the F-4. So it was kinda' like we did on the BOMARC, but with different form factors. We even did a redesign of the Mark 48 torpedo electronics to bail out a sister organization located in Baltimore.

And then at one point which was around '67 or '68---I've forgotten the exact dates. I remember well when it occurred because what happened is that we had competed for the radar for the F-15, and had lost, which was a big blow, and we sure as hell hadn't planned to lose that to Hughes. I ended up as Engineering Manager of the BWI site about then. I remember that well, because one of the early things I had to do was take care of the fact that we had more people than we had work for. The whole Air Arm philosophy from the beginning was to treat all your co-workers as family---and we had not had a RIF in engineering before. Well when we had to actually reduce force---

Hochheiser:

After losing the F-15 contract?

Vester:

Yes. I pretty well told the management team, we're going to do this from the bottom up, okay.

Hochheiser:

Bottom meaning seniority?

Vester:

No. The guys who are going to make the decisions are the supervisors.

Hochheiser:

Ah, not the guys at the top of the organization.

Vester:

Right. I'm a great believer in bottom up management. The folks at the top are never necessarily well informed enough about individual capabilities of personnel.

Any way, I pretty well said we've got to get set for the long haul, so don't just get rid of the youngsters or anything like that. Just out of curiosity after it was all over, I plotted the experience levels of what was left and compared it with the experience levels before, and the curves were essentially identical. The guys had done a good job.

But this approach was not without some peril. One of the guys chosen to go in the Surface Division was a "he wrote the book" type and the then current President of Westinghouse, Bob Kirby, who had come up through the ranks at Surface, got a call from him. Bob sent Dr. Hutchinson on his staff down to see what the hell was going on. Hutch had a long history at Westinghouse dating back to Rickover and knew a lot of older people who worked there who apparently approved our actions, so no changes were made to the plan. Hutch was a ham and often dropped in to see me when in Baltimore---he was sort of a mentor over the years. A question he asked had major impact on me---"How do the French design airplanes with so few engineers?"

Another thing we did, and I think this is another important factor that helped us in years to come, we set up a guy named Earl King, and his job was to get a job for every one of the lay-offs. And he spent a year to 18 months and got every one of those people placed.

Hochheiser:

The guys you had to let go, were they generally with other companies or with other parts of Westinghouse, or some other---

Vester:

All over the area. And you know, a lot of them went with the government due to where we're located here.

Hochheiser:

Sure.

Vester:

Some of them ended up being customers. It was the right thing to do and was a big, big plus with the people who were left.

Hochheiser:

Okay, so you're now the chief engineer. One of the first things you have to do is figure out how to reduce the size of the organization because you lost this big contract.

Vester:

Yes.

Hochheiser:

But there were other contracts going on.

Vester:

Right, Right. My management style at that stage was to focus on the show-stopper problems. Since our role was almost always as a subcontractor of a key subsystem we could really screw up a customer's program if we didn't fix such problems quickly. My actions were not much different from previously---get a real understanding of the problem directly from the working level engineers and pull in resources to solve it. Since I had years of direct contact with the best engineers and what they could bring to the party, and could make them available for advice quickly---I felt that was a most productive use of my time. And I think that worked for me. I know that's not conventional management theory, but I only showed up for show-stoppers and hoped that the lower level managers would bring the same urgency to the problem. I never took ownership for the problem---just was a friendly helper. I guess it also satisfied my desire to be in the middle of the engineering. [Laughter]

Customers were often aware of such major problems so it helped that I knew the details when talking with them. So I spent very little time in my office. I spent most of the time

wandering around talking. As a general rule when I wanted to talk to someone I went to their office or desk---guess I wasn't comfortable asking them to come up to my office.

We won some pretty big contracts over time. We won the AWACS radar from our friends at Boeing and there were a lot of other things---electro-optical systems, like Pave Spike---an airborne laser target designator.

Electronic Countermeasures

I haven't even mentioned the electronic countermeasures field. We made almost all of the electronic countermeasure pods for "under the wing" mounting on fighters.

Hochheiser:

And what systems did they go into?

Vester:

They went on all the fighters that had the wing mounts---F-4 being the most common. The ALQ-131 was one of the major ones we won in this period. For example, sometime in the early 70's, I noticed that I hadn't seen John McKinley for several days---John ran the countermeasures engineering group. I asked "where's John? Is he sick or something?" And it turned out that he was at the Pentagon and he had been sequestered there with several of his guys for almost a week. [Laughs] Israel was in a war at the time---not sure which one.

Hochheiser:

That would make it 1973.

Vester:

Okay. That would be about the time. And the trouble was they were losing, and the Russians had pumped in a lot of new anti-aircraft stuff. And the countermeasures they had wasn't taking care of it. Some colonels in the Air Force decided to bypass the system, called our guys in and they collectively came up with what was needed. Our guys came up with the mods, incorporated them into a bunch of pods and nobody had even gotten the President's permission to do it. [Laughs] But by the time we finished the pods in a few days, somebody finally convinced the President, whoever that was at the time, to approve flying the pods over. And it turned the whole battle around. So that certainly helped our reputation in the customer community.

Hochheiser:

Did you yourself have a lot of interface with the customer during those days?

Vester:

Only when there was a show-stopper problem, generally. The engineers, like McKinley, who ran the engineering on major product lines, had a lot more direct contact with their customers, so I always had info on what the customer was thinking through them.

Engineers as Resources

Hochheiser:

And so resources, I assume there are several aspects. The right people? Funding? Equipment? Do all these things go into resources?

Vester:

Yes, but I was most interested in the people---am I running out of time?

Hochheiser:

No. We've got plenty of time.

Vester:

Plenty of time. Okay--

Hochheiser:

I mean, yeah, part of my job is to check that but no, we've got plenty of time. I'm enjoying this. Just keep going.

Vester:

Okay. Well let me tell you a few other things that I was doing at that time.

Hochheiser:

Please.

Vester:

The things that I thought were important most of all was the caliber of the engineers, and we were fortunate in that the Westinghouse student course had a good reputation and all the universities were happy to have them show up. They had a network with the colleges that worked to get a lot of talented engineers. So I did spend a modicum of time interviewing kids who my guys had identified as high potential. I spent significant

time with them, basically patting them on the butt you might say. But it was mostly trying to convince them that hey, this is a really exciting place to work---and I really believed that.

The other thing we did during that period, and I not sure who started this, but we set up a program to finger high potential high school kids here in Baltimore and get them to sign up for a co-op work/study program with us and John Hopkins. And that was probably one of the most successful programs we've had. Most of us in engineering management took part in interviewing some of the kids and took particular pride in seeing them succeed. Of course, Hopkins was part of the bait and it's a pretty damn good school.

Hochheiser:

Oh yes.

Vester:

Incidentally, I got my Masters at Hopkins eventually.

Hochheiser:

Doing this at night while you were here?

Vester:

Yeah, during the first 8 or 9 years. And I wrote my Masters paper on that magnetic modulator I was telling you about.

Hochheiser:

Right.

Vester:

So I worried about the caliber of our people and even went out to schools recruiting occasionally, since we were a major customer for GSC hired kids.

The other part was we had an extremely aggressive educational program, basically college level courses.

Hochheiser:

Taught right here?

Vester:

Taught right here?

Hochheiser:

Right here.

Vester:

Yes, and courses taught by some of our top engineers. Guys like George Axelby. It's one thing to be a college professor, but teachers who are doing state of the art design and development all day are a cut above that. My own son, who instead of taking engineering or something he chose liberal arts, majored in psychology with a minor in math. He basically majored in unemployment [Laughter] according to one of our friends who had a similar situation. But I did get someone at Westinghouse to give him a job back then, and he ended up taking a series of computer programming courses taught by one of our software hot shots in the Surface Division---and became a very proficient software programmer. He didn't stay at Westinghouse much longer than it took to get that education, but being taught by a guy that was really good. And that's been his life's work and he's done very well at it.

So let's see now. Where are we?

PAVE SPIKE

Hochheiser:

We were talking about the various things you did during the years you were chief engineer.

Vester:

Yeah, yeah. Well I learned a lot technically. There was a wide spectrum of different technologies being pursued---fire control radars, tactical ground radars, FAA systems, communication systems, electro-optical systems, etc. PAVE SPIKE was our first airborne laser target designator. I think they may have flown just a few of those before the Vietnam War ended.

Hochheiser:

So that was coming along just at the end of the Vietnam War?

Vester:

Right. It's kind of interesting because the initial buy of SPIKES was rather small. I think we made more of those for the Brits than for the U. S. And the reason they were so

good was our mechanical design capability had grown very sophisticated with gyros, making high rate hydraulically driven antennas which had to be very stable in a high vibration environment, etc. PAVE SPIKE was the best laser designator, bar none, I think anybody ever built. But they didn't make very many and I believe that a Martin subsidiary down in Florida got the laser designator for the later fighters like the F-16. And when they had the first Iraq war, you know, they were---we had those pictures of the bombs going right through the selected windows---

Hochheiser:

Right. Yeah, I remember.

Vester:

You remember seeing that. Well I could tell which missions were the Brit's and which were the U. S. F-16's because in the U. S.'s you could see the vibration. And the Brit's was kinda' super stabilized. Charlie Kline was in charge of our electro-optical group and he was a great engineer and a super person.

Management Philosophy

I'm going to change the subject a little and tell you some of my management philosophy. First I was always very direct and demanded my guys be the same---tell it like it is---that is, drop the BSing. I suspect that some of my bosses thought I lacked finesse and that had something to do with my long tenure as a supervisor. But that was me--take it or leave it. As I moved on where I had more customer face time, I'm convinced that was an asset. Most of them at the higher levels understood that the first step to solving a problem was admitting you had one.

The other thing I would never tolerate was the internal game playing stuff. It's pretty easy and a lot of people end up doing this in companies, and I think it's a terrible mistake to play one group off against another in terms of trying to motivate them to do better. And my idea was no, no, no, we're not competitors inside---the competition is Hughes. And frequently it was Hughes, but there were others, of course.

I inherited the matrix organization, which some people think waters down the lines of authority so much until it shouldn't work; actually it works great because nobody can mandate from on high that you've got to do this or that. Let's look at a guy that's, lets say, an engineering manager of a program that's trying to get his job through. He gets assigned some people, and obviously the caliber of these people is important so he gets to make some choices, but as the job progresses he's got to use the right touch, which

is a light touch, to get the job done with these people. And in many respects, actually separating the management line of authority for pay and all that kind of stuff from the working thing, it's not a bad idea. If you're managing a group of engineers, for example, in the matrix, and they are signed over to a program, you've got a leg in that program and feel responsibility for its success---sort of another manager pair of eyes looking at progress and lending help to the program engineering managers. And the engineers gained a lot of varied experience.

System Development and Stanford Executive Program

And let's see what else. I failed to mention that a new organization was established around the time I became Engineering Manager of the BWI site. It was called the System Development Division, and it centralized the business responsibility for all of the development programs and also included all of the engineers on site plus the program management of development programs---

Hochheiser:

Okay, so you reported to the head of System Development---?

Vester:

Right.

Hochheiser:

Who was that?

Vester:

John Stuntz at that time.

Hochheiser:

Okay.

Vester:

I eventually got to be general manager of SDD but before that I had been in just engineering kind of roles. So I guess the company decided that you didn't want to go to Harvard but you've got to go somewhere to get a little business learning. [Laughter] So I went out to Stanford, to the Stanford Executive Program, which was like a summer spent on courses like creative accounting and---just kidding! In fact, the guy that taught accounting was the top expert in the accounting standards organization in the U. S. at that time. But that was a nice summer break from---

Hochheiser:

Were the things you studied there useful?

Vester:

Yes. Because I was really an engineer, you know. Any management thoughts I had were pretty much whatever come to you naturally without formal training. I do think I had accumulated some wisdom from previous bosses.

Hochheiser:

Right.

Vester:

But it was definitely useful with respect to the people who were there---from every industry you can name---banking, mining, wine, retailing, oil, railroads, gambling, insurance, chemicals, etc., etc.---from all over the world. Most of the professors were big name experts in their fields so the instruction was first class. But the relations and discussions with the attendees were the highlight of the course for me.

One of the guys who I spent some time with was Don Schulz from HP. Don was GM of their plant in Loveland, Colorado. He was the program manager on the first HP calculator which created such a stir. Now HP had been one of our test equipment suppliers for years and I had many HP friends. Anyway, Don passed along a business rule that had been created by an HP marketing manager. The rule was used when you wanted to expand your business---'twas called the three-legged stool rule. The legs of the stool were: Customers-Technology-A Product. Rule was don't charge out to expand on more than one leg at a time---that's conservative but raises your probability of success significantly.

Then the head of the Westinghouse Research Lab, George Mechlin, who incidentally ran our Underseas Division in Annapolis before going to the lab, started chipping at me about the three-legged stool rule. He said it's too conservative, which for the lab is true since they typically have only one leg. And at SDD we had a similar problem. Most of our new business planning was done, to a large extent, based on where you put your R&D money. And we had set up some guidelines that if a guy comes in with a great idea but it doesn't fit exactly, but you don't know, maybe don't even know who the customer might be, you give them a little money but we'd set it up so they got minimal money until they sold one of the military labs into putting up some earnest money. And part of the philosophy behind that is it's a lot harder to sell something new if the labs don't

have a part in creating it. Once a lab spends some of their money, then all of a sudden you've got an advocate over on the customer side. So if the technology works out, you've got almost two of the legs covered.

Hochheiser:

Right, because now they've got an investment in it as well as you.

Vester:

Right. Now Stuntz moved up to run the Aerospace Division and I replaced him as SDD general manager. But I ended up actually holding that job plus my Engineering Manager job, reporting to myself so to speak, [Laughter] for about the first year.

Hochheiser:

That must have been an awful lot to do.

Vester:

Yes. But the business responsibility for the development contracts wasn't that much of an additional load.

Hochheiser:

And that's the first time you had business responsibility.

Vester:

Yes, but we eventually broke free a competent manager to fill the Engineering Manager slot.

Hochheiser:

And who is it that you finally---?

Vester:

Johnny Pearson, a good old boy from North Carolina, who had played a significant management role in the original Pulse Doppler development under Harry Smith and had been a solid manager since. Now we had a lot of active development programs in SDD at that time. I noticed from your schedule that Bill Jones is coming in this afternoon.

Hochheiser:

Bill's coming in this afternoon.

Vester:

Well he was in charge of something called the EAR program, which featured an electronically agile antenna, which eventually grew to be the B-1 radar. And some of these guys in Advanced Development, like Bill, had enough marketing, management, and technical skills to have started something in development and had a chance to carry it all the way to production. And as you'll see, he's a very dynamic fellow and quite a good guy.

Advanced Technology Lab and VHSIC

One other asset we had in SDD was an integrated circuit facility called ATL or Advanced Technology Lab. Westinghouse had entered the commercial IC business at a time when the super entrepreneurs were promising just about anything and hoping they could do it. And I suppose the corporate fathers couldn't live with that. So they folded the business and gave the facility to the Defense Center. So we were able to do some other things that we couldn't do before.

Hochheiser:

So is that plant here in Baltimore then?

Vester:

Yes, it was, and I guess it's still there. I've been retired 25 years now so---[Laughter] I used to drive down the road outside going home, but there was nothing here but woods. [Laughs] Speaking of ATL, they had a contract on the Very High Speed Integrated Circuit back then.

Hochheiser:

Right, I've come across that.

Vester:

The VHSIC program.

Hochheiser:

Yes.

Vester:

And we had one of the contracts along with most of the commercial IC companies. But there was one company who refused to take a contract, namely Intel. And you know the rest of the story.

Hochheiser:

Intel's story is certainly well known.

Vester:

Yes. [Laughter] But they proved an important fact---namely that if you have to spend your own money on a development, you sure as hell spend it a lot more wisely. Gordon Moore used to visit Gene Strull at ATL about once a year and was most interested in the IC manufacturing tools we were using. Gene was often first in line to buy the latest equipment to support a classified program we had, and Moore was probably steering some wise equipment purchases for Intel.

WX-200 and Defense Center Reorganization

Now, Harry Smith had moved up to GM of the Aerospace Division and looking out towards the next generation of fighter aircraft had started an in-house program called the WX-200. There were a few people in the Pentagon who were worrying about the spiraling cost of fighter planes---driven somewhat by the electronic systems on board. So Harry set a target of $200K for the cost, about ½ the current costs. I was in the middle of this since Harry and I were, at heart, engineers---Noel Longuemare was the chief architect of the system. Anyway the forces in the Pentagon who were pushing lower costs won some battles and the light weight fighter program was born. After General Dynamics won the flyoff against McDonnell, we had a competitive pulse doppler radar flyoff against Hughes for the winning F-16. The conceptual work that was done on the WX-200 had changed the mind set in engineering to focus on cost, and although the GD specs made some changes to the WX-200 plans, we had a leg up already. We also used some of my old Electrical Design guys to design the flyoff radar, giving us reliable hardware to use in the flyoff-which after we won gave us a leg up on the transition to production of the APQ-66 radar. The F-16 contract has proved to be what is surely the most lucrative business area for the BWI site---I note that 30 some years later Northrop-Grumman are still updating F-16 radars.

In about 1978, there was a major reorganization of the Defense Center triggered by the move of Nick Petrou to Pittsburgh to fill a corporate job. Harry Smith moved up to head up the Defense Group. Harry made changes to balance the load between the Aerospace and Surface divisions. He moved the AWACS program to the Surface Division---AWACS

radar was physically big---and appointed Maurice Ani as GM. I moved over as GM of Aerospace, and took along a coupla' classified programs where we wanted to keep customer continuity.

Hochheiser:

So this was a lateral move to run a different part of the operation?

Vester:

Well it wasn't a lateral move, it was a promotion.

Hochheiser:

Because it was a bigger chunk of the business it was a promotion?

Vester:

Yes. In my first year we did $165 million worth of business.

Hochheiser:

In the Aerospace division?

Vester:

In the Aerospace division. When I retired in '84 we did $982 million.

Hochheiser:

That's quite a lot of growth.

Vester:

Yes.

Hochheiser:

In six years.

Vester:

Six years. The billings increased by a factor of 6 and the profits increased by a factor of 10 approximately. Since the biggest challenges facing Aerospace at that time was getting the production of the F-16 radar up to speed and I had built up good relations with GD engineering during the fly-off and also was the only senior manager with production experience was probably a factor in the appointment.

Hochheiser:

What were the factors that led to such dynamic growth in the business?

Vester:

Well, Carter's inflation and Reagan's defense build-up contributed. There were a number of programs we had won and were entering production about then---the APQ-66 for the F-16 being the biggest, the ALQ131 ECM pods, a Tail Warning radar for the B-52, the B-1 radar which used the EAR electronically agile antenna married with F-16 radar hardware. There was about $100 million of space program billings in the $982 million for 1984.

And I was kinda' using the three-legged stool rule to select targets. As soon as we got the F-16 radar rolling in the factory, my division engineering manager, Noel Longuemare, started a dialog with the Tactical Air Command to create a new set of requirements for a follow-on to the APQ-66 radar for the F-16. The idea was to box out a new aircraft to do the mission of the F-15. So we were able to give birth to a APQ-68 which gave the F-16 competitive capabilities to the F-15, and some capabilities beyond. I borrowed John Stuepnagel from SDD to run this program The ECM department won a next generation system called ALQ-135, which was planned for joint use by both the Air Force and the Navy.

DIVADS

One of the most important wins we had at Aerospace was something called DIVADS. Now you probably never heard of that.

Hochheiser:

No. How do you spell that?

Vester:

D_I_V_A_D_S which stood for Division Air Defense System. We had a major goal of getting into the Army systems. One prime contractor who was competing was Ford Aerospace, and we sold them on the idea that we've got a big production line going here with F-16 radars, and these are digital, so we can get you into a learning curve thing with lower costs, and higher reliability both in the fly-off with General Dynamics in San Diego and in the production phase. They bought in and we together waxed the GD team---GD's radar was so unreliable, they were using a very sharp eyed gunner who was manually sighting and tracking incoming targets in some final tests. And this whole idea

of using an airborne radar to direct an air defense gun we sold hard and got a coupla' generals in the Army procurement as advocates for the concept.

I also got invited to some seminars at the Carlisle, PA Army think tank facility and managed to provoke a confrontation with the head of Hughes Aircraft when he started bitching about the costs of underfunded fly-offs. I made the point that the Army was served better by a war between two engineering groups than by a war between two marketing groups. What I didn't say then, but later did to individual Army folks, was that the thinly funded fly-off required use of your best talent, and led to designs that used a maximum of already existing designs---cheaper and more reliable.

This was a big opening into the Army and it led to an opening for SDD to compete for a radar surveillance and fire control system for the Army's new Apache helicopter. I retired before that got to the production phase. But we had added a third customer leg to our stool.

IEEE Story

Now let me tell you an IEEE story.

Hochheiser:

Okay.

Vester:

Sometime after we lost the E-9, Sy Herwald got pulled back to Pittsburgh where he went on to become an Executive Vice President in other things. And we got a new GM for Air Arm Division named Pat Conley.

Hochheiser:

Right.

Vester:

Dr. Pat Conley. We never saw Pat. He was a more introverted General Manager. The only time I ever saw him was when we had a small fire in the plant and he summoned all the supervisors to a general meeting where he said "The next guy who has a fire in this place is going to be fired." [Laughter] I never saw him walking around.

Hochheiser:

That wasn't his style.

Vester:

For sure, but he didn't stay very long and returned to Pittsburgh, and later went to work for the Boston Consulting Group. In the late '60s he wrote a paper for the IEEE about learning curves. Have you heard about this before?

Hochheiser:

No I haven't.

Vester:

The whole learning curve stuff started in World War II where the government used those to monitor later lots [of] manpower costs on things they were buying to catch cheaters. They were a straight line on semi-log paper. Pat's paper was a very insightful paper. He showed that in any selection of industries, each had a distinct learning curve for the total costs--not just the labor costs. For each doubling of units built, they would have X% decrease in costs. Now you could calculate what buying market shares was worth.

Well that paper did several things. Don Povejsil who was GM of the Nuclear Fuels Division at the time, and had been at Air Arm when Pat was there, almost surely read Pat's paper. Because what he did is he went out and sold a number of long term contracts to supply nuclear fuel to utilities. This was fairly early in the nuclear game. And clearly he was selling them at what the current price was, and he was going to make a mint downstream. But he had one slight problem, and the slight problem is that [Laughs] the people that were feeding the nuclear fuels business wasn't a free market outfit, okay. It was----what do [you] call them?

Hochheiser:

A cartel?

Vester:

It turned out to be a cartel. And that almost broke Westinghouse. As a matter of fact, Westinghouse got out of it by invoking the "no longer commercially viable" clause part of contract law.

I read Pat's paper and passed a copy around to some of our engineering management fellows who were in Electrical Design. We had our yearly R&D show coming up. Our Chief Scientist, Dr. Paul Pan, organized the show and it drew a standing room only crowd from the military labs. You've heard of Paul before?

Hochheiser:

Yes, I have.

Vester:

Well I was scheduled to give the opening address at the show---so I sent a photographer out to take pictures of the most picturesque, ingenious use of bricks that he could find. He came back with a lot of pretty fancy architecture kind of stuff. So my pitch started with a sequence of these pictures with some patter about architects being really ingenious people. "But did you notice that all of those fine structures were made with one building block---just a plain bloody brick which was designed centuries ago?" And I was trying to get in the idea that you can use your ingenuity to do a lot of cool things, but why make it with different newly designed blocks? Why not use something that's got all this learning curve on? And I talked a bit about learning curves and ended with saying, one of the things we're doing in our R&D programs is looking for the next brick.

Now Harry Brown and Irv Kaplan in Electrical Design were at the show and had read Pat's paper. And at that point we all were busy as hell trying to win the F-16 program and Harry and Irv came [up] with a great idea, which was we're going to pick most of the "bricks" (ie; integrated circuits) that we put in this thing out of what we expect to be used in the commercial computer market for the next few years. And so they did. And they made some damn good choices. So we tapped into all the Moore's law stuff and in essence fed off the learning curve of the commercial computer business. I'm not sure, 25 years later now, how much that impacts, but I do notice that the Northrop-Grumman folks seem to be winning all the ball games. Of the only new fighters, the F-22 and the F-35, they've got the whole ball of wax on both of them. And their new scalable active aperture system looks like it is built with the ultimate "brick."

But that whole emphasis on learning curves, I think, had a pretty good impact on our cost competitiveness. And I used to, occasionally, when I was working the Navy, trying to get them to let us into some of their programs, pull out an old handwritten piece of graph paper. It was a record of the costs of the F-16 radars rolling out. It wasn't a nicely manicured piece of propaganda, it was just my record of the learning curve on that product. I think that was pretty effective as most of them really perked up when they saw how fast we were moving on the learning curve. Several Admirals commented that most of their suppliers' costs were going up instead of down. And part of that, I believe, was due to growth in the computer field---but more of it was due to Emmett Wheeler's efforts pushing the systems through production---he was the ultimate problem solver and while he was solving problems, costs went down and reliability went up.

So now I'll give you the last piece of this story which involved a friend of mine, Bob Dwight.

Hochheiser:

Right. I spoke to him yesterday.

Vester:

Bob's a great guy. He and I worked together for Chuck Bagwell, who ran the autopilot job, way back. And Bob was great friends with Pat Conley---I guess because they both lived on Gibson Island. Anyway, in later years I was in the corner office that Conley used to occupy and Bob brought him in and I met him for the first time. [Laughs] He came in to see Bob and wanted to see his old office. He looked around, looked at the pictures on the wall, and he said Jesus, the same pictures are still here. [Laughter] And obviously the guys that had been in that office had all been engineers and they could care less about that. He was pleased to see the same old desk, dents and all. But what was most interesting to me was that Pat was working as a consultant to MITI in Japan of all things.

Now why would the Japanese be interested in Pat Conley? I started looking at what was going on in Japan, and realized his learning curve paper had been well read there. In later years at Aerospace, we were doing work with Mitsubishi so I visited over there occasionally. I was struck by the fact that the general manager of every plant I went to was an engineer. I asked about their financial control, and all they had was a bookkeeper. Once when I was being escorted through a plant, I was querying a first line supervisor about things---and many of the charts, etc. he had on his bulletin board were in English---obviously aimed at visiting firemen like me. In looking at the ones in Japanese, one looked familiar, so I asked what that was. From his body language and smile, I knew it was important to him, and he proceeded to tell me about their growth in market share. I was struck by the powerfulness of having a first line supervisor being motivated by market share. Course I had watched the Japanese capture the market in Ham Radio gear, so I now saw some of their tactics. But I think we've gone off the subject a little bit so let's get back.

Articles, Observations and Retirement

Hochheiser:

Yes. So I guess we're getting up close now into the 1980's and getting close to the end of your career at Westinghouse.

Vester:

Yes. Let me see if there are other points.

[End of tape one. Start of tape two]

Vester:

I guess one thing I hadn't mentioned before is that the reliability lessons that we learned on the space systems---I think I did mention that---migrated into the airborne stuff. And I think that was a big plus to us.

Hochheiser:

I don't know if there's anything else you wanted to bring up.

Vester:

Well, from my own personal viewpoint, I got quite a lesson out of the loss of the E-9. I mean, if you aren't careful, you push the customer into a spot where you almost force him to bail out on you. That's sort of an obvious lesson, but it gets to be a gut lesson when it happens to you.

Hochheiser:

I have a couple other questions.

Vester:

Yeah.

Hochheiser:

One, since I'm from the IEEE, I'd like to ask you about your participation, if any, in IEEE over the years. You briefly touched about it back in your student days.

Vester:

No. [Laughs] Well, first of all I was more of a doer than a paper writer, okay.

Hochheiser:

Okay.

Vester:

I actually wrote more articles for the ham magazines than I did---

Hochheiser:

Than for the engineering.

Vester:

Now I wrote articles on Gemini because that was high profile so people asked me to and I gave a pitch to the German Rocket Society in Munich, and you know, that kind of stuff.

Hochheiser:

Yes.

Vester:

Just a word about the ham articles---in 1959 we had used a high frequency crystal filter to solve an intermod problem on the BOMARC pulse Doppler. I saw the opportunity to make a ham version with 4 surplus crystals---at $1 per crystal, which turned out to be a very popular idea. Then we used that filter to create a single-conversion transceiver which had about ½ the tubes of the only other available transceiver made by Collins---which cost $1100. A little outfit named Swan had a version of my design on the market in about a year---which cost around $300. So that was very satisfying.

After I retired, I taught myself machine language programming. And in my sailing, I needed weather fax information, but the machines to copy that were expensive. So I created a software program WEFAX to copy the fax information direct from the ham receiver with only a simple clipper between the receiver and any laptop. Later I used the same clipper and an expansion of the software to allow full transmitting and receiving of ham color SSTV (slow scan television). That was very popular also, and the program was included in a disk that was attached to the ARRL Handbook for a few years after.

One thing I forgot to mention during the Gemini discussion. I actually got invited up to MIT to give a paper on the Gemini radar, okay. And so I gave it and got questions and so forth. And when it was over, there's always a few folks come up. And a guy introduced himself as Norman Sears of the famous Sears and Feldman. [Laughs] That's not what he said, he just said he was Norman Sears.

Hochheiser:

Right.

Vester:

And he was really fuming at me a little bit. He said I know you guys are tops in the fire control radar business, but he didn't think this was going to work. And later, I figured out why he probably thought that. It's that his paper was written back when the talk was

the stuff we were going to do on SAINT, which was to go after an uncooperative target. In other words, I think he wrote his paper back then. And somehow or other he hadn't grasped the fact that the actual thing we were doing was a different mission.

Hochheiser:

Mission, right, because you had two things that were trying both to hook up.

Vester:

Yes. But the MIT brand had been carrying the day early on.

Hochheiser:

Okay.

Vester:

Another guy to mention, one of the people we had working in our mechanical engineering department was a guy named Frank Rushing. And the reason Frank is important is he was such a fantastic mechanical engineer. He was a resource beyond belief. And he was a lot older than the rest of us. He had won the Timoshenko Prize early in his career. Westinghouse gave this to their top mechanical engineer and he had been sent over to Europe to a German university to study. The other thing about it is he actually was at the table with the lady who wrote the Ship of Fools, on the ship journey to Europe.

Hochheiser:

Katherine Ann Porter?

Vester:

Yes. And so I asked him about that and he said well she had her own gigolo that took care of her, okay. When Frank finally retired for the second time I told this little story at his retirement party. If you read the book, there's a Texas engineer in there that she really unloads on, okay. And Frank is one of these unbelievably great guys, you know, good looking, smart, friendly---the kind of fellow that any gal could go for, I think. And I'm sure what happened, she was probably making a pass at him and it didn't---[Laughter]

But to tell you a few other things about Frank, as he went on from there. During World War II, Westinghouse was one of the companies that was working on how to enrich uranium.

Hochheiser:

Right.

Vester:

And Frank was Chief Engineer of that centrifuge program. Prior to that Frank had designed a highly precise rotating-machinery dynamic balancing tool. Westinghouse, before WWII, sold off the balancing machine to another company since the potential market looked to be about 20 units. And that machine was used for all those gyros and many other devices that were produced for World War II. Anyway, Frank's centrifuges worked, but the government chose a more expensive alternative because they figured the centrifuge technology would be too easily reproduced by smaller countries.

Now a little post script to that, which is again, interesting, but maybe not appropriate for what we're doing here but let me mention it to you real quick.

Hochheiser:

Okay.

Vester:

There was a guy in our class at Stanford that worked for an outfit in Sweden who made centrifuges for milk separation. And I was standing next to him with a group at cocktail hour. And he was talking about doing business with the Red Chinese, and he said that it was kind of hard negotiating with them because they wouldn't let you go home until you agreed with them. So later on I grabbed him and said you people helped the Red Chinese get their centrifuges. He turned a little pale and finally said, they asked us but we didn't do it--- his body language said something different. Frank had previously told me he thought that the Chinese bomb was using centrifuges. So it's a small world.

Hochheiser:

Yes, so you retired in 1984?

Vester:

Yes.

Hochheiser:

Now is that because you were 65 at the time.

Vester:

No, no, no.

Hochheiser:

So you retired a bit early.

Vester:

Yes. I retired as soon as I got 58, which was the earliest you could retire.

Hochheiser:

Ah.

Vester:

I have two passions in life. One of them is ham radio.

Hochheiser:

Right.

Vester:

And I've gotten out of bed before daylight almost all my life---getting up to work some DX. And the other passion is sailing. And I had decided sometime earlier that I was going to go sailing, and I was going to do it early while my health was good. So that's what I did. [Laughs] The Aerospace Division had grown to be three Divisions by then and there were three good men to keep the fires burning--- namely Jim Holman, Bill Montgomery, and Carl Shyman.

Baltimore Atmosphere

Hochheiser:

How was Westinghouse-Baltimore as a place to work? In terms of colleagues, in terms of social life, activities?

Vester:

It was great, great. One of the most significant social events we had were the parties we had after every win. And I'll tell you that was another part of the family getting together to celebrate kind of thing. And I still get the Northrop-Grumman magazine that they put out and a lot of that collegial family thing is still carried through since they bought it, which I'm happy to see, because some of the people who have worked for both companies have told me they are more business-like.

I was talking to Joe Laine just a few weeks ago. Joe was a supplier trouble shooter---a very good one. Our practice was to send in talent like Joe to help single source suppliers who got into trouble. But Joe said he couldn't do that in Northrop-Grumman now. And you see, with a big Systems contractor there's a lot of worry about 'is something improper going to go on,' so a much greater arm's length relation with suppliers is enforced.

But I've held you guys up too long so lets---

Hochheiser:

Well no, I think you held us up just about the right time. But I think we're finished.

Vester:

Okay.

Hochheiser:

Thank you very much.

Vester:

Yes, I enjoyed it.